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Osteology of *Micropercops swinhonis* from Korea (Perciformes: Odontobutidae)

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The skeletal system of freshwater goby *Micropercops swinhonis* from Korea is figured and described in detail. The osteological characteristics of the species are as follows: infraorbital bearing a subocular shelf present; mesopterygoid present and separated from metapterygoid; scapula forked and dorsal postcleithrum present; and caudal skeleton and first dorsal pterygiophore formula highly variable.

Key words : Odontobutidae, osteology, *Micropercops swinhonis*, Korea

Introduction

Micropercops swinhonis (Günther, 1873) is a small freshwater goby, being inhabited in a shallow pool which is densed with water plants in riverside of downstream of the Mangyong River and a tributary streams of upstream of the Somjin River in the Korean Peninsula (Kim *et al.* 1986, Kim and Kang, 1993). It is also distributed in China (Nichols, 1943; Fowler, 1962) and the Amur and Blkhash-Ili basins (Kochetov and Kochetov, 1986; Glukhovtesv and Dukravets, 1987). The species was described originally under the name of *Eleotris swinhonis* based on several specimens about 50 mm in total length from Shanghai, China by Günther (1873), and was recorded firstly in Korea by Kim *et al.* (1986). Kim and Kim (1996, 1997) reported the breeding habits, egg development, and population ecology of this species since the necessity of scientific investigation for *M. swinhonis* have stressed by Kim and Kang (1993). Little is known about the skeletal characteristics of the species, except Hoese and Gill (1993) who were presented some osteological features of the species establishing the family Odontobutidae.

In present study, we made precise description of the whole skeletal system in *Micropercops swinhonis* for the purpose of adding more biological information of the species.

Materials and Methods

Osteological examination was made on eight specimens of *Micropercops swinhonis* stained in Alizarin Red-S, and Leica MZ8 dissecting microscope with a camera lucida was utilized in actual dissecting and drawing. Six specimens (35.5 ~ 40.3 mm SL) of them are cleared and stained following Potthoff (1984). Terminology for skeletal structures is those of Springer (1983) and Murdy (1985).

Material examined. *Micropercops swinhonis*: CNUC (Chonbuk National University, Chonju, Korea) 24981, 40.1 mm SL, male, 16 Apr. 1995; CNUC 24982, 39.2 mm SL, male, 16 Apr. 1995; CNUC 24984, 35.5 mm SL, male, 16 Apr. 1995; CNUC 24985, 40.0 mm SL, male, 16 Apr. 1995; CNUC 24986, 40.3 mm SL, male, 16 Apr. 1995; CNUC 24987, 30.7 mm SL, female, 9 Apr. 1994; CNUC 24988, 32.3 mm SL, female, 9 Apr. 1994; CNUC 24989*, 35.4 mm SL, male, 16 Apr. 1995; CNUC 24990*, 36.3 mm SL, male, 16 Apr. 1995; CNUC 24991*, 32.0 mm SL, male, 16 Apr. 1995;

CNUC 24992*, 34.0 mm SL, female, 9 Apr. 1994; CNUC 24993*, 33.0 mm SL, female, 9 Apr. 1994; CNUC 24994*, 29.9 mm SL, female, 9 Apr. 1994; CNUC 24995, 36.4 mm SL, male, 16 Apr. 1995. All materials examined are collected from the Chongho reservoir, Puan-gun, Chollabuk-do, Korea. *were examined by radiography only.

Results

Osteology of *Micropercops swinhonis* (Günther)

1. Cranium (Fig. 1)

The cranium is comprised of eleven paired and five unpaired elements. The former includes the nasal, lateral ethmoid, frontal, epioccipital, pterosphenoid, sphenotic, pterotic, basisphenoid, prootic, intercalar and exoccipital bones, and the latter the vomer, median ethmoid, parasphenoid,

