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One New Species and One New Record of Electridae (Bryozoa: Cheilostomatida) from Korea

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ABSTRACT

A taxonomic study of the family Electridae Stach, 1937 (Bryozoa: Cheilostomatida) was carried out using materials collected from six localities of Korea from 1984 to 2021. *Aspidelectra melolontha* (Landsborough, 1852) is newly added to the bryozoan fauna of Korea, and *Electra jindoica* n. sp. is new to science. European *A. melolontha* is known to occur in brackish water of low salinity, but the species is found in New Zealand and Argentina seawater. This species is also reported as a fouling bryozoan from China and New Zealand. *Electra jindoica* n. sp. is distinguished by smaller zooid, larger kenozooid, and developed cryptocyst from *E. asiatica* Grischenko, Dick and Mawatari, 2007. With the addition of two species reported herein, six species and four genera of Electridae from Korea have been recorded: *Aspidelectra melolontha*, *Arbopercula tenella*, *Conopeum hexagonum*, *C. reticulum*, *C. seurati*, and *Electra jindoica* n. sp. Furthermore, the genera *Aspidelectra* and *Electra* are new to the Korean bryozoan fauna based on this study.

Keywords: *Aspidelectra*, *Electra*, Electridae, Bryozoa, new species, Korea

INTRODUCTION

The family Electridae Stach, 1937 (1851) shows the principal characteristics including well-developed proximal gymnocyst, narrow and periopesial cryptocyst, absence or presence of periopesial spines and kenozooids, and lack of avicularia and ovicells (Cook et al., 2018; Schwaha, 2020). Nikulina (2010) established three new genera based on unique combinations of features of spines, cryptocysts, and opercula, *Arbocuspis*, *Arbopercula*, and *Osburnea*, so that nine Recent species initially attributed to the Electridae were transferred into these genera. To date, 17 genera comprising 109 living species have been recorded worldwide (WoRMS, https://www.marinespecies.org/, 14 Nov 2023).

According to previous papers (Seo, 1992, 1996, 2005, 2010; Gong and Seo, 2003, 2004; Seo and Kil, 2019; Yu et al., 2021), four species of *Arbopercula tenella*, *Conopeum hexagonum*, *C. reticulum* and *C. seurati* have been reported in the Korean bryozoan fauna. *Electra tenella* was first reported by synonymizing with *E. angulata* (see Song, 1985) and adding more specimens (Seo, 1992), and then changed into *Arbopercula tenella* in the encyclopedia (Seo and Kil, 2019). Therefore, no *Electra* species is recorded at present. *C. hexagonum*, endemic to Korea, was reported from Oryukdo, off the coast of Busan (Seo, 1996), and two non-indigenous species, *C. reticulum* and *C. seurati*, were introduced by international shipping (Yu et al., 2021) to Korean waters. Eight species of the genus *Electra* are distributed in the Northwest Pacific Ocean, including the East China Sea and the waters further north than Hokkaido. They are as follows: *E. asiatica*, *E. axialata*, *E. gracilis*, *E. inarmata*, *E. inermis*, *E. monilophora*, *E. pseudopilosa*, and *E. zhoushanica* (Wang, 1988; Liu et al., 1999, 2001; Grischenko et al., 2007). Except for *E. asiatica* from the waters further north than Hokkaido, Japan, the remaining seven species were found in the East China Sea. Thus, more *Electra* species are likely to be distributed in the Yellow Sea and its adjacent waters, such as the Western South Sea. This study aims to clarify the bryozoan fauna of the family Electridae by comparing their morphological characteristics.

