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# New Korean record of the Banded Driftfish, *Psenes arafurensis* (PISCES: Nomeidae)

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## Abstract

*Psenes arafurensis*, belonging to the family Nomeidae, is described based on four specimens (184.8–199.0 mm in standard length) collected from Korea. The species is most similar to the congeneric species *P. maculatus* and *P. pellucidus*, but differs from them in the number of lateral-line scales. (44–47 in *P. arafurensis* vs 67–70 in *P. maculatus* and 120 in *P. pellucidus*) and the number of vertebrae (31 in *P. arafurensis* vs 34–38 in *P. maculatus* and 40–42 in *P. pellucidus*). The present study is a new record of *P. arafurensis* with voucher specimens from Korean waters.

**Keywords:** *Psenes arafurensis*, Nomeidae, New record, Korea

## Background

The family Nomeidae in the order Perciformes contains three genera and 16 species worldwide (Nelson 2006), of which three genera and nine species occur in Japan (Nakabo and Doiuchi 2013) and two genera and four species occur in Korea (*Cubiceps squamiceps*, *Psenes cyanophrys*, *P. maculatus* and *P. pellucidus*) (Kim 2011). Of these, two species (*P. cyanophrys* and *P. maculatus*) were first reported from Korea by Myoung et al. (2001). Myoung et al. (2002) reported *P. arafurensis* as a new Korean nomeid fish, and suggested the new Korean name “A-ra-pu-ra-dom”, but no morphological description of *P. arafurensis* was given. Therefore, we cannot confirm that the species occurs in Korean waters, and the morphological traits of Korean *P. arafurensis* remain unknown. Recently, we collected four specimens of *P. arafurensis* from various localities in Korea. Here, we describe the morphology of these *P. arafurensis* specimens and confirm their taxonomic status using molecular analysis.

## Methods

Four specimens were collected using a purse seine net from three localities in Korean waters (Jejudo

Island, Yeonggwang and Gunsan), between August and September, 2013 and in September, 2014 (Fig. 1). Counts and measurements were made according to Regan (1902) and Hubbs and Lagler (2004). The numbers of vertebrae were counted from radiographs (Hitex HA-100; Hitex Co., Tokyo, Japan). The specimens were deposited in the Ichthyology Laboratory of Pukyong National University (PKU), Korea.

Genomic DNA was extracted from muscle tissue using Chelex 100 resin (Bio-Rad, Hercules, California, USA) and polymerase chain reaction (PCR) was conducted using a universal primer set to amplify the mitochondrial DNA (mtDNA) cytochrome c oxidase subunit I gene (COI) (Ward et al. 2005; Ivanova et al. 2007). We also obtained the mitochondrial COI sequences of three Nomeidae species from the National Center for Biological Information (NCBI) database. The sequences were aligned using ClustalW (Thompson et al. 1994) in BioEdit (ver. 7) (Hall 1999). A neighbor-joining (NJ) tree (Saitou and Nei 1987) was constructed using the Kimura two-parameter model (Kimura 1980) in MEGA 5 (Tamura et al. 2011). We submitted the nucleotide sequence data of these specimens to the NCBI.

