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New Record of *Uraspis uraspis* and Redescription of *Uraspis helvola* (Pisces: Carangidae) from Korea

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ABSTRACT The fish species *Uraspis helvola* and *U. uraspis* (family Carangidae, Perciformes) were collected from Korea, and described and compared based on morphological and molecular characters. *Uraspis helvola* and *U. uraspis* were clearly distinguished by differences in the beginning point of the straight lateral lines scales (dorsal fin soft rays 12th~13th in *U. helvola* vs. 15th~16th in *U. uraspis*), and in the naked area on the breast extends to the pectoral fin base (naked area half way in *U. helvola* vs. naked area widely connected in *U. uraspis*). Molecular analysis using 530 base-pairs of mitochondrial DNA cytochrome *c* oxidase subunit I gene strongly supported the morphological identification. We described it as the new Korean record, and proposed the new Korean name "min-jeon-gaeng-i-sok" for the genus *Uraspis*, and "heuk-gi-min-jeon-gaeng-i" for the species *U. uraspis*.

Key words: *Uraspis helvola*, *Uraspis uraspis*, new record, redescription, Carangidae, Korea

INTRODUCTION

The family Carangidae (Perciformes) is widely distributed worldwide, and includes 140 species in 32 genera (Nelson, 2006). There are 59 species in 24 genera in Japan (Senou, 2013), 54 species in 22 genera in Taiwan (Lin and Shao, 1999), and 31 species in 17 genera in Korea (Kim *et al*., 2014). The family is characterized by the presence of two separated dorsal fins, a thin caudal peduncle, deeply forked caudal fins, and a scute on the lateral line (absent in some genera) (Nelson, 2006). The genus *Uraspis* Bleeker, 1855 is characterized by the presence of a white tongue and embedded anal fin spines (Lin and Shao, 1999). This genus is composed of three species including *U. helvola* (Forster, 1801), *U. secunda* (Poey, 1860), and *U. uraspis* (Günther, 1860). Prior to this study, both *U. helvola* and *U. uraspis* had been reported from Taiwan and Japan, while only *U. helvola* had been reported from Korea. *Uraspis helvola* has been reported by several authors previously (Chyung, 1977; Kim, 2000; Kim *et al*., 2005), however, it was briefly described and without voucher specimens. Therefore, we provide the detailed morphological description of a new recorded *U. uraspis* collected from Korea and molecular comparison with congeneric species, *U. helvola*. Also we re-describe in detail the morphological characteristics of *U. helvola* collected from Korea.

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MATERIALS AND METHODS

Using a purse seine net, 4 specimens of *U. uraspis* were collected off the coast of Jejudo Island, Korea, and 5 specimens of *U. helvola* were collected from the same location and the Yellow Sea, Korea. The specimens were fixed in 10% formalin and then preserved in 70% ethanol, and used for determining the morphological characteristics of *U. uraspis* and *U. helvola* as described by Lin and Shao (1999) and Senou (2013). Counts and measurements were made according to the method of Gunn (1990); measurements were made using digital Vernier calipers, and values were rounded to 0.1 mm. The fin rays and vertebrae were counted using radiography (Sehwa Medical System SMS-CM, Korea), and the specimens were deposited in the Ichthyology Laboratory Collection, Pukyong

National University (PKU).

