



First record of *Brachaluteres ulvarum* (Tetraodontiformes: Monacanthidae) from Jeju-do Island, southern Korea

Se Hun Myoung^{1,*}, Joo Myun Park¹, Hyo Jin Lee², Laith A. Jawad³

¹ Dokdo Research Center, Korea Institute of Ocean Science and Technology, Uljin 36315, Korea

² East Sea Environment Research Center, Korea Institute of Ocean Science and Technology, Uljin 36315, Korea

³ School of Environmental and Animal Sciences, Unitec Institute of Technology, 139 Carrington Road, Mt Albert, Auckland 1025, New Zealand

Abstract

A single specimen (39.4 mm standard length) of *Brachaluteres ulvarum*, belonging to the family Monacanthidae has been recorded for the first time from Supseom, Jeju-do Island of southern Korea on 6 March 2021. This species was characterized by the presence of a small second dorsal spine present, the posterior end of pelvic without encasing scales, and numerous thin dark longitudinal lines on body. It was morphologically similar to the *B. taylori*, but distinguished by the ratio of the caudal peduncle to the head length (*B. ulvarum*, 2.5 to 3.7 times; *B. taylori*, 3.5 to 5.2 times). In addition, the former is well distinguished from the latter through mitochondrial cytochrome c oxidase subunit I (COI) sequences by genetic distances of range from 0.088 to 0.090. The new Korean name “Kko-ma-jwi-chi-sog” is proposed for the genus *Brachaluteres*, and “Kko-ma-jwi-chi” for the species *B. ulvarum*.

Keywords: *Brachaluteres ulvarum*, Monacanthidae, First record, Jeju-do Island, Korea

Introduction

The file fishes (Monacanthidae) mainly inhabit shallow coastal reefs and algal beds depths of 10–200 m (Hutchins, 2001; Nelson et al., 2016). The body of the file fish is laterally compressed, and their skins are covered with small spines. In addition, they have two separated dorsal fins, the first dorsal fin usually with two spines, while the second usually smaller or absent (Nelson, 1994). Four species of *Brachaluteres* are reported worldwide (Froese & Pauly, 2021), with one species recorded in Japanese

waters (Hayashi & Hagiwara, 2013), but no occurrence reported in Korea waters. The genus *Brachaluteres* is characterized by no protruded pelvic bone lacking spine at its end, dorsal and anal rays short and low with all less than 30 rays, and subcircular body (Hutchins & Swainston, 1985).

The first record of *B. ulvarum* has been reported as a new species in a bay around Misaki Japanese waters in 1902 (Jordan & Fowler, 1902), but there has been a lack of data on their additional occurrence and life history. Only a study of their spawning behavior was conducted by Akagawa et al. (1995). This spe-

Received: Apr 28, 2021 Revised: May 12, 2021 Accepted: Jun 2, 2021

*Corresponding author: Se Hun Myoung

Dokdo Research Center, Korean Institute of Ocean Science and Technology, Uljin 36315, Korea

Tel: +82-54-780-5348, Fax: +82-54-780-5349, E-mail: sh_myoung@kiost.ac.kr

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cies is distributed in relatively narrow area along the southern coast of Japan and listed in the category of least concern (LC) in the list of IUCN (Matsuura et al., 2019).

In this study, we report the first occurrence of *B. ulvarum* in Korean waters based on one specimen collected in SCUBA diving from the Supseom, Jeju-do Island. The identification of the species was grounded on the morphological characteristics, and records of its mitochondrial cytochrome c oxidase subunit I (mt COI) sequences.

Materials and Methods

One specimen of *B. ulvarum* was collected from Supseom (33°13'47.50" N, 126°35'45.89" E) in the southern coast of Je-

ju-do Island, Korea, via SCUBA diving on 6 March 2021 (Fig. 1). In the laboratory, measurements and meristic counts were recorded following the method of Hutchins (1977). The sizes of body parts were measured to the nearest 0.1 mm using digital Vernier calipers with add of microscope. The specimen was then preserved in 5% formalin for 24 h and later transferred to 70% ethanol for depositing at the Marine Biodiversity Institute of Korea (MABIK).

