

A Review of the Spined Loaches, Family Cobitidae (Cypriniformes) in Korea

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ABSTRACT The family Cobitidae of Korea was reviewed as 16 species in 5 genera with the key to species for the identification by the external features. The three genera of *Iksookimia*, *Koreocobitis*, and *Kichulchoia* erected from the genus *Cobitis* were reclassified based on the presence or absence of Gambetta's zones on the body sides, their body pigmentation, the shape of lamina circularis in males, the number of unbranched anal fin rays, and some molecular phylogenetic data. By the results of these reexamination, the generic names of the three species were changed as *Cobitis choii*, *Iksookimia pacifica*, and *Kichulchoia mutifasciata*. It was remarked biogeographically that most species of genera *Cobitis*, *Iksookimia*, *Koreocobitis*, and *Kichulchoia* show the disjunct distributions with bottom-dwelling preferences as endemic to Korean peninsular. Three species of *Cobitis choii*, *Kichulchoia brevifasciata*, and *Koreocobitis naktongensis* are considered to be critically endangered according to the severe habitat destruction and the alteration of river topography.

Key words : Spined loaches, Cobitidae, *Cobitis*, *Iksookimia*, *Kichulchoia*, *Koreocobitis*, *Misgrunus*, lamina circularis

INTRODUCTION

The fishes of the family Cobitidae are distributed in the bottoms of freshwaters in the entire temperate Eurasia including the Morocco where about 140 species in 16 genera are recognized. These loaches are small, elongate body forms with great variation of colour patterns on body sides and the presence of an suborbital spine. Taxonomic studies on the Cobitidae have been carried out in connection with the secondary sexual character, lamina circularis (Vladykov, 1935; Ikeda, 1936). Many ichthyologists have been interested in these loaches, but their wide geographic ranges and extensive morphological variabilities made it difficult for them to carry out classification studies to reach a stable taxonomy and systematics (Saitoh *et al.*, 2000).

Since *C. taenia* was recorded from Korea (Jordan and Starks, 1905; Jordan and Metz, 1913), two species of *Cobitis mutifasciata* and *C. rotundicaudata* have been described by Wakiya and Mori (1929). And Uchida

(1939) reviewed in detail 5 species in the genera *Cobitis* and *Misgrunus*. Recently many cobitid taxa have continuously been described from Korea and known in available field observations (Kim, 1975; Kim *et al.*, 1976, 1999, 2000, 2003; Kim and Son, 1984; Kim and Lee, 1987, 1995, Kim and Park, 1997). The diploid-triploid coitid complex lineages were reported as an unisexual reproductive mode by hybridogenesis between *Cobitis hankugensis* and *Iksookimia longicorpa* in the Nakdong River, Korea (Kim and Lee, 2000). Three genera of *Iksookimia*, *Koreocobitis*, and *Kichulchoia* were erected from the genus *Cobitis* (Nalbant, 1993; Kim *et al.*, 1997, 1999), however they were not provided a phylogenetic classification.

13 species in 6 genera of *Acanthopsis*, *Cobitis*, *Paralepidocephalus*, *Misgrunus*, and *Paramisgrunus* have been reported from China (Chen, 1981). Hosoya (2002) classified Japanese Cobitidae into 8 species and 4 subspecies including unidentified species and subspecies in the genera *Misgrunus*, *Niwaella*, and *Cobitis*. And the striated spined loaches in Japan and Korea were discussed with their phylogenetic positions by the mitochondrial DNA analysis (Kitakawa *et al.*, 2004). Vasil'eva (2001) pre-

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sented the loaches of genus *Misgrunus* of Russian Asia with taxonomic problems of related forms from adjacent countries. 35 species in 3 genera of the Cobitidae in Europe have been reviewed with available taxonomic informations in the handbook of European Fishes (Kottelat and Freyhof, 2007). And the molecular phylogeny of the family Cobitidae was discussed with the problems of their generic delimitation (Slechtova *et al.*, 2008).

The present paper is to re-evaluate the delimitation of the genera *Cobitis*, *Iksookimia*, *Niwaella*, and *Kichulchoia* and to provide a review of the family Cobitidae known from Korea today and their biogeographical aspects.

MATERIALS AND METHODS

Most specimens on which this study is based were collected in Korea by the author and his colleagues. Most holotypes and paratypes belong to the collections of the Faculty of Biological Science, Chonbuk National University (CNUC). Methods of counting and measuring followed Hubbs and Lagler (2004). Vertebral counts were taken from radiographs, and the Weberian apparatus located at the anterior vertebral column was counted as four vertebrae. Gambetta's zones in pigmentations of the genus *Cobitis* were defined as described by Gambetta (1934). Measurements expressed as percentage of standard length (SL) or head length (HL) are given as range with mean. The terminology of the morphological aspects on the mouth and barbels, scales, pigmentations, suborbital spine, and gas bladder capsule followed Nalbant (1963).

Key to genera of family Cobitidae in Korea

- 1a. Non-functional suborbital spine; scales with small eccentric focal area. *Misgrunus*
- 1b. Movable suborbital spine, scales with large central focal area. 2
- 2a. Irregular densely dark small spots on body sides; margin of caudal fin slightly rounded. *Koreocobitis*
- 2b. A series of blotches, vertical bars or stripes on body sides; margin of caudal fin truncate. 3
- 3a. 4 branched anal rays, 6 branched dorsal rays; no lamina circularis at pectoral fin base in males. *Kichulchoia*
- 3b. 5 branched anal rays, 7 branched dorsal rays; lamina circularis at pectoral fin base in males. 4
- 4a. Body pigmentation usually four Gambetta's zones; tip of 2nd pectoral fin ray of males not pointed. *Cobitis*
- 4b. Body pigmentation a row of dark brown vertical blotches below midlateral part and irregular dark brown-

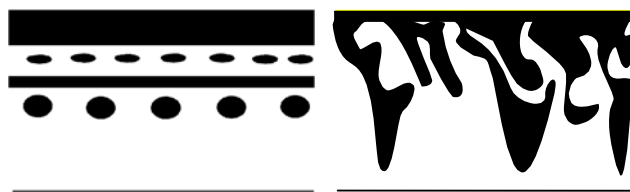


Fig. 1. Typical body pigmentation of genera *Cobitis* (left) and *Iksookimia* (right).

ish vermiculate speckles above dorsolateral part.
 *Iksookimia*
 (Fig. 1)

Genus *Cobitis* Linnaeus

Cobitis Linnaeus, 1758; 303 (type species: *C. taenia*).

Body slightly elongated and compressed. Mouth small, inferior with 3 pairs of barbels. Mental lobes on lower lip, small with pointed tip. Suborbital spine erectile, moveable, bifid. Anterior chamber of air bladder enclosed in a bony capsule of globular form. Four Gambetta's zones on body sides. Caudal fin truncated. Body covered by minute oval scales with medium focal area. Lateral line short, not exceeding pectorals. Males with lamina circularis at base of pectoral fin rays. About 50 species in Eurasia and Morocco and 4 species in Korea.

Key to the species of the genus *Cobitis* in Korea

- 1a. Body pigmentation consisting of a series of dark brown roundish or rectangular blotches on below midlateral part (Z4 zone). 2
- 1b. Body pigmentation consisting of 3 to 4 dark brown stripes on midlateral part (Z1-4 zones). *C. tetralineata*
- 2a. Body pigmentation consisting of a series of dark brown rectangular blotches on below midlateral part (Z4 zone); roundish lamina circularis at base of pectoral fin of males; large scales with medium sized focal area. 3
- 2b. Body pigmentation consisting of a series of dark brown roundish blotches on below midlateral part (Z4 zone); elongated lamina circularis at base of pectoral fin of males; small scales with large focal area. *C. choii*
- 3a. Fourth Gambetta's zone with a series of ovoid blotches; 2n chromosomes 48; interorbital width narrow, 11-14% in head length. *C. hankugensis*
- 3b. Fourth Gambetta's zone with a series of rectangle blotches; males with two stripes (Z2 and Z4) in spawning season; 2n chromosomes 50; interorbital width broad, 14-19% in head length. *C. lutheri*

***Cobitis choi* Kim and Son, 1984** (Plate 1. A)

Cobitis choi Kim and Son, 1984: 49 (type locality: Ochang-myon, Cheongwon-gun, Chungcheongbuk-do, Miho-cheon stream, a tributary of the Geum River, Korea).

Iksookimia choi, Nalbant, 1993: 105 (transferred).

Common name: Miho spined loach (English); Mi-ho-jong-gae (Korean).

Specimens examined: Holotype CNUC 4854, 1, 54.7 mm SL, Ochang-myon, Changwon-gun, Chungcheongbuk-do, May 28, 1983; paratypes CNUC 4847-48, 4850-51, 5028-30, 5039, 5041, 5043, 5046, 5056, 5060, 12, 55.2-69.2 mm SL, same data of holotype.

Description: D ii7, A iii5, P₁ i7-8, P₂ i5i Gr. 14-16, Vert. 43-45. Morphometric data are given in Table 1. Body elongated and laterally compressed but its thickness high variable, tapering into a slender caudal peduncle. Head slightly compressed, snout pointed anteriorly; eye small. superior, lateral and intermediate between tip of snout and gill opening; mouth small, inferior with 3 pairs barbels; suborbital spine slender, short, bifid.

Origin of dorsal nearer base of caudal fin than tip of snout. Caudal peduncle shorter than head and narrow. Lateral line short, not exceeding length of pectorals. Body covered by minute oval scales with large focal area.

Colour: Body pale yellowish with Z4 zone of 13 to 17 small roundish or triangular dark brownish blotches; Z2 to Z3 zones very small indistinct or confluent; Pigmentation of head with dark brownish minute dots. A conspicuous black spot on caudal fin base above. Dorsal and caudal fin with three or more rows of grayish dots.

Sex dimorphism: Males have the serrated elongate lamina circularis at base of pectoral fins and the thickened second pectoral fin ray.

Distribution: It is distributed only the Miho-cheon River and its adjacent streams of the tributary in the Geum River.

Habitat and biology: This species inhabits under fine sand bottoms in the flowing shallow waters with less than one meter deep and spawns in May to June.

Etymology: The generic name was given for all loaches described by Linnaeus (1758). The species name "choi" was dedicated to Dr. Ki-Chul Choi, who has contributed much to the studies of the fresh-water fishes in Korea.

Remarks: This species was described as a valid species distincted from *C. koreensis* based on the peculiar lamina circularis with serrated marginal part in males, a row of brownish round blotches on body sides, and small scales with large focal area (Kim and Son, 1984). Although Nalbant (1993) transferred it the genus *Iksookimia* based on the elongate lamina circularis in the males, it was considered to be placed again into the genus

Cobitis by its body pigmentation composition and the suggestion of molecular phylogeny by RAG-1 analysis in the northern cobitid fishes (Slechtova *et al.*, 2008). This species is threatened for their survival by the destruction of the specific habitats, so it has been designated as the endangered species of the Ministry of Environment and as a natural monument species from the Cultural Heritage Administration of Korea. According to current findings, it should be classified as endangered based on the very small population size and decline by the habitat destruction and the river improvement project (IUCN, 2001).

***Cobitis hankugensis* Kim, Park, Son, and Nalbant, 2003** (Plate 1. B)

Cobitis hankugensis Kim, Park, Son, and Nalbant, 2003: 2 (type locality: Sancheong-gun, Gyeongsangnam-do, Nakdong River, Korea).

Cobitis taenia, Jordan and Starks, 1905: 201 (list, Busan, Wonsan); Mori, 1928: 54; Uchida, 1939: 401 (redescription in detail); Mori, 1952: 50 (list); Chyung, 1977: 210; Kim, 1980 (subspecies).

Cobitis sinensis, Jordan and Metz, 1913: 12 (Suwon, Wonsan, Busan, Pungtung); Kim and Jeong, 1987: 71 (Nakdong R.); Choi *et al.*, 1990: 111; Kim, 1997: 305. *Cobitis laoensis*, Kim *et al.*, 1999: 376.

Common name: Nakdong spine loach (English); Ki-reum-jong-gae (Korean).

Specimens examined: Holotype CNUC 33912, male, 79.4 mm SL, Dojernri, Sengburi-myon, Sanchong-gun, Gyeongsangnam-do, Oct. 3, 2002; paratypes CNUC 33913-17, 1 male and 4 females, 71.2~99.4 mm SL, same locality and date as in holotype; CNUC 33918-22, 2 males and 3 females, 65.5~84.6 mm SL, Geochang-eup, Geochang-gun, Gyeongsangnam-do, Aug. 15, 1981; CNUC 32743-47, 2 males and 3 females, Unbong-myon, Namwon-si, Jeollabuk-do; CNUC 68.9~82.1 mm SL, Yaechon-eup, Yaechon-gun, Gyeongsangbuk-do, April 6, 1986.

