Korean J. Ichthyol. 11(1), 1~11, 1999

A Revision of the Genus *Microphysogobio* in Korea with Description of a New Species (Cypriniformes, Cyprinidae)

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The five species of the genus *Microphysogobio* in Korea are reviewed with the keys to species and their illustrations : *M. longidorsalis, M. jeoni* sp. nov., *M. koreensis, M. yaluensis,* and *M. rapidus. Microphysogobio tungtingensis uchidai* was treated as a junior synonym of *M. yaluensis* based on having the distinct papillae of upper lip and the color pattern on body sides by the examination of the type specimens. *Microphysogobio jeoni* is described as a new species from the specimens collected in the Naktong River, Han River and Keum River, Korea. it is well distinguished from the related species by the slender body, undeveloped papillae of upper lip and unspotted fins. *Microphysogobio yaluensis* was showed the clinal variations in the number of lateral line scales and vertebrae among the populations in the western drainages of Korea. It is remarked biogeographically that the five species of *Microphysogobio* are all endemics to Korea with the restricted ranges.

Key words : *Microphysogobio*, clinal variation, endemic, biogeography

Introduction

The genus *Microphysogobio* is the small benthic freshwater fishes (Cyprinidae) which are restricted in East Asia (Howes, 1991; Nelson, 1994). The classification of the genus *Microphysogobio* has been chaotic and has attracted little attention (Banarescu, 1992). After Mori (1933) mentioned firstly the taxonmic position of genus *Microphysogobio* without type species, he described two new species of *Microphysogobio koreensis* and *M. longidorsalis* from Korea in 1935, of which *M. koreensis* was designated as the type species of the genus. Banarescu and Nalbant (1966, 1973) published two revisionary papers on the genus *Microphysogobio* including 9 and 10 species. Subsequently Banarescu (1992) listed 23 species of the genus in his a critical updated checklist of the subfamily Gobioninae.

The genus *Microphysogobio* of Korea had been considered as 4 species: *Microphysogobio koreensis* Mori, 1935, *M. longidorsalis* Mori, 1935, *M. yaluensis* (Mori, 1927), and *Microphysogobio* sp. Uchida, 1939 (Chyung, 1977). Of them *Microphysogobio* sp. was described as *M. tungtingensis uchidai* by Banarescu and Nalbant (1973), Jeon (1990) examined the morphology of *Microphysogobio tungtingensis* in Korea and Chae and Yang (1999) described a new species *Microphysogobio rapidus* based on the specimens collected from the Naktong River, Korea.

Through the recent investigation on the Korean *Microphysogobio* species, we found that *M. tungtingensis uchidai* was a synonym of *M. yaluensis* and differed from *Microphysogobio* sp. Uchida. The purpose of this paper is to provide a taxonomic revision of Korean *Microphysogobio* including a new species and comments on the biogeographical features of them.

Materials and Methods

Most specimens on which this study was based were collected in Korea by authors and deposited at Faculty of Biological sciences, Chonbuk Natio-

nal University, Chonju, Korea (CNUC). The type specimens of *Microphysogobio tungtingensis uchidai* deposited in the National Museum of Natural History (NMNH), U.S.A. were observed for the examination. Counts and measurments followed Hubbs and Lagler (1964). In the counts of the scales above or below lateral line, a small scale at the origin of dorsal or anal fin was made as one. Vertebral counts were taken from radiographs and the Weberian apparatus located at the anterior vertebral column was counted as four vertebrae. Fin rays and lateral line scales were counted with a stereo-microscope. Meristics and measurements expressed as percentage of standard length (SL) or head length (HL) were given as range with mean±SD within parentheses.

Systematic Account

Genus *Microphysogobio* Mori, 1933

Type species : *Microphysogobio koreensis* Mori, 1933: 114 (type species no indicated)

Diagnosis: Small sized, elongate body with dorsal profile more or less convex and ventral profile horizonal. Mouth inferior, horse-shoe shaped; papillae on upper lip in a single row, median ones larger: lateral part of lower lip enlarged, with well developed papillae in many rows. A pair of short maxillar barbels at corner of mouth. Snout short, usually blunt; eyes rather large, supra-lateral : interorbital slightly concave.

Lateral line complete, straight or only slightly decurved anteriorly. Scales rather large, 33~44 in lateral line, 2~3 between lateral line and insertion of pelvic fins. Swim-bladder reduced, its anterior chamber enclosed by a thick fibrous capsule and posterior chamber small. Seven divided ray in dorsal and six in anal. Peritoneum blackish. A row of lateral spots along body sides.

Distribution: East Asia from Amur to north Vietnam and the islands of Hainan and Taiwan.

Key to the species of *Microphysogobio* of Korea

1a. Dorsal fin large, upper margin of it strongly convex ..... *M. longidorsalis*
b. Dorsal fin small, upper margin of it slightly concave or straight 2
2a. Undeveloped papillae on upper lip; most fins unspotted ..... *M. jeoni* new species
b. Developed papillae on upper lip; dorsal, caudal and anal fins usually several row of dark spots 3
3a. Papillae on upper lip small, 15 to 23 at right half of a row; breast at pectoral fin origin scaled ..... *M. koreensis*
b. Papillae on upper lip more larger, 6 to 14 at right half of a row; breast at pectoral fin orig-in no scale 4
4a. Scales above lateral line 4; a median pad of lower lip divided ..... *M. yaluensis*
b. Scales above lateral line 5; a median pad of lower lip undivided ..... *M. rapidus*

Microphysogobio longidorsalis Mori, 1935

Korean name: Baekasari
(Fig. 1; Fig. 2A; Fig. 3A)

Microphysogobio longidorsalis Mori, 1935: 171 (north Han River); Uchida, 1939: 373; Mori, 1952: 57; Chyung, 1977: 208; Kim, 1984: 436-