Genomic DNA was extracted from muscle tissues using a DNA extraction kit (Bioneer Co. LTD, Korea). The mitochondrial DNA partial cytochrome *c* oxidase subunit I (mtDNA COI) was amplified using the polymerase chain reaction (PCR). VF2 (5′-TCAACCAACCACAAAGACATTGGCAC-3′) and FishR2 (5′-ACTTCAGGGTGACCGAAGAATCAGAA-3′) primers used in the PCR procedure, were designed by Ward *et al*. (2005). The PCR was carried out in a MJ Mini Thermal Cycle (PCT-1148; Bio-Rad) in a total volume of 20 μL comprising 1 μL of total DNA, 2 μL of 10Xbuffer, 1.6 μL of 2.5 mM dNTPs, 1 μL of each primer, 0.1 μL Ex Taq, and 13.4 μL sterile distilled H_2O. The PCR proceeded under the following conditions: initial denaturation at 95°C for 5 min, 35 cycles of 95°C for 1 min, 50°C for 1 min, 72°C for 1 min, and a final extension at 72°C for 5 min. The PCR products were purified using a DNA purification kit (DavinchK Co. LTD., Korea). The DNA was sequenced using a ABI 3730XL Sequencer (Applied Biosystems, Foster City, CA, USA) using the ABI PRISM BigDye Terminator v3.1 Ready Reaction Cycle Sequencing Kit (Applied Biosystems). All sequences determined here are deposited in GenBank under Accession numbers KU 578085-KU 578093. The sequences were aligned using ClustalW (Thompson *et al*., 1994) in BioEdit version 7 (Hall, 1999). The mtDNA COI sequences of other *Uraspis* species (JX 261042, JX 261028, HQ 560984, JF 952885) and two outgroups (*Carangoides orthogrammus*: JQ 431539, and *Caranx sexfasciatus*: KJ 202141), from the NCBI (National Center for Biological Information) database were compared. The genetic distances were calculated according to the Kimura two-parameter model (Kimura, 1980). A neighbor-joining (NJ) tree based on 10,000 bootstrap replications was constructed using MEGA 6 (Tamura *et al*., 2011).

Genus *Uraspis* Bleeker, 1855

(New Korean genus name: min-jeon-gaeng-i-sok)

Uraspis Bleeker, 1855: 417 (type species: *Uraspis carangoides* Bleeker, 1855 = *Uraspis uraspis*).

Zamora Whitley, 1931: 108 (type species: *Caranx Hullianus* McCulloch, 1909).

Description. Tongue, roof and floor of mouth white, the rest dark; anal fin spines reabsorbed or reduced and immovable; no teeth on vomer or palatines (Smith-Vaniz, 1999).

Remarks. Only three species throughout the world (Froese and Pauly, 2015).

Uraspis helvola (Forster, 1801) (Fig. 1)

(Korean name: min-jeon-gaeng-i)

Scomber helvolus Forster, 1801: 35 (type locality; Ascension Island, eastern Atlantic Ocean).

Caranx helvola: Mori, 1952: 96 (Korea); Chyung, 1977: 380 (Korea).

Uraspis helvola: Kim *et al*., 2005: 314 (Korea); NIBR, 2011: 109 (Korea); Allen and Erdmann, 2012: 440 (Australia); Senou, 2013: 892 (Japan).

Materials. PKU 9453, one specimen, 158.6 mm in standard length (SL), Jejudo Island, Korea (33°36′N, 127°21′E), 20 July 2013; PKU 9576, one specimen, 193.0 mm SL, Jejudo Island, Korea (33°41′N, 127°12′E), 5 August 2013; PKU 9774, one specimen, 271.3 mm SL, Korea (36°70′N, 125°40′E), 9 September 2013; PKU 12577, one specimen, 198.7 mm SL, Jejudo Island, Korea (32°86′N, 126°76′E), 17 August 2015; PKU 12589, one specimen, 159.5 mm SL, Jejudo Island, Korea (33°14′N, 126°34′E), 20 August 2015.

Description. All counts are listed in Table 1. Proportion as % SL: body depth 43.6∼48.8; head length 29.6∼32.4; curved lateral line length 34.3∼38.2; straight lateral line length 40.0∼43.8; soft dorsal fin base length 47.2∼53.1; soft anal fin base length 36.5∼40.3; soft dorsal fin lobe height 15.6∼22.2; soft anal fin lobe height 14.8∼20.1; pectoral fin length 24.7∼30.0; snout to origin of spinous dorsal fin 35.9∼39.8; maximum scute length 1.6∼2.2. Proportion as % HL: eye diameter 18.9∼22.4; snout length 30.2∼34.2; postorbital length 43.8∼48.2; upper jaw length 40.9∼43.1.

Body oblong and compressed (Fig. 1). Dorsal fin separated, and spinous dorsal fin lower than soft fin. Pectoral fin falcate (not in younger specimens) reaching to beyond intersection of straight and curved lateral lines. Anal fin spines embedded. Caudal peduncle thin and caudal fin deeply forked. Straight part of lateral line longer than curved part. Posterior end of maxilla extends to the middle of eye, and lower jaw projected. Eye diameter smaller than snout length. Small mouth with 1 or 2 rows of sharp conical teeth present on each jaw. Naked area of breast separated from naked base of pectoral fin by a broad band of scales (Fig. 3).

