

New Record of a Moray Eel, *Strophidon dorsalis* (Muraenidae, Anguilliformes) from Korea

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ABSTRACT A single specimen of *Strophidon dorsalis* (1,254 mm in total length), belonging to the family Muraenidae, was firstly collected in a fish trap off the coastal waters of Jindo Island in July 2018. It was characterized by having unpatterned body coloration, thin body, slightly rounded snout, two superorbital pores, three infraorbital pores, and six mandibular pores. This species is distinguishable from a morphologically similar species, *S. sathete* inhabiting the Korean waters by having three infraorbital pores (vs. four in *S. sathete*), last infraorbital pore below an anterior part of the eye (vs. below a posterior part of the eye), body depth 3.2~4.1% in total length (vs. 1.8~3.1%), and total vertebrae 154~167 (vs. 188~200). We add *S. dorsalis* to the Korean fish fauna and propose a new Korean name, “Seo-mang-gom-chi” for the species.

Key words: *Strophidon dorsalis*, Muraenidae, first record, Jindo Island, Korea

INTRODUCTION

The genus *Strophidon* McClelland, 1844, belonging to the family Muraenidae, has been reported three species, worldwide [*S. sathete* (Hamilton, 1822); *S. ui* Tanaka, 1918; and *S. dorsalis* (Seale, 1917)] (Hibino *et al.*, 2017; Fricke *et al.*, 2020). This genus is characterized by the following morphological characters: body elongate, its depth 40 times or more in total length (TL), tail about equal to preanal length, dorsal fin well developed, anterior nostrils simple tubes, teeth not noticeably molariform, usually some canine teeth present; dorsal fin origin before the anus, one to four branchial pores (Böhlke and Randall, 2000). Two species, *S. sathete* and *S. ui* in this genus have been reported in Japan (Hataoka, 2013) and one species, *S. sathete* in Korea up to the date (Kim *et al.*, 2020).

Recently, a single specimen of unrecorded moray species was collected by a fish trap off Jindo Island (Sea block

no. 212), Korea. The specimen was identified as *S. dorsalis* based on the number of vertebrae and sensory pores on the head, and body coloration. In addition, nucleotide sequencing of the mitochondrial cytochrome c oxidase subunit I (COI) gene was carried out to confirm the correctness of species identification of the specimen. Here, we described the detail morphological characters based on the specimen and added the species to the list of the Korean fish fauna.

MATERIALS AND METHODS

Measurements followed the method of Böhlke and Randall (2000). Vertebral counts were made from soft X-ray photo (M-150W, Japan); the vertebral formula was expressed as predorsal-preanal-total vertebrae (Böhlke, 1982). Teeth counts followed the method of Böhlke *et al.* (1989) by using a magnifying glass and stereomicroscope. The examined specimen was deposited at the MABIK (Marine Biodiversity Institute of Korea), Korea.

Molecular identification of the specimen was conduct-

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ed by using the DNA sequences (597 bp) of mitochondrial cytochrome c oxidase subunit I (COI) gene. Genomic DNA extraction and PCR were performed according to Loh *et al.* (2015). The DNA sequence of COI gene (Accession No.: MT679541) obtained from the present specimen was compared with those of *S. dorsalis* (HQ564522, MG7202304, HM422422), *S. sathete* (MK246808, JF494701), *Gymnothorax formosus* (KP874184, outgroup) and *G. kidako* (AP002976, outgroup) deposited at the National Center for Biological Information (NCBI) databases. The phylogenetic tree (Fig. 4) was constructed and genetic distances were estimated by using the program MEGA 7.0 (Kumar *et al.*, 2016) to confirm the relationships between the DNA sequence from the specimen and those depositing in NCBI.

***Strophidon dorsalis* (Seale, 1917)**

(New Korean name: Seo-mang-gom-chi)

(Figs. 1, 2; Table 1)

Gymnothorax dorsalis Seale, 1917: 92 (type locality: Hong

Kong); Böhlke, 1997: 96 (Indo-Pacific); Randall and Lim, 2000: 585 (South China Sea); Loh *et al.* 2011: 51 (Taiwan); Böhlke and Smith, 2002: 106 (Indo-Pacific); Yoshida *et al.*, 2013: 19 (Thailand); Psomadakis *et al.*, 2015: 14 (Pakistan).