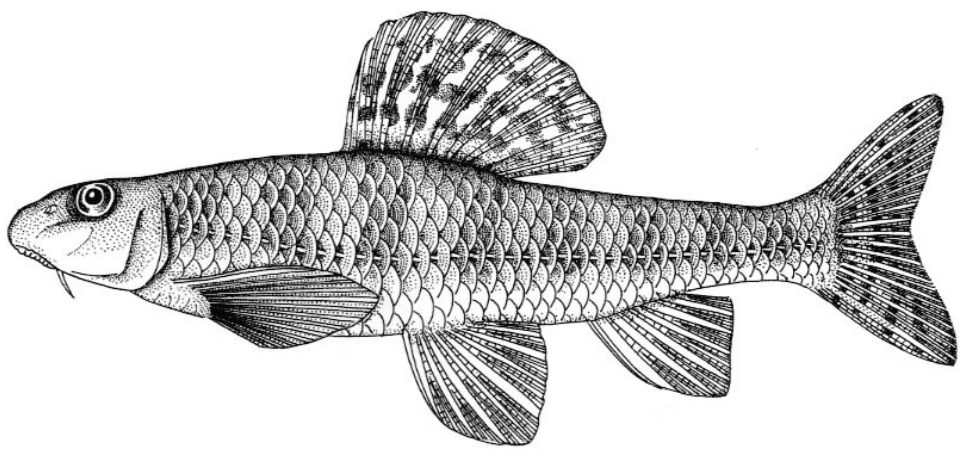

Fig. 1. *Microphysogobio longidorsalis*, CNUC 24546, 106.4 mm SL.

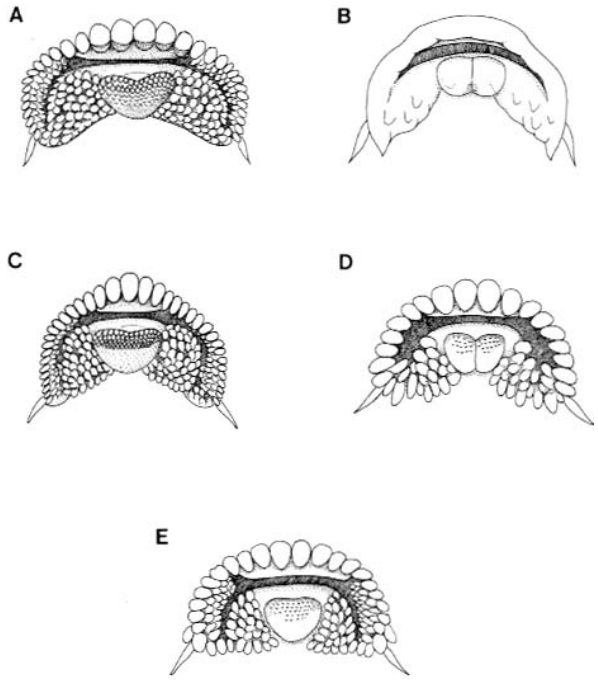

Fig. 2. Comparison of ventral view of mouth in the species of the genus *Microphysogobio*.
A: *M. longidorsalis* B: *M. jeoni* C: *M. koreensis*
D: *M. yaluensis* E: *M. rapidus*

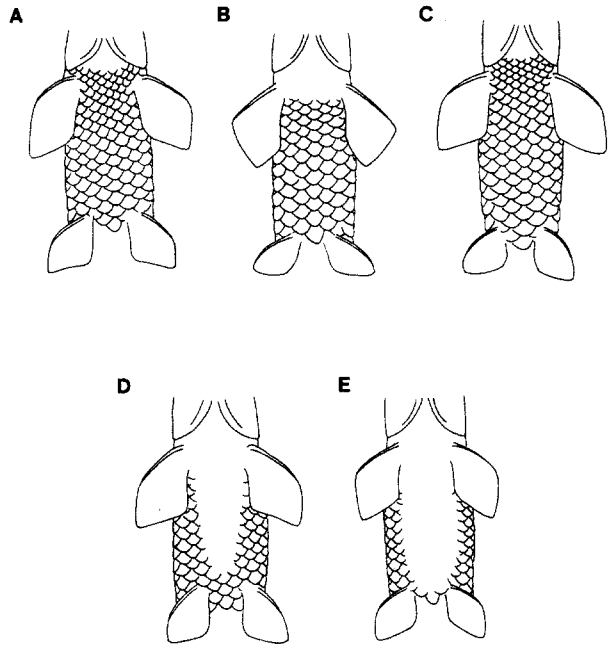

Fig. 3. Comparison of scale disposition on the breast in the species of genus *Microphysogobio*.
A: *M. longidorsalis* B: *M. jeoni* C: *M. koreensis*
D: *M. yaluensis* E: *M. rapidus*

448; Kim, 1997: 238-239; Banarescu, 1992: 326.
Microphysogobio tafangensis longidorsalis, Banarescu and Nalbant, 1973: 280-281.

Materials: CNUC 24470-24479, 10 specimens, 55.0~75.5 mm SL, Yongweol-up, Yongweol-gun, Kangwon-do, Korea, Jun. 14, 1997; CNUC 24540-24559, 20, 56.5~82.3 mm SL, Kongkeun-myon, Hweangsong-gun, Kangwon-do, Korea, Jun. 15, 1998.

Description: Dorsal fin rays iii 7; anal fin rays iii 6; pelvic fin rays 8; lateral line scales 40~41, 5/4: vertebrae 38~40; pharyngeal teeth 5-5.

Body depth 20.6~23.4% of standard length; head length 21.5~23.6%, predorsal distance 41.7~45.5%; preanal distance 71.3~74.4%; prepelvic distance 47.7~51.5%; prepectoral distance 21.3~24.0%; caudal peduncle length 16.9~20.1%; caudal peduncle depth 8.6~10.2%. Snout length 47.2~53.7% head length; eye diameter 19.8~23.0%; interorbital width 25.0~31.5%; barbel length 16.7~23.9%; caudal peduncle depth 45.3~57.4% of caudal peduncle length.

Body rather deeper, oblong and caudal peduncle compressed. Head rather small, snout blunt, slightly concave above. Nostril closer to eye than to tip of snout. Eye rather large, supra-lateral. Interorbital broad, slightly concave. Jaw horny, strongly cutting. Papillae of upper lip in two row at middle part. Median mental pad of lower lip heart-shaped with papillose. Lateral part of lower lip with several rows of small papillae (Fig. 2A). Barbels small. Lateral line slightly decurved anteriorly and straight posteriorly. Origin of dorsal fin closer to tip of snout than caudal base. Origin of pelvic fin slightly behind than that of dorsal one. Breast at origin of pectoral fin scaled (Fig. 3A).