Description: D iii7, A iii5, P₁ 7-9, P₂ 6. C 7-8+8, Vert. 43-46. Morphometric data are given in Table 1. Body elongated, laterally compressed. Head moderate with small eye, placed in middle. Nostril double on each side, close set, anterior one with short tube. Mouth small, inferior, arched, with lip surrounding, lower lip divided into two median mental lobes. Three pairs of barbels, first one rostral, other two pairs on maxillo-mandibular. Third barbel slightly longer than eye diameter. Suborbital spine concealed in skin, strongly curved, bifid, its terminal not reaching middle of eye.

Dorsal fin origin almost directly above pelvic fin origin, Distal margin of dorsal fin more or less straight. Body covered with small round scales, head naked.

Table 1. Proportional measurements of genus *Cobitis* from Korea. Mean in parenthesis

| | <i>C. choii</i> | | <i>C. hankugensis</i> | | <i>C. lutheri</i> | <i>C. tetralineata</i> | |
|-------------------------------|-----------------------|---------------------|------------------------|---------------------|---------------------|------------------------|---------------------|
| | Holotype CNUC 4854 | Paratypes (n=12) | Holotype CNUC 33912 | Paratypes (n=20) | Non-types (n=29) | Holotype CNUC 723 | Paratypes (n=38) |
| Standard length (mm) | 54.7 | 55.2~69.2 | 79.4 | 63.2~99.4 | 51.3~85.5 | 73.4 | 43.7~104.2 |
| In standard length (%) | | | | | | | |
| Body depth | 15.2 | 13.8~19.5 (15.7) | 13.7 | 13.2~16.7 (14.3) | 14.3~20.1 (16.1) | 16.5 | 14.4~18.2 (16.1) |
| Head length | 21.4 | 18.2~22.7 (19.9) | 19.9 | 18.2~21.2 (19.9) | 20.3~25.6 (21.6) | 20.6 | 17.3~23.8 (20.6) |
| Snout length | 9.9 | 7.7~9.6 (8.7) | 10.3 | 8.4~11.1 (9.4) | 8.8~10.8 (9.7) | 8.7 | 7.9~10.8 (9.5) |
| Eye diameter | 3.8 | 2.8~3.7 (3.2) | 3.1 | 2.7~3.6 (3.2) | 3.0~4.7 (3.5) | 4.1 | 2.9~4.3 (3.5) |
| Interorbital width | 2.6 | 1.2~2.5 (2.0) | 2.4 | 2.1~2.8 (2.4) | 2.8~4.3 (3.4) | 3.5 | 2.4~4.1 (3.2) |
| Third barbel length | 4.8 | 2.7~4.9 (3.9) | 3.1 | 2.9~4.4 (3.5) | 1.8~4.5 (3.1) | 3.8 | 2.4~4.3 (3.4) |
| Predorsal length | 52.1 | 50.5~56.7 (52.1) | 50.8 | 48.6~54.7 (50.7) | 48.5~57.7 (52.2) | 52.3 | 49.2~53.6 (50.8) |
| Prepectoral length | 23.4 | 19.8~23.8 (21.4) | – | – | 20.2~25.8 (22.1) | 23.3 | 19.2~25.2 (21.7) |
| Prepelvic length | 53.0 | 51.5~59.5 (53.7) | 52.0 | 49.9~55.8 (52.6) | 51.6~60.2 (53.9) | 51.0 | 50.6~53.7 (51.9) |
| Preanal length | 75.0 | 75.0~87.8 (77.7) | 79.7 | 76.8~81.1 (78.7) | 69.2~89.7 (79.7) | 78.9 | 75.3~79.7 (77.8) |
| Pectoral-pelvic length | 31.1 | 31.1~38.7 (34.3) | – | – | 30.1~34.7 (32.4) | 23.7 | 26.5~33.7 (31.5) |
| Pelvic-anal length | 24.1 | 22.1~28.4 (24.6) | – | – | 24.0~28.9 (26.0) | 24.9 | 23.3~28.5 (25.9) |
| Caudal peduncle length | 17.2 | 14.7~18.5 (16.9) | 14.6 | 11.9~16.2 (14.6) | 12.3~15.9 (14.3) | 14.7 | 13.9~18.2 (15.8) |
| Caudal peduncle depth | 8.0 | 6.7~8.8 (10.3) | 8.7 | 7.5~10.0 (8.6) | 8.5~10.7 (9.5) | 10.2 | 8.4~10.7 (9.5) |
| In head length (%) | | | | | | | |
| Snout length | 44.8 | 42.9~47.9 (45.0) | 51.9 | 42.0~53.7 (47.4) | 42.5~52.1 (46.4) | 45.8 | 45.2~46.4 (45.7) |
| Eye length | 16.1 | 13.5~17.3 (15.9) | 15.8 | 13.9~17.5 (16.0) | 16.0~19.4 (17.7) | 19.6 | 17.2~19.7 (18.6) |
| In caudal peduncle length (%) | | | | | | | |
| Caudal peduncle depth | 48.9 | 42.1~52.1 (48.9) | 59.5 | 49.6~76.3 (59.3) | 67.3~80.8 (67.3) | 64.7 | 55.7~61.4 (60.2) |

Lateral line short, not reaching length of pectoral fin.

Colour: Body yellowish with dark brownish blotches of four Gambetta's zones. Z2 zone is a series of 9-15 narrow elongate blotches and Z3 zone is like a line of continuous spots; Z4 zone consisting a row of 9-12 rectangular or ovoid blotches. A distinct dark spot present at upper part of caudal fin base.

Sex dimorphism: The males have a round lamina circularis at base of pectoral fins. The second fin ray of pectoral fin is longer and thicker in the males than in females. In the spawning season, the blotches of 2nd and 4th Gambetta's zones of males are occasionally connected to form stripe. Body size is usually larger in the female than in the males.

Distribution: It is distributed in the Nakdong River, the Hyongsan River, and its adjacent streams.

Habitat and biology: It inhabits on sand bottoms in the shallow flowing waters and feeds aquatic benthic algae and small arthropods. It spawns in May to June.

Etymology: It was named after "Hankug", the Korean common name of Korea, where this species is endemic.

Remarks: This species has been confusedly reported in Korea as *Cobitis taenia*, or *C. sinensis*. Uchida (1939) reported *Cobitis taenia* in detail with morphological variations of body pigmentation and ecological features. After Kim (1980) classified it as three subspecies, *Cobitis taenia taenia*, *C. t. lutheri*, and *C. t. striata* by the differences of body colour patterns and the geographic distribution, *Cobitis hankugensis* was described as a valid

species which was distinct from the related species or subspecies based on the lamina circularis at the base of pectoral fin in the males and their body pigmentations. Diploid-triploid *Cobitis* unisexual lineages were reported as *Cobitis sinensis* (= *hankugensis*)-*longicorpa* complex from the Nakdong River, Korea, where both species of *Cobitis hankugensis* and *Iksookimia longicorpa* inhabits sympatrically (Kim and Lee, 2000).

Cobitis lutheri Rendahl, 1935 (Plate 1. C1 and C2)

Cobitis taenia lutheri Rendahl, 1935: 330 (description, type locality: Chanka Lake Basin).

Cobitis taenia lutheri, Kim, 1980: 239 (first record to Korea).

Cobitis lutheri, Kim and Lee, 1988: 91 (valid species).

Common name: Luther spined loach (English); Jeomjul-jong-gae (Korean).

Specimens examined: CNUC 29591-94, 2 females and 2 males, 50.3~84.5 mm SL, Hwasan-myon, Wanju-gun, Jeollabuk-do, July 8, 1996; CNUC 30393-408, 8 females and 8 males, 54.6~72.9 mm SL, Bongdong-eup, Wanju-gun, Jeollabuk-do, April 18, 2002.

Description: D iii7, A iii5, P₁ 8, P₂ 6, C 7+7, Vert. 39-41. Morphometric data are given in Table 1. Body elongated, relatively high and laterally compressed. Head moderate and compressed with upper profile convex. Snout long, protruded; eye small superior and lateral;

mouth small, inferior, arched with thickened lips; mental lobes well developed with short process. Three pairs of barbels, one pair of rostral, one pair of maxillary, and one pair of maxillo-mandibular. Suborbital spine concealed in skin and moveable, relatively short, slightly curved, bifid; nostrils closer to eye than tip of snout, close together, anterior pair in a short tube; interorbital space narrow and flat.

Origin of dorsal fin almost equally distant between tip of snout and caudal fin base; pelvic fin origin behind that of dorsal fin; edge of dorsal fin and caudal fin straight; caudal peduncle compressed, shorter than head. Body covered by minute oval scales with median focal area. Lateral line short, not exceeding length of pectoral fins.

Colour: Main colour light yellow. Body generally with four Gambetta's zones on body sides; the first zone formed of irregular speckles connected at the predorsal blotches and degenerated posteriorly; the second zone formed of a series of small quadrate blotches; the third zone spotted with a small dots; the fourth zone arranged in a row of somewhat broad quadrate blotches.

Sex dimorphism: Males have larger roundish lamina circularis at the base of pectoral fins, but females have no it. The second pectoral fin ray is larger in males than in females. Generally the body size of the species is larger in females than in males; body colour patterns of males shows the second and fourth Gambetta's zones changing to be broad stripes respectively in spawning season.

Distribution: It is distributed in the streams flowing into the west coast of Korean Peninsula and distributed in China mainland, Kyushu Island of Japan, and the Ussuri River Basin in Russia.

Habitat and biology: It inhabits on sand bottoms of the streams. It was known that the species showed the many hermaphroditic individuals in related to the protandrous sex reversal by the histological study (Kim and Park, 1992).

Etymology: The species was named in honour of Prof. A. Luther in Helsingfors, who collected the type specimen.

Remarks: After *Cobitis taenia lutheri* was described as a new subspecies from Chanka Lake Basin, Russia based on the type specimen (Rendahl, 1935), it was reported as the first record in Korea (Kim, 1980). And then Kim and Lee (1988) subsequently raised it to a valid species differing from *C. taenia* based on the differences of the sex dimorphism in body pigmentation and body size.

***Cobitis tetralineata* Kim, Park and Nalbant, 1999** (Plate 1. D)

Cobitis tetralineata Kim, Park, and Nalbant, 1999: 373 (description, type locality: Gurae-eup, Gurae-gun, Jeollanam-do, Seomjin River, Korea); Kim and Park, 2002:

226.

Cobitis taenia, Uchida, 1939: 401 (pigmentation variation).

Cobitis taenia striata, Kim, 1980: 239 (new record from Korea).

Cobitis striata, Kim and Lee, 1988: 91 (characters, karyotype and distribution).

Common name: Korean striped spine loach (English); Jul-jong-gae (Korean).

Specimens examined: Holotype CNUC 723 male, 73.4 mm SL, Gurae-eup, Gurae-gun, Jeollanam-do, September 30, 1975; paratypes CNUC 724-725, 3 females, 77.4~90.0 mm SL, locality and date are same as in holotype.

Description: D iii7, A ii-iii5, P₁ 8, P₂ 5-6, C 6-7+6-7, Vert. 41-44. Morphometric measurements are given in Table 1. Body elongate, laterally compressed. Head small, slightly compressed with small eye that are closer to snout than to hind margin of operculum; interorbital space narrow and convex; nostrils closer to eye than tip of snout, close together, anterior pair in a short tube. Suborbital spine reduced. Mouth arched with fleshy lips; upper lip with weak transverse wrinkles on surface, well separated from upper jaw; lower lip with two well-developed lobes and a pointed tip. Three pairs of barbels, first on rostral, second on maxilla, and third on maxillo-mandibular.

Origin of dorsal fin situated nearly at midpoint between tip of snout and base of caudal fin; origin of pelvic fins nearly under that of dorsal; margin of dorsal and caudal fins practically straight. Caudal peduncle short, laterally compressed. Body covered with minute oval scales with large eccentric focal area. Lateral line short, not reaching length of pectoral fin.

Colour: Body light yellowish with four dark-brown longitudinal stripes. Dorsal blotches in front of dorsal fin generally indistinct, but 7-9 rectangular or ovoid blotches are situated behind dorsal fin. The first Gambetta's zone is composed of a series of small irregular blotches anteriorly that are degenerated posteriorly. The second and fourth Gambetta's zones are well developed with broad stripes passing from the behind margin of opercula to the base of caudal fin. The third zone, a narrow brownish stripe or spotted line reduced to a trace or entirely lacking posteriorly. A black spot is conspicuously present at upper part of caudal fin base. Rays of dorsal and caudal fins are formed by three or four bands with many speckles. Head with numerous minute brownish spots and an oblique dark brownish stripe from tip of snout to occiput passing through eye.

Sex dimorphism: The second fin ray of pectoral fin is longer in males than in females. The males have a roundish lamina circularis at base of pectoral fin, but females have no it.

Distribution: It is distributed in only the Seomjin River, Korea.