To compare molecular data, total genomic DNA was extracted from the muscle tissue using 10% Chelex resin (Bio-Rad, Hercules, CA, USA). A portion of the mitochondrial COI gene was amplified using universal primers (Ward et al., 2005). PCR was performed in a 30 μ L reaction tube containing 1 μ L genomic DNA, 2 μ L 10 \times PCR buffer, 2 μ L 2.5 mM dNTP, 1 μ L

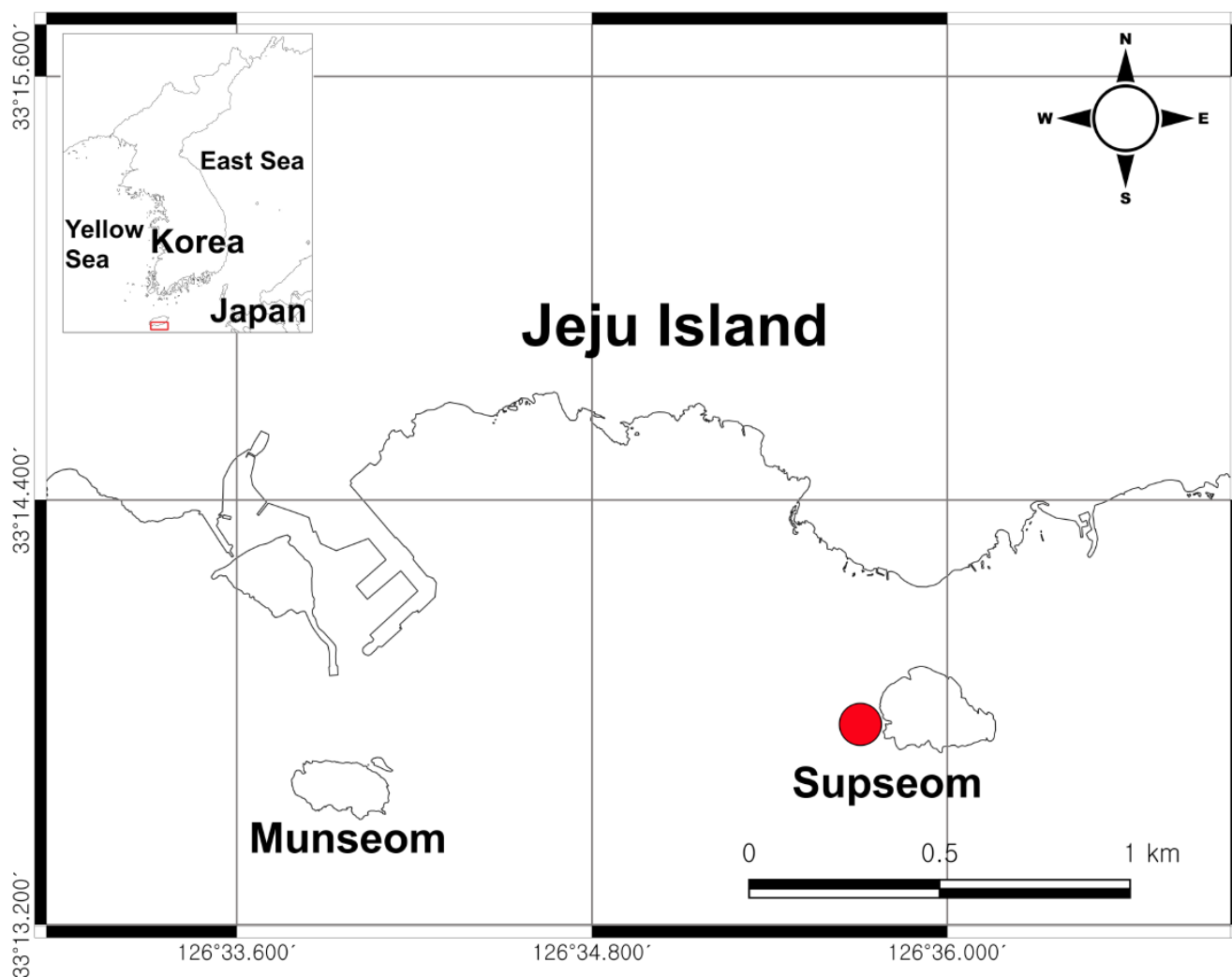


Fig. 1. Map showing the sampling area of *Brachaluteres ulvarum* from Supseom, Jeju-do Island, southern Korea.

of each primer, 0.1 μ L Ex-Taq DNA polymerase, and 22.9 μ L sterile distilled H₂O, using a thermal cycler (MJmini PTC-1148, Bio-Rad). The PCR profile consisted of initial denaturation at 95°C for 5 min, followed by 34 cycles of denaturation at 95°C for 1 min, annealing at 50°C, extension at 72°C for 1 min, and a final extension at 72°C for 5 min. PCR products were purified using ExoSAP-IT (United States Biochemical, Cleveland, OH, USA) and sequenced using an ABI PRISM BigDye Terminator v3.1 Ready Reaction cycle sequencing kit (Applied Biosystems, Waltham, MA, USA) on an ABI 3730xl DNA analyzer (Applied Biosystems). We compared our molecular data with those of the mtDNA COI sequences from other *Brachaluteres* species and one outgroup, *Paraluteres prionurus* (KP194657), download from the NCBI GenBank (National Center for Biotechnology