Colour pattern: In formalin, dark brown above and whitish or yellowish below; eight to ten brown vague bands along lateral line. Dorsal and caudal fin with several bands of brown spots. Pectoral and pelvic faint stripes. Anal pale.

Distribution and habitat: This species is distributed only in the west Korea subdistrict (Kim, 1997); the Han River, Imjin River, Keum River, and Taedong River. It is found in the pebble bottoms of clean rapid waters in the upper reaches of the rivers.

Remarks: *M. longidorsalis* is similar with *M. tafangensis* of China mainland in the external

shape of body and dorsal fin, but it is easily distinguished from the latter by 38-40 lateral line scales (vs about 33 in *M. tafangensis*) and scaled breast in front of pectorals (Fig. 3A) (vs naked breast).

Microphysogobio jeoni, new species

Korean name: Doengkyongmochi
(Fig. 4; Fig. 2B; Fig. 3B)

Microphysogobio sp. Uchida, 1939: 382; Mori, 1952: 52; Chyung, 1977: 208.
Microphysogobio tungtingensis, Choi *et al.*, 1990: 80.
Microphysogobio uchidai, Kim, 1984: 442; Kim, 1997: 244; Chae and Yang. 1999; 17.

Materials: Holotype: CNUC 24425, 63.2 mm SL, male, Tosan-myon, Andong-shi, Kyonsangbuk-do, Korea, Apr. 7, 1996; Paratypes: USNM 355303, 5, 56.8~79.6 mm SL, Tosan-myon, Andong-shi, Kyongsangbuk-do, Korea, Apr. 7, 1996; CNUC 10582-10586, 5, 57.7~87.0 mm SL, Hwajeong-myon, Uiryng-gun, Kyongsangbuk-do, Korea. Nov. 7, 1987; CNUC 24459-24463, 5, 61.0~84.6 mm SL, Yoju-up, Yoju-gun, Kyongki-do, Korea, Apr. 17, 1998; CNUC 24483-24487, 5, 52.5~84.0 mm SL, Songsan-myon, Kunsan-Shi, Chollabuk-do, Korea, May 1, 1998.

Diagnosis: This species is distinguished from its congeners by the combination of following characters: undeveloped papillae on upper lip; body comparatively low and elongated; unspotted fins; scales of upper half on body mostly bordered blackish.

Description: Dorsal fin rays iii 7; anal fin rays iii 6; ventral fin rays 8; pectoral fin rays 12~14 (holotype 13); lateral line scales 36~41 (39), 5/3~4 (4); vertebrae 36~40 (38); pharyngeal teeth 5-5.

Table 1. Proportional measurement and meristic counts of *Microphysogobio jeoni* sp. nov. (Mean±SD)

Characters	Holotype	Paratypes
No. of individuals	1	20
Standard length (mm)	63.2	57.8~84.0
In standard length (%)		
head length	21.3	19.8~23.5 (21.8±1.1)
body depth	15.2	14.8~18.9 (16.6±1.3)
predorsal length	42.2	41.1~44.8 (42.9±0.9)
preanal length	73.1	73.3~76.6 (74.5±0.9)
preventral length	46.4	46.0~48.8 (47.6±0.8)
prepectoral length	21.1	20.5~23.8 (22.3±0.9)
caudal peduncle length	17.3	15.1~18.8 (17.0±1.0)
caudal peduncle depth	7.5	7.3~9.2 (8.2 ±0.5)
dorsal base length	13.7	12.8~14.7 (13.7±0.5)
anal base length	8.9	7.3~9.2 (8.2 ±0.5)
distance from ventral to anal	27.6	25.7~30.5 (27.4±1.2)
In caudal peduncle length (%)		
caudal peduncle depth	43.1	39.1~50.1 (45.7±2.9)
In head length (%)		
snout length	38.2	34.1~43.3 (38.6±2.0)
eye diameter	31.9	24.6~31.7 (27.9±1.8)
interobital width	22.5	20.5~26.9 (23.8±1.8)
barbel length	14.5	13.5~20.8 (17.8±2.1)

The morphometric characters are given in Table 1. Body almost low, elongated and caudal peduncle compressed. Head rather small, snout rather pointed. Eye large, supra-lateral; interorbital width flat. Mouth inferior, horse-shoe shaped; upper lip smooth or undeveloped; median mental pad of lower lip two pieces, ovoid and lateral parts of it expanded, with a few of papillae (Fig. 2B). Barbels small. Lateral line complete, straight; scales rather larger. Breast

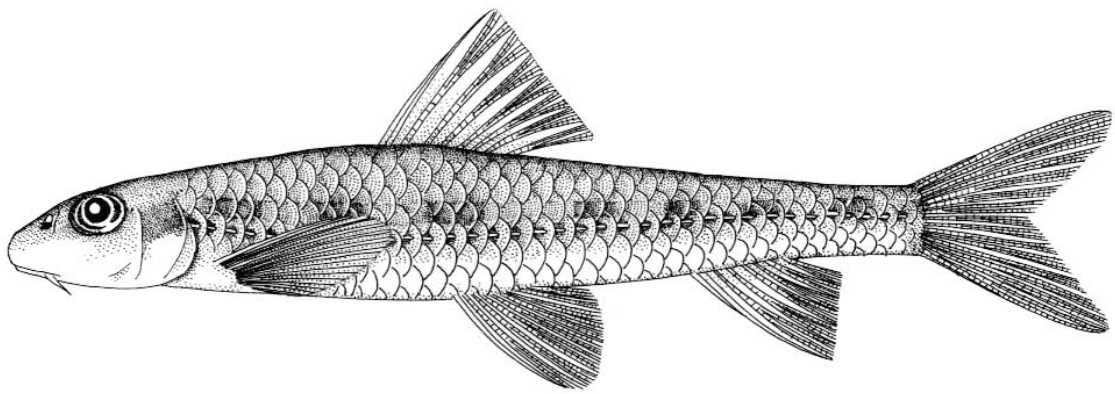

Fig. 4. *Microphysogobio jeoni* new species, holotype CNUC 24425, 63.2 mm SL.

mostly scaled (holotype and specimens of Naktong River) or somewhat naked variably (some specimens of Han and Keum River) at middle part of pectoral fin origin (Fig. 3B). Origin of dorsal fin closer to tip of snout than caudal base. Origin of pelvic fin slightly behind than that of dorsal one. Edge of dorsal fin straight or slightly concave; caudal fin deeply forked.