MATERIALS AND METHODS

A taxonomic study on Korean Electridae (Bryozoa: Cheilo-

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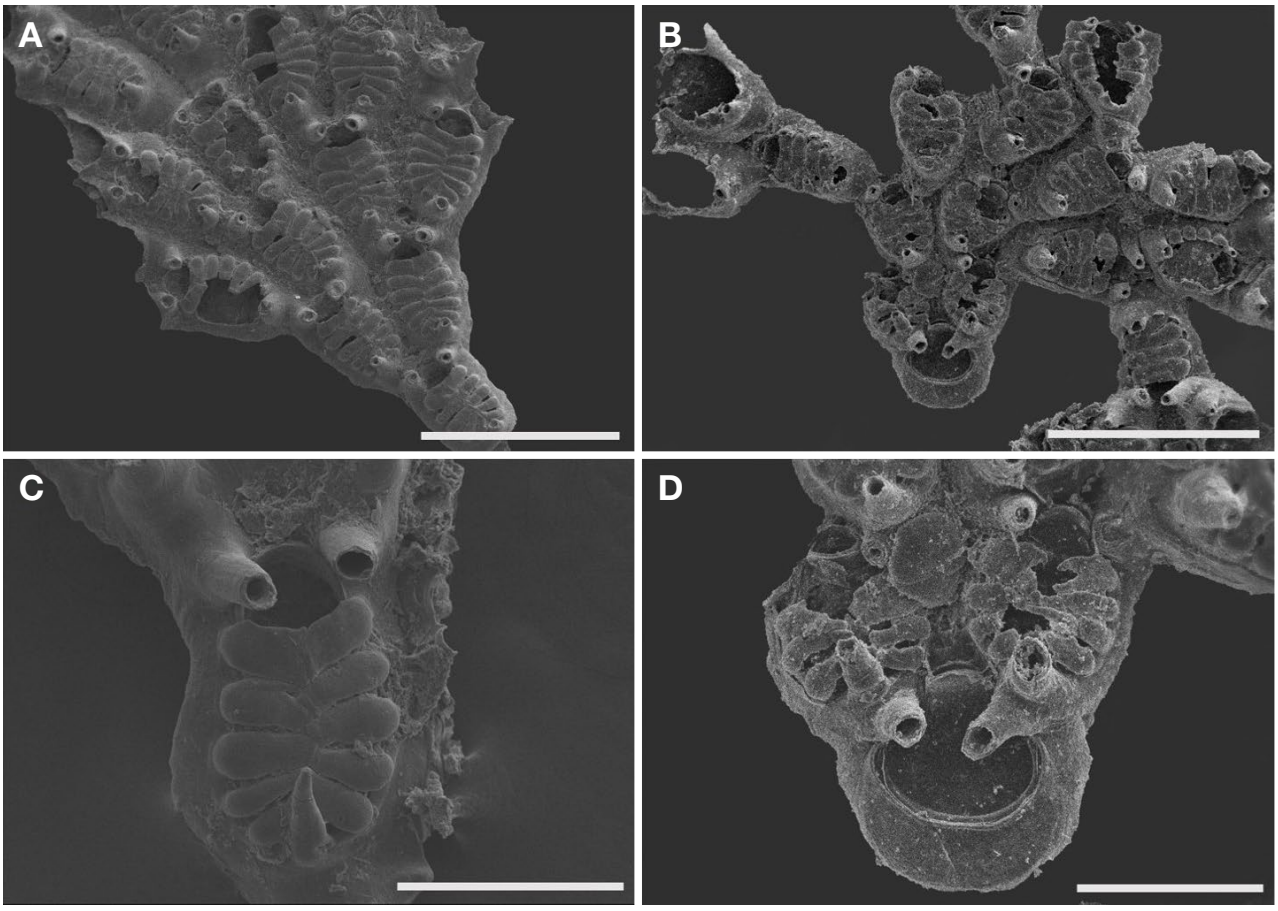

Fig. 1. *Aspidelectra melolontha* (Landsborough, 1852). A, Arrangement of zooids; B, Arrangement of zooids with ancestrula; C, Detailed zooid showing costal spines, electriform spine and orifice; D, Ancestrula and daughter zooids. Scale bars: A, B=5 mm, C, D=0.2 mm.

stomatida) was done with the materials collected from six localities in ports, coastal seas, and islands of Korea from 1984 to 2021. Most of these specimens were obtained from shells and rocks in the intertidal zone and preserved in 95% ethyl alcohol. For identification, the external features of the zooids were first observed under a stereomicroscope (Stemi SV6; Carl Zeiss, Germany). Then, some parts of the colony were bleached with hot aqueous sodium hypochlorite, washed in water and 95% alcohol, dried, and gold coated (MCM-100; SEC, Korea). After that, they were observed with a scanning electron microscope (SEM, SNE-3200M Mini; SEC) at 15 kV accelerating voltage. Measurements were made on SEM images of zooids using Image J.