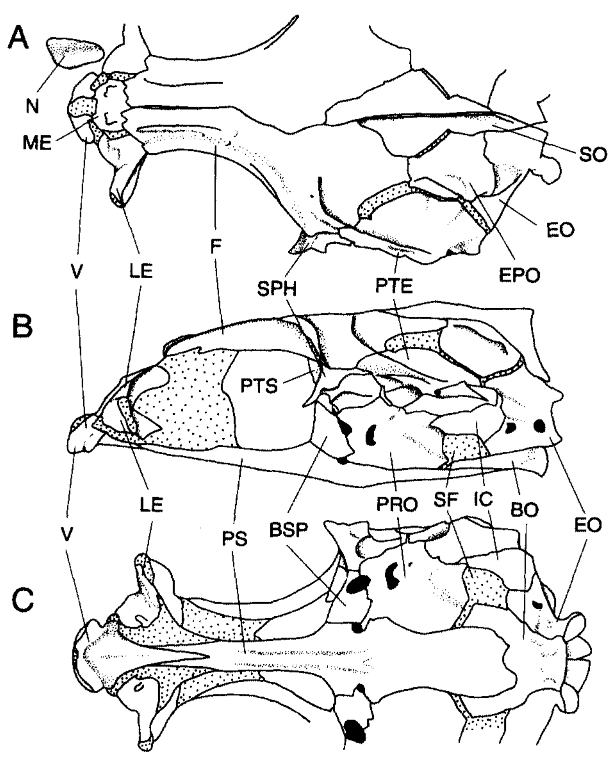

Fig. 1. Dorsal (A), lateral (B) and ventral (C) aspects of cranium in *Micropercops swinhonis*. BO-basioccipital; BSP-basisphenoid; EO-exoccipital; EPO-epioccipital; F-frontal; IC-intercalar; LE-lateral ethmoid; ME-median ethmoid; N-nasal; PRO-prootic; PS-parasphenoid; PTE-pterotic; PTS-pterosphenoid; SF-subtemporal fossa; SPH-sphenotic; V-vomer. Scale bar indicates 1 mm.

supraoccipital and basioccipital bones. The nasal is a roofless trough like bone without canal structure and is suspended over the ethmoid region of the cranium by a weak connective tissue. The lateral ethmoid bears a lateral process which is tipped by cartilage and is articulated with the lacrimal laterally. It is pierced by a foramen for the olfactory tract. The lateral ethmoid synchondrally joins to the median ethmoid medially, and the vomer and parasphenoid ventrally. The frontal is the largest bone of the cranium, and is firmly joined to the ethmoid anteriorly, the supraoccipital, epioccipital and pterotic posteriorly, and the pterosphenoid and sphenotic postero-ventrally. The lateral margin of the frontal bears a shallow trough which carries the supraorbital sensory canal. The epioccipital, occupying the postero-dorsal region of the cranium, is bound by the supraoccipital, frontal, pterotic and exoccipital. It provides the area of attachment for the dorsal arm of the posttemporal. The parietal is absent. The pterosphenoid lies beneath the frontal near the posterior end of the orbit. It joins to the frontal dorsally, the sphenotic postero-laterally, and the basisphenoid ventrally, and participates to form the trigemino-facial foramen with the sphenotic, basisphenoid and prootic. The sphenotic forms the postero-lateral margin of the orbit and has a synchondral connection with the pterosphenoid antero-medially, and joins to the pterotic posteriorly and the prootic postero-ventrally. It articulates with anteriormost dorsal condyle of the hyomandibula. The pterotic is located on the postero-lateral region of the cranium, and synchondrally joins to the frontal and epioccipital dorso-medially, the sphenotic anteriorly, the prootic and intercalar ventrally, and the exoccipital posteriorly. Antero-ventrally, the pterotic articulates with the postero-dorsal condyle of the hyomandibula. The basisphenoid forms the posterior margin of the orbit beneath the pterosphenoid, and joins to the prootic posteriorly and the parasphenoid ventrally. The prootic is conspicuous due to its possession of large facial nerve foramina in antero-lateral region of cranial floor. It joins to the basisphenoid anteriorly, the sphenotic and pterotic dorsally, the intercalar posteriorly, and the parasphenoid ventrally. The subtemporal fossa (*sensu* Birdsong, 1975) is relatively large cartilaginous area of the postero-lateral region of the cranium. It is bound by the prootic anteriorly, the exoccipital posteriorly, the intercalar dorsally, and the basioccipital ventrally. The intercalar occupies the postero-lateral region of the cranium beneath the pterotic, and it joins to the prootic anteriorly and the exoccipital posteriorly. The ventral margin of the intercalar forms the boundary of the subtemporal fossa. The exoccipital forms the posterior cranial wall, and joins to the intercalar anteriorly, the supraoccipital, epioccipital and pterotic dorsally, and the basioccipital ventrally. It has a condyle for articulation with the first vertebra, and bears a vagal and glossopharyngeal foramina.

The toothless vomer is broadened anteriorly and produced posteriorly into a narrow process. It synchondrally joins to the median ethmoid and lateral ethmoid postero-dorsally, and the parasphenoid posteriorly. The median ethmoid is located on the anterior region of the cranium. It joins to the frontal posteriorly, the vomer antero-ventrally and also synchondrally to the lateral ethmoid laterally. On its dorsal surface two small projections serve as points of attachment for the maxillary-ethmoid ligaments. The supraoccipital occupies the postero-medial area of the cranial roof, and bears a low thin crest in midline. It joins to the frontal anteriorly and the epioccipital and exoccipital ventro-laterally. The parasphenoid forms much of the medial floor of the cranium. The basioccipital situates at the postero-lateral region of the cranium. It synchondrally joins to the prootic anteriorly, and also to the exoccipital dorsally, the parasphenoid antero-ventrally and the centrum of the first vertebra posteriorly. It serves the attachment site of the Baudelot's ligament on its postero-lateral face.