Colour pattern: Grayish above, paler below; about 10 rectengular brown spots on lateral line. Scales on upper half of body mostly bordered blackish. Upper part of head blackish. Most fins unspotted.

Distribution and habitat: This species is distributed in the Naktong River, Han River, Keum River, and Taedong River in Korea. It is found on the sand bottoms of slowly running waters in the middle or lower reaches of the rivers.

Etymology: The specific name, "*jeoni*" refers to Dr. Sang-Rin Jeon, a professor of Sangmyong University, Seoul, Korea, who contributed his efforts to the promotion of ichthyological study in Korea.

Remarks: Uchida (1939) reported that *Microphysogobio* sp. differed from *M. koreensis*, *M. yaluensis*, and *M. longidorsalis* in Korea. Thereafter Banarescu and Nalbant (1973) described a subspecies *Microphysogobio tungtingensis uchidai* from 5 specimens of the Naktong River drainage which deposited in NMNH of Smithsonian Institution, and then treated *Microphysogobio* sp. Uchida as a synonym of *M. t. uchidai*. Since then many korean ichthyologists used *M. tungtingensis uchidai* for *Microphysogobio* sp. Uchida without any check of type specimens. Jeon (1990) assumed that the specimens of the Naktong River and Keum River conform to *M. t. uchidai* and those of the Han River conform to *M. t. tungtingensis*. However in the result of the present examination of a holotype (USNM 162674, 41.4 mm SL) and two paratypes (USNM 204099, 34.9~36.9 mm SL) of *M. tungtingensis uchidai* from the Smithsonian Institution, we found that the *M. t. uchidai* is a junior synonym of *M. yaluensis* based on the evident papillae of the upper lip, body proportion, and color pattern of body. And we found that *Microphysogobio* sp. Uchida differed from *M. tungtingensis* (Nichols, 1926) and its congeners of China mainland recorded by Banarescu and Nalbant (1973) in the papillae disposition of the upper lip (smooth in *Microphysogobio* sp. vs. distinct), the predorsal distance (41.7~45.5% SL, vs 38.0~41.0%), the number of scale above and below (5/3~4, vs 4/2) and the scaled breast (scaled or somewhat scaled, vs scaleless). Because *Microphysogobio* sp. was considered as a distinct species without valid name, we named it for the first time as *Microphysogobio jeoni*. The new species is similar with *Microphysogobio linghensis* (Xie, 1986) in smooth upper lip and colour pattern on body sides, but differed from the latter in the number of lateral line scales (37~41 in *M. jeoni* vs 34~37), the body depth (14.0~18.4% vs 18.0~23.3%, and the colour pattern of most fins (unspotted vs spotted).

***Microphysogobio koreensis* Mori, 1935**

Korean name: Moreajoosa

(Fig. 5; Fig. 2C; Fig. 3C)

Microphysogobio koreensis Mori, 1935: 173 (Naktong River, Korea); Uchida, 1939: 377-382; Chyung, 1977: 207; Kim, 1984: 436-448; Kim, 1997: 240-241.

Microphysogobio kachekensis koreensis, Banares-

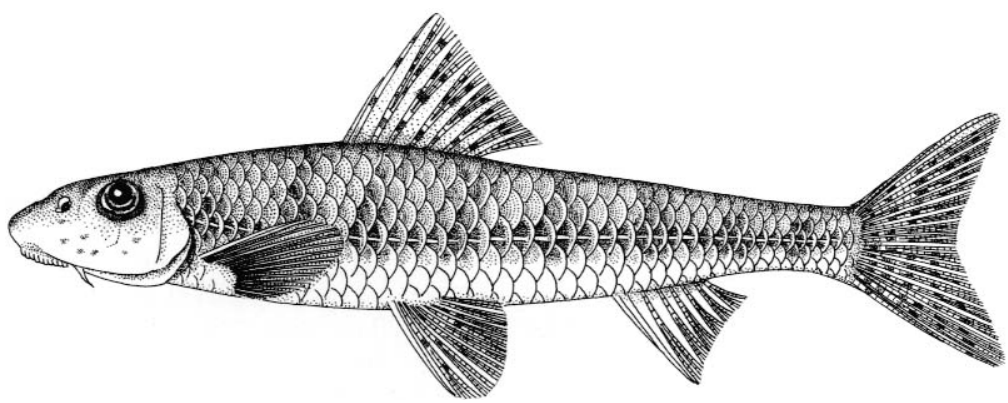

Fig. 5. *Microphysogobio koreensis*, CNUC 24896, 106.9 mm SL.

cu and Nalbant, 1973: 251-253.

Materials: CNUC 24321-24328, 8, 89.0~93.3 mm SL, Chusang-ri, Kumseo-myon, Sanchong-gun, Kyongsangnam-do, Korea, Nov. 30, 1989; CNUC 24329, 103.3 mm SL, CNUC 24896, 106.9 mm SL, Yurim-myon, Hamyang-gun, Kyongsngnam-do, Korea, Jan. 23, 1985; CNUC 24331-24333, 3, 74.8~83.3 mm SL, Sangdong-myon, Miryang-shi, Kyongsangnam-do, Korea, Apr. 16, 1997; CNUC 24335-24336, 2, 70.9~71.6 mm SL, Tansong-myon, Sanchong-gun, Kyongsangnam-do, Korea, Aug. 5, 1997; CNUC 24318-24319, 2, 92.9~101. 5 mm SL, Chusan-myon, Hwasun-gun, Chollanam-do, Korea, Dec. 27, 1987.