RESULTS

Order Cheilostomatida Busk, 1852
Suborder Membraniporina Ortmann, 1890
Superfamily Membraniporoidea Busk, 1854
Family Electridae Stach, 1937
[1]*Genus *Aspidelectra* Levinsen, 1909

[2]*1. *Aspidelectra melolontha* (Landsborough, 1852) (Fig. 1)

Lepralia melolontha Landsborough, 1852: 319, pl. 18, fig. 70; Busk, 1854: 78, pl. 85, fig. 3; Norman, 1903: 93, pl. 8, fig. 9.
Membraniporella melolontha: Hincks, 1880: 202, pl. 27, figs 9, 10; Prenant and Bobin, 1966: 573, fig. 198.
Aspidelectra melolontha: Levinsen, 1909: 160; Ryland and Hayward, 1977: 74, fig. 26; Hayward and Ryland, 1998: 138, fig. 31; López-Gappa and Liuzzi, 2016: 1162, fig. 2c.
Membraniporella aragoi zhoushanica Wang, 1989: 1, fig. 1.
Aspidelectra zhoushanica: Gordon et al., 2008: 42, fig. 3.2.
Aspidelectra orientalis Liu and Wass in Liu, Yin and Ma, 2001:

Korean name: [1]*방패지기이끼벌레속 (신칭), [2]*딱정벌레이끼벌레 (신칭),

443, pl. 16, fig. 5.

Material examined. Korea: Chungcheongnam-do: Taean-gun, Anhenug, 36°40′50.7″N, 126°09′08.9″E, 29 Oct 1984, MABIK IV00173457; Incheon: Ongjin-gun, Baengnyeong Island, 37°55′10.9″N, 124°39′16.1″E, 24 Nov 2007; Jeollanam-do: Wando-gun, W of Cheongsan Island, 34°09′30.5″N, 126°46′8.0″E and N of Soan Island (Soando), 34°13′49.7″N, 126°38′54.9″E, 29 Jul 2016.
Substratum. Rocks and shells of *Crassostrea gigas* (oyster).
Description. Colony encrusting, unilaminar, forming narrow, linear, pluriserial branches (Fig. 1A, B). Autozooids mostly completely contiguous, with occasional small disjunctions, quincuncial where branches wide enough, longer than wide, 0.19−0.36 mm long (0.30 ± 0.05 mm) and 0.19−0.21 mm wide (0.20 ± 0.008 mm) (Fig. 1A, C). Frontal shield cribrimorph, comprising 9−16 moderately broad, flattened costal spines; some costae bifurcate at the tips, and all spines meet and slightly interdigitate with opposing spines (Fig. 1C). Gymnocyst smooth, very narrow to scarcely existent laterally, wide proximally, bearing a median electriform (non-articulated) spine (Fig. 1C). Orifice more or less transversely D-shaped, flanked on each side by another electriform spine, each produced from the proximal part of an adjacent zooid. No avicularia or ooecia. Ancestrula more or less circular, about 0.23 mm diameter, with large round opesia, oral area flanked by a pair of spines each contributed by a daughter zooid (Fig. 1B, D).
Remarks. As López-Gappa and Liuzzi (2016) have remarked, northeast Asian occurrences of *Aspidelectra* are indistinguishable from *A. melolontha* in the waters of northwestern Europe. The form of the colony, autozooids, and ancestrula all conform, so that *A. zohoushanica* (unnecessarily renamed by Liu and Wass in Liu et al., 2001) must be considered a junior subjective synonym.

In European waters, *A. melolontha* occurs in brackish water of low salinity, but the species can survive through fully marine waters. Gordon et al. (2008) encountered a colony on a recreational vessel in New Zealand, and López-Gappa and Liuzzi (2016) found the species at a port in Argentina. In northeast Asia, it is known in the Yellow Sea region - from Zhoushan, China, and the South Sea coast of South Korea, and in the northeastern Yellow Sea at Baengnyeong Island, the westernmost point of South Korea.

This species is known to be fouling bryozoan from China (Liu et al., 2001) and attaching to the hull in New Zealand (Gordon et al., 2008). However, Korean specimens encrusted only rocks and oyster shells in the intertidal zone on the sandy mud bottom, typically shown in the Yellow and Western South Seas.
Distribution. Korea (Yellow and Western South Seas), China (East China Sea), New Zealand, Atlantic coasts of Europe, North Sea, and South America.