Information, www.ncbi.nlm.nih.gov). Sequences were aligned using ClustalW (Thompson et al., 1994) in BioEdit, version 7 (Hall, 1999). The genetic divergences were calculated using the Kimura 2-parameter (K2P) (Kimura, 1980) model with Mega 6 (Tamura et al., 2013). Phylogenetic trees were constructed using the neighbor-joining method (Saitou & Nei, 1987) in Mega 6 (Tamura et al., 2013), with confidence assessed based on 1,000 bootstrap replications.

Results and Discussion

Genus *Brachaluteres* Bleeker, 1865

(New Korean genus name: Kko-ma-jwi-chi-sog)

Brachaluteres Bleeker (1865): 100 (type species: *Aleuterius trosulus*)

Body slightly compressed, subcircular; gill opening placed above pectoral fin base; no protruded pelvic bone lacking spine at its end; dorsal ray and anal ray short and low with all less than 30 soft rays (Hutchins & Swainston, 1985).

Brachaluteres ulvarum Jordan & Fowler, 1902

(New Korean name: Kko-ma-jwi-chi) (Fig. 2)

Brachaluteres ulvarum Jordan & Fowler (1902): 271 (type locality: Misaki, Japan); Matsuura et al. (1984): 361 (Japan); Akagawa et al. (1995): 397 (Japan); Hayashi (2002): 1404 (Japan).

Materials examined

Brachaluteres ulvarum (MABIK PI00049731) 39.4mm standard length (SL) Supseom, Jeju-do Island, Korea, 33°13'47.50" N, 126°35'45.89" E, rocky substrate, 12 m, coll. S.H. Myoung (SCUBA diving), hand net, 6 March 2021.