Description: Dorsal fin rays iii 7, anal fin rays iii 6, pelvic fin rays 8; lateral line scales 40-42, 5/3; vertebrae 39-41; pharyngeal teeth 5-5.

Body depth 17.2~21.5% SL; head length 21.7~23.1%; predorsal distance 43.2~45.8%; preanal distance 74.4~77.5%; prepelvic distance 47.6~51.7%; prepectoral distance 21.5~24.5%; caudal peduncle length 14.2~17.2%; caudal peduncle depth 8.1~9.0%. Snout length 42.4~49.2% of HL; eye diameter 21.0~26.4%; interorbital width 24.9~30.2%; barbel length 16.0~26.6%. Caudal peduncle depth 48.7~60.2% of caudal peduncle length.

Body elongate, more or less compressed posteriorly, head slightly compressed. Snout blunt, slightly concave above; eye rather large, high and lateral; interorbital narrow and flat. Jaw horny, strongly cutting. A row of papillae at middle part of upper lip and several rows of small papillae at lateral part of it; mental pad of lower lip heart shaped (Fig. 2C). Lateral line stright. Origin of dorsal fin closer to tip of snout than caudal base. Origin of pelvic fin slightly behind that of dorsal. Breast scaled at origin of pectoral fins (Fig. 3C)

Colour pattern: In life, bluish brown above, silvery white below with bluish stripe at middle of body sides. In formalin, dark brown above body sides, pale below; ten to thirteen indistinct brown blotches along lateral line scales. Dorsal, caudal, pectoral and pelvic fins with several bands of small dark spots. Anal pale.

Distribution and habitat: This species is distributed in both the Naktong River and Somjin River. It is found on some pebble bottoms with sand of 50 to 100 cm depth at the lowest areas of the rapid rivers.

Remarks: Mori (1935) gave measurement data of *M. koreensis* from 16 specimens and indicated *M. koreensis* as a type species of the genus *Microphysogobio* in his description. Although he recorded that the present species distributed in the rivers of the Naktong, Somjin, Yongsan, Keum and Han, Uchida (1939) reported that the species was distributed in the Naktong River and Somjin River. We could also observe it only the two rivers till now. Banarescu and Nalbant (1966, 1973) considered it as a subspecies of *M. brevirostris* or *M. kachekensis* differently, after that Banarescu (1992) revised it as a distinct species and ascribed it *M. brevirostris* species group including *M. yaluensis*.

***Microphysogobio yaluensis* (Mori, 1927)**

Korean name: Tolmaja

(Fig. 6; Fig. 2D; Fig. 3D)

Pseudogobio yaluensis Mori, 1927 : 62-63.

Microphysogobio yaluensis, Uchida, 1939: 385-389; Chyung, 1977: 207; Kim, 1984: 441; Kim, 1997: 241-243.

Microphysogobio tungtingensis uchidai Banarescu and Nalbant, 1973: 264-265.

Materials: CNUC 24309-24317, 9, 45.3~59.2 mm SL, Yangpyong-up, Yangpyong-gun, Kyongki-do, Korea, Oct. 16, 1996; CNUC 24217-24236, 20, 48.9~68.5 mm SL, Sakok-myon, Kongju-shi, Chungchongnam-do, Korea, May 19, 1987; CNUC 24500-24519, 20, 56.1~87.3 mm SL, Kwanchon-myon, Imsil-gun, Chollabuk -do, Korea, Mar. 20, 1998; CNUC 24257-24266, 10, 35.4~49.8 mm SL, Taejon-myon, Tamyang-gun, Chollanam-do, Korea, Mar. 24, 1997; CNUC 24289-24308, 20, 58.5~86.1 mm SL, Tosan-myon, Andong-shi, Kyongsangbuk-do, Korea, May 15, 1996; USNM 162674, 41.4 mm SL (holotype of *M. tungtingensis uchidai*), USNM 204099, 2, 34.9~36.9 mm SL (paratype of it), Sinchon-ri, Korea. 35°16.5′N, 128°50.7′E, about 25 km west -northwest of Pusan, collected by V.G. Springer.

Description: Dorsal fin rays iii 7; anal fin rays iii 6; pelvic fin rays 8; lateral line scales 35~40, 4/3; vertebrae 34~39; pharyngeal teeth 5-5.

Body depth 14.4~24.6% of SL; head length 20.1~24.6%; predorsal distance 42.6~51.1%; preanal distance 73.6~81.8%; prepelvic distance 45.8~56.4%; prepectoral distance 20.6~27.1%; caudal peduncle length 11.9~18.7%; caudal peduncle depth 6.8~11.0%. Snout length 35.2~

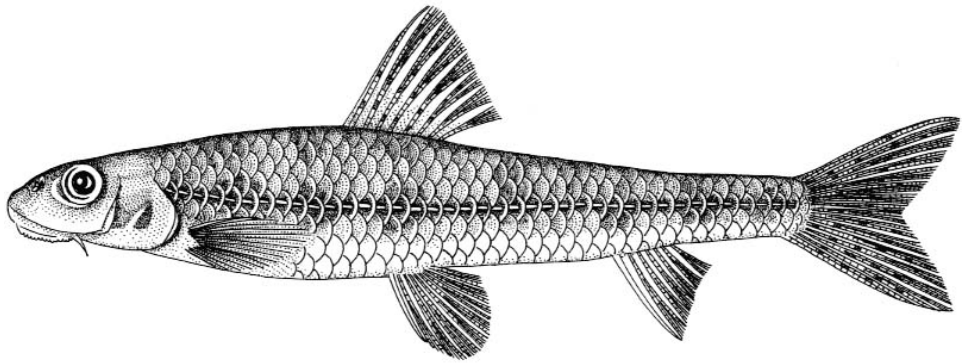

Fig. 6. *Microphysogobio yaluensis*, CNUC 24511, 67.8 mm SL.