Genus *Electra* Lamouroux, 1816

[1]*2. *Electra jindoica* new species (Fig. 2)

Material examined. Korea: Holotype, Jeollanam-do: Jindo-gun, Jeopdo, 34°23′28.4″N, 126°17′32.6″E, 25 Oct 2021, HNIBRIV345; Goheung-gun, Yeompo Port, 34°25′33.5″N, 127°29′39.3″E, 15 May 2018; Paratype, Chungcheongnam-do: Taean-gun, Cheongpodae, 36°38′15.88″N, 126°17′56.73″ E, 26 May 2017.
Substratum. Shell of *Mytilus galloprovincialis*.
Etymology. The species name refers to Jindo (Jin Island), where the holotype specimen was collected.
Description. Colony encrusting, unilaminar (Fig. 2A, B). Autozooids oval, barrel-shaped or subrectangular, rounded distally, 0.30−0.39 mm long (0.34 ± 0.02 mm) and 0.12−0.17 mm wide (0.15 ± 0.01 mm) (Fig. 2C). Gymnocyst smooth, relatively very narrow distally and laterally, well-developed proximally; proximal gymnocyst occupying up to 30% of zooidal length, some tapering proximally, often with minute transverse striations (Fig. 2C, D). Cryptocyst well-developed proximally, narrow distally and laterally, sloping down toward opesia, uniformly granular; distal border of cryptocyst somewhat projecting into opesia distally (Fig. 2C−E). Mural rim raised, beaded (Fig. 2C). Opesia oval, elliptical, or rounded-quadrate in outline, often with straight proximal margin, 0.19−0.25 mm long (0.22 ± 0.01 mm) and 0.10−0.14 mm wide (0.12 ± 0.01 mm), occupying about 65% of zooidal length (Fig. 2C−E). Frontal membrane thin (Fig. 2B, D). Operculum thin, chitinized, semicircular (Fig. 2C). Single prominent chitinous spine on almost at center of gymnocyst, just below opesia, electriform (non-articulated), conically pointed, sometimes lacking, or 2 (Fig. 2C−E). Kenozooids of irregular shape and size, rare among autozooids (Fig. 2B, E), sometimes with same pointed chitinous spine as one of autozooid (Fig. 2D); elongate oval opesia entirely surrounded by granular cryptocyst (Fig. 2D, E). No avicularia or ooecia. Ancestrula and young colony showing the growth form not observed.
Remarks. Nikulina (2007) established a new genus *Einhornia* for five species with a single proximedial spine in the zooids and a calcified operculum. These two characters clearly distinguish *Einhornia* from the genus *Electra*, which has many spines and an uncalcified operculum. However, *E. asiatica* Grischenko, Dick and Mawatari, 2007 from Japan and *Electra*

Korean name: [1]*진도엘렉트라이끼벌레 (신칭)