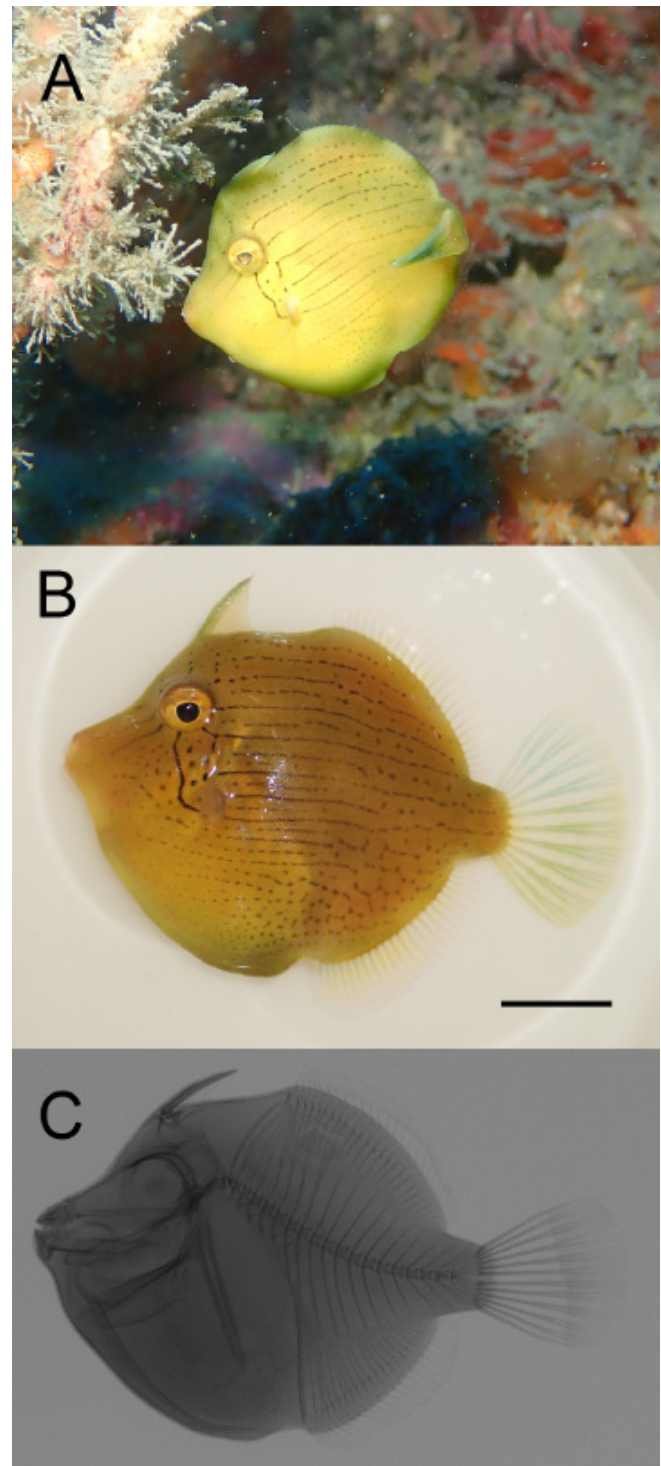


Fig. 2. *Brachaluteres ulvarum*, fresh, MABIK PI00049731, 39.4 mm SL, Supseom, Jeju-do Island, southern Korea. (A) an underwater photo, (B) images taken in the laboratory, (C) X-ray. Scar bar=1 cm. MABIK, Marine Biodiversity Institute of Korea; SL, standard length.

Description

Body counts, measurements, and proportions of body parts against to SL are shown in Table 1. Body deep, compressed, and generally round (Fig. 2). Head short and deep. Mouth small and terminal. Belly rounded downwards, without protruding spine. Origin of first dorsal spine slightly behind center of the eye, and gill slit the behind of eye. Origin of pectoral fin just below gill slit. Pectoral fin short and its end round. First dorsal spine slender, end of spine connected by a thin membrane. Second dorsal spine very small, located behind the first dorsal spine (Fig. 2C). Heights of second dorsal fin and anal fin short. Origin of these fins almost in the middle of body with origin of anal fin slightly behind, and both ends reach caudal peduncle part. Caudal fin big and its end round.