Color. When fresh, body dark overall, vertical gradually fading bands; all fins slightly faded in color but remaining black, except for pelvic fin; darkish gray between and above nostrils and eyes; dark gray from upper part of eyes to caudal part. Body dark black entirely; not silvery color after fixation.

Distribution. Busan, Tongyeong, Jejudo Island and sou-

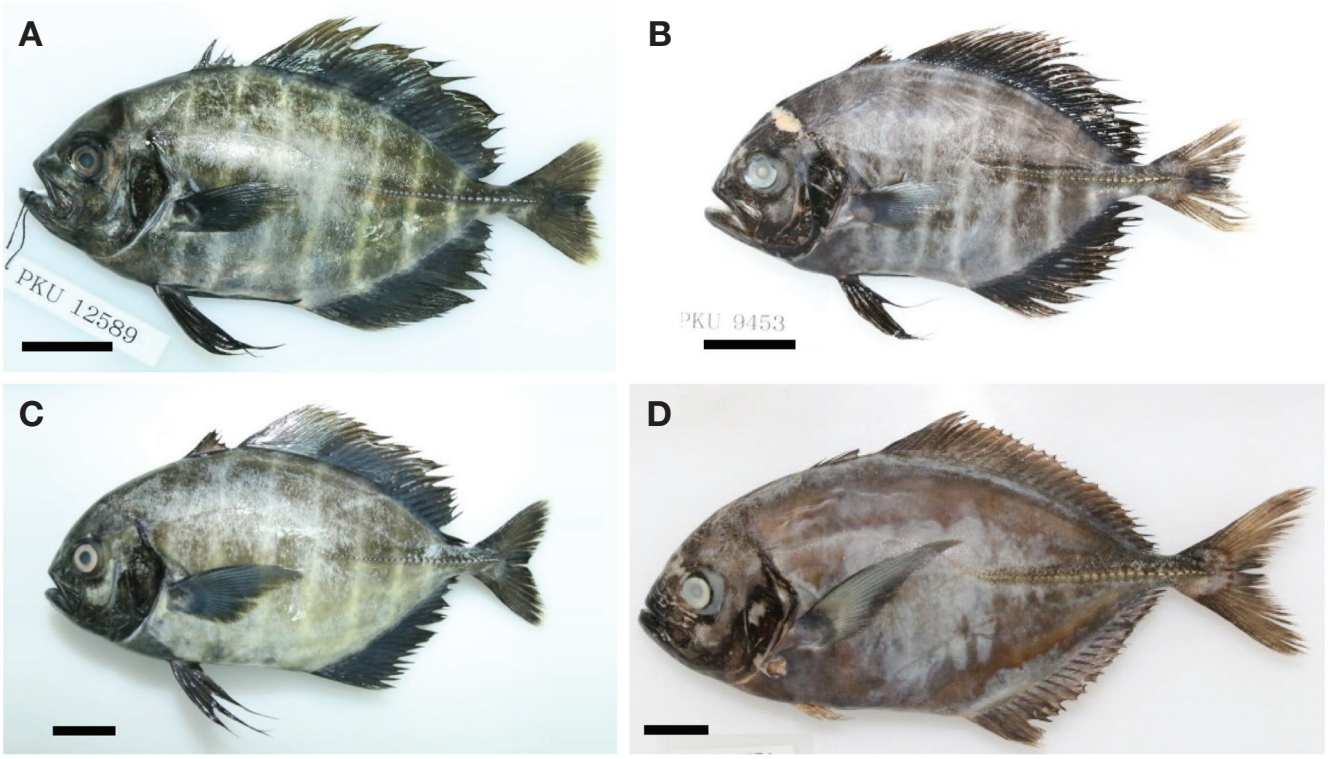

Fig. 1. *Uraspis helvola*. A: PKU 12589, 159.5 mm SL; B: PKU 9453, 158.6 mm SL; C: PKU 12577, 198.7 mm SL; D: PKU 9774, 271.3 mm SL. Scale bar: 30 mm.