Habitat and biology: The species inhabits on the sand bottoms of the clean stagnant waters with 10~20 cm/sec in current velocity and 30~30 cm in water depth. It feeds mainly on chironomids, arcellids, branchioids, and aquatic algae and spawns from late June to middle July, 22~26°C water temperature. The average number of mature eggs in ovary about 12,000. Males of 13~14 months old after hatching had lamina circularis at the base of pectoral in as a secondary sexual character (Kim *et al.*, 2006).

Etymology: It was named from the Latin “tetra”, meaning four, and the Latin “linea”, meaning line-like an allusion to the four brownish longitudinal stripes on the body sides.

Remarks: *Cobitis taenia striata* was firstly described from Japan by Ikeda (1936) as a subspecies based on the roundish lamina circularis at the base of pectoral fin in the males and the stripe bands on body sides. Saitoh and Aizawa (1987) classified it as seven local races in three independent species based on the morphometric characters and their geographical distribution. However they did not assign them scientific names because of their relationship with the European populations of *Cobitis taenia* and the absence of the type specimens of *C. t. striata*. From this viewpoint, the specimens of Korean “*Cobitis striata*” populations could not be assigned as *C. striata* just like as a Japanese specimens owing to the difference of body pigmentation between them. Thereafter this species was described it as distinct species, *Cobitis tetralineata* based on the having four longitudinal dark brown stripes on body sides (vs. three longitudinal stripes in *C. striata* of Japan) and a jet-black spot at upper part of caudal fin base (vs. two black spots at base of caudal fin in *C. striata* of Japan).

Genus *Iksookimia* Nalbant, 1993

Iksookimia Nalbant, 1993: 101 (type species: *Cobitis koreensis* Kim, 1975).

Body elongate, but more stout and compressed. Mouth small, inferior with longer 3 pairs of barbels. Mental lobes on lower lip well developed. Suborbital spine generally reduced with small thorn, bifid, erectile, movable. Body covered with minute scales, large focal area. Lateral line short, not exceeding pectorals. Body colour pattern no typical four Gametta’s zones, with a row of brownish vertical blotches, sometimes reduced form below midlateral part and somewhat irregular vermiculate speckles or few brownish blotches on dorso-lateral part. Males with usually well developed lamina circularis at base of pectoral fin rays and a beak-like tip of second pectoral ray. 6 species in Korea.

Key to species of genus *Iksookimia*

- 1a. Males with an elongate lamina circularis at base of pectoral fin. 2
- 1b. Males with more or less roundish lamina circularis at base of pectoral fin. 4
- 2a. Colour patterns composing of a row of brownish vertical elongate blotches below midlateral body sides; moderate scales with small focal area. 3
- 2b. Colour patterns composing of a row of brownish reduced vertical or heart-shaped blotches below midlateral body sides; small scales with large focal area. *I. pacifica*
- 3a. A row of 10 or more vertical elongate blotches with densely irregular speckles above dorso-lateral body sides. *I. koreensis*
- 3b. A row of less 9 brownish vertical elongate blotches with few larger vertical elongate blotches on dorso-lateral body sides. *I. pumila*
- 4a. Males with a well developed lamina circularis at base of pectoral fin; first one or two brown vertical bars with black colour just behind operculum. 5
- 4b. Males with reduced lamina circularis at base of pectoral fin; no vertical bars with black colour just behind operculum. *I. yongdokensis*
- 5a. A row of dark brownish vertical elongate bars broad in its width, which are continuous to dorso-lateral irregular blotches. *I. longicorpa*
- 5b. A row of dark brownish vertical elongate bars narrow in width, which are discontinuous to dorso-lateral with densely small spots. *I. hugowolfeldi*

Iksookimia hugowolfeldi Nalbant, 1993 (Plate 1. E)

Iksookimia hugowolfeldi Nalbant, 1993: 106 (type locality: Jangseong-gun, Jeollanam-do, Yongsan River, Korea).

Common name: South speckle spined loach (English); Nam-bang-jong-gae (Korean).

Specimens examined: CNUC 30301-3; CNUC 30323; CNUC 30409-30413

Description: D iii7, A iii5. P₁ i7-8, P₂ i5-6, Gr. 13-15, Vert. 44-46. Morphometric characters are given in Table 2. Body relatively stout, compressed. Head large with eye equidistant from tip of snout to hind margin of operculum. Suborbital spine relatively smaller and slender, bifid. Mouth small, inferior, three pairs of barbels long. Mental lobes well developed with point tip. Predorsal length much longer than post dorsal. Insertion of pelvic fins on same line of insertion of dorsal. Margin of caudal fin nearly straight. Body covered with minute oval scales with small focal area. Lateral line incomplete, not exceeding pectoral fin length.

Colour: Body pale yellowish with brownish densely

speckles dorsolaterally; a row of 9-11 brownish narrow vertical elongate blotches below midlateral part; 9-13 dark brownish spots on dorsal part; a dark gray-brownish stripe from tip of snout to eye; a small jet black dot at upper part of caudal fin base. Dorsal and caudal fin with 3-4 rows of brownish dots.

Sex dimorphism: Males have the second pectoral fin ray with more thick and longer than other fin rays; a roundish lamina circularis at base of pectoral fin in males.

Distribution: It is distributed in the Yongsan River basin and its adjacent streams flowing into the southwest coast of the Jeollanam-do, Korea.

Habitat and biology: It inhabits on small pebbles with sand bottoms along the streams.

Etymology: This genus is named in honour of Korean ichthyologist, Dr. Ik-Soo Kim, who described most of species placed in this genus. This species name was named in the memory of Hugo Wolfeld, Bucharest, Romania, of the most able aquarium fish breeder and amateur ichthyologist.

Remarks: Formerly this species has been known as a geographic population of *Iksookimia longicorpa*, Nalbant (1993) described it as a valid species based on more stout body, larger head, smaller and slender suborbital spine than in *I. longicorpa*.

***Iksookimia koreensis* Kim, 1975 (Plate 1. F)**

Cobitis koreensis Kim, 1975: 51 (type locality: Gapyong-gun, Gyeonggi-do, Han River, Korea).

Iksookimia koreensis, Nalbant, 1993: 101 (transferred).

Common name: Speckle spined loach (English); Cham-jong-gae (Korean).

Specimens examined: Holotype CNUC 21674, male, 74.4 mm SL, Sang-myon, Gapyong-gun, Gyeonggi-do, Oct. 5, 1974; paratypes CNUC 21675-21679, 5, 71.7~89.5 mm SL, same locality and date as in holotype; CNUC 25623, 1, 78.5 mm SL, Sinyang-myon, Yesan-gun, Chungcheongnam-do, Jun. 1, 2001; CNUC 29563-586, 29588-9, 57.1~90.1 mm SL, Hwasan-myon, Wanju-gun, Jeollabuk-do, Oct. 1, 2001.

Description: D iii7, A iii5, P₁ i6-8, P₂ i5-6i, Gr. 14-16, Vert. 45-48. Morphometric measurements are given in Table 2. Body elongate and laterally compressed, but its thickness variable. Head elongate, compressed with upper profile convex. Snout long, and rounded; eye small, superior, lateral, and nearer tip of snout than gill opening. Mouth small, inferior with fleshy lips, lower divided by two lobes; 3 pairs of long barbels. Moveable suborbital spine, bifid.

Dorsal origin nearer base of caudal fin than tip of snout tip, and a little in front of pelvics. Distal margin of caudal fin slightly truncated. Scales small, cycloid with a large focal area. Lateral line short, not exceeding length

of pectoral fins.

Colour: Body pale yellowish, with dark brownish vertical blotches of a row of 10 to 18 on below midlateral body sides and brownish irregular speckles on dorsolateral part of body sides. Head with minute numerous spots. A conspicuous black spot at caudal fin base above.

Sex dimorphism: Males have smaller body size and longer second pectoral fin ray than in females. Males have elongated lamina circularis at base of pectoral fin.

Distribution: It is distributed in upper and middle course of Han, Geum, Imjin, Mangyong, Dongjin, and Samchokoship-cheon River, Korea.

Habitat and biology: It inhabits on the clear stony bottoms and feeds on mainly aquatic insects with benthic algae and spawns from June to July.

Etymology: The species name "koreensis" was referred to the type locality of this species, Korea.

Remarks: Although it was described as *Cobitis koreensis* (Kim, 1975), Nalbant (1993) transferred it the distinct genus as the type species based on having no four Gambetta's zones on body sides.

***Iksookimia longicorpa* Kim, Choi, and Nalbant, 1976 (Plate 1. G)**

Cobitis longicorpus Kim, Choi, Nalbant, 1976: 171 (type locality: Sunchang-gun, the Seomjin River, Korea).

Iksookimia longicorpa, Nalbant, 1993: 105 (transferred).

Common name: Large speckle spined loach (English); Wang-jong-gae (Korean).

Specimens examined: Holotype CNUC 505, male, 106.3 mm SL, Bokheung-myon, Sunchang-gun, Jeollabuk-do, Aug. 3, 1974; paratypes 506-512, 7, 90.2~122.2 mm SL, Seomjin River of Jinan-gun, Namwon-si, Sunchang-gun, and Seungju-gun, April, 11, 1976.

Description: D iii7, A iii5, P₁ i6-7, P₂ i5i, Gr. 14-16, Vert. 46-48. Morphometric characters given in Table 2. Body elongate and laterally compressed, but its thickness variable. Head elongate, compressed with convex profile, snout long, protrude, and bluntly rounded. Eye small, superior, lateral, and intermediate between tip of snout and gill opening. Mouth small inferior and with fleshy lips, lower lip divided into two developed mental lobes with pointed tip. Three pairs of barbels, first on rostrum, second on maxillae, and third on maxillio-mandibular. Suborbital spine movable, bifid.

Origin of dorsal nearer base of caudal fin base than tip of snout, and a little in front of pelvics. Margin of caudal fin slightly straight. Body covered by minute oval scales with large focal area. Lateral line short not exceeding length of pectoral fin.

Colour: Body pale yellowish with a series of 10-13 dark brownish vertical broad bands on below midlateral body sides and first or second blotches with black coloured

Table 2. Proportional measurements of genus *Iksookimia* from Korea. Mean in parenthesis