Strophidon dorsalis: Loh *et al.*, 2015: 33 (Taiwan); Ho *et al.*, 2015: 162 (Taiwan).

Material examined. one specimen, MABIK PI00049569, 1,254 mm in TL, Jindo Island (sea block no. 212) with a fish trap, 25 July 2018.

Description. Counts and measurements are shown in Table 1. Body elongated and cylindrical, slightly compressed behind anus and compressed tail; head long (Fig. 2A) with two supraorbital pores, three infraorbital pores and six mandibular pores (Fig. 2B); mouth moderately large; snout blunt and short (two times of eye diameter); anterior nostril with a short tube; posterior nostril above eye; eyes closer to snout than posterior tip of jaw; upper jaw projecting slightly than lower jaw; in upper jaw, five in-



Fig. 1. *Strophidon dorsalis*, MABIK PI00049569, 1,254 mm TL, Jindo Island, Korea.

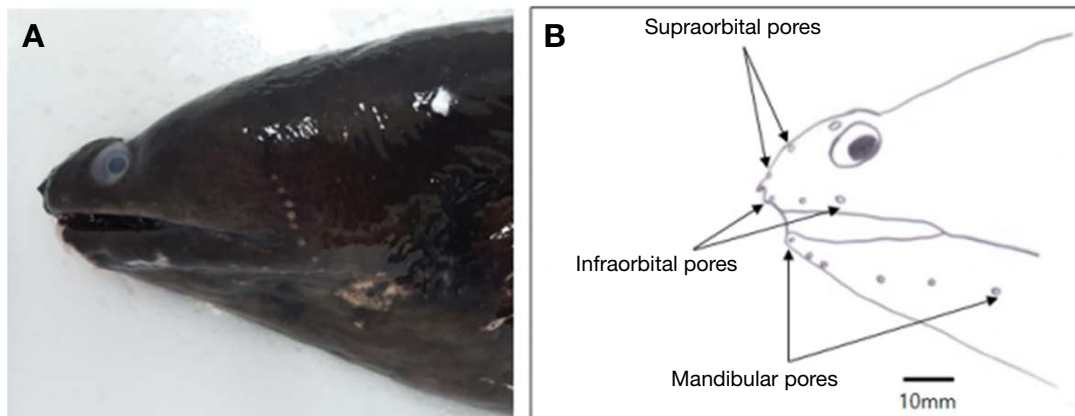
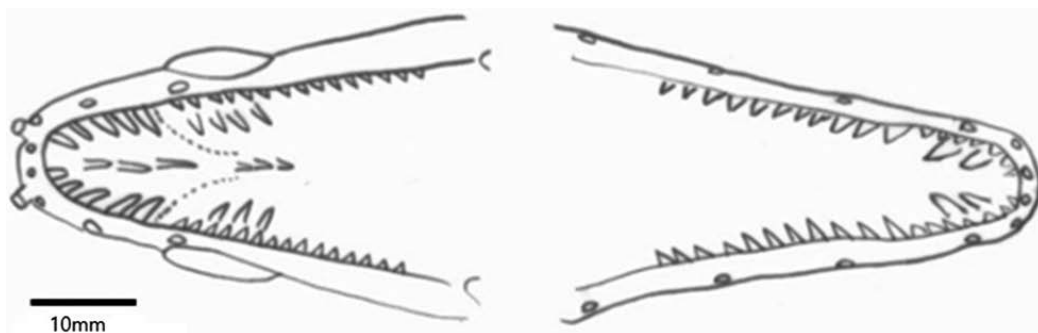


Fig. 2. Head (A) and sensory pores (B) of *S. dorsalis* (MABIK PI00049569).