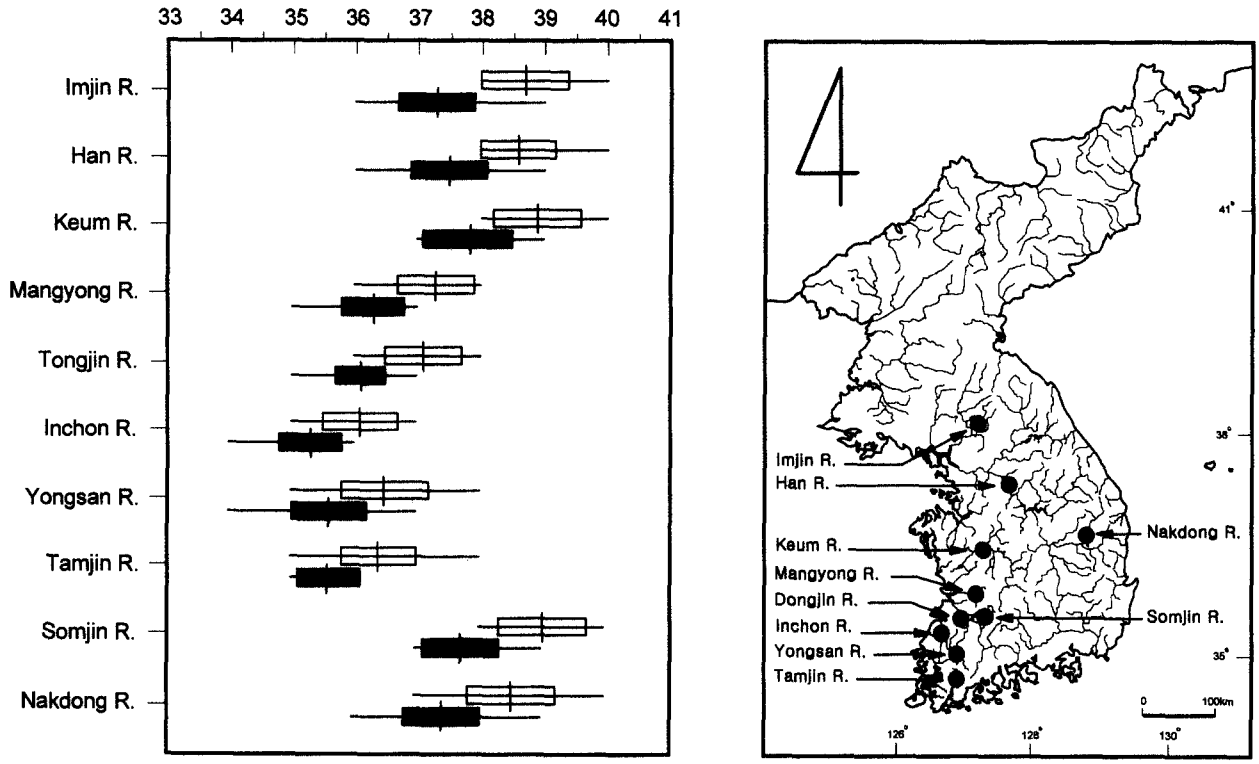

Fig. 7. The geographical variation of the number of lateral line scales (hollow rectangles) and vertebrae (black rectangles) in *Microphysogobio yaluensis* in Korea. The diagram indicates the mean (vertical line), standard deviation (rectangle), and range (horizontal line).

49.6%; eye diameter 21.6~31.6%; interorbital width 24.1~35.4%; barbel length 11.9~28.4%. Caudal peduncle depth 40.1~79.1% of caudal peduncle length.

Body deep and slightly compressed; caudal peduncle low and slightly long; snout rather point; eye large, high and lateral; interorbital distance wide, slightly convex. Mouth inferior, horse-shoe shaped; papillae on upper lip in one row, median ones much larger; mental pad at median part of lower lip heart shaped and well developed papillae at lateral part of it (Fig. 2D). Barbel small. Lateral line complete, straight. Edge of dorsal fin slightly concave and caudal fin forked deeply. Breast inside pectoral fins naked (Fig. 3D).

Colour pattern: In formalin, dark above lateral line and pale below it; an inconspicuous late-

ral band on body sides; edge of most scales above marked with brown; dorsal and caudal fin with black spots; anal fin pale.

Distribution and habitat: This species is widely distributed in Korea; the Amnok (Yalu) River, Taedong River, Han River, Keum River, Mankyong River, Tongjin River, Yongsan River, Tamjin River, Somjin River and Naktong River. It was found at shallow sand bottoms with pebbles in the slowly running waters.

Remarks: *M. yaluensis* was described as *Pseudogobio yaluensis* based on a specimen collected from the Amnok River (Mori, 1927) and redescribed in detail from 15 specimens of the Naktong River by Uchida (1939). Mori recorded that the number of lateral line scales of the species was 36, but Uchida reported it as 39~43. In the present study, we found that *Microphysogobio yaluensis* had 35 to 40 of lateral line scales based on the examination of populations of the Imjin River, Han River, Keum River, Mankyong River, Tongjin River, Inchon River, Yongsan River, Tamjin River, Somjin River, and Naktong River in Korea. Among them both the northern populations (rivers of the Imjin and Han) and the southeastern populations (rivers of the Naktong and Somjin) had 38 to 40 lateral line scales and 36 to 39 vertebrae, while the southwestern populations (Tamjin and Yongsan River) had 35 to 38 lateral line scales and 34 to 36 vertebrae. On the other hand it is remarked that the populations of the Mankyong River and Tongjin River located in the intermadiate regions between two areas had 36 to 39 lateral line scales and 35 to 37 vertebrae respectively (Fig. 7). We recognized that *M. yaluensis* distributed from north to southwest area showed the clinal variation in the number of lateral line scale and vertebrae of them.