Coloration of the specimen

Body color light brown or yellowish, and lower part of the belly

light green. Body has black lines and black dots connected vertically. Three black lines both between the eye and mouth, and between eye and dorsal part. Several black dots and two black lines stretch from eye to bottom of pectoral fin base and gill slit. Black dots vertically connected from the mouth to caudal part through below pectoral fin, while black dots at upper part of pectoral fin connected from behind of eyes to caudal part. These vertical patterns mostly in a line at front body part and in dots at behind of body toward caudal part. Small hexagonal patterns appear on lower rear body as a dotted line. First dorsal spine light green, all soft rays generally transparent with light green or light blue.

Distribution

Brachaluteres ulvarum is restrictly distributed in parts of the Northwest Pacific region, especially off Japan (Matsuura et al., 1984; Hayashi, 2002) and Korea (present study).

Table 1. Morphometric measurements of the *Brachaluteres ulvarum* in comparison with previous records

Morphological characters	Present specimen	Hutchins & Swainston (1985)	Jordan & Fowler (1902)
No. of specimen	1	5	1
Standard length (mm)	39.4	36–62	63.5
Counts			
Dorsal fin rays	11–27	11, 27–30	1, 27
Anal fin rays	25	24–26	25
Pectoral fin rays	11	10–12	-
Caudal fin rays	12	12	-
Vertebrae	20	20	-
Measurements			
Ratio of standard length			
Body depth	1.4	1.4–1.5	1.4–1.5
Head length	3.3	2.8–3.3	3.2–3.4
Snout length	4.2	4.0–4.8	-
Soft dorsal fin base	2.2	2.1–2.3	-
Ratio of head length			
Eye diameter	2.6	2.6–3.4	-
Gill slit length	5.0	4.2–5.9	-
First dorsal spine length	1.3	1.2–1.5	-
Interdorsal space	1.2	1.2–1.5	-
Longest soft dorsal ray	3.4 (8th)	2.9–4.3 (8th)	-
Caudal-fin length	1.0	1.0–1.3	-
Caudal peduncle depth	2.0	-	1.8
Caudal peduncle length	2.6	2.5–3.7	2.3
Ratio of Caudal peduncle depth			
Caudal peduncle length	1.3	1.3–1.4	-

Mt DNA COI region

As a result of comparing the mitochondrial cytochrome c oxidase subunit I gene (COI) sequence (611 bp), present specimen with the mtDNA COI region of *B. ulvarum* registered in NCBI, the genetic distance of the two individuals was found to be 0.002. And another two species in genus *Brachaluteres* fishes with genetic distances of 0.088–0.164 (Fig. 3).

Discussion and Conclusion

The morphometrics of the specimen is well matched the original description of *B. ulvarum* given by Jordan & Fowler, 1902. However, compared with the holotype, there was a difference in the number of dorsal fin spines and in the caudal peduncle length. The second dorsal fin is very small and difficult to identify. In this study, it could be confirmed through x-ray. In addition, the difference in caudal peduncle length is thought to be a difference according to growth, and it is judged that the morphology measurement through more individuals is necessary in the future. The presence of two dorsal fin spines, and the range of the caudal peduncle length is well matched with the description suggested by Hutchins & Swainston (1985).

The genus *Brachaluteres* contains 4 species globally, and it forms small populations (Akagawa et al., 1995; Nelson et al., 2016). *B. ulvarum* occurs in southern Japanese waters from Wakayama Prefecture to Chiba Prefecture, including Sagami Bay and the Sagami-nada Sea, while *B. jacksonianus* (Quoy & Gaimard, 1824) in eastern Indian Ocean and Australian water, *B. taylori* Woods (1966) in western Pacific, and *B. fahaqa* Clark & Gohar (1953) in western Indian Ocean (Red Sea) (Froese &

Pauly, 2021; Hutchins & Swainston, 1985 ; Matsuura et al., 2019).

The occurrence of *B. ulvarum* in the Korean waters is unexpected, because the species has only been reported from the Japanese waters (Hutchins & Swainston, 1985). In addition, there have been no previous records of the members of the genus *Brachaluteres* from Korean waters (MABIK, 2020). Therefore, our finding is the first documental record of *Brachaluteres* species in Korean waters. The data is also significant understanding additional zoogeographical pattern in the population of this species within Korean waters, filling the geographic gap its distribution in Northwest Pacific region.