Table 1. Comparison of the morphological characters of *Uraspis helvola*

	Present study	Forster (1801)	Lin and Shao (1999)	Senou (2013)
Total length (TL, mm)	181.1~313.3 (n = 5)	–	–	–
Standard length (SL, mm)	158.6~271.3	–	–	–
Fork length (FL, mm)	171.5~293.2	–	193.0~296.0 (n = 3)	–
Counts				
Dorsal fin rays	VII-VIII + I, 27~28	VIII, 29	VII-VIII (posterior 1 embedded and not apparent) + I, 28~29	VIII + I, 25~30
Pectoral fin rays	i, 21~22	21	i, 20~21	–
Anal fin rays	(II) + I, 20~22	III, 21	(detached spines embedded and not apparent) + I, 21~22	(II) + I, 19~22
Scutes	34~35	–	33~37	23~40
Gill rakers	6~8 + 13~15	–	5~6 + 14~15	5~8 + 13~17
Vertebrae	24	–	24	24

thern Sea, Korea (Mori, 1952; Chyung, 1977; Kim *et al*., 2005; present study); St. Helena and Ascension Islands (Smith-Vaniz, 1990); Persian Gulf (Carpenter *et al*., 1997); Indo-Pacific (Lin and Shao, 1999); Japanese archipelago (Senou, 2013).

Remarks. The specimens were identified as *U. helvola* based on the naked area being separated into two parts, and the straight lateral line scales being longer than the curved line scales (Lin and Shao, 1999). In terms of body dimensions, the percentage body depth and pelvic fin length declined with growth. *Uraspis helvola* is distinguishable from *U. uraspis* by the percentage length of straight to curved lateral line scales (straight line scales longer in *U. helvola*, curved line scales longer in *U. uraspis*). Scutes occasionally antrorse (*Uraspis* only), and in some cases occur on both the curved and straight lateral line segments (Gunn, 1990). In *U. helvola* the average number of retrorse scutes increases with growth, while