***Microphysogobio rapidus* Chae and Yang, 1999**

Korean name : Youlmaja

(Fig. 8; Fig. 2E; Fig. 3E)

Microphysogobio rapidus Chae and Yang, 1999: 17-21 (Naktong River, Korea)

Materials: CNUC 24520-24539, 20, 48.0~71.5 mm SL, Yongsun-myon, Munkyong-shi, Kyongsangbuk-do, Korea, May 22, 1998; CNUC 2023-2045, 24846-24852, 23, 48.3~62.4 mm SL, Chilsungbuk-dong, Chinju-si, Kyongsangnam-do, Korea, April 17, 1982; CNUC 3938-3939, 2, 52.6-56.7 mm SL, Sinbum-ri, Muan-myon, Miryang-gun, Kyongsangnam-do, Korea, July 25, 1982; CNUC 2672, 2674, 2675, 3, 60.1-65.0 mm SL, Miryang-gun, Kyongsangnam-do, Korea, Aug. 12, 1981; CNUC 1524, 65.4 mm SL, Miryang-gun, Kyongsangnam-do, Korea, Aug. 25, 1976; CNUC 2706, 2709, 2715, 2717, 4, 61.9~69.2 mm SL, Sanchong-gun, Kyongsangnam-do, Korea, Aug. 12, 1981.

Description: Dorsal fin rays iii 7; anal fin rays iii 6; 8 pelvic fin rays; lateral line scales 39~42, 5/4; vertebrae 38~39; pharyngeal teeth 5-5.

Body depth 18.2~21.6% of SL; head length 22.9~25.7%; predorsal distance 45.9~49.2%; preanal distance 72.2~75.6%; prepelvic distance 49.4~54.0%; prepectoral distance 23.2~27.0%; caudal peduncle length 15.2~17.9%; caudal peduncle depth 7.3~8.8%. Snout length 41.5~47.3% of HL; eye diameter 24.0~26.6% of HL; interorbital width 23.5~29.0%; barbel length 15.9~20.6%. Caudal peduncle depth 41.1~55.9 % of caudal peduncle length.

Body slightly deep and caudal peduncle low; head small; snout somewhat pointed, slightly concave above; nostril closer to eye than to tip of

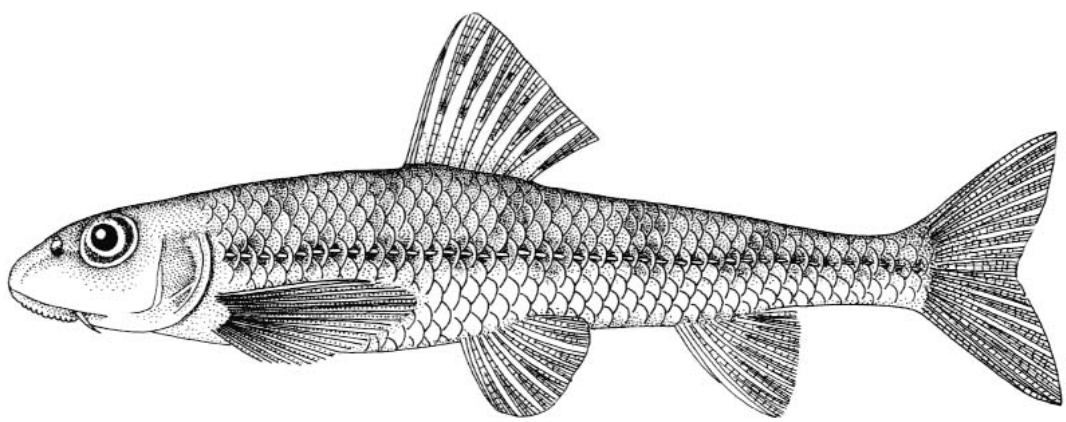

Fig. 8. *Microphysogobio rapidus*, CNUC 24538, 60.9 mm SL.

snout; eye high, lateral; interorbital distance narrow and flat; mouth inferior, horse-shoe shaped; papillae on upper lip in a single row, median ones larger; lateral part of lower lip enlarged with well developed papillae in several rows and heart-shaped mental pad of lower lip undivided (Fig. 2E); barbel short. Lateral line straight, slightly decurved at anterior part of it. Origin of dorsal fin nearer to tip of snout than caudal fin base, and anterior than origin of pelvic fin. Edge of dorsal fin straight or somewhat concave and caudal fin deeply forked. Breast inside pectoral fins naked (Fig. 3E).

Colour pattern: In spawning season, dark spots scattered above and silverly white below with 7~9 dark round spots on a greenish stripe of body sides; pectoral and pelvic fins reddish. In formalin, conspicuous dark stripe on body sides and indistinct stripes on rays of dorsal and caudal fin.

Distribution and habitat: This speciese is restrictly distributed in the Naktong River (Munkyong, Andong, Yongyang, Sangju, Milyang and Sanchong), where it inhabited sympatrically with *M. yaluensis* and rarely with *M. jeoni*. It is found on the pebble bottoms with sand at the lower part of rapids along the streams.

Remarks: *Microphysogobio rapidus* was described from 25 specimens collected from the Naktong River, Korea by Chae and Yang (1999). The species is very similar to *Microphysogobio yaluensis*, but it differs from *M. yaluensis* and its congeners by 5 scales above lateral line, undivided mental pad of lower lip and a longitudinal greenish stripe on body sides in spawning season.