There are several factors that might stop recording *B. ulvarum* from Korean waters previously. Among these, we can reside on (i) the lack of sampling in the area prevents the regular detection of this species in the Korean waters and has been overlooked in the past; (ii) due to global change, a recent natural colonization within Korean waters has been taken place; (iii) Korean waters is considered as one of the busiest waterways in the world and ballast water from ships is a possible; (iv) it is rare in the area.

Through this study, a record of *B. ulvarum* from the southern Korean water was given. In addition, its species verification as *B. ulvarum* was made by molecular study using mtDNA COI region (611 bp) as well as by its potential distribution range and body morphometrics. Finally, we propose the new Korean names “Kko-ma-jwi-chi-sog” for the genus *Brachaluteres*, and “Kko-ma-jwi-chi” for the species *B. ulvarum* because four species belonging to these genus have a maximum size of less than 10 cm TL, also, this species is the largest of which is 7.5 cm SL, and is small fish species.

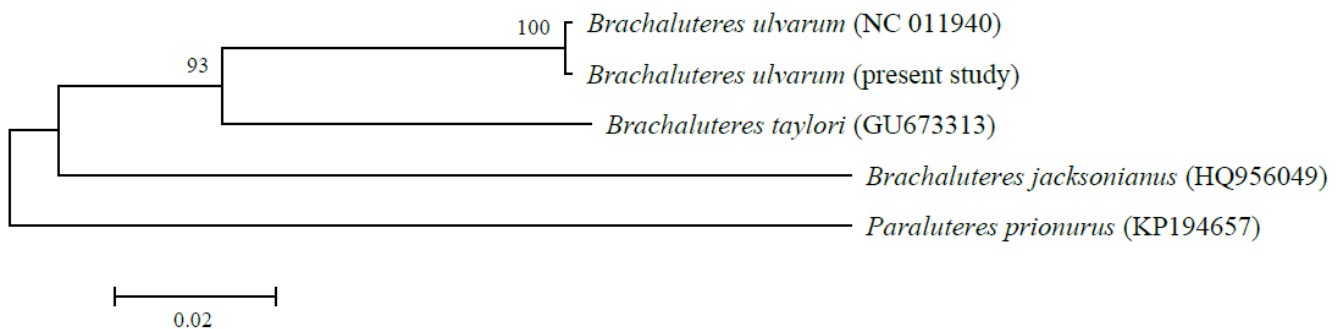


Fig. 3. A neighbor-joining tree based on partial mtDNA COI region using *Brachaluteres ulvarum* (MABIK PI00049731), showing the relationships among three species of *Brachaluteres* and one outgroup (*Paraluteres prionurus*). Numbers at branches indicate bootstrap probabilities in 10,000 bootstrap replications. Scale bar equals 0.02 of Tamura and Nei’s distance (1993) with K2 parameter model. COI, cytochrome c oxidase subunit I; MABIK, Marine Biodiversity Institute of Korea.

Competing interests

No potential conflict of interest relevant to this article was reported.

Funding sources

This research was funded by the Korea Institute of Ocean Science & Technology (grant numbers PE99913).

Acknowledgements

We are grateful to Dr. Hyun Soo Rho, Dr. Won-Gi Min and Mr. Min-Su Woo, Korea Institute of Ocean Science and Technology for assistance with sampling.

Availability of data and materials

All datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This article does not require IRB/IACUC approval because there are no human and animal participants.

ORCID

Se Hun Myoung	https://orcid.org/0000-0002-0630-9565
Joo Myun Park	https://orcid.org/0000-0003-0094-7926
Hyo Jin Lee	https://orcid.org/0000-0001-7045-5623
Laith A. Jawad	https://orcid.org/0000-0002-8294-2944

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