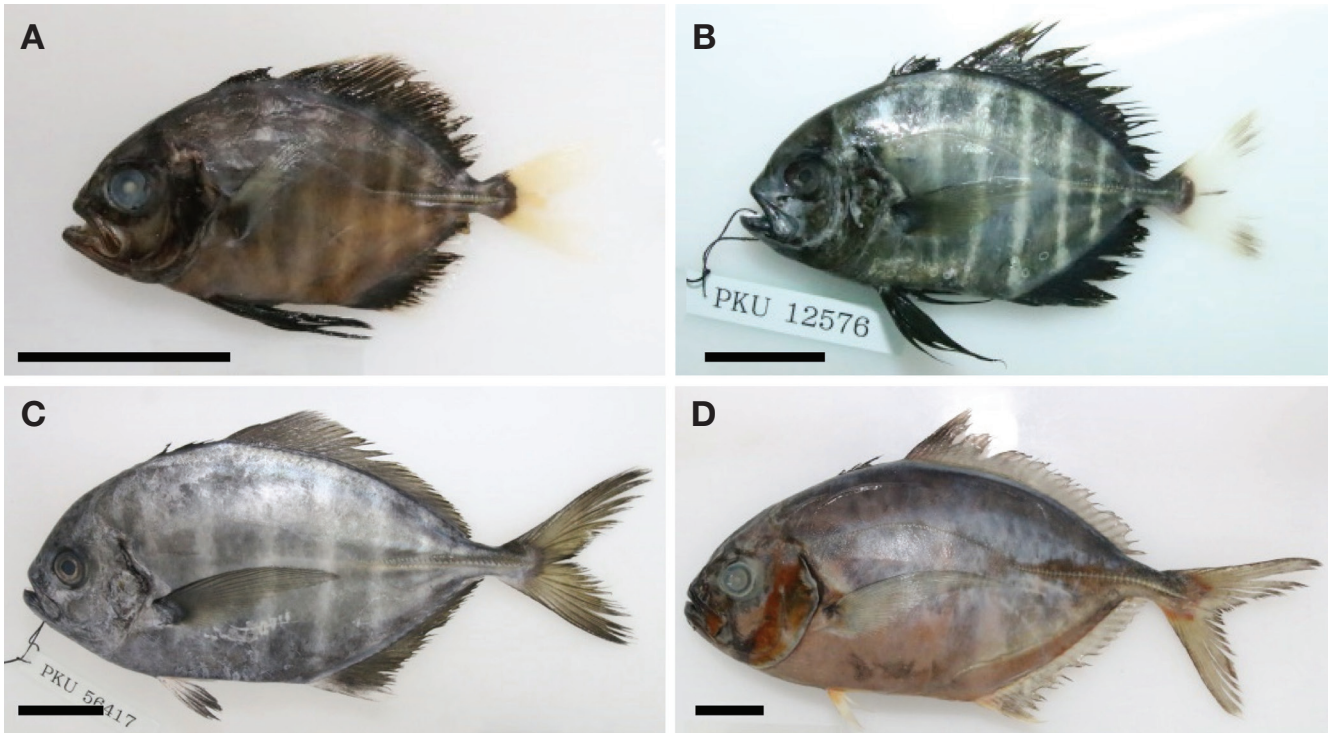

Fig. 2. *Uraspis uraspis*. A: PKU 12359, 74.6 mm SL; B: PKU 12576, 107.4 mm SL; C: PKU 56417, 197.3 mm SL; D: PKU 11330, 237.2 mm SL. Scale bar: 30 mm.

the average number of antrorse scutes decrease. In fish longer than 150 mm only retrorse scutes occur (Reuben, 1968). In contrast, all our *U. helvola* specimens had antrorse scutes, and *U. uraspis* specimens had retrorse scutes. However, we could not identify the scutes of *U. helvola* specimens shorter than 150 mm, or establish at what stage scute transformation occurs in *U. uraspis*. Further study is required to clarify the changes that occur in each body part with growth.

Uraspis uraspis (Günther, 1860) (Fig. 2)

(New Korean name: heuk-gi-min-jeon-gaeng-i)

Caranx uraspis Günther, 1860: 444 (type locality: Ambon Island, Molucca Islands, Indonesia).

Uraspis uraspis: Masuda *et al*., 1984: 155 (Japan); Lin and Shao, 1999: 62 (Taiwan); Myers and Donaldson, 2003: 625 (Mariana Islands); Larson *et al*., 2013: 125 (Australia); Senou, 2013: 892 (Japan).

Materials. PKU 11330, one specimen, 237.2 mm in standard length (SL), Jeju-si, Jejudo Island, Korea (33°61′N, 126°48′E), 27 September 2014; PKU 12359, one specimen, 82.5 mm SL, Korea (34°58′N, 128°57′E), 17 July 2015; PKU 12576, one specimen, 107.4 mm SL, Jejudo Island, Korea (33°76′N, 126°83′E), 17 August 2015; PKU 56417, one specimen, 197.3 mm SL, Jeju-si, Jejudo Island, Korea (33°78′N, 126°96′E), 12 October 2015.

Description. All counts are listed in Table 2. Proportion as % SL: body depth 45.5∼56.0; head length 30.5∼35.5; curved lateral line length 40.4∼44.0; straight lateral line length 32.7∼35.5; soft dorsal fin base length 47.1∼52.7; soft anal fin base length 34.2∼37.2; soft dorsal fin lobe height 15.3∼28.5; soft anal fin lobe height 15.9∼27.8; pectoral fin length 32.3∼35.7; snout to origin of spinous dorsal fin 34.8∼44.0; maximum scute length 1.9∼2.5. Proportion as % HL: eye diameter 20.5∼29.1; snout length 28.3∼35.1; postorbital length 41.8∼44.5; upper jaw length 41.1∼46.0.

Body oblong and compressed (Fig. 2). Dorsal fin separated, and spinous dorsal fin lower than soft fin. Pectoral fin falcate, reaching to beyond function of straight and curved lateral line in bigger specimens (PKU 11330, PKU 56417) but not smaller specimens. Anal fin spines embedded. Caudal peduncle thin and caudal fin deeply forked. Arched anterior part of lateral line longer than straight part, and it starts at dorsal fin soft rays 15th∼16th. Posterior end of maxilla extends to the middle of eye, and lower jaw projected. Eye diameter smaller than snout length. Small mouth with 1 or 2 rows of sharp conical teeth on each jaw. Naked area on breast extends and is widely