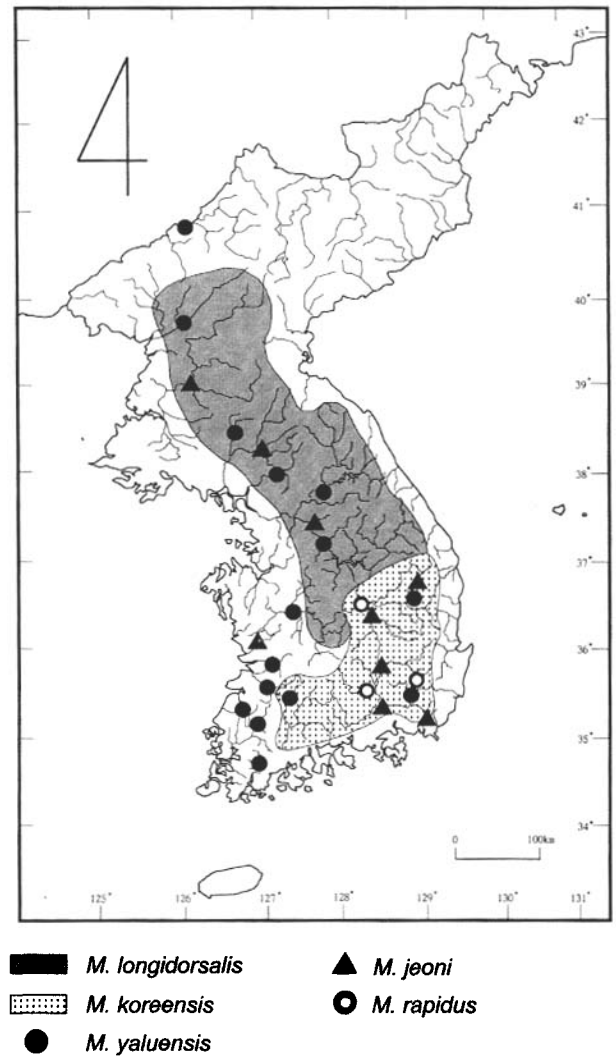

Fig. 9. The geographical distribution pattern in the five species of genus *Microphysogobio* in Korea.

Discussion

The genus *Microphysogobio* are restrictly distributed in East Asia from Amur to north Vietnam and well adapted to the rheophilic and benthic habitats (Banarescu and Nalbant, 1973). Hosoya (1986) considered it as a higher specialized genus in the Gobioninae based on the cephalic lateral line system and their osteology. The monophyly of the genus *Microphysogobio* was supported by synapomorphies that were encapsulation of swim bladder, development of papillae on lip, and deep suborbital (Banarecu and Nalbant, 1966, 1973; Banarescu, 1992).

Banarescu and Coad (1991) reported that East Asia was regarded as a evolution centre of cyprinid fishes since the early Pliocene. And Lindberg (1972) recognized that the freshwater fishes of Korean Peninsula might be dispersed from China mainland along the Paleo-Hwangho River in the late Pliocene to the Pleistocene, based on the common fish fauna between China mainland and Korean Peninsula and the geography of paleocoastline and Paleoriver channels at that time. Recently Banarescu (1992) have listed 23 species and 7 subspecies in the genus *Microphysogobio* which have restricted as endemic ranges in East Asia : 19 species or subspecies in China mainland, 2 in Taiwan Island, 5 in Vietnam and Hainan Island and 4 in Korea. The five species of the genus *Microphysogobio* presented in Korea are all endemic to Korea. In general, the most

endemic freshwater fishes in Korea are inhabited on the riffle bottoms of the streams such as the habitats of the subfamilies Gobioninae and Cobitinae which show higher ratio as over 60% in the endemism (Kim, 1998). Such richness of endemic species in the genus *Microphysogobio* could also be explained by the fact that they have been influenced by the adaptation to the rheophilic waters and the barrier of mountain ranges like the other endemic freshwater fishes in Korea (Kim, 1997).

Microphysogobio jeoni differed from the other 4 species in having no papillae on upper lip and the lower body depth. On the other hand, both *Microphysogobio longidorsalis* and *M. koreensis* are characterized by well developed papillae on upper lip and the scaled breast (Figs 2 and 3). And both *Microphysogobio yaluensis* and *M. rapidus* are very similar each other in their appearances, but distinguished from the other three species by the papillae on the upper lip.

It is remarked biogeographically that *Microphysogobio yaluensis* distributed broadly shows the clinal variations among the populations in the number of lateral line scale and vertebrae from north to south along the western drainage of Korea (Fig. 7). And *Microphysogobio jeoni* showed some variations among their populations in the upper lip papillae and the scale disposition on breast, but the details will be investigated later. It is worth mentioning that *Microphysogobio longidorsalis* ranges mainly in the west Korea subdistrict, while *M. koreensis* and *M. rapidus* restricted in the south Korea subdistrict (Fig. 9).

Acknowledgments

The present study was supported by the Basic Research Institute Program, Ministry of Education, Project no. 4428 (1997). We express our sincere thanks to the Drs Victor G. Springer and Susan L. Jewett of the National Museum of Natural History of the Smithsonian Institute in U.S.A. for the loan of type specimens of *Microphysogobio tungtingensis uchidai*. We appreciate to Dr. P. Banarescu for sending many papers for us and thank to Dr. C.L. Lee of Kunsan National University, Korea for helpful comments about this manuscript. We thank Dr. Youn Choi, Kunsan National University, Korea for drawing of *Microphysogobio* species and Dr. Jae-Hwan, Shim, for sending the specimens of *Microphysogobio yaluensis* from the Tamjin River and Yongsan River, Korea.

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Received April 2, 1999
Accepted May 12, 1999

한국산 모래주사속 (Genus *Microphysogobio*) 어류의 분류학적 연구

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한국산 모래주사속(Genus *Microphysogobio*) 5종 배가사리 *M. longidorsalis*, 둥경모치 *M. jeoni*, 모래주사 *M. koreensis*, 돌마자 *M. yaluensis*, 여울마자 *M. rapidus*를 분류학적으로 재검토하여 검색표와 그림을 제시하고 지리적 변이에 대하여 논의하였다. 그 가운데 둥경모치의 학명은 지금까지 *Microphysogobio* sp. Uchida, 1939와 *M. tungtingensis uchidai* Banarescu and Nalbant, 1973로 사용되어 왔으나, 본 조사에서 *M. t. uchidai*는 모식표본의 확인결과 *M. yaluensis*의 동종이명임이 확인되었다. 그리고 둥경모치는 중국산 *M. tungtingensis*나 *M. linghensis*와 아주 비슷하지만 등지느러미 기점이 훨씬 뒤에 있고, 상순 유두돌기가 민틋하며, 흉복부에 비늘이 배열되어 있어 이들과는 잘 구별되므로 별종인 *M. jeoni*로 기재하였다. 우리나라에 널리 분포하는 돌마자는 측선비늘수와 척추골수에 있어서 clinal variation을 보여주어 지리적으로 주목되었다. 둥경모치는 상순유두돌기와 흉부비늘의 배열상태가 집단간에 약간의 변이를 보였다. 돌마자와 둥경모치는 비교적 널리 분포하나 배가사리는 서한아지역에만 출현하고 모래주사와 여울마자는 남한아지역에만 제한 분포한다.