| | <i>I. hugowofeldti</i> | | | <i>I. koreensis</i> | | | <i>I. longicorpa</i> | | | <i>I. pacifica</i> | | | <i>I. pumila</i> | | | <i>I. yongdokensis</i> | | |
|-------------------------------|------------------------|---------------------------|--------------------|-------------------------|--------------------|---------------------------|----------------------|-------------------------|---------------------|---------------------------|--------------------|--|------------------|--|--|------------------------|--|--|
| | Non-types (n=9) | Holotype CNUC 21674 | Paratypes (n=5) | Holotype BEIU 505 | Paratypes (n=7) | Holotype CNUC 25111 | Paratypes (n=16) | Holotype CUB 9374 | Paratypes (n=27) | Holotype CNUC 21827 | Paratypes (n=7) | | | | | | | |
| Standard length (mm) | 55.7~67.8 | 74.4 | 71.7~89.5 | 106.3 | 90.2~122.5 | 68.4 | 45.4~114.6 | 50.9 | 42.3~62.3 | 71.4 | 51.2~74.4 | | | | | | | |
| In standard length (%) | | | | | | | | | | | | | | | | | | |
| Body depth | 14.6~15.8 (15.3) | 13.8 | 13.0~14.8 (13.9) | 15.1 | 12.1~15.6 (13.8) | 14.5 | 10.9~15.6 (13.6) | 13.8 | 12.7~15.6 (14.2) | 13.4 | 14.0~16.0 (14.8) | | | | | | | |
| Head length | 19.2~21.4 (20.5) | 19.4 | 19.6~20.2 (20.0) | 18.8 | 18.3~21.9 (20.0) | 21.3 | 19.7~21.5 (20.6) | 20.8 | 19.9~23.8 (21.9) | 20.3 | 19.0~21.0 (20.3) | | | | | | | |
| Snout length | 8.7~9.7 (9.4) | 8.1 | 8.7~9.6 (9.0) | 8.7 | 8.8~9.9 (9.3) | 10.2 | 8.4~10.6 (9.5) | 9.0 | 8.0~10.3 (9.3) | 8.8 | 8.2~9.6 (8.8) | | | | | | | |
| Eye diameter | 2.8~3.4 (3.1) | 3.1 | 2.8~3.2 (3.0) | 2.4 | 2.3~3.2 (2.7) | 3.2 | 2.9~4.0 (3.3) | 3.7 | 3.4~4.9 (4.0) | 3.4 | 3.3~3.7 (3.5) | | | | | | | |
| Interorbital width | 3.4~3.9 (3.6) | 2.4 | 2.3~3.2 (2.9) | 2.9 | 2.1~2.9 (2.4) | 3.4 | 1.4~3.2 (2.5) | 3.7 | 2.7~3.8 (3.3) | 3.4 | 2.5~3.4 (2.9) | | | | | | | |
| Third barbel length | 4.2~5.5 (5.0) | 4.4 | 4.1~5.4 (4.5) | 4.4 | 4.3~5.6 (4.9) | 5.3 | 3.0~5.2 (4.0) | 7.5 | 4.2~7.6 (6.3) | 4.3 | 2.9~5.4 (4.6) | | | | | | | |
| Predorsal length | 54.3~56.8 (55.1) | 53.8 | 53.4~57.6 (54.7) | 55.4 | 54.4~57.9 (55.3) | 53.4 | 49.4~54.4 (52.0) | 53.4 | 52.5~55.7 (54.3) | 54.2 | 54.8~58.9 (56.2) | | | | | | | |
| Prepectoral length | 19.4~21.9 (20.6) | 20.2 | 13.1~21.5 (19.0) | 21.3 | 20.1~23.9 (21.7) | 22.4 | 17.8~23.4 (21.2) | 21.6 | 20.7~24.2 (22.5) | 22.4 | 20.0~23.8 (22.1) | | | | | | | |
| Prepelvic length | 54.3~57.4 (56.6) | 53.9 | 52.7~54.4 (53.5) | 56.8 | 54.8~57.6 (56.4) | 53.2 | 51.8~55.9 (53.3) | 54.6 | 54.3~58.5 (56.0) | 55.6 | 55.1~59.1 (56.8) | | | | | | | |
| Prenasal length | 80.7~83.1 (81.7) | 77.2 | 76.7~79.0 (77.8) | 80.2 | 79.5~82.4 (81.2) | 78.9 | 77.7~81.0 (79.5) | 78.6 | 77.6~82.1 (79.9) | 81.0 | 78.0~81.5 (79.9) | | | | | | | |
| Pectoral-pelvic length | 34.1~37.9 (36.4) | 35.5 | 33.3~36.3 (34.6) | 37.3 | 34.4~38.1 (37.0) | 31.6 | 30.9~35.6 (33.1) | 35.8 | 32.4~39.0 (34.9) | 33.2 | 33.6~37.9 (36.0) | | | | | | | |
| Pelvic-anal length | 22.1~25.9 (24.4) | 22.4 | 22.9~26.0 (24.7) | 23.9 | 23.3~27.0 (24.8) | 25.6 | 24.8~28.3 (25.6) | 23.6 | 21.8~26.8 (24.3) | 25.8 | 22.1~25.4 (23.1) | | | | | | | |
| Caudal peduncle length | 12.0~15.6 (13.6) | 19.1 | 15.8~16.5 (16.2) | 15.3 | 12.6~15.1 (14.0) | 14.5 | 13.2~15.4 (14.4) | 15.1 | 13.4~19.6 (14.8) | 13.9 | 13.6~16.0 (14.5) | | | | | | | |
| Caudal peduncle depth | 10.2~10.8 (10.5) | 10.2 | 9.4~11.2 (9.9) | 10.3 | 9.1~11.2 (9.9) | 9.2 | 6.5~8.7 (7.4) | 9.8 | 8.8~11.3 (9.9) | 10.6 | 8.6~11.6 (9.9) | | | | | | | |
| In head length (%) | | | | | | | | | | | | | | | | | | |
| Snout length | 42.9~52.3 (47.2) | 45.5 | 43.6~48.5 (46.1) | 45.2 | 40.8~53.9 (47.9) | 51.0 | 38.8~51.0 (46.7) | 49.1 | 40.7~48.7 (45.1) | 41.8 | 37.0~45.2 (41.2) | | | | | | | |
| Eye length | 12.3~18.1 (15.0) | 16.3 | 14.9~16.5 (15.9) | 15.5 | 14.0~17.7 (15.3) | 18.9 | 14.6~21.6 (17.2) | 15.2 | 13.6~17.1 (15.4) | 11.4 | 11.4~15.0 (13.1) | | | | | | | |
| In caudal peduncle length (%) | | | | | | | | | | | | | | | | | | |
| Caudal peduncle depth | 67.1~109.4 (78.6) | 57.4 | 59.2~69.3 (65.3) | 72.8 | 65.4~78.8 (73.1) | 62.5 | 40.6~62.5 (50.0) | 68.9 | 60.6~81.0 (69.3) | 83.9 | 65.2~89.3 (79.6) | | | | | | | |

than others; brownish irregular densely small speckles on dorso-lateral body sides. A dusky gray line from tip of snout to front of eye on each side of head. Dorsal and caudal fins with three or more rows of dark spots. A conspicuous dark spot above caudal fin base.

Sex dimorphism: Males are smaller in body size than in females and have a lump like lamina circularis at base of pectoral fins.

Distribution: It is distributed mostly the Seomjin and Nakdong River, Korea.

Habitat and biology: This species inhabits on the pebble bottoms of fast flowing shallow waters. It feeds mainly on the chironomids, aquatic insect larvae, small arthropods and benthic algae. Spawning takes place from early June to July in water temperature exceeding 20°C. Females attain 65~90 mm TL at one year old, 90~110 mm TL at 2 year old, and over 110 mm TL at older than 3 year.

Etymology: It was from Latin, “longus” meaning long and Latin, “corpus” meaning body. The specific name referred to its larger body size.

Remarks: Although it was known to be distributed in only the Somjin River, the later investigators reported it to be found in the Nakdong River and its adjacent small streams flowing into southeast coast of Korea. The genus name of this species also transferred into *Iksookimia* from *Cobitis*, because of having no Gambetta’s zones on body sides.

***Iksookimia pacifica* Kim, Park, and Nalbant, 1999**
(Plate 1. H)

Cobitis pacifica Kim, Park, and Nalbant, 1999: 380 (type locality: Yonkok-myon, Gangneung-si, Gangwon-do, Yonkok stream flowing into northeast coast, Korea); Kim and Park, 2002: 228 (listed).

Cobitis taenia granoiei, Kim, 1980: 244 (new record to Korea).

Cobitis melanoleuca, Nalbant, 1993: 107 (transferred from *granoiei*); Kim, 1997: 310 (listed).

Common name: North speckle spined loach (English); Buk-bang-jong-gae (Korean).

Specimens examined: Holotype CNUC 25111, male, 68.4 mm SL, Sinwang-ri, Yonkok-myon, Gangneung-si, Gangwon-do, Jul. 7, 1996; paratypes CNUC 25126-25128, 3, 100.7~114.6 mm SL, Gyongseo-dong, Gangneung-si, Gangwon-do, May 20, 1973; CNUC 692-704, 13, 45.4~92.6 mm SL, Songpyong-ri, Goseong-gun, Gangwon-do, Jul. 9, 1979.

Description: D iii7, A iii5 P₁ i7-9, P₂ i5-6i, Gr. 16-19, Vert. 45-49. Morphometric characters are given in Table 2. Body well elongated with a large head, and compressed with upper profile convex. Eye small placed in middle of head or a little behind. Mouth arched with surrounded

lips large enough and rounded mental lobes with pointed tip. Suborbital spine small, concealed in skin, bifid.

Dorsal fin origin somewhat anterior to pelvic fin origin and nearer base of caudal fin than to snout; distal margin of dorsal and caudal fins almost straight. Body covered with minute scales with large focal area. Lateral line very short, not exceeding pectoral fin length.

Colour: Body light yellowish, with a row of 9-13 dark brownish reduced vertical blotches below midlateral body sides and few brownish narrow undulated blotches with discontinuity posteriorly on dorso-lateral part of body. There is a small faded black spot on upper part of caudal fin base. Dorsal and caudal fins have 3-4 transverse row of grayish dots.

Sex dimorphism: Males have the thickened second pectoral fin ray and a triangle shaped lamina circularis at base of pectoral fin.

Distribution: It is distributed in the Gangneung Namdae-cheon River and its northern adjacent streams flowing into the east coast, Korea.

Habitat and biology: It inhabits on the sandy bottoms with a little pebbles of the streams. It feeds on the larvae of aquatic insects. It spawns in June to July at water temperature 25~27°C.

Etymology: The name of species was given after the Pacific Ocean, the slope towards the river is flowing in the eastern coast of Korea.

Remarks: *Cobitis pacifica* was formerly regarded as *C. taenia*, *C. granoiei* or *C. melanoleuca* in Korea, however it was described as a distinct species by a combination of characters of body pigmentation, peculiar lamina circularis, small scales, narrow caudal peduncle, and larger head (Kim *et al.*, 1999). In this study, the genus name of this species was replaced to *Iksookimia* from *Cobitis* based on the undulated body pigmentation on the dorso-lateral part of body and a row of brownish reduced vertical blotches on midlateral part of body and the result of molecular phylogeny on the northern cobitid fishes (Slechtova *et al.*, 2008).

***Iksookimia pumila* Kim and Lee, 1987** (Plate 1. I)

Cobitis koreensis pumila Kim and Lee, 1987: 57 (type locality: Bekcheon River, Buan-gun, Jeollabuk-do, Korea).

Iksookimia pumila, Nalbant, 1993: 105 (transferred as valid species).

Common name: Buan speckle spined loach (English); Bu-an-jong-gae (Korean).

Specimens examined: Holotype CNUC 9374, female, 50.9 mm SL, Sangseo-myon, Buan-gun, Jeollabuk-do, Oct. 9, 1986; paratypes CNUC 4624-4634, 9374-84, 9395-6, 27, 42.3~62.3 mm SL, same locality and date as in holotype.

Description: D iii7, A iii5, P₁ i6-7, P₂ i4-5i, Gr. 14-17, Vert. 42-45. Morphometric data are given in Table 2. Body small size, elongate and laterally compressed. Head slightly compressed; small eye placed in middle of head; small mouth inferior, arched with surrounded lips, and developed mental lobes; three pairs of barbel, first on rostral, second on maxillar and third on maxillo-mandibular. Suborbital spine bifid.

Dorsal fin origin somewhat ahead of pelvic fins closer to base of caudal fin base than tip of snout. Distal margin of dorsal and caudal fins more or less straight. Lateral line short, not exceeding pectoral fin length. Scales small cycloid, on trunk, non on head. Body covered by minute large focal area except head.

Colour: Body pale yellowish with a row of 5-10 dark brownish vertical elongate blotches below midlateral part and a row of less 10 dark brownish vertical short blotches without irregular speckles on dorso-lateral part; head with brownish spots and a dusky oblique line from tip of snout to rear of eye; dorsal and caudal fin ray with three rows of brownish spots; a conspicuous black spot above caudal fin base.

Sex dimorphism: Males have an elongate lamina circularis at base of pectoral fin, similar with that of *I. korensis*.

Distribution: It is distributed only in the Buan Bekcheon River, flowing into the west coast of Buan-gun, Jeollabuk-do, Korea.

Habitat and biology: It inhabits on clear pebbles bottoms with little sand flowing shallow waters and feeds on the aquatic insect and algae. Spawning season is known April to June.

Etymology: The species name was from Latin "pumilus" meaning dwarfish, which refers to its small body.

Remarks: It was described as a subspecies of *C. korensis* by the geographic division, however Nalbant (1993) regarded it as a valid species by the differences of body colour patterns and the morphological characters. This species restricted only the small stream is threatened by the Dam which was constructed in the middle course in 1996.

***Iksookimia yongdokensis* Kim and Park, 1997**
(Plate 1. J)

Iksookimia yongdokensis Kim and Park, 1997: 249 (type locality: Yeongdokoship R., Yongdok-gun, Gyeongsangbuk-do, Korea).

Common name: East speckle spined loach (English); Dong-bang-jong-gae (Korean).

Specimens examined: Holotype CNUC 21827 males, 72.2 mm SL, Yongjeon-ri, Dalsan-myon, Yongdok-gun, Gyeongsangbuk-do, May 18, 1996; paratypes CNUC 21791, male, 69.5 mm SL, same locality and date as in holotype; CNUC 21792-21794, 2 males and 1 female,

Naenam-myon, Gyongju-si, Gyeongsangbuk-do, May, 18, 1996; CNUC 21802, male, 71.2 mm SL, Chuksan-myon, Yongdok-gun, Gyeongsangbuk-do, May 18, 1996.

Description: D iii7, A iii5, P₁ i7-8, P₂ ii5i, C 7-8+7-8, Gr. 13-14, Vert. 41-43 (44). Morphometric data are given in Table 2. Body elongated, compressed with larger head slightly; eye small, on upper lateral surface of head closer to snout than to gill opening. Interorbital space broad, convex. Moveable suborbital spine, bifid. Mouth small, inferior with fleshy lips; upper lip furrowed in median area and well developed mental lobes with pointed tip. Three pairs of long barbels, third barbel more than twice eye diameter.

Dorsal fin origin closer to base of caudal fin base than tip of snout, a little in front of pelvics. Distal margin of dorsal fin more or less convex, that of caudal fin slightly truncated. Caudal peduncle shorter than head, compressed. Body covered by minute oval scales with large central focal area. Lateral line short, not exceeding length of pectoral fin.