Table 2. Comparison of the morphological characters of *Uraspis uraspis*

	Present study	Günther (1860)	Gunn (1990)	Lin and Shao (1999)	Senou (2013)
Total length (mm)	99.9∼284.4 (n = 4)	–	–	–	–
Standard length (mm)	74.6∼237.2	–	–	204.0∼252.0 (n = 4)	–
Fork length (mm)	84.1∼255.0	–	–		–
Counts					
Dorsal fin rays	VII-VIII + I, 26∼27	VIII + I, 28	VI-VIII + I, 24∼26	VII-VIII (posterior 1 or 2 embedded and not apparent) + I, 25∼27	VI-VIII + I, 24∼30
Pectoral fin rays	i, 21	–	–	i + 20∼21	–
Anal fin rays	(II) + I, 20	II + I, 21	II + I, 18∼20	(detached spines embedded and not apparent) + I, 20	(II) + I, 17∼22
Scutes	33∼35	–	28∼32	36∼39	24∼39
Gill rakers	5∼7 + 13∼14	–	5∼6 + 14∼15	5∼6 + 13∼16	4∼7 + 13∼17
Vertebrae	24	–	–	24	24

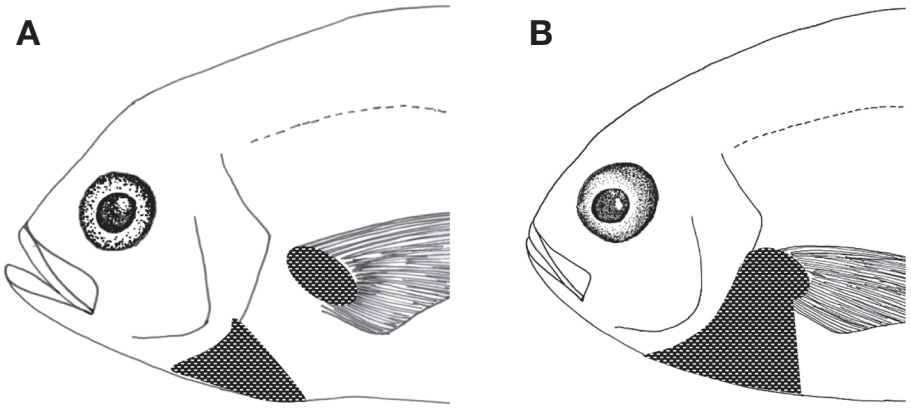

Fig. 3. Black shading indicates the naked area on the breast of *Uraspis helvola* (A) and *U. uraspis* (B).

connected to the pectoral fin base (Fig. 3).

Color. Body sparkling silvery and sooty; obvious gradually fading vertical band; darkish gray between and above nostrils and eyes; dark gray from upper part of eyes to caudal part; rays translucent; caudal fin all white changing with growth to yellow with dark posterior margin; Tongue, roof, and floor of mouth white, and the rest of mouth dark. Body dark black entirely; not silvery color after fixation.

Distribution. Jejudo Island and southern Sea, Korea (present study); south to northern Australia, southwestern Indian Ocean (Letourneur, 2004); Japan, Indo-western Pacific, New Guinea (Senou, 2013)

Remarks. The specimens collected from Korea during this study belong to the genus *Uraspis*, based on the white tongue and roof and, floor of the mouth, and the embedded anal fin spine (Lin and Shao, 1999). They were identified as *U. uraspis* by the wide naked area between the breast and the base of the pectoral fin, and the curved part of the lateral line being longer than the straight part (Gunn, 1990). These specimens were agreed well with the results of the previous studies including the original description (Table 2). The genus *Carangoides* and *Caranx* also have a wide naked area between the breast and the base of pectoral fin, but the arrangement of teeth and the inside mouth color distinguish this genus (Lin and Shao, 1999). *Uraspis uraspis* was clearly distinguished from *U. helvola* by the beginning point of the straight lateral line scales (below dorsal soft rays 15th∼16th in *U. uraspis* vs. 12th∼13th in *U. helvola*), and the naked area on the breast extending continuously to the pectoral fin base (the naked area is widely connected in *U. uraspis* vs. naked area half way in *U. helvola*). *Uraspis uraspis* gradually turns pale in body and fin color with growth, which is also a characteristic distinguishing it from *U. helvola*. To confirm the taxonomic status of the specimens, we analyzed 530 base-pair sequences of the mtDNA COI gene. The *U. uraspis* specimens (PKU 11330, PKU 12359, PKU 12576, and PKU 56417) were clearly separated from the *U. helvola* specimens (PKU 9453, PKU 9576, PKU 9774,