Table 1. Comparison of morphological characters between present and previous studies on *Strophidon dorsalis*

Characters	Present study	Böhlke (1997)	Ray and Mohapatra (2015)	Loh <i>et al.</i> (2015)
No. of specimens	1	6	2	5
Total length (mm)	1,254	450~822	460~490	415~1050
Vertebra				
Predorsal	8	8~9	8	8~9
Preanal	61	62~65	63	66~69
Total	161	154~163	159	164~167
Teeth				
Intermaxillary	5	6	6	5~7
Median	3	2~3	2~3	3
Maxillary				
Inner	3~4	2~5	5	2~5
Outer	15	15~21	19~20	15~18
Vomerine	3	3~11	9	3~7
Dentary				
Inner anterior	2	4	4	2~5
Outer	18	17~24	19	18~23
In % of total length				
Head length	9.1	11~12	11.1~11.2	9.5~11.1
Tail length	55.5	–	–	–
Trunk length	35.7	–	–	–
Body depth at gill opening	3.7	3.2~4.1	3.7	3.5~4.0
Body depth at anus	3.1	3.2~4.1	3.3	–
Predorsal length	6.8	7.7~9.6	8.3~9.2	8.1~9.6
Preanal length	44.9	43.0~44.0	42.4~43.4	41.0~44.3
In % of head length				
Length of upper jaw	30.1	30.0~37.0	30.9~32.4	32.0~36.7
Length of lower jaw	30.1	30.0~35.0	30.3~30.4	30.6~35.9
Snout length	11.2	12.0~15.0	12.7~?	12.5~13.4
Eye diameter	4.9	5.0~8.0	7.8~8.2	5.4~5.9
Interorbital width	9.1	8.8~11.0	9.8~10.4	9.9~13.7
Gill opening length	13.8	–	–	–

**Fig. 3.** Shape of teeth of *S. dorsalis* (MABIK PI00049569). Left side: upper jaw, right side: lower jaw.

termaxillary teeth on each side, three median teeth (Fig. 3); maxillary teeth biserial, an outer row of 15 short triangular teeth and an inner row of three to four tall depress-

ible teeth; vomerine teeth uniserial three in number; in lower jaw (Fig. 3), dentary teeth biserial, an anterior inner row of two large teeth and an outer row of 18 smaller

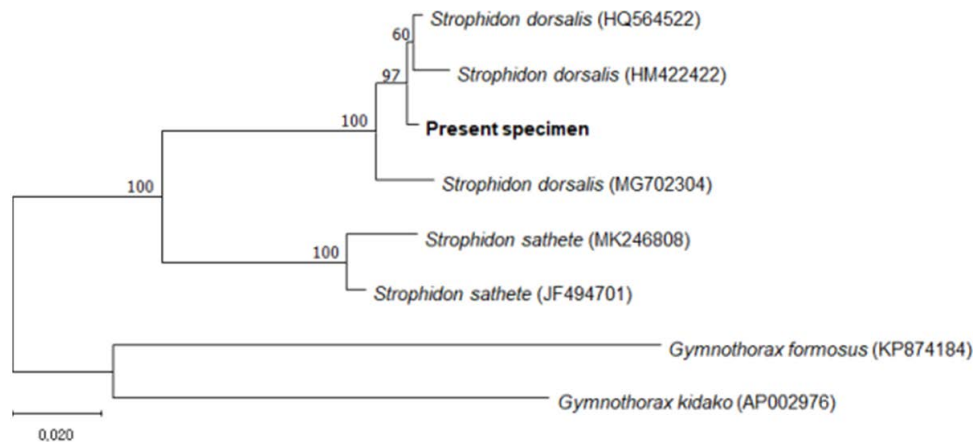


Fig. 4. The phylogenetic relationships inferred using the Neighbor-Joining method. The numbers above the branches reveal bootstrap values.

teeth; the origin of dorsal fin above before the pectoral pore; dorsal and anal fins confluent with caudal fins; pectoral and pelvic fins absent; anus located almost middle part of body, tail much longer than preanal length.

Coloration. When fresh, body greyish, dorsal part of body more dark and ventral part pale with unpatterned coloration; dorsal, anal and caudal fin dark brown. Body and all fins uniform deep brown after fixation.

Distribution. Known from Indo-West Pacific: Pakistan, India, Malaysia, Indonesia, Taiwan (Böhlke, 1997) and Korea (present study).