## Material examined

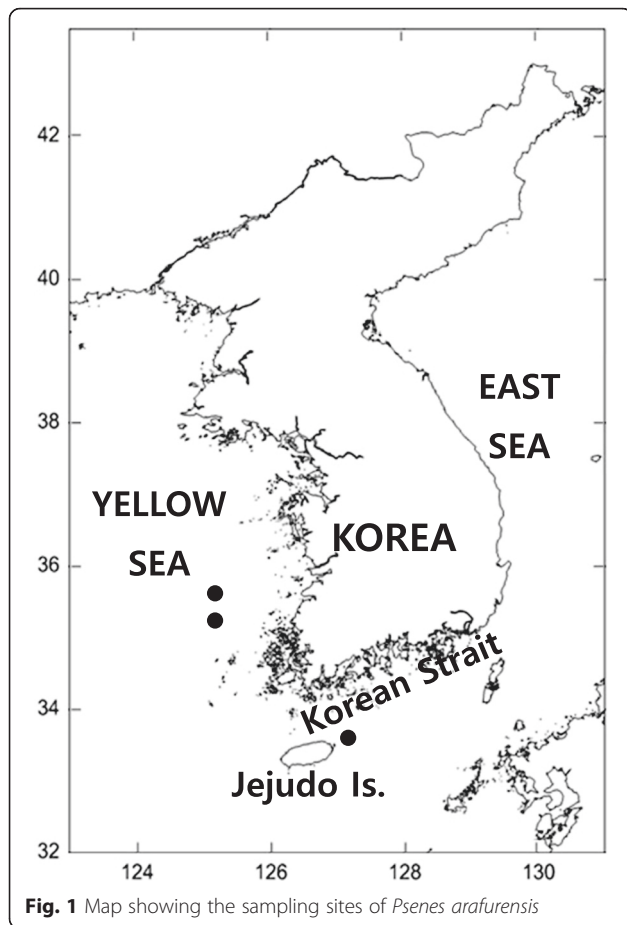
PKU 9645, 1 specimen, 185.6 mm SL, 33°67.99'N, 127°47.85'E, Jeju-si, Jejudo Island, Korea, August 2013; PKU 9855, 1 specimen, 194.0 mm SL, 35°32.80'N, 125°58.99'

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E, Yeonggwang-gun, Jeollanam-do, Korea, September 2013; PKU 9949, 1 specimen, 199.0 mm SL, 35°95.89' N, 125° 65.04' E, Gunsan-si, Jeollabuk-do, Korea, September 2013; PKU 11311, 1 specimen, 184.8 mm SL, 33°67.99' N, 127° 47.85' E, Jeju-si, Jeju Island, Korea, September 2014. Additional muscle tissues used for molecular analysis: FAKU 130210 (muscle tissue was transferred to PKU 12385), Oki Island, Shimane Prefecture, Japan, August 2003; FAKU 132174 (muscle tissue was transferred to PKU 12386), Chitose, Maizuru, Kyoto, Japan, November 2009.

## Results and discussion

### *Psenes arafurensis* Günther, 1889

(Korean name: A-ra-pu-ra-dom)

(Fig. 2; Table 1)

*Psenes arafurensis* Günther, 1889: 13 (type locality: Arafura Sea, western Pacific); Kuitert 1993: 381 (Australia); Bianchi et al 1993: 176 (Namibia); Chirichigno and Vélaz 1998: 291 (Peru); Randall and Lim 2000: 644 (South China Sea); Myoung et al. 2002: 222 (Jeju Island and South Sea of Korea); Nakabo 2002: 963 (Japan); Menezes et al. 2003: 104 (Brazil); Parin and Piotrovsky 2004: S51 (Indian



**Fig. 2** *Psenes arafurensis*, PKU 9949, 199.0 mm SL, Gunsan-si, Jeollabuk-do, Korea

Ocean); McEachran and Fechhelm 2005: 807 (Mexico); Allen and Erdmann 2012: 1042 (East Indies).

*Psenes benardi* Rossignol and Blache, 1961: 384 (Guinea).

### Description

Dorsal fin rays XI-I, 20–21; pectoral fin rays 19–20; anal fin rays III, 21–22; lateral-line scales 46–48; gill rakers 25–27; vertebrae 30–31. Meristic and morphometric characters are shown in Table 1. Body ovate, deep [41.5–44.8 % standard length (SL)], and compressed. Head large (30.5–33.3 % SL); eyes large (28.8–31.2 % of head length); snout rounded and short; two pairs of nostrils located nearer to tip of snout than to eye. Mouth terminal; upper jaw oblique, posterior margin not reaching to middle part of eye; teeth on jaws small and conical in a single row. Lateral line slightly arched, located nearer to dorsal part of body than to middle part of body. Two dorsal fins separated from each other by a narrow space; first dorsal fin beginning at base of pectoral fin, reaching anus; second dorsal fin beginning at anus, reaching anterior caudal peduncle, base length of first dorsal fin much shorter than that of second dorsal fin; two fins of similar depth. Anal fin origin slightly behind origin of second dorsal fin; spines of anal fin weak. Pectoral fin origin slightly anterior to the origin of pelvic fin, reaching to 9–10th second dorsal fin rays. Pelvic fin short, reaching to origin of second dorsal fin. Caudal fin long and strongly forked. Caudal peduncle short (4.5–4.9 % SL) and compressed. Body, head and cheeks covered with relatively large ctenoid scales.