Colour: Body pale yellowish, a row of 9-13 dark brown vertical elongate bars below midlateral part of body sides; denser irregular brownish speckles on dorso-lateral part of body. Dorsal and caudal fin with 3-4 rows of brownish dots. A small jet black dot on upper part of caudal fin base.

Sex dimorphism: Males have a longer second pectoral fin ray than in females, with a beak-like projection at distal end. The lamina circularis at base of the pectoral fin in males is reduced triangular form.

Distribution: It is restricted to the rivers flowing into the east coast of Gyeongsangbuk-do, Korea: Yongdokoshipcheon R., Hyongsan R., Chuksancheon R., and Songcheon R.

Habitat and biology: It inhabits usually clear, slow moving shallow waters over small pebbles bottoms with little sands along upper or middle courses of the rivers. It feeds on small arthropods including aquatic insect larvae and aquatic algae.

Etymology: The fish is named after Yongdok-gun in the Yongdokoship River basin, the type locality.

Remarks: This species was erected from *Iksookimia longicorpa* based on the following characters: the reduced lamina circularis at base of the pectoral fin in the males, no black blotches just behind the operculum and 2n chromosomes, 100.

Genus *Kichulchoia* Kim, Park, and Nalbant, 1999

Kichulchoia Kim, Park, and Nalbant, 1999: 374 (type species: *Niwaella brevifasciata*).

Choia Kim, Park, and Nalbant, 1997: 192 (junior homonym of *Choia* Walcott, 1920, in Porifera).

Body elongate, compressed. Mouth small, inferior with

fleshy transverse wrinkles on surface of lip, upper lip with three pairs of barbels and lower lip with well developed mental lobes. Caudal peduncle shorter than head. Lateral line short, not exceeding pectorals. Body covered with minute scales, large focal area. No Gambetta's zone on body sides. A row of brownish vertical elongate blotches below midlateral body sides. 4 unbranched anal fin rays and 6 unbranched dorsal fin rays. Males have no lamina circularis at base of pectoral fin rays. 2 species, endemic to Korea.

Key to species of genus *Kichulchoia*

- a. A series of vertical elongate bands on mid-ventral part of body sides and lips smooth without wrinkles on surface and large barbels. *K. brevifasciata*
- b. A series of vertical elongate bands on dorso-ventral part of body and lips with numerous transversal wrinkles on surface and short barbels. *K. multifasciata*

Kichulchoia brevifasciata (Kim and Lee, 1995) (Plate 1. K)

Niwaella brevifasciata Kim and Lee, 1995: 285 (type locality: Pungyang-myon, Goheung-gun, Jeollanam-do, Korea).

Choia brevifasciata, Kim, Park, and Nalbant, 1997: 192 (designation of distinct genus; junior homonym).

Kichulchoia brevifasciata, Kim, Park, and Nalbant, 1999: 374 (transferred).

Common name: Dwarf loach (English); Jom-su-su-chi (Korean).

Specimens examined: Holotype CNUC 19907, male, 41.9 mm SL, Goup stream, Yamak-ri, Pungyang-myon, Goheung-gun, Jeollanam-do, Korea, Apr. 2, 1994; paratypes 19909, male, 39.2 mm SL, and 19910-19902, 3 females, 47.5~55.3 mm SL, same locality and date as for holotype.

Description: D iii6, A ii4, P₁ i7, P₂ i(3)4i, C 8+8, Gr. 12-13, Vert. 42-46. Morphometric data are given in Table 3. Body elongated laterally compressed. Head small, slightly compressed with blunt snout. Eye small on upper lateral surface intermediate between snout and gill opening. Interorbital space narrow, convex. Suborbital spine strongly curved, bifid. Mouth small, inferior, with fleshy lips; lower lip divided with two well developed lobes; upper lip with weak transverse wrinkles on surface, well separated from upper jaw. Three pairs of barbel long.

Dorsal and pelvic fins situated far backward. Distal margin of dorsal fin more or less straight, that of caudal fin slightly rounded. Caudal peduncle shorter, well developed crests dorsally and ventrally. Body covered with minute oval scales with large focal area. Lateral line short, not exceeding length of pectoral fin.

Colour: Body pale yellow to light brown with dark

brown markings. Irregular brownish speckles on dorso-lateral body side and 13 to 19 dark vertical bars below midventral body sides. A conspicuous black spot on upper part of caudal fin base. Head uniformly spotted, lacking a dark oblique line from snout to eye. Dorsal and caudal fins with 2 or 3 rows of brownish dots.

Sex dimorphism: Not obvious in external features. Males are possibly smaller than in females.

Distribution: It is distributed in the small streams flowing into the southwestern coast of Goheung-gun, Jeollanam-do and its two adjacent island, Geogeum Island of Goheung-gun and Geumo Island of Yocheon-gun, Jeollanam-do, Korea.

Habitat and biology: It inhabits on the pebbles covered bottoms of shallow, quick flowing streams and feeds on aquatic insect larvae, algae, and vegetal remains. It spawns in May to July and its matured females (5 cm in TL) have about 500 eggs in the gonad.

Etymology: The generic name was given in honour of Emeritus Prof. Ki-Chul Choi, Seoul National University, Korea, in appreciation of his contribution in the study of the freshwater fishes of Korea. The specific name *brevifasciata* was from Latin "brevis" meaning short and Latin "fasciata" meaning banded in reference to the lateral body coloration of the species.

Remarks: This species was described as the genus *Niwaella* owing to the lack of a lamina circularis on the pectoral fin base of the males and a dark oblique line from snout to eye. Although it was transferred into the genus *Choia* by having only 4 branched rays in the anal fin, the genus name *Choia* was again changed into *Kichulchoia* owing to be a junior homonym of *Choia* Walcott, 1920, in Porifera. The distributional range of the species is very narrow, restricted to the fresh waters of southwestern coast of Jeollanam-do, Korea. According to current investigation, it should be classified as EN by the population reduction and habitat destruction.

Kichulchoia multifasciata (Wakiya and Mori, 1929) (Plate 1. L)

Cobitis rotundicaudata Wakiya and Mori, 1929: 31 (type locality: Nakdong River, Daegu, Korea).

Niwaella multifasciata, Sawada and Kim, 1977: 55 (transferred).

Common name: Su-su-mi-kku-ri (Korean).

Specimens examined: CNUC 30262-3, 30354-74, 23, 66.8~119.8 mm SL, Yurim-myon, Sanchong-gun, Gyeongsangnam-do, Apr. 13, 2002.

Description: D iii6, A iii4, P₁ i7-8, P₂ i5-6i, C 8+8, Gr. 18-21, Vert. 52-54. Body much elongate, and compressed, with upper profile convex; snout long produced and bluntly rounded; eye moderate size, superior, lateral and situated a little anterior tip of snout than posterior

Table 3. Proportional measurements of genus *Kichulchoia*, *Koreacobitis* and *Misgurnus* from Korea. Mean in parenthesis

| | <i>Kichulchoia brevifasciata</i> | | <i>K. multifasciata</i> | | <i>Koreacobitis nakdongensis</i> | | <i>K. rotundicaudata</i> | | <i>Misgurnus anguillicaudatus</i> | | <i>M. mizolepis</i> | |
|-------------------------------|----------------------------------|--------------------|-------------------------|---------------------|----------------------------------|--------------------|--------------------------|----------------------------------|-----------------------------------|--|---------------------|--|
| | Holotype CNUC 19907 | Paratypes (n=14) | Non-types (n=23) | Holotype CNUC 21229 | Paratypes | Non-types (n=17) | Non-types (n=21) | Non-types (n=12) | | | | |
| Standard length (mm) | 40.3 | 33.9 ~ 57.9 | 66.8 ~ 119.8 | 105.4 | 84.3 ~ 134.0 | 84.1 ~ 139.4 | 55.8 ~ 136.3 | 93.2 ~ 122.4 | | | | |
| In standard length (%) | | | | | | | | | | | | |
| Body depth | 11.9 | 11.4 ~ 14.1 (12.7) | 9.7 ~ 12.5 (11.2) | 13.3 | 9.8 ~ 13.6 (12.3) | 11.5 ~ 13.3 (12.2) | 10.8 ~ 15.5 (13.5) | 13.4 ~ 16.1 (14.6) | | | | |
| Head length | 17.6 | 15.5 ~ 19.3 (17.8) | 12.6 ~ 15.0 (13.7) | 19.8 | 20.3 ~ 22.2 (20.8) | 18.3 ~ 20.2 (19.1) | 15.6 ~ 19.8 (17.7) | 15.0 ~ 18.6 (17.1) | | | | |
| Snout length | 6.9 | 6.4 ~ 9.0 (7.9) | 5.8 ~ 6.6 (6.2) | 8.9 | 8.0 ~ 9.2 (8.5) | 8.1 ~ 9.3 (8.6) | 6.5 ~ 8.1 (7.2) | 6.0 ~ 7.5 (6.7) | | | | |
| Eye diameter | 3.0 | 2.4 ~ 2.9 (2.7) | 1.9 ~ 2.6 (2.2) | 2.8 | 2.2 ~ 2.8 (2.4) | 2.1 ~ 2.7 (2.4) | 1.8 ~ 3.0 (2.3) | 1.9 ~ 3.2 (2.2) | | | | |
| Interorbital width | 2.7 | 2.3 ~ 3.6 (2.9) | 1.8 ~ 2.6 (2.3) | 2.7 | 2.0 ~ 2.9 (2.4) | 1.6 ~ 2.5 (2.2) | 2.3 ~ 5.0 (3.8) | 3.5 ~ 5.3 (3.9) | | | | |
| Third barbel length | 5.0 | 4.8 ~ 7.0 (5.9) | 2.7 ~ 4.2 (3.1) | 5.2 | 4.6 ~ 5.8 (5.3) | 3.9 ~ 5.6 (4.7) | 2.8 ~ 7.6 (5.2) | 6.5 ~ 10.9 (8.4) | | | | |
| Predorsal length | 55.6 | 53.6 ~ 58.3 (55.6) | 60.4 ~ 65.2 (62.5) | 55.3 | 54.8 ~ 57.7 (55.7) | 53.7 ~ 56.2 (54.8) | 55.1 ~ 60.2 (57.7) | 53.4 ~ 57.3 (55.3) | | | | |
| Prepectoral length | 17.6 | 16.0 ~ 19.2 (17.8) | 13.0 ~ 15.7 (14.3) | 21.0 | 18.6 ~ 19.9 (19.4) | 18.4 ~ 20.2 (19.2) | 16.1 ~ 19.1 (18.2) | 10.6 ~ 19.6 (16.6) | | | | |
| Prepelvic length | 54.8 | 51.1 ~ 56.5 (54.2) | 59.5 ~ 64.3 (61.2) | 55.0 | 78.2 ~ 81.7 (79.7) | 51.1 ~ 54.3 (52.9) | 57.2 ~ 61.7 (59.5) | 57.2 ~ 60.9 (59.6) ¹¹ | | | | |
| Preal length | 77.9 | 75.1 ~ 81.2 (78.4) | 83.4 ~ 87.7 (85.4) | 76.9 | 78.2 ~ 81.7 (79.7) | 75.0 ~ 78.9 (77.4) | 71.5 ~ 79.7 (75.1) | 73.4 ~ 92.4 (76.1) | | | | |
| Pectoral-pelvic length | 36.0 | 32.6 ~ 39.7 (36.6) | 44.6 ~ 50.7 (47.6) | 34.1 | 44.6 ~ 50.7 (47.6) | 33.3 ~ 36.3 (34.6) | 39.7 ~ 44.8 (42.1) | 42.0 ~ 45.5 (44.0) | | | | |
| Pelvic-anal length | 22.6 | 20.8 ~ 25.3 (23.5) | 22.5 ~ 25.7 (24.2) | 23.4 | 23.6 ~ 27.7 (25.3) | 23.3 ~ 25.4 (24.3) | 12.7 ~ 18.2 (15.1) | 12.1 ~ 16.2 (14.4) | | | | |
| Caudal peduncle length | 16.6 | 14.9 ~ 18.0 (16.2) | 10.0 ~ 17.5 (11.5) | 17.7 | 15.9 | 16.6 ~ 19.1 (18.0) | 12.5 ~ 22.3 (17.5) | 16.6 ~ 19.2 (14.4) | | | | |
| Caudal peduncle depth | 9.9 | 9.0 ~ 11.2 (10.3) | 7.4 ~ 8.9 (8.2) | 11.4 | 11.5 | 9.2 ~ 11.5 (10.4) | 8.7 ~ 12.1 (10.4) | 12.0 ~ 14.5 (13.1) | | | | |
| In head length (%) | | | | | | | | | | | | |
| Snout length | 44.0 | 41.5 ~ 48.4 (45.1) | 44.4 ~ 52.7 (47.9) | 46.0 | 42.9 ~ 49.8 (46.0) | 45.4 ~ 49.6 (47.0) | 43.5 ~ 47.9 (45.0) | 36.0 ~ 44.0 (41.9) | | | | |
| Eye diameter | 17.3 | 14.7 ~ 18.8 (17.3) | 18.2 ~ 22.0 (20.3) | 12.5 | 10.9 ~ 14.2 (12.5) | 10.8 ~ 14.2 (12.5) | 9.5 ~ 13.7 (11.7) | 13.1 ~ 15.2 (14.1) | | | | |
| In caudal peduncle length (%) | | | | | | | | | | | | |
| Caudal peduncle depth | 79.0 | 69.1 ~ 90.8 (78.1) | 73.2 ~ 85.2 (77.7) | 72.3 | 50.7 ~ 72.0 (60.6) | 50.7 ~ 72.0 (60.6) | 70.1 ~ 77.2 (74.1) | 73.3 ~ 87.5 (80.7) | | | | |

margin of operculum. Mouth small, inferior and with flesh lips, lower divided and with two lobes; with three pairs of short barbels. Suborbital spine movable, bifid. Lateral line short, not exceeding pectoral fin length. Origin of dorsal and pelvic fins situated far backward. Caudal peduncle much compressed, its length shorter than head.