Remarks. The present specimen, belonging to the family Muraenidae, is characterized by having body very elongated, cylindrical, slightly compressed behind anus, dorsal and anal fins confluent with caudal fin, pectoral and pelvic fins absent, anus located before mid-body, tail much longer than preanal length, unpatterned coloration, infraorbital pore located below anterior part of eye and body depth at gill opening 3.7%. These morphological characteristics of the present specimen were well matched with those of *S. dorsalis* described by Seale (1917). However, as there were no detailed measurements in the original paper by Seale (1917), our measurements were compared with those in other previous reports of *S. dorsalis* (Böhlke, 1997; Loh *et al.*, 2015; Ray and Mohapatra, 2015). The results revealed that most of the morphological traits examined were consistent with each other. However, there were some differences in head length, predorsal fin length, snout length and eye diameter (Table 1). These differences tended to decrease (head length, predorsal fin length, snout length and eye diameter) in proportion as the size increases. Thus it may be regarded as an intraspecific variation. In addition, we adopted a molecular identification method based on COI DNA sequences to make sure of the accurate species

identification. The result indicated that COI sequence of the present specimen was almost identical (97.8~99.3%) to those of *S. dorsalis* obtained from NCBI, but was different from *S. sathete* (Fig. 4). Thus, we identified our specimen to be *S. dorsalis* based on both morphological and molecular characters.

Strophidon dorsalis morphologically resembles *S. sathete* inhabiting the coastal waters of Jeju Island, Korea. The former is distinguishable from the latter by having the body depth at gill opening (3.2~4.0% in total length *vs.* 1.8~2.9% for *S. sathete*), vertebral count (preanal vertebrae 61~69, total vertebrae 154~167 *vs.* preanal vertebrae 78~83, total vertebrae 188~200), and the number of infraorbital pores (four *vs.* three) (Böhlke, 1997; Loh *et al.*, 2015). We suggest a new Korean name, “Seo-mang-gomchi” for the species, because it was collected at the coastal waters near Seomang in Jindo Island.

ACKNOWLEDGEMENTS

We would like to express my gratitude to Park, Su-Young, a TAC investigator at the Korea Fisheries Resources Agency, and the officials of Jindo County National Federation of Fisheries Cooperative for providing the sample. This work was supported by the Efficient Securement of Marine Bioresources and Taxonomic Research (2020M00100) funded by the National Marine Biodiversity Institute of Korea (MABIK).