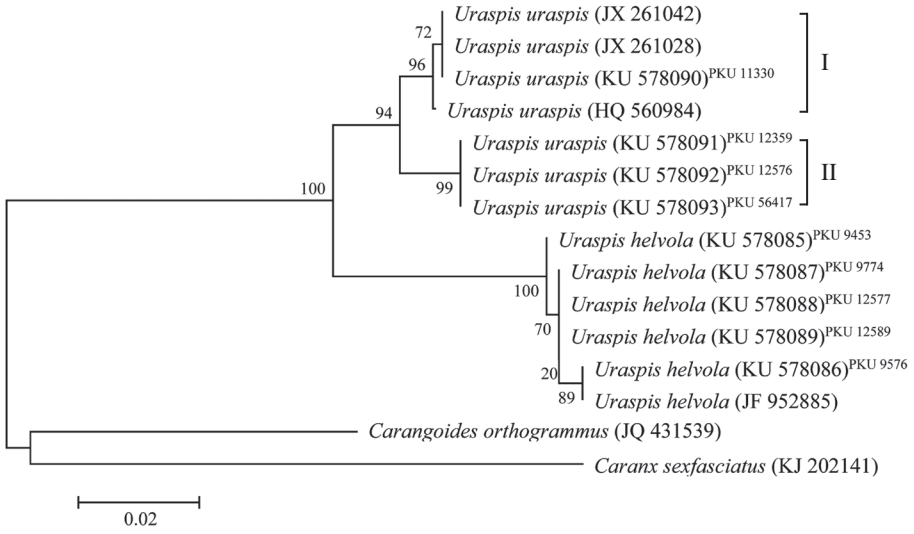

Fig. 4. Neighbor-joining tree inferred from mtDNA-COI analysis, showing the relationships between the species *Uraspis uraspis*, *U. helvola*, *Carangoides orthogrammus* (JQ 431539), and *Caranx sexfasciatus* (KJ 202141), the latter two included as outgroups. Numbers at the ends of branches indicate bootstrap probabilities for 10,000 bootstrap replications. Bar indicates a genetic distance of 0.02.

PKU 12577, and PKU 12589), with a genetic distance of $d=0.054\sim0.058$. The genetic distance between these two species and outgroups are 0.125∼0.156 for *Carangoides orthogrammus* and 0.167∼0.185 for *Caranx sexfasciatus*. The range of values for the mean Kimura 2-parameter (K2P) distance was generally consistent with the taxonomic hierarchy in Carangidae: 0%∼4.82% among individuals within species, 0%∼16.4% among species within genera; and 8.64%∼25.39% among genera within families (Mat Jaafar *et al*., 2012). *Uraspis uraspis* and *U. helvola* were separated by approximately 5.4%∼5.8% in genetic distances, as described previously. In *U. uraspis* we found two groups (I and II) having a genetic difference of $d=0.015\sim0.017$, but we were unable to distinguish them based on morphological differences. Further research is required to clarify the relationship between these two groups.

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한국산 전갱이과 어류 1미기록종, *Uraspis uraspis* 및 *Uraspis helvola*의 재기재

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요 약 : 전갱이과에 속하는 민전갱이(*Uraspis helvola*)의 형태적 특징을 상세히 재기재하고, 국내에서 처음으로 채집된 *U. uraspis*와 비교 분석하였다. 민전갱이와 *U. uraspis*는 측선의 직선 부위 시작점 위치(민전갱이: 등지느러미 연조 12번째~13번째, *U. uraspis*: 등지느러미 연조 15번째~16번째)에서 구분되며, 가슴지느러미에서 흉부 사이 무린역의 연결성(민전갱이: 무린역이 분리, *U. uraspis*: 무린역이 연결)에 따라 명확하게 구분된다. 새롭게 보고되는 *U. uraspis*의 속명과 국명은 각각 "민전갱이속"과 "흑기민전갱이"로 제안한다.

찾아보기 낱말 : *Uraspis helvola*, *Uraspis uraspis*, 미기록종, 재기재, 전갱이과, 한국