Colour: In life body yellowish and pinkish head, snout, barbels, pectoral and pelvic fin base in spawning season. Head scattered with numerous blackish spots. Body sides with a series of 13-18 brownish vertical elongate blotches dorso-ventrally. Dorsal and caudal fin with two broad blackish blotches. A conspicuous black spot with upper part of caudal fin base.

Distribution: It is distributed only in the upper courses of the Nakdong River, Korea.

Habitat and biology: It inhabits on the pebble bottoms of fast flowing clear and cold waters and feeds on mainly the aquatic attached algae. Spawning generally takes place from late of December to January. The number of eggs increases with size of females and ranges from about 700 to 900.

Etymology: The specific name *multifasciata* was from Latin “multi” meaning numerous and Latin “fasciata” meaning banded.

Remarks: It was described as a valid species based on the specimens collected from Daegu, Nakdong River, Korea by Wakiya and Mori (1929) and was reported its morphology and ecology in details by Uchida (1939). The genus name transferred into *Niwaella* by the characters of the mouth part and no lamina circularis at the base of pectoral fin base in males by Sawada and Kim (1977). Slechtova *et al.* (2008) suggested that the genus *Kichulchoia* was sister to *Niwaella multifasciata* by the analysis of the molecular phylogeny of the northern clade of the family Cobitidae. It was considered in this study that *N. multifasciata* should be replaced as the genus *Kichulchoia* by having 4 branched rays in anal fin, 6 branched rays in dorsal fin, and no having the lamina circularis at the base of pectoral fin in the males.

Genus *Koreocobitis* Kim, Park, and Nalbant, 1997

Koreocobitis Kim, Park, and Nalbant, 1997: 191 (type species: *Cobitis rotundicaudata* Wakiya and Mori).

Body elongated, cylindrical just behind head, but well compressed in rest or its length. Mouth inferior, slightly arched with thickened lip, well furrowed. Three pairs of barbel longer. Suborbital spine moveable, erected, bifid. No Gambetta's zones, densely brownish small spots on all body sides. Body covered by minute scales with large focal area. Lateral line short, not exceeding pectorals. Males with well developed lamina circularis at base of pectoral fin. 2 species, endemic to Korea.

Key to species of genus *Koreocobitis*

- a. Body colour orange with densely small dark spots from head to tail; caudal fin with round margin.
..... *K. rotundicaudata*
- b. Body colour yellow with large dark mottled blotches from head to tail; caudal fin with somewhat truncate margin.
..... *K. naktongensis*

***Koreocobitis naktongensis* Kim, Park, and Nalbant, 2000 (Plate 1. M)**

Koreocobitis naktongensis Kim, Park, and Nalbant, 2000: 89 (type locality: Inwol-myon, Namwon-gun, Jeollabuk-do, Korea).

Cobitis rotundicaudata, Wakiya and Mori, 1929: 33 (original description).

Common name: Eol-luk-se-ko-mi-kku-ri (Korean).

Specimens examined: Holotype CNUC 21229, male, 108.3 mm SL, Jukkun-ri, Inwol-myon, Namwon-si, Jeollabuk-do, April 8, 1995; paratypes CNUC 21231-21238, 2 males and 6 females, 84.3~134.0 mm SL, same date and locality as in holotype.

Description: D iii7, A iii5, P₁ i8-9, P₂ i5-7i, C 7-8+7, Gr. 13-14, Vert. 44-48. Morphometric data are given in Table 3. Body elongate and compressed. Head compressed with upper profile convex. Snout long, protruded and bluntly rounded; eye moderate superior and lateral; mouth small, inferior, slightly arched with thickened lips, well furrowed; mental lobes well developed with a short prolongation at tip. Three pairs of barbels, one rostral, one maxillary, and one maxillo-mandibular. Suborbital spine moveable, relatively small straight.

Origin of dorsal fin nearer base of caudal fin base than tip of snout; distal edge of dorsal fin convex. Caudal peduncle with adipose crest shorter than head, much compressed; caudal fin somewhat truncated marginally. Body covered minute oval scales with large focal area; no scales on cheek and opercular part. Lateral line very short, not exceed pectoral fin.

Colour: Body in life yellowish, brownish densely small spots with some irregular dark blotches on body sides. Dorsal and caudal fins yellowish with brown bands marginally. In formalin body grayish with many dark brown blotches; white stripe from tip of snout to back of head; dorsal fin dusky with a black band and caudal fin a black band marginally; caudal fin base with a black spot on upper part.

Sex dimorphism: The second pectoral fin ray in males is thickened and more longer than in females. The lamina circularis at the base of pectoral fins in male look like squarish in larger specimens and roundish form in small specimens.

Distribution: It is distributed only in the Nakdong

River, Korea.

Habitat and biology: It inhabits on the large stones or rock of the rapid somewhat deep waters in the upper clear streams.

Etymology: The generic name was named from “Koreo” meaning Korea and “cobitis”, the generic name for all loaches described by Linnaeus (1758). This genus is endemic to Korea. The species name *naktongensis* referred to the type locality, the Naktong River, Korea.

Remarks: This species was erected from *Koreocobitis rotundicaudata* by the differences in the pigmentation and colour of body sides, head length, and margin of caudal fin. And it is restricted in the Naktong River, Korea. Because of continuing to decline the populations it has been designated as an endangered species from the Ministry of Environment of Korea. On the basis of recent findings about its distribution, it should be classified as EN by the small population size and decline (IUCN, 2001).

***Koreocobitis rotundicaudata* (Wakiya and Mori, 1929) (Plate 1. N)**

Cobitis rotundicaudata Wakiya and Mori, 1929: 32 (type locality, Danyang, South Han River, Korea); Uchida, 1939: 414 (morphological data).

Iksookimia rotundicaudata, Kim, 1997: 303 (transferred).

Koreocobitis rotundicaudata, Kim *et al.*, 2000: 91 (re-description).

Common name: Se-ko-mi-kku-ri (Korean).

Specimens examined: CNUC 24918-24925, one male and 7 females, 107.2 ~ 132.6 mm SL, Yorang-myon, Jeongseon-gun, Gangwon-do, Korea, Jul. 9, 1996.

Description: D iii7, A iii5, P₁ i9, P₂ i5-6i, Gr. 13-15, Vert. 48-49. Morphological data are give in Table 3. Body elongate, cylindrical, and compressed behind dorsal fin origin. Head somewhat compressed with upper profile convex; snout long, protruded and rounded; eye small, superior lateral; mouth small, inferior, slightly arched with thickened lips well furrowed, slightly arched with thickened lips, well furrowed. Mental lobes well developed with a short prolongation at tip. Three pairs of barbel, one rostral, one maxillary, and one maxillo-mandibular. Suborbital spine moveable, relatively small slightly curved.

Dorsal fin origin closer to base of caudal fin than tip of snout, a little in behind of pelvics, distal edge of dorsal fin convex. Caudal peduncle with adipose crest shorter than head, much compressed; caudal fin rounded marginally. Body covered with minute oval scales with large focal area; no scales on cheek and operculum part. Lateral line short, not exceed pectoral fin.

Colour: Body in life light pink to orange colour with densely brownish small spots whiout larger brownish blotches. Tip of snout and base of caudal with also light

pink and orange colour. Dorsal with a blackish band along margin and dusky band its base. Caudal fin base with a black spot on its upper part; submarginal part of caudal fin with a broad black concentric circle.

Sex dimorphism: Males have a more or less squarish lamina circularis at base of pectoral fins.

Distribution: It is distributed in the Han R., Imjin R., and Samchokoship-cheon R., Korea.

Habitat and biology: It inhabits usually on the large pebble bottoms along somewhat fast flowing streams, less than 80 cm deep and spawns in May and June at water temperature 20 ~ 23°C. The stomach of adult specimens contained mostly aquatic insect larvae.

Etymology: The species name, *rotundicaudata* was from Latin “rotundi” meaning rounded and Latin “caudata” meaning tail.

Remarks: It was described as *Cobitis rotundicaudata* originally from the specimens collected in the Han River and the Nakdong River, from Korea by Wakiya and Mori (1929). Thereafter Nalbant (1963) mentioned it as the genus *Misgrunus* by the body pigmentation. However it was divided as a distinct genus *Koreocobitis* by the diagnostic characters of colour patterns of body sides and movable suborbital spine (Kim *et al.*, 1997).

Genus *Misgrunus* Lacepede, 1803

Misgrunus Lacepede, 1803: 16 (type species: *M. fossilis*).

Body elongated and compressed with relatively small head and bluntly round snout. Mouth small, inferior with well developed lip. Upper lip with three pairs of barbel. Suborbital spine no functional. Body covered minute scales with small eccentric focal area. Lateral line short, not exceeding pectorals. Brownish densely small spots on body sides without regular blotches or stripes. Caudal fin round marginally. Males with lamina circularis at base of pectoral fin. 6 species in Eurasia and 2 species in Korea.

Key to species of genus *Misgrunus*

- a. Body cylindrical, a distinct dark brown spot present at upper part of caudal fin base, shorter barbel less than 2.5 times in eye diameter. *M. anguillicaudatus*
- b. Body compressed, indistinct dark brown spot at upper part of caudal fin base, longer barbel more than 4.0 times in eye diameter. *M. mizolepis*

***Misgrunus anguillicaudatus* (Cantor, 1842) (Plate 1. O)**

Cobitis anguillicaudatus (Cantor, 1842): type locality, Chusan.

Misgrunus anguillicaudatus, Jordan and Starks, 1905

(list, Busan).

Common name: Asian weather loach (English); Mikku-ri (Korean).

Specimens examined: CNUC 25568, 107.4 mm SL, Gwangduk-myon, Cheonan-si, Chungcheongnam-do, May 31, 2001; CNUC 27752, 136.3 mm SL, Sindongmyon, Gongju-si, Chungcheongnam-do, Jun. 2, 2002; 29513, 29517, 55.7~71.0 mm SL, Yomchi-eup, Asansi, Chungcheongnam-do, Sep. 9, 2001; CNUC 29514, 29519, 29521, 55.8~71.0 mm SL, Nalseom-myon, Yongdok-gun, Gyeongsangbuk-do, Aug. 6, 1998; CNUC 29536, 129.3 mm SL, Sinpung-myon, Gongju-si, Chungcheongnam-do, Jun. 2, 2001; CNUC 29540, 78.6 mm SL, Yougu-eup, Gongju-si, Chungcheongnam-do, Aug. 31, 2001; CNUC 30276, 30280, 30734, 84.1~120.6 mm SL, Inwol-myon, Namwon-si, Jeollabuk-do, Apr. 20, 2000; CNUC 30732-30733, 83.1~120.6 mm SL, Bongdong-eup, Wanju-gun, Jeollabuk-do, Apr. 20, 2000; CNUC 30738, 97.1 mm SL, Inwol-myon, Namwon-si, Jeollabuk-do, Apr. 18, 2002.

Description: D iii7, A iii(5)6-7, P₁ i7-9i, P₂ i(4)5-7i, Gr. 16-19, Sc. 174-185 (178), Vert. 45-49. Morphometric data are given in Table 3. Body elongated, cylindrical, but caudal peduncle and head somewhat compressed. Snout long, protruded, mouth small inferior arched with fleshy lip. Upper lip with three pairs of barbel, lower lip with well developed mental lobes. No functional suborbital spine. Lateral line very short, not exceeding pectoral fin. Body covered by minute oval or round scales with small eccentric focal area.

Colour: Body in life light yellowish with densely dark spots on body sides, caudal and dorsal fins with some rows of small spots, caudal fin base with a black spot on upper part. Males have lamina circularis at base of pectoral fin.

Sex dimorphism: Second pectoral ray in males is thickened and longer than in females. Males have minute tubercles on pectoral fins in spawning season.

