INTRODUCTION

The family Flabellidae Bourne, 1905 consists of the representative azooxanthellate solitary corals that inhabit both soft and hard substrates (Tokuda et al., 2010). The flabellid corals currently comprise 100 extant species in 14 genera worldwide (Cairns, 2017). Among them, the genus Flabellum is one of the cosmopolitan scleractinian genera, with a depth range of 36–3,186 m (Cairns and Zibrowius, 2016). Two subgenera, Flabellum (Ulocyathus) and Flabellum (Flabellum), are free-living, but the former is mainly distinguished from the latter by having serrate or jagged calicular edges (CE) in the skeletal structures (Cairns, 1989), as well as external soft tissues (Tokuda et al., 2010). It has been suggested that the development of external soft tissues in deep-sea corals helps to protect them from chemical corrosion of the calcareous skeleton (Roniewicz and Stolarski, 1999). With the presence of external soft tissues, Flabellum (Ulocyathus) species have been reported to live in deeper waters (up to 3,200 m deep) than other free-living flabellids. To date, 21 species have been recorded in the subgenus Flabellum (Ulocyathus) (Hoeksema and Cairns, 2021). Despite its wide distribution over the Atlantic, Pacific, Indian Ocean, and Subantarctic at a depth of 180–3,200 m (Cairns, 1989), any species of the subgenus Flabellum (Ulocyathus) has not been reported in Korean waters until now.

In Korea, four species of three genera in the family Flabellidae: Flabellum (Flabellum) pavoninum Lesson, 1831; Javania insignis Duncan, 1876; Truncatoflabellum carinatum Cairns, 1989; and T. formosum Cairns, 1989 have been reported (Song, 1982, 1991). The present study newly reports Flabellum (Ulocyathus) deludens Marenzeller, 1904 from Korea with a diagnosis and figures based on its morphological characteristics.

The specimens were collected using a trawl at a depth of 100 m from the subtidal zone off Seogwipo-si, Jeju-do, Korea in 2019. The newly recorded species is described and compared with the other similar consubgeneric species in detail based on morphological characteristics, including corallum size, calicular diameter, calicular edge, face angle, edge angle, and septal arrangement. Flabellum (Ulocyathus) deludens is characterized by its solitary, highly compressed, wedge-shaped corallite with a small cylindrical pedicel, radiating inverse chevron-patterned lateral stripes on thecal faces, highly jagged calicular edges, and hexameral septal arrangement in five cycles. As a result of this study, five species in the family Flabellidae have been recorded from Korea.

Keywords: Flabellum (Ulocyathus) deludens, flabellid, Scleractinia, azooxanthellate, Korean waters

ABSTRACT

This study newly records a deep-sea coral, Flabellum (Ulocyathus) deludens from Korea. The specimens were collected by trawling at a depth of 100 m off Jejudo Island in 2019. The newly recorded species is described and compared with the other similar consubgeneric species in detail based on morphological characteristics, including corallum size, calicular diameter, calicular edge, face angle, edge angle, and septal arrangement. Flabellum (Ulocyathus) deludens is characterized by its solitary, highly compressed, wedge-shaped corallite with a small cylindrical pedicel, radiating inverse chevron-patterned lateral stripes on thecal faces, highly jagged calicular edges, and hexameral septal arrangement in five cycles. As a result of this study, five species in the family Flabellidae have been recorded from Korea.

Keywords: Flabellum (Ulocyathus) deludens, flabellid, Scleractinia, azooxanthellate, Korean waters
The First Record of Flabellum (Ulocyathus) deludens from Korea


Phylum Cnidaria Hatschek, 1888
Class Anthozoa Ehrenberg, 1834
Order Scleractinia Bourne, 1900
Family Flabellidae Bourne, 1905
Genus Flabellum Lesson, 1831

Diagnosis. Corallum solitary, fixed, or free. Corallum cera
toid, campanulate, or compressed; base not reinforced with
stereome. Wall epithecal, usually lacking costae. Transverse
division lacking. Pali, dissepiments, and synapticulae absent.
Columella rudimentary, with a simple fusion of lower inner
edges of larger septa. Exclusively azooxanthellate.

Key to the subgenera of the genus Flabellum
1. Calicular edge smooth  ···················
   Flabellum (Flabellum)
2. Calicular edge jagged  ··················
   Flabellum (Ulocyathus)

18 Subgenus Flabellum (Ulocyathus) Sars, 1851
Diagnosis. Calicular edge serrated or jagged. External soft
tissues present.

20 Flabellum (Ulocyathus) deludens Marenzeller, 1904
   (Table 1, Fig. 1)
Flabellum deludens Marenzeller, 1904: 269-272, Pl. 17,
figs. 10, 10a; Yabe and Eguchi, 1942: 101-103, Pl. 5, figs.
9-11.
Flabellum (Ulocyathus) deludens: Cairns, 1989: 55, 56, Pl.
18f; Cairns and Zibrowius, 1997: 154-156.

Material examined. Korea: 3 inds., Jeju-do: Seogwipo-si,
33°21′58.41″N, 127°11′44.83″E, 100 m deep, 1 May 2019,
Lee SH (MABIK CN00081034).