2. Circumorbital bones (Fig. 2A)

The circumorbital bones consist of a roughly rectangular lacrimal and one or two (mainly one) infraorbital bones. The lacrimal bears a well developed articular facet at its dorsal tip and articulates with the lateral ethmoid dorsally. There is a gap between the lacrimal and the anteriormost infraorbital, and is also between infraorbitals when second one is present. The anterior infraorbital has a well developed subocular shelf. The posterior one when present is a very small bone, being connected to the cranium by a weak connective tissue. The sensory canal structure on the circumorbital bones is lacking.

3. Jaws (Fig. 2B)

The jaws comprise the premaxilla, maxilla in the upper jaw and the dentary, anguloarticular, retroarticular and coronomeckelian in the lower jaw. Cartilaginous element includes the rostral cartilage and Meckel's cartilage. The premaxilla bears three processes: an ascending process, articular process, and postmaxillary process. The premaxilla possesses two or three rows of teeth: the outer row of caninoid teeth and the inner rows of conical teeth. The maxilla is composed of a long thin shaft with two processes at its proximal end: a medial process which articulates with articular process of the premaxilla, and a shorter lateral process which articulates with the palatine. The dentary forms a deep pocket that receives the anguloarticular posteriorly. The teeth on the dentary are caninoid of two or three rows. The anguloarticular inserts onto the dentary anteriorly and receives the articular process of the quadrate posteriorly. The slim, cylindrical Meckel's cartilage runs longitudinally along the medial face of the anguloarticular, and the coronomeckelian locates between the anguloarticular and the Meckel's cartilage. The retroarticular is situated on the postero-ventral corner of the anguloarticular.

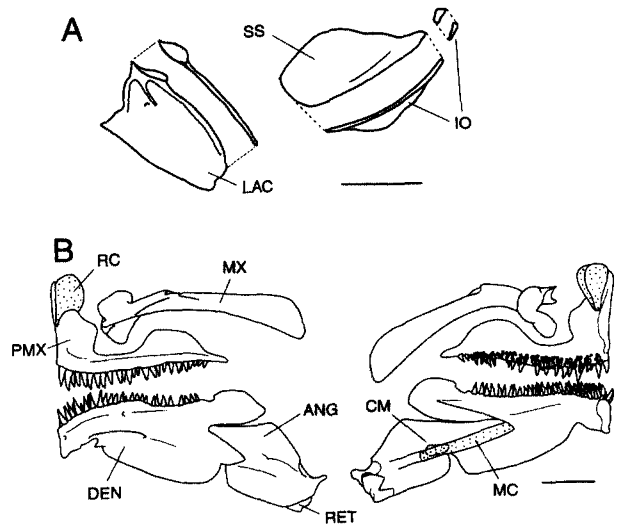

Fig. 2. Dorsal (above) and lateral (below) aspects of circumorbital bones (A), and lateral (left) and medial (right) aspects of jaws (B) in *Micropercops swinhonis*. ANG-anguloarticular; CM-coronomeckelian;-DEN dentary; IO-infraorbital; LAC-lacrimal; MC-Meckel's cartilage; MX-maxilla; PMX-premaxilla; RC-rostral cartilage; RET-retroarticular; SS-subocular shelf. Scale bars indicate 1 mm.

4. Suspensorium and opercular bones (Fig. 3A)

The suspensorium consists of the palatine, mesopterygoid, ectopterygoid, metapterygoid, quadrate, symplectic and hyomandibula, and the opercular bones include the preopercle, opercle, subopercle and interopercle. The edentate palatine articulates with the lateral process of the maxilla anteriorly, the ectopterygoid and mesopterygoid posteriorly and the lateral ethmoid dorsally. The mesopterygoid, being situated on the ectopterygoid, is separated from the metapterygoid. The triangular ectopterygoid is overlapped with the quadrate postero-medially. The metapterygoid firmly joins to the hyomandibula postero-dorsally and broadly to the symplectic ventrally. The quadrate articulates with the ectopterygoid anteriorly, the anguloarticular antero-ventrally, the preopercle posteriorly, and the symplectic dorso-medially. It also synchondrally joins to the mesopterygoid and metapterygoid dorsally. The roughly rod shaped symplectic is overlapped with the metapterygoid dorsally and the quadrate ventrally in medial aspect. It is also separated from the preopercle by a large space. The hyomandibula is the largest element among the suspensorial bones and articulates with the cranium dorsally and the opercle posteriorly. The crescent-shaped preopercle bears a deep groove housing the sensory canal along its posterior margin. It contacts with the hyomandibula anteriorly and the quadrate ventrally. The opercle is a roughly oval-shaped bone and joins to the subopercle ventrally. The interopercle is situated under the preopercle and is separated from the subopercle posteriorly.