Distribution: It is widely distributed in the Northeastern Asia (Korea, China, Japan, and Russia).

Habitat and biology: It inhabits in the stagnant shallow waters of swamps, irrigation ditches and rice-field with muddy bottoms and rare in the streams. It feeds on aquatic algae, small invertebrates, and organic detritus. The breeding season of the species continued from April to June. The species has remarkable tolerance to deoxygenated waters by the cutaneous and intestinal respiration.

Remarks: It is popular as a food fishes in Korea and commonly reared in the freshwater aquaculture in Asia. Uchida (1939) reported *Misgrunus* sp. as an undescribed species from the population of the Banpo Lake, near the Tuman River, North Korea based on the number of lateral line scales of 170~190 and the peculiar shape of lamina circularis at the base of pectoral fin in the males. In the

related to these specimens, it was described as a distinct species *Misgrunus buphoensis* from the river mouth of the Tuman River, North Korea (Kim and Park, 1995).

Misgrunus mizolepis Gunther, 1888 (Plate 1. P)

Misgrunus mizolepis Gunther, 1888: 434 (type locality, Yangtze R., Kiu-kiang, China); Mori, 1936: 18 (listed); Uchida, 1939: 458 (redescription).

Paramisgrunus dabryanus, Vasil'eva, 2001: 553 (senior synonym).

Common name: Chinese mud loach (English); Mikko-ra-zi (Korean).

Specimens examined: CNUC 27744, 62.2 mm SL, Cheongyang-gun, Chungcheongnam-do, Aug. 30, 2001; CNUC 30296, 30297, 30737, 111.7~120.9 mm SL, Dokjin-gu, Jeonju-si, Jeollabuk-do, May 2, 2002; CNUC 30315, 30316, 30507-30512, 112.9~171.0 mm SL, Dokjin-gu, Jeonju-si, Jeollabuk-do, May 13, 2002.

Description: D iii(6)7, A iii(4)5, P₁ i7-9i, P₂ i(4)5-6(7), Gr. 12-14, Sc. 115-125 (121), Vert. 48-51. Morphometric data are given in Table 3. Body rather compressed posteriorly. Mouth small inferior with three pairs of barbel, third barbel more longer than about 4 times in eye diameter. Eye small, no moveable suborbital spine. Lateral line incomplete, situated at base of pectoral fin. Caudal peduncle depth high well developed ridge ventrally and dorsally.

Colour: Body yellowish dark brownish dorsally and pale ventrally. Body sides densely brownish small spots. An indistinct a black spot at upper part of caudal fin base.

Sex dimorphism: Males have a lamina circularis at base of pectoral fin with longer second pectoral fin ray. Males are smaller in body size than females.

Distribution: It is distributed in the China mainland and Korean Peninsula.

Habitat and biology: It inhabits usually stagnant shallow waters on the muddy bottoms of ditches along middle or lower courses of streams. It feeds on mainly organic detritus. Spawning takes places from April to June.

Remarks: Uchida (1939) considered *M. mizolepis* is distinguished by the scales with larger size and smaller number than *M. anguillicaudatus* (4 times in eye diameter and 110~135 vs. 2~2.5 times in eye diameter and 150~180). This species is known to be tolerant to the pollutant waters than *M. anguillicaudatus*. Vasil'eva (2001) discussed that this species identified a junior synonym of *Paramisgrunus dabryanus* Sauvage, 1878 according to the priority principle. It is considered to be needed further study based on the Chinese specimens.

DISCUSSION

The biogeographical aspect of the family Cobitidae is

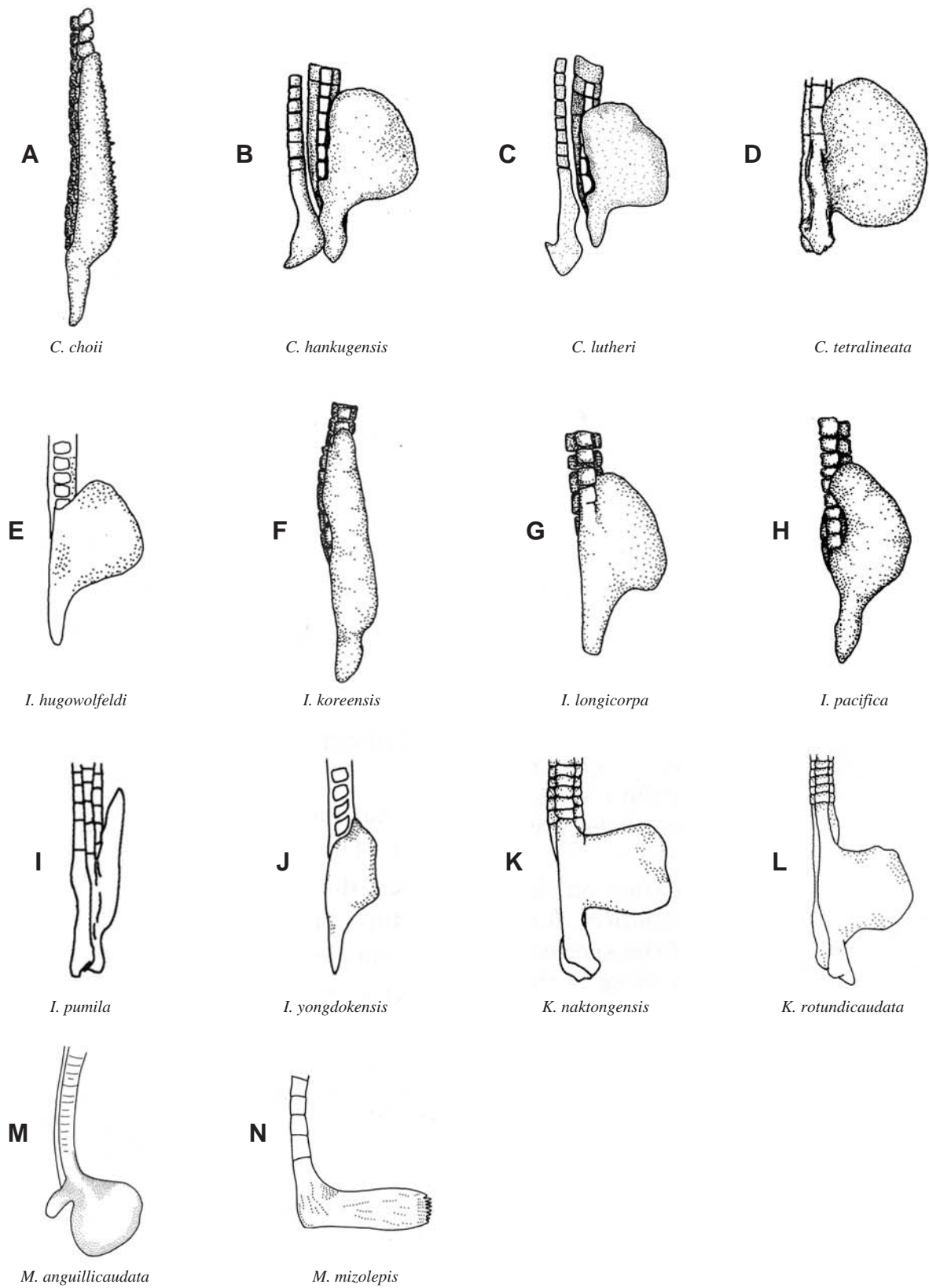


Fig. 2. Dorsal views of Lamina circularis at base of pectoral fin of males of species in genera *Cobitis* (A-D), *Iksookimia* (E-J), *Koreocobitis* (K, L), and *Misgurnus* (M, N).

one of most interesting topics in the study on the freshwater fishes in Korean Peninsula. However their phylogenetic relationships remain unclear because of the deficient taxonomic information. Although several species and genera of the cobitid fishes have been added as new taxa and revised frequently in Korea by the further studies, it was needed to be reviewed systematically with the application of molecular approaches. Till now most species have been identified mostly by the colour patterns of the body sides, the structure of lamina circularis at base of pectoral fin in the males (Fig. 2), and scale structure. The fifteen Korean cobitid fishes were classified into seven types as granule, villi, papilla, grapevine, hillock, sawtooth-like form, and unadorned form by the external appearances of egg envelope and discussed with relation to their habitats (Park and Kim, 2003). However recently Slechtova *et al.* (2008) pointed that the genera *Cobitis*, *Iksookimia*, and *Niwaella* were polyphyletic based on the molecular phylogenetic analysis and the status and delimitation of these taxa need to be carefully re-evaluated. According to this suggestion, the some morphological characters of them and the delimitation of the genera were found to be some problems. So *Niwaella multifasciata* was reclassified as the genus *Kichulchoia* by having four anal unbranched rays and six dorsal unbranched rays in spite of the difference in the external morphological features. Accordingly *Niwaella delicata* is considered as monotypic species in Japan. And *Cobitis pacifica* and *Iksookimia choii* were also replaced as *Iksookimia pacifica* and *Cobitis choii* respectively based on presence or absence of Gambetta's zone of the body pigmentations in this review. It is reviewed by 16 species in 5 genera of *Misgrunus*, *Cobitis*, *Iksookimia*, *Koreocobitis*, and *Kichulchoia* in Korean peninsula.

Since Mori (1936) reported that Korean peninsula was

divided into two Subregions, China and Siberia based on the freshwater fish fauna of East Asia, the zoogeographical division in Korea was recognized different other authors (Choi, 1973; Jeon, 1980). After then Kim (1997) dealt with the three biogeographical subdistricts such as West Korea, South Korea, and Northeast Korea by the Korean endemic freshwater fish fauna and the barrier of the Bekdu-mountains ranges (Fig. 3).

Concerning the origin of the freshwater fishes of Korea, it was known that the freshwater fishes of China mainland and Siberia might be dispersed into Korea by the Paleo-Hwangho River and the Paleo-Amur River respectively in the late Pliocene to the Pleistocene based on the common fish fauna between them and the geography of Paleocostline and Paleoriver channels at that time (Lindberg, 1972). Most ancestors of cobitid fishes might be introduced to the Korean peninsula at that time with other common freshwater fishes together through two routes, and thereafter they might have adapted from the isolated stream environments of the Korean peninsula as endemic cobitid fishes. Watanabe *et al.* (2006) reviewed in terms of achievements and perspectives that analyses of genuine freshwater fishes have disclosed their speciation and dispersal patterns throughout temperate East Asia since the Neogene, along with the formation of the Japanese Archipelago.

In the West Korea Subdistrict including the rivers flowing into the Yellow Sea coast from the western slope of the Bekdudaegan mountains (the Taebeg-Sobeg-Noryong mountains), the following cobitid species are restricted: *Iksookimia koreensis* distributed in the Han R., Imjin R., Keum R., Mangyong R., *I. pumila* in the Bekcheon R., *Cobitis choii* in the Keum R., and *Koreocobitis rotundicaudata* in the Han R. and Imjin River. In the South Korea Subdistrict covered in the drainages of the rivers

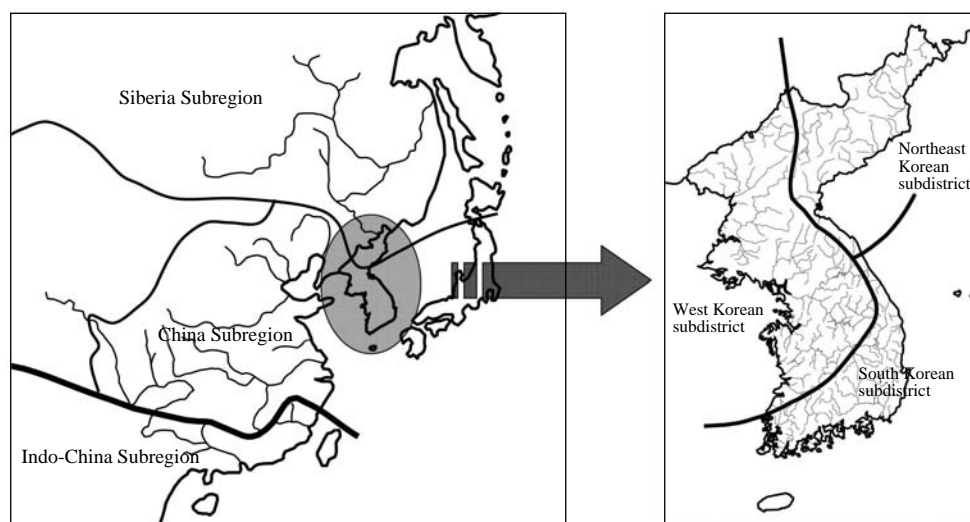


Fig. 3. Zoogeographical divisions of freshwater fishes of East Asia and Korean Peninsula (Mori, 1936; Kim, 1997).