### Coloration

*When fresh*, the dorsal surfaces of the head and body are dark purple, the ventral surfaces are gray, dorsal and caudal fin dark gray; pectoral fins translucent; pelvic fins and anal fin gray. *After fixation*, the dorsal surfaces of the head and body are dark brown, the ventral surfaces are gray brown, fin color as for fresh specimens.

**Table 1** Comparison of counts of *Psenes arafurensis* among authors

Characters	Present study	Günther (1889)	Regan (1902)	Nakabo and Doiuchi (2013)
Number of specimens	4	1	1	-
Total length (mm)	249.5–270.1	38.1	-	-
Fork length	201.8–219.7	-	-	-
Standard length	184.8–199.0	-	30	150.0
In % of standard length				
Head length	30.5–33.3	37.5	40.0	-
Body depth	41.5–44.8	60.0	60.0	-
Preanal length	57.0–59.3	-	-	-
Caudal peduncle length	10.3–10.6	-	-	-
Caudal peduncle depth	4.5–4.9	-	-	-
Eye diameter	9.0–10.4	-	-	-
% of head length				
Eye diameter	28.8–31.2	40.0	37.5	-
Snout length	29.5–31.9	16.7	16.7	-
Interorbital space	37.6–41.9	-	-	-
Upper jaw length	31.3–34.2	-	-	-
Caudal peduncle depth	13.4–15.5	-	-	-
Meristic characters				
Dorsal fin rays	XI-I, 20–21	VII ?, 20	XI-I, 22	X-XI-I-II, 19–21
Anal fin rays	III, 21–22	III, 22	III, 22	III, 20–21
Pelvic fin rays	I, 5	-	I, 5	-
Pectoral fin rays	19–20	-	-	18–20
Scales in lateral line	46–48	47	47 3/20	44–45
Gill rakers	25–27	-	-	-
Vertebrae	30–31	-	31	-