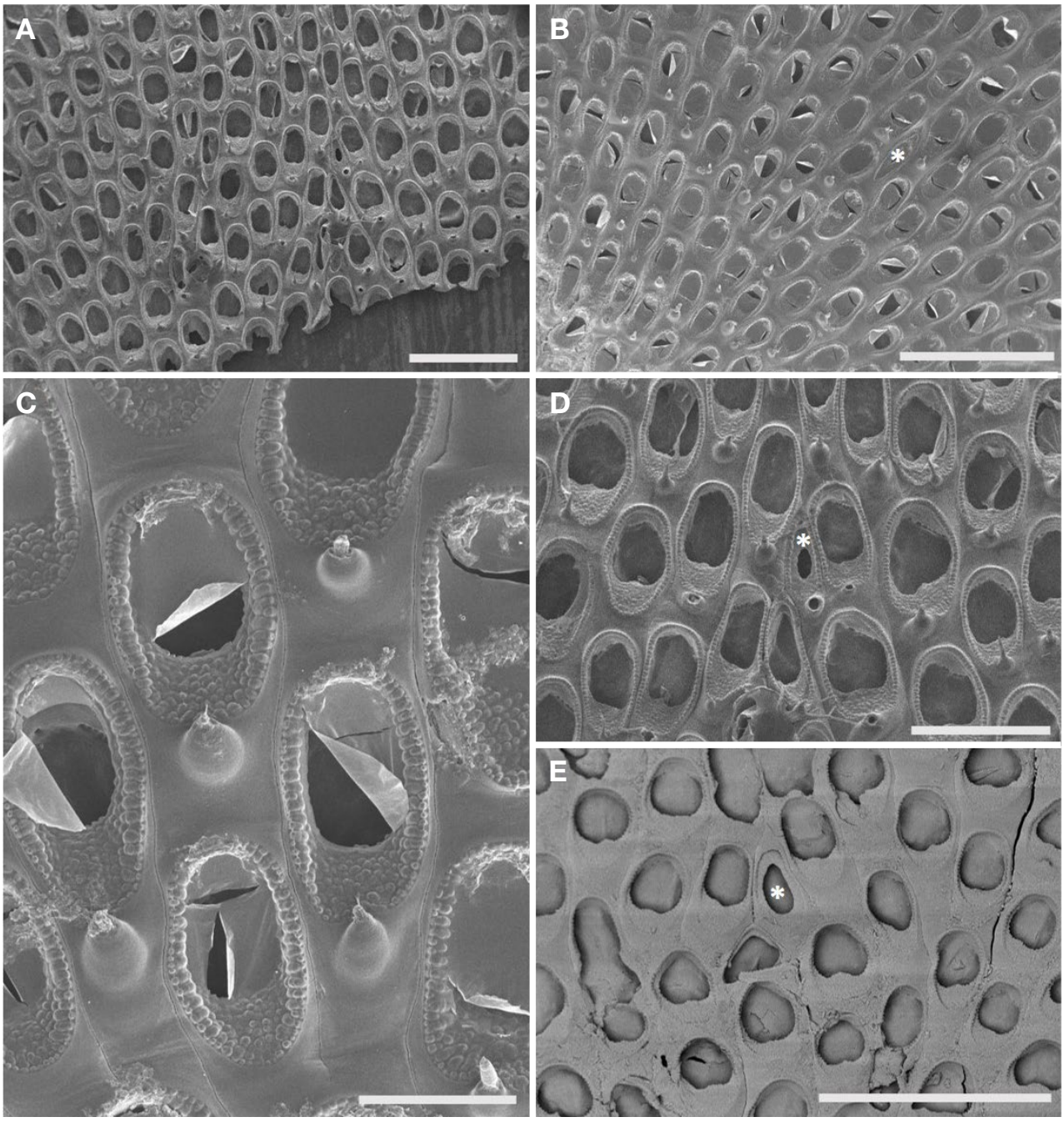

Fig. 2. *Electra jindoica* new species. A, Arrangement of zooids, from Jeopdo; B, Arrangement of zooids and kenozooid, from Cheongpodae; C, Detailed zooids showing electriform spine, operculum, well-developed granulated cryptocyst, mural rim and kenozooid, from Cheongpodae; D, Zooids and kenozooid, from Jeopdo; E, Zooids without spinous processes and kenozooid, from Yeompo Port; The asterisks indicate kenozooids. Scale bars: A, B, E = 0.5 mm, C = 0.1 mm, D = 0.3 mm.

jindoica n. sp. from Korea have a single pointed chitinous spine on the gymnocyst as the genus *Einhornia*. On the contrary, they have a chitinized operculum, like other species of *Electra*. Thus, a single spine on the gymnocyst of the features of *Einhornia* is suggested to be deleted. Eventually, invalidation of the genus *Einhornia* is possible by reviewing molecular and morphological data using more specimens of two *Electra* species from Korea and Japan.

Among congeners, *Electra jindoica* n. sp. morphologically most resembles *Electra asiatica* Grischenko, Dick, and Mawa-

tari, 2007. Both species have a chitinized operculum, developed gymnocyst with minute transverse striation, and single pointed chitinous spine on the gymnocyst proximal to the opesia. However, *Electra jindoica* n. sp. has smaller zooids and larger kenozooids and developed cryptocyst than *E. asiatica*. Moreover, the kenozooids in Japanese *E. asiatica* are entirely ringed by a granular cryptocyst and have a small, roughly circular opesia. In contrast, this new species has kenozooids with elongate oval opesia. Unfortunately, the ancestrula and periancestrular zooids, considered essential for identification, were not observed in Korean specimens.

Regarding distribution, the new species occurred in temperate water with sandy mud bottom in the Yellow and Western South Seas, Korea, while *E. asiatica* is a boreal species from Kamchatka, the Sea of