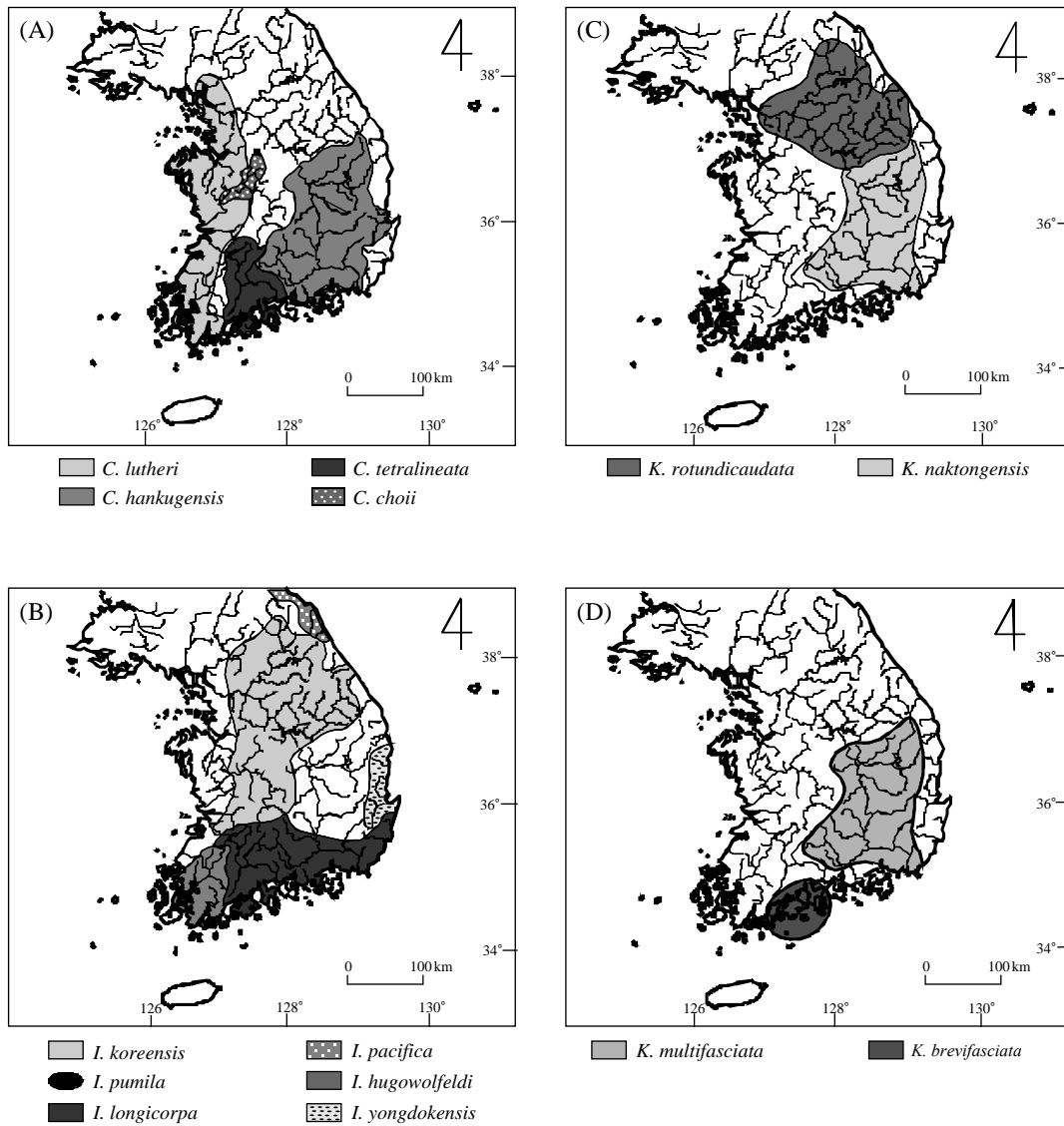


Fig. 4. The vicariant distributional patterns in species of genera *Cobitis* (A), *Iksookimia* (B), *Koreocobitis* (C), and *Kichulchoia* (D) from Korea.

flowing into the southeastern slope of the mountains. the following 6 cobitid fishes are restricted: *Cobitis hankugensis* and *Koreocobitis naktongensis* in the Nakdong River, *Iksookimia yongdokensis* in the Hyongsan R., Yongdokoship R., Chuksan R., and Songcheon R., *I. longicorpa* in the Nakdong R., Somjin R., and their adjacent streams, *I. hugowolfeldi* in the Yongsan R. and its adjacent streams, and two species of *Kichulchoia* in this area as the disjunct distribution. The Northeast Korea subdistrict comprises most drainages of Gangwon-do, Hamgyeongbuk-do and Hamgyeongnam-do in the northeastern part of Bekdudaegan mountains: *Iksookimia pacifica* distributed in this subdistrict (Fig. 4). It is biogeographically significant that 13 cobitid species have the disjunct distribution ranges as the endemic species and 3

genera of *Iksookimia*, *Koreocobitis*, and *Kichulchoia* are included as the endemic to Korea (Fig. 4). The vicariant biogeographic pattern like this may be suggested as a good example of allopatric speciation (Fig. 3).

And it was remarked ecologically that most cobitid fishes exhibited significantly the selectivity of their bottom habitats among the genera. The four species of *Cobitis* inhabited generally on the sand bottoms, most species of *Iksookimia* except *I. pacifica* preferred the pebble bottoms with rapid waters, and two species of *Misgrunus* hid generally in the muddy bottoms respectively. And so *Cobitis* and *Misgrunus* species are mainly occurred in the lower or middle courses of the streams, while most species of *Iksookimia*, *Koreocobitis*, and *Kichulchoia* distributed in the upper courses of the rivers.

Because most cobitid fishes inhabiting in the middle or upper courses of the streams are remarkably threatened by the habitat destructions or the river alteration in relation to the river improvement projects, it should be protected their specific habitat based on the Korean Red List of fishes with the conservation status

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한국산 미꾸리과(잉어목) 어류의 연구

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요 약 : 한국산 미꾸리과 어류 5속 16종을 외부 형태 중심으로 검색표를 작성하고 형태, 분포, 서식지 등을 정리하여 제시하였다. 체측에 감베타 반문이 없는 참종개속 (*Iksookimia*), 새코미꾸리속 (*Koreocobitis*), 줌수수치속 (*Kichulchoia*) 어류는 기름종개속 (*Cobitis*)을 분리하여 독립된 속으로 구분하였다. 본 조사에서는 표피 반문 배열과 뒷지느러미 연조수의 차이점을 재확인하여 미호종개는 *Cobitis choii*, 북방종개는 *Iksookimia pacifica*, 그리고 수수미꾸리는 *Kichulchoia brevifasciata*로 속명을 변경하였다. 참종개속, 새코미꾸리속, 줌수수치속에 포함하는 대부분의 어류는 특수한 서식처 바닥을 선호하면서도 뚜렷한 지리적 분단현상을 나타내고 있어서 생물지리적으로 매우 주목된다. 미호종개, 줌수수치, 얼룩새코미꾸리는 서식처 파괴와 개체군 감소로 절멸 위기에 있어 보호가 요구된다.

찾아보기 낱말 : 미꾸리과, 참종개속, 기름종개속, 줌수수치속, 새코미꾸리속, 골질반

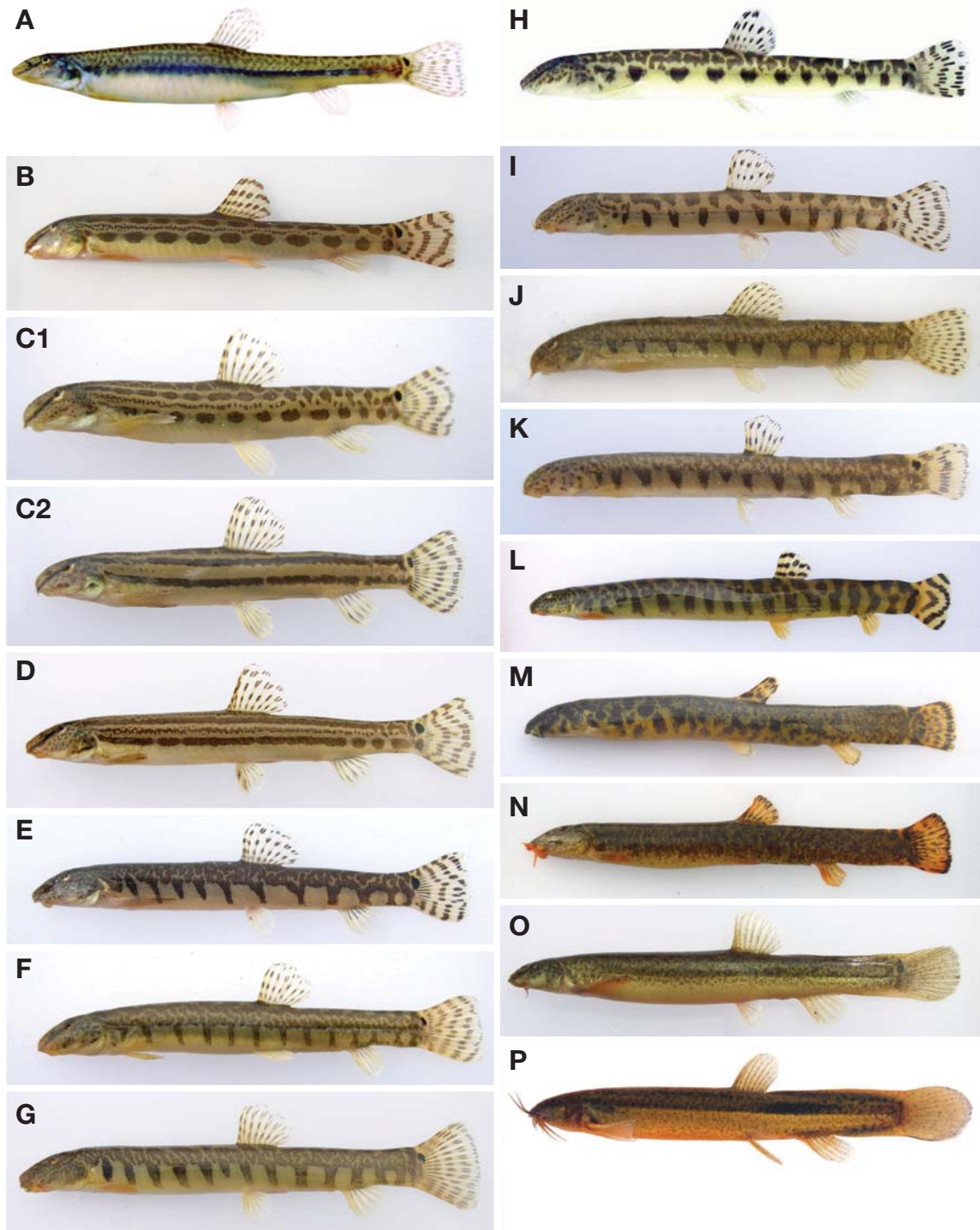


Plate 1. Photographs of sixteen species of four genera *Cobitis*, *Iksookimia*, *Kichulchoia*, *Koreocobitis*, and *Misgrunus* in Korea: A, *Cobitis choui*, Cheongwon-gun, Chungcheongbuk-do, Korea, 62.4 mm in SL; B, *C. hankugensis*, Namwon-si, Jeollabuk-do, Korea, 70.8 mm; C1, *C. lutheri* (♀), Wanju-gun, Jeollabuk-do, Korea, 51.5 mm; C2, *C. lutheri* (♂), Wanju-gun, Jeollabuk-do, Korea, 56.8 mm; D, *C. tetralineata*, Sunchang-gun, Jeollabuk-do, Korea, 74.0 mm; E, *Iksookimia hugowolfeldi*, Jangseong-gun, Jeollanam-do, Korea, 67.8 mm in SL; F, *I. koreensis*, Wanju-gun, Jeollabuk-do, Korea, 57.1 mm; G, *I. longicorpa*, Sunchang-gun, Jeollabuk-do, Korea, 84.0 mm; H, *I. pacifica*, Goseong-gun, Gangwon-do, 92.6 mm; I, *I. pumila*, Buan-gun, Jeollabuk-do, Korea, 56.8 mm; J, *I. yongdokensis*, Yongdeok-gun, Gyeongbuk, Korea, 53.5 mm; K, *Kichulchoia brevifasciata*, Goheung-gun, Jeollanam-do, Korea, 51.8 mm in SL; L, *K. multifasciata*, Sancheong-gun, Gyeongsangnam-do, Korea, 66.8 mm; M, *Koreocobitis naktongensis*, Sancheong-gun, Gyeongsangnam-do, Korea, 136.2 mm; N, *K. rotundicaudata*, Pyeongchang-gun, Gangwon-do, Korea, 84.1 mm; O, *Misgrunus anguillicaudata*, Wanju-gun, Jeollabuk-do, Korea, 83.1 mm; P, *M. mizolepis*, Yongkwang-gun, Jeollanam-do, Korea, 100.9 mm.