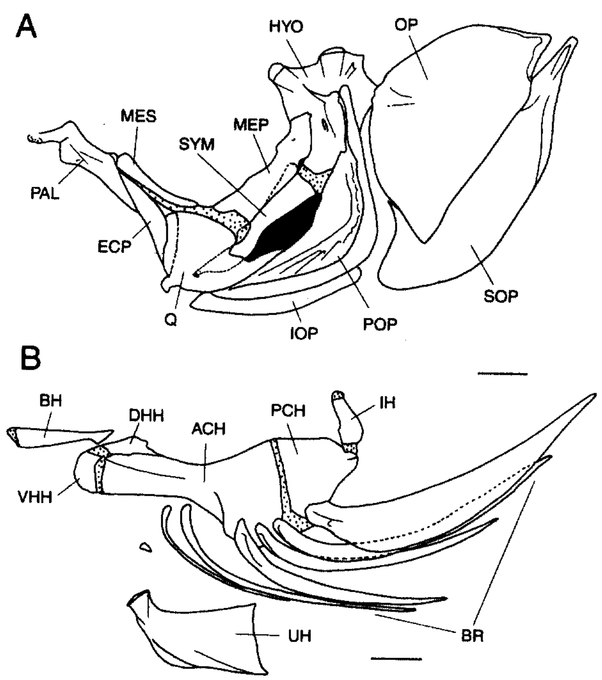

Fig. 3. Lateral aspects of suspensorium and opercular bones (A), and of hyoid arch (B) in *Micropercops swinhonis*. ACH-anterior ceratohyal; BH-basihyal; BR-branchiostegals; DHH-dorsal hypohyal; ECP-ectopterygoid; HYO-hyomandibula; IH-interhyal; IOP-interopercle; MEP-metapterygoid; MES-mesopterygoid; OP-opercle; PAL-palatine; PCH-posterior ceratohyal; POP-preopercle; Q-quadrate; SOP-subopercle; SYM-symplectic; UH-urohyal; VHH-ventral hypohyal. Scale bars indicate 1 mm.

5. Hyoid arch (Fig. 3B)

The hyoid arch comprises the basihyal, dorsal and ventral hypohyals, anterior and posterior ceratohyals, interhyal, six or seven branchiostegals and urohyal. The basihyal is triangular and tipped by cartilage anteriorly, and connected with the dorsal hypohyal by a weak ligament. The dorsal and ventral hypohyals join to the anterior ceratohyal posteriorly, and the ventral one is connected postero-medially to the urohyal by a strong ligament. The anterior ceratohyal forms a synchondral joint with the posterior ceratohyal. It also joins to the hypohyals anteriorly and bears five or six (mainly five) branchiostegals: the anteriormost two or three are attached to the slender portion ventrally and the next three are attached to the expanded portion of the anterior ceratohyal laterally. The posterior ceratohyal articulates with the interhyal postero-dorsally, and bears a blade-like branchiostegal which is the largest of all branchiostegals. The rod-like interhyal articulates with the medial face of suspensorium dorsally and with the postero-dorsal portion of the posterior ceratohyal ventrally. The urohyal is roughly rectangular in shape with a head, articulating with the basibranchials 1~2 and hypobranchial 1 dorsally.

6. Branchial arch (Fig. 4)

The branchial arch consists of the four epibranchials, four infrapharyngobranchials and a rod-like interarcual cartilage in the upper part, and the four basibranchials, three hypobranchials, five ceratobranchials in the lower part. The epibranchial 1 is medially bifurcated with each arm bearing a cartilaginous tip, and the dorsal arm of them articulates with the infrapharyngobranchial 2 via the interarcual cartilage. The epibranchials 2 ~ 4 articulate medially with their respective infrapharyngobranchials. The infrapharyngobranchial 1 is a small cartilaginous element situating at the medial tip of the epibranchial 1. The infrapharyngobranchials 2 ~ 4 have tooth plate fused to each bone. The basibranchials are unpaired bones in a straight line, and the basibranchials 2 ~ 3 of them are well ossified. The basibranchial 2 articulates with the hypobranchial 1 laterally, and the basibranchial 3 with the hypobranchial 2 antero-laterally and with the hypobranchial 3 postero-laterally. The hypobranchials 1 ~ 3 are joined by a ligament and articulate with their respective ceratobranchials posteriorly. The ceratobranchials 1 ~ 3 join to their respective hypobranchials anteriorly, the ceratobranchial 4 joins to the basibranchial 4, and the ceratobranchial 5 is connected to the basibranchial 4 by a ligament and bears a large triangular tooth plate.