Korean name: 18톱니부채돌산호아속(신칭), 20사각톱니부채돌산호(신칭)

Fig. 1. Flabellum (Ulocyathus) deludens Marenzeller, 1904 (MABIK CN00081034): A, Lateral view; B, Edge view; C, Calicular view;
D, Stereo microscope image of granulated septal faces. C, columella; CE, calicular edge; EA, edge angle; FA, face angle; IE, inner
edge; P, pedicel; S, septa; SF, septal face. Scale bars: A-C = 1 cm, D = 2 mm.
Diagnosis. Corallite (Fig. 1A) solitary, fragile, highly compressed, wedge-shaped, with a small cylindrical pedicel and jagged CE. Greatest calicular diameter (GCD) 30–50 mm, least calicular diameter (LCD) 20–30 mm, height 28–36 mm. GCD : LCD = 1.50–1.67. Pedicel cylindrical with an ellipse in cross-section. Greatest pedicel diameter 1.09–1.30 mm, least pedicel diameter 1.78–2.38 mm, height 1.09–1.31 mm. Edge angle (Fig. 1A) 95.46°–104.34°. Face angle (Fig. 1B) 45.04°–46.92°. Lateral edge length 25–35 mm. CE (Fig. 1A) deeply jagged with corresponding septal upper exsertness. CE1, 2 >> CE4 >> CE3 >> CE5, CE5 rudimentary. CE1, 2: 3.85–6.36 (mean = 5.12) mm; CE3: 1.65–3.26 (mean = 2.46) mm; CE4: 2.49–3.83 (mean = 3.18) mm in height. Thecal extensions (Fig. 1C) between S1 or S2 and its neighboring Ss forming a rectangle with an apex of CE1 or CE2; those between S1 and neighboring Ss or Ss forming a triangle with an apex of CE3. Thecal faces (Fig. 1A) slightly convex and granulated with ridged red brown costae and radiating inverse chevron (A) patterned lateral stripes upward in red brown and white. Costae red brown. Pedicel white. Costae red brown and white. Pedicel white. Costae red brown and white. Pedicel white.

Distribution. Korea (Jejudo Island); Japan (Honshu, Shikoku, and Kyushu); Philippines (Lubang Island to Moro Gulf); Vietnam; Indonesia (Banda sea, Arafura Sea, Sumatra). Elsewhere: Bay of Bengal, Andaman Sea, off Ceylon, Laccadive Sea, Saya de Malha, South China Sea (Spratly Islands).

Remarks. The key morphological characteristic differences of calicular edge and shape, edge angle, face angle, and septal arrangement in the four consubgeneric species from Japan, Philippine, and Indonesian regions: F. (U.) deludens, F. (U.) marenzelleri Cairns, 1989, F. (U.) japonicum Moseley, 1881, and F. (U.) apertum borealis Cairns, 1994 (sensu Marenzeller, 1904; Yabe and Eguchi, 1942; Cairns, 1994; Cairns and Zibrowius, 1997), are compared and summarized with the specimens of the present study (Table 1). The corallite shapes of the four species are laterally compressed, but F. (U.) deludens is distinguished from the other three species by having the largest edge angle and highest rectangular thecal extension (up to 6 mm). In particular, the thecal extensions between S1 or S2 and its neighboring Ss forming a rectangle with an apex of CE1 or CE2 are much more distinctive in height than others, by which F. (U.) deludens differs from F. (U.) marenzelleri,

**Table 1. Comparison of morphological characteristics of species within the subgenus Flabellum (Ulocyathus)**

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<tbody>
<tr>
<td>Calicular edge</td>
<td>Deeply lacerate</td>
<td>Slightly convex</td>
<td>Highly convex</td>
<td>Serrate</td>
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<tr>
<td>Serrate lancets</td>
<td>S1, S2 &gt; S3, S4 &gt; S5</td>
<td>S1, S2 &gt; S3, S4 &gt; S5</td>
<td>S1, S2 &gt; S3 &gt; S4</td>
<td>S1, S2 &gt; S3 &gt; S4</td>
</tr>
<tr>
<td>Height</td>
<td>62–74 mm</td>
<td>90–108 mm</td>
<td>40–48 mm</td>
<td>47–54 mm</td>
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<tr>
<td>Robustness</td>
<td>Fragile</td>
<td>Fragile</td>
<td>Fragile</td>
<td>Robust</td>
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Eunae Choi, Hye-Won Moon
The First Record of Flabellum (Ulocyathus) deludens from Korea

whose thecal extensions are mostly even and lower in height. Although the edge angles of F. (U.) deludens in previous records vary from 90° to 150°, the edge angles of the specimens examined in this study (95.46°–104.34°) are closer to those (90°) in the original description. Furthermore, the high rectangular thecal extensions of CE (up to 6 mm) and radiating inverse chevron-shaped red brown growth lines of thecal faces along with the corresponding ridged red brown costae in these specimens are distinctive enough for F. (U.) deludens.

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

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REFERENCES
Cairns SD, 1998. Azooxanthellate Scleractinia (Cnidaria: Antho-
zoa) of Western Australia. Records of the Western Australian Museum, 18:361-417.