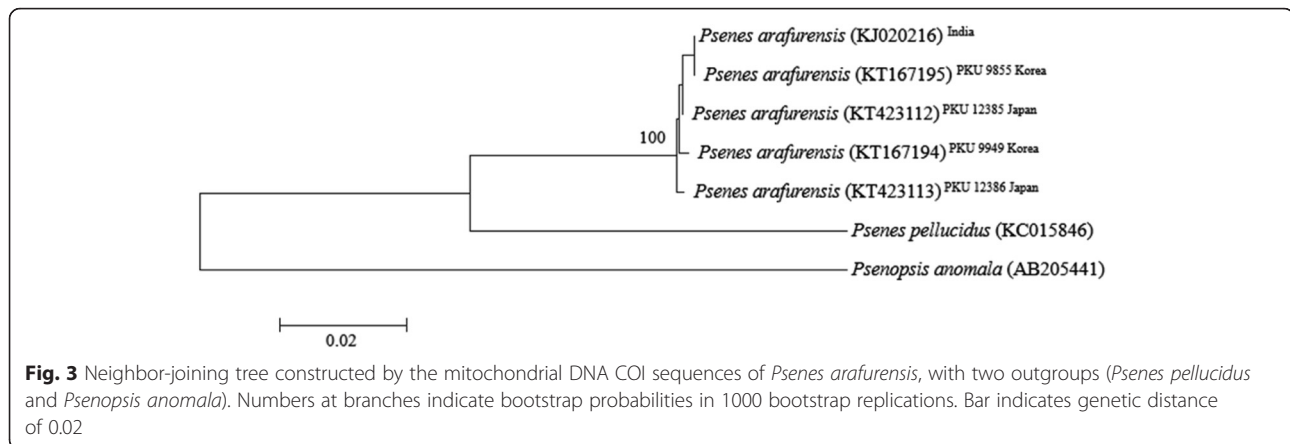
### Distribution

This species is found in the tropical and subtropical seas of the Pacific, Indian and Atlantic Oceans, at depths of 150–850 m (Nakabo and Doiuchi 2013), and off Jeju Island at the eastern margin of the Yellow Sea and the Korean Strait (present study).

### Remarks

These four specimens collected from Korean waters are similar to *Psenes arafurensis*, *P. cyanophrys*, *P. maculatus* and *P. pellucidus* in having a short snout (29.5–31.9 % head length) and fewer scales in the lateral line (46–48) (Nakabo and Doiuchi 2013). These four species can be distinguished easily from each other by differences in the number of lateral line scales (44–47 in *P. arafurensis*, 60–63 in *P. cyanophrys*, 67–70 in *P. maculatus* and 120 in *P. pellucidus*) and vertebrae (31 in *P. arafurensis*, 30–31 in *P. cyanophrys*, 34–38 in *P. maculatus* and 40–42 in *P. pellucidus*); the present specimens resemble *P. arafurensis* closely, having 44–47 lateral line scales and 31 vertebrae (Abe et al. 1963; Heemstra 1986;

Nakabo and Doiuchi 2013). However, the number of dorsal fin spines in these specimens is obviously different from the original description of *P. arafurensis* [11 in the present specimens vs. 7 in Günther (1889)], although other counts entirely correspond with the present study. Regan (1902) pointed out the miscount of this character by Günther (1889) and indicated that the actual number is 11. According to this correction, the number of dorsal fin spines of the present specimens is also congruent with the holotype of *P. arafurensis*. However, several morphometric differences were observed between the present four specimens and the holotype shown by Günther (1889) and Regan (1902) (Table 1). Proportional changes with growth, especially between young and sub-adult stages, are generally known in the nomeid fishes (Haedrich 1967), and the body sizes of the present specimens (184.8–199.0 mm SL) are much larger than that of the holotype (30 mm SL). Therefore, we concluded that these morphometric differences are intraspecific variations caused by body size differences. So, to identify the species more accurately, we analyzed 562 base pairs of



the mtDNA COI sequence. The mtDNA COI sequence determined in this study is nearly identical to the sequences of Indian and Japanese *P. arafurensis* (genetic distances,  $d = 0.002\text{--}0.004$ ) (Fig. 3). Therefore, these morphological differences seem to be intraspecific variations. Since a Korean name, “A-ra-pu-ra-dom”, for *P. arafurensis* has already been proposed by Myoung et al. (2002), we also adopted this name for the species.

### Conclusions

Four specimens of nomeid fish were collected in Korean waters (Jejudo Island, Yeonggwang and Gunsan), between August and September, 2013 and in September, 2014. These specimens were identified as belonging to *Psenes arafurensis*, based on numbers of short snout (29.5–31.9 % head length), vertebrae (31) and fewer scales in the lateral line (46–48). An analysis of 562 base pair sequences of mitochondrial DNA cytochrome c oxidase subunit I showed that sequences in our specimens are concordant with those of *P. arafurensis* from the India, and Japan (genetic distance = 0.002–0.004).

### Competing interests

The authors declare that they have no competing interests.

### Authors' contributions

WJL and JHR wrote the manuscript. MGY, HSA and JYW carried out the molecular genetic experiments. FT offering Japanese specimens and data. JKK suggested all aspects of study design, and commented on the earlier drafts of the manuscript. All authors read and approved the final manuscript.

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