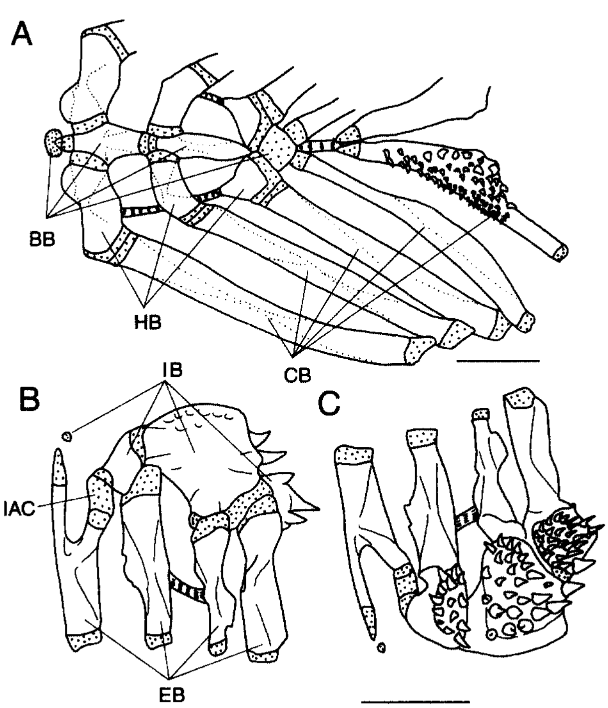

Fig. 4. Dorsal aspects (A, B) of lower and upper gill arches, respectively, and ventral aspect (C) of upper gill arch of *Micropercops swinhonis*. BB-basibranchial; CB-ceratobranchial; EB-epibranchial; HB-hypobranchial; IAC-interarcual cartilage; IB-infrapharyngobranchial. Scale bars indicate 1 mm.

7. Pectoral girdle (Fig. 5A)

The pectoral girdle comprises the posttemporal, supracleithrum, cleithrum, postcleithrum, coracoid, scapula and four radials. The extrascapula is absent. The posttemporal is composed of the central body with a broad dorsal arm which is connected with the epioccipital and a narrow ventral one which is joined to the intercalar. The central body of the posttemporal possesses weak projections and joins to the supracleithrum ventrally. The blade-like supracleithrum is joined to the postero-medial face of the posttemporal and to the dorso-lateral face of the cleithrum. The cleithrum is an elongated, crescent-shaped bone,

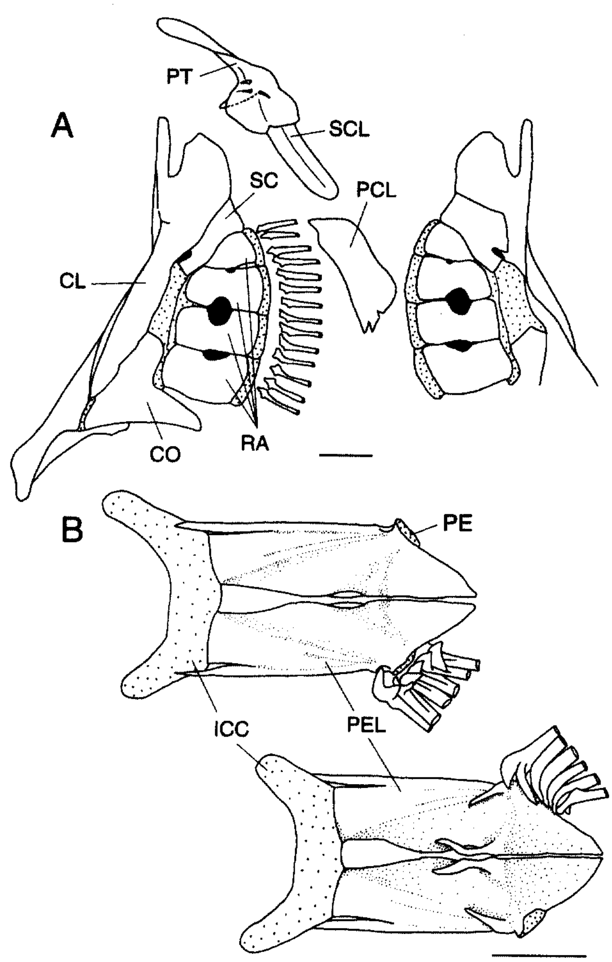

Fig. 5. Lateral (left) and medial (right) aspects of pectoral girdle (A), and dorsal (above) and ventral (below) aspects of pelvic girdle (B) in *Micropercops swinhonis*. CL-cleithrum; CO-coracoid; ICC-intercleithral cartilage; PCL-postcleithrum; PE-pelvic radial; PEL-pelvis; PT-posttemporal; RA-radial; SC-scapula; SCL-supracleithrum. Scale bars indicate 1 mm.

and is articulated with its mate at ventral end. There is a deep notch, which the Baudelot's ligament passes from the basioccipital to the postero-medial face of the supracleithrum, in the dorsal margin of the cleithrum. It also joins to the scapula, radials and coracoid posteriorly. The leaf-like dorsal postcleithrum is present, but the ventral one is lacking. The scapula is situated between the cleithrum and the uppermost radial, and represents the forked scapula type (*sensu* Akihito, 1967, 1969). The coracoid is a triangular bone and forms a synchondral joint with the cleithrum anteriorly, and with the lowermost radial postero-dorsally. There are four radials which are tipped by cartilage at their margins: the uppermost radial is triangular and the rest are rectangular in shape.