REFERENCES

Böhlke, E.B. 1982. Vertebral formulae for type specimens of eels (Pi-

- sces: Anguilliformes). Acad. Natl. Sci. Phila., 134: 31-49.
- Böhlke, E.B. 1989. Methods and Terminology. In: Böhlke, E.B. (ed.), Fishes of the Western North Atlantic, Part 9, Vol. 1, Orders Anguilliformes and Saccopharyngiformes. Sears Found. Mar. Res., Yale Univ. Press, New Haven, U.S.A., pp. 1-7.
- Böhlke, E.B. 1997. Notes on the identity of elongate unpatterned Indo-Pacific morays, with description of a new species (Muraenidae, subfamily Muraeninae). Proc. Acad. Natl. Sci. Phila., 147: 89-109.
- Böhlke, E.B. and J.E. Randall. 2000. A review of the moray eels (Anguilliformes: Muraenidae) of the Hawaiian Islands, with descriptions of two new species. Proc. Acad. Natl. Sci. Phila., 150: 203-278.
- Böhlke, E.B. and D.G. Smith. 2002. Type catalogue of Indo-Pacific Muraenidae. Proc. Acad. Natl. Sci. Phila., 152: 89-172.
- Fricke, R., W.N. Eschmeyer and R. Van der Laan (eds.). 2020. Eschmeyer's catalog of fishes: genera, species, references. Available at: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>, (accessed 2 Mar. 2020).
- Hamilton, F. 1822. An account of the fishes found in the river Ganges and its branches. Edinburgh & London. vii + 405pp.
- Hatooka, K. 2013. Muraenidae. In: Nakabo, T. (ed.), Fishes of Japan with pictorial keys to the species, 3rd ed. Tokai Univ. Press, Kanagawa, Japan, pp. 244-261.
- Hibino, Y., U. Satapoomin and S. Kimura. 2017. A new species of the genus *Diaphenchely* (Anguilliformes: Muraenidae) from Thailand. Ichthyol. Res., 64: 458-463. <https://doi.org/10.1007/s10228-017-0578-3>.
- Ho, H.C., D.G. Smith, J.E. McCosker, Y. Hibino, K.H. Loh, K.A. Tighe and K.-T. Shao. 2015. Annotated checklist of eels (orders Anguilliformes and Saccopharyngiformes) from Taiwan. Zootaxa, 4060: 140-189. <https://doi.org/10.11646/zootaxa.4060.1.16>.
- Kim B.Y., S.J. Koh, M.J. Kim and C.B. Song. 2020. First record of the slender giang moray, *Strophidon sathete* (Muraenidae, Anguilliformes) from Korea. Korean J. Ichthyol., 32: 21-25. <https://doi.org/10.35399/isk.32.1.4>.
- Kumar, S., G. Stecher and K. Tamura. 2016. MEGA7: Molecular evolutionary genetics analysis version 7.0 for bigger datasets. Mol. Biol. Evol., 33: 1870-1874.
- Loh, K.H., K.T. Shao, H.C. Ho, P.E. Lim and H.M. Chen. 2015. A new species of moray eel (Anguilliformes: Muraenidae) from Taiwan, with comments on related elongate unpatterned species. Zootaxa, 4060: 030-040. <https://doi.org/10.11646/zootaxa.4060.1.5>.
- Loh, K.H., K.T. Shao and H.M. Chen. 2011. *Gymnothorax melanosomatus*, a new moray eel (Teleostei: Anguilliformes: Muraenidae) from southeastern Taiwan. Zootaxa, 3134: 43-52. <https://doi.org/10.11646/zootaxa.3134.1.2>.
- McClelland, J. 1844. Apodal fishes of Bengal. Calcutta J. Nat. Hist., 5: 151-226, Pls. 5-14.
- Psomadakis, P.N., H.B. Osmany and M. Moazzam. 2015. Field identification guide to the living marine resources of Pakistan. FAO species identification guide for fishery purposes. Food and Agriculture Organization of the United Nations, Rome, x + 386pp.
- Randall, J.E. and K.K.P. Lim. 2000. A checklist of the fishes of the South China Sea. Raffles Bull. of Zool. Natl., Suppl. 8: 569-667.
- Ray, D. and A. Mohapatra. 2015. First record of the moray eel *Gymnothorax dorsalis* Seale, 1917 (Anguilliformes: Muraenidae) from Indian waters. Indian J. Fish., 62: 132-134.
- Seale, A. 1917. New species of apodal fishes. Bull. Mus. Comp. Zool., 61: 79-94.
- Tanaka, S. 1918. Two new species of Japanese fishes. Zool. Mag., 30: 51-52.
- Yoshida, T., H. Motomura, P. Musikasinthorn and K. Matsuura. 2013. Fishes of northern Gulf of Thailand. Natl. Mus. Nat. Sci., i-viii+1-239.

한국산 곱치과 어류 첫기록종, *Strophidon dorsalis*

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요 약 : 곱치과에 속하는 *Strophidon dorsalis* 1개체 (전장 1,254 mm)가 2018년 7월 우리나라 남해안의 진도연안에서 연안통발로 처음 채집되었다. 이 종의 특징은 몸에 무늬가 없고, 주둥이가 약간 둥근 형태를 띠며, 2개의 안상골공 (superorbital pores), 3개의 안하골공 (infraorbital pores), 그리고 6개의 하악골공 (mandibular pores)을 갖는다. 이 종은 형태적으로 가는곱치 (*Strophidon sathete*)와 유사하지만 안하골공이 3개이며 (vs. 가는곱치는 4개), 마지막 안하골공은 눈의 앞부분에 위치하며 (vs. 안하골공이 눈의 뒷부분에 위치), 전장에 대해 체고비율이 3.2~4.1% (vs. 1.8~3.1%), 그리고 척추골수가 154~167개 (vs. 188~200)로 구분할 수 있다. 이 어종의 국명은 '서망곱치'로 제안한다.

찾아보기 낱말 : 곱치과, *Strophidon dorsalis*, 첫기록종, 진도