8. Pelvic girdle (Fig. 5B)

The pelvic bone is roughly a rectangular bone. Each pelvis is broad, with the entire anterior margin capped by a large horn-like pelvic intercleithral cartilage, and its postero-lateral edge bears cartilaginous pelvic radial. Posteriorly, one spine and five soft rays are articulated with the pelvic bone. Among them, outer three or four soft pelvic fin rays articulate with the pelvic radial. There are two processes, one arises from the ventro-medial face and the other from the postero-lateral face of the pelvic bone.

9. Caudal skeleton (Fig. 6)

The caudal skeleton comprises the second preural centrum (PU2), third preural centrum (PU3), urostyle, epurals, hypurals and parhypural bones. The urostyle, hypural 3 and hypural 4 are fused. The hypural 5 is autogenous, and autogenous uroneurals are lacking. There are two or three epurals above the ural centrum (Fig. 6F). Usually a large ventral procurrent cartilage occupies the interhemal space between PU2 and PU3, and it is sometimes ossified (Fig. 6A). The dorsal procurrent cartilage is also present, and is sometimes divided into two or three elements (Figs. 6D, 6E), or absent (Fig. 6F). The hypurals 1~2 articulate with the ural centrum anteriorly, and joins to the parhypural ventrally. The parhypural is usually autogenous and is sometimes fused with hypurals 1~2 (Fig. 6D). The shape of neural spines of the PU2 and PU3 is various. They are fused with each centrum proximally, and are expanded or bifurcated distally. There are 6 to 8 dorsal and ventral procurrent rays (unsegmented); 1 segmented, unbranched ray inserting on the posteriormost epural; 1 segmented, unbranched ray on hypural 5; 7 branched rays on hypurals 3~4; 6 branched rays on hypurals 1~2 and parhypural; 2 segmented, unbranched rays on hemal spine of the PU2.

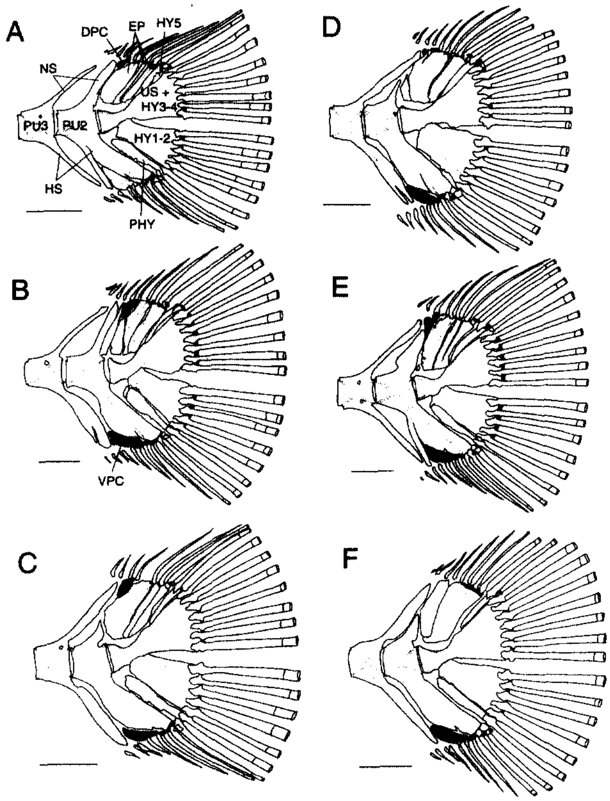

Fig. 6. Lateral aspects of caudal skeleton in *Micropercops swinhonis*. A, CNUC 24987; B, CNUC 24986; C, CNUC 24988; D, CNUC 24995; E, CNUC 24985; F, CNUC 24984. DPC-dorsal procurrent cartilage; EP-epural; HS-hemal spine; HY-hypural; NS-neural spine; PHY-parhypural; PU-preural centrum; US-urostyle; VPC-ventral procurrent cartilage. Scale bars indicate 1 mm.

10. Vertebrae and median fin supports (Figs. 7-8)

The vertebral column comprises 14 to 16 precaudal and 17 to 18 caudal vertebrae (Figs. 7, 8A, Table 1). The anteriormost vertebra bears a well developed condyle on both sides for articulation with the exoccipital (Fig. 8A). The epipleural ribs are associated with the anteriormost 13 vertebrae, and pleural ribs with the 3rd to 15th. The 6th epipleural rib is sometimes expanded, and bears a dorsal projection on its distal tip. The

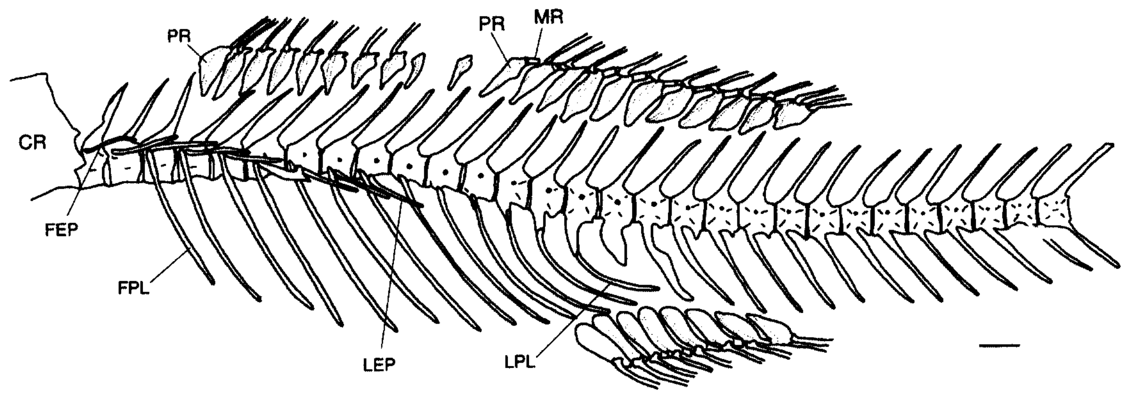

Fig. 7. Vertebrae and median fin elements of *Micropercops swinhonis*. CR-cranium; FEP-first epipleural; FPL-first pleural; LEP-last epipleural; LPL-last pleural; MR-median radial; PR-proximal radial. Scale bar indicates 1 mm.

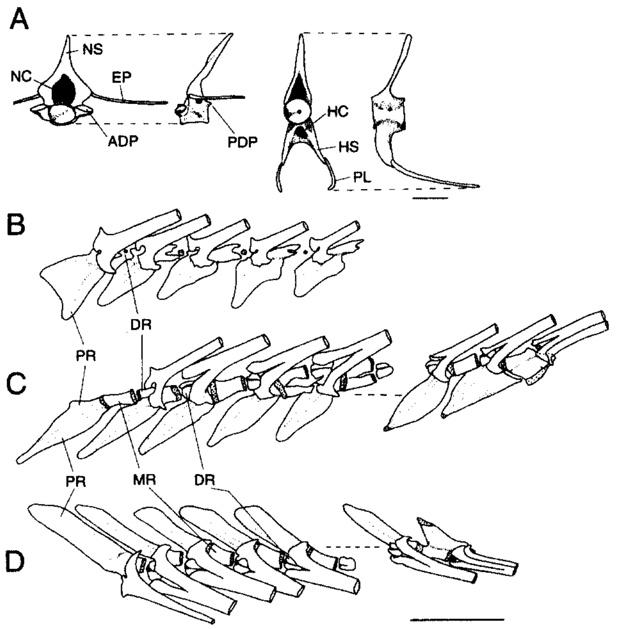

Fig. 8. Anterior (left) and lateral (right) aspects of first precaudal and caudal vertebrae (A), respectively, and dorso-lateral aspects of anterior portion of first dorsal (B) and second dorsal (C) fins, and ventro-lateral aspect of anal fin (D) in *Micropercops swinhonis*. ADP-anterior dorsal prezygapophysis; DR-distal radial; EP-epipleural; HC-hemal canal; HS-hemal spine; MR-median radial; NC-neural canal; NS-neural spine; PDP-posterior dorsal postzygapophysis; PL-pleural rib; PR-proximal radial. Scale bars indicate 1 mm.

Table 1. Dorsal pterygiophore formula (DF, sensu Birdsong *et al.* 1988) and meristic counts of *Micropercops swinhonis*. D, dorsal-fin rays; A, anal-fin rays; EP, epipleural; PL, pleural; V, vertebrae

SL(mm)	Sex	DF	D	A	EP	PL	V
40.3	♂	3-2121111	IX-11	9	13	13	16+16
40.1	♂	3-311211*1*	VIII-11	9	9	13	14+18
40.0	♂	3-3121111	X-11	9	10	13	14+18
36.4	♂	3-3121111	IX-11	9	10	13	16+17
36.3	♂	3-2121111	IX-11	9	–	–	–
35.5	♂	3-2121111	IX-12	9	10	13	16+17
35.4	♂	3-2112111	IX-12	9	–	–	–
32.0	♂	3-2121111	IX-11	11	–	–	–
39.2	♀	3-2112111	IX-12	10	11	13	15+18
34.0	♀	3-2212111	IX-12	9	–	–	–
33.0	♀	3-12121111	X-12	9	–	–	–
32.3	♀	3-2112111	IX-11	9	12	13	16+17
30.7	♀	3-2112111*	VIII-12	11	12	13	15+18

Table 2. Diagramatic indication of the distal radials of the first dorsal pterygiophores in *Micropercops swinhonis*. Open, half solid and closed circles indicate cartilage, partially ossified and fully ossified distal radials, respectively

SL(mm)	Sex	1st	2nd	3rd	4th	5th	6th	7th	8th
40.3	♂	●	◐	○	○	○	○		
40.1	♂	○	○	○	○				
40.0	♂	◐	○	○	○	○	○	○	
36.4	♂	◐	◐	◐	○	○	○	○	
32.3	♀	○	◐	○	○	○	○		
30.7	♀	◐	◐	◐	○	○	○		

first dorsal fin consists of 8 to 10 spines, whose pterygiophores have the variable formula (Table 1). The distal radials of the first dorsal fin is fully ossified, partially ossified or cartilaginous (Figs. 8B, 8C, Table 2). The second dorsal fin consists of one unbranched ray and 10 to 11 branched soft rays. Each of second dorsal fin elements is associated with its own tripartite pterygiophore (proximal+medial+distal radials) except the anterior two or three pterygiophores. The posteriormost distal radial of the second dorsal fin is cartilaginous. The anal fin consists of a spine and 8 to 10 branched soft rays. Except the anterior two pterygiophores which are bipartite, the rest ones are tripartite pterygiophores like as those in the second dorsal fin. The posteriormost distal radial of the anal fin is also cartilaginous.

Discussion

Recently, Birdsong *et al.* (1988) recognized the *Micropercops* group consisting of *Micropercops* and *Perccottus* in his Eleotrididae based on phenetic similarities in numbers of vertebrae and first dorsal fin pterygiophores. Hoese and Gill (1993) newly established the family Odontobutidae by adding *Odontobutis* which was also previously assigned to the Eleotrididae to the *Micropercops* group of Birdsong *et al.* (1988). Although Hoese and Gill (1993) could not to provide evidence for the monophyly of the Odontobutidae, they listed eight morphological features to characterize the family. All of them were found in *M. swinhonis* of the study, but scapular foramen of the species is different with that of Hoese and Gill (1993). They illustrated a enclosing scapula type which has a complete foramen (Hoese and Gill, 1993, Fig. 3A), but all the specimens observed of *M. swinhonis* in the present study have a forked scapula type bearing a incomplete foramen. The forked scapula is also appeared in *O. obscura*, although both forked and enclosing scapula types occur in the same specimen (Akihito, 1967, 1969). In addition, Hoese and Gill (1993) presented a small dorsal procurrent cartilage in the caudal skeleton, but it is absent at least in the specimen of CNUC 24984 meaning the presence of variation of the bone. Especially, the composition of the caudal skeleton in *M. swinhonis* is quite variable, for example, the elongation of neural spine of PU2, ossification of ventral procurrent caudal cartilage, fusion of posterior two epural bones and fusion of hypurals 1～2 with parhypural were observed. Both the small second infraorbital and first vestigial branchiostegal is present only one specimen of 40.1 mm SL, but they seem to be malformation as in *O. obscura* reported by Akihito (1969). It is reported that the infraorbital bone is absent in *O. obscura* and *P. glehni* by Akihito (1969), but the bone is present and with a well developed subocular shelf in *M. swinhonis*. Akihito (1969) reported that the bone (using the term, suborbital) is present in both *Bostrichthys sinensis* and *Oxyeleotris marmorata*. Springer (1983) mentioned that Akihito's (1969) "suborbital" is not a bone of infraorbital series but an ossification of the antero-ventral portion of the membrane lining the orbital cavity, and suggested the new term "intraorbital" be applied to it. However, we regarded this bone of *M. swinhonis* as one of the infraorbital bones because of its liner position between the lacrimal and the sphenotic, although the infraorbital sensory canal connecting them is obscure. Akihito (1969, Fig. 1) indicated that the mesopterygoid overlaps the metapterygoid posteriorly in both *O. obscura* and *P. glehni*, but that of *M. swinhonis* is separated from the metapterygoid as other gobiid fishes. The dorsal postcleithrum is present in only the eleotridids among gobioids (Springer, 1983). It is reported in both *O. obscura* and *P. glehni* by Akihito (1969) and we found it in also *M. swinhonis*. The pterygiophore formula of *M. swinhonis* as well as composition of dorsal pterygiophores of the first dorsal fin is highly variable, as mentioned by Hoese and Gill (1993). Winterbottom (1993) indicated that there is no distal radial on the last dorsal and anal fin pterygiophores in gobioids, but *M. swinhonis* has a cartilaginous distal radial apparently.

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한국산 좀구굴치의 골학적 연구

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전북 부안군 청호저수지산 좀구굴치의 전골격계를 기재하고 도시하였다. 본종은 안하골에 안하골상이 있는 점, 내익상골이 후익상골로부터 분리하는 점, 견갑골이 이차상이고 상후의쇄골이 있는 점 등의 골학적인 특징을 보인다. 한편, 미골격과 등지느러미 담기골식에서는 많은 변이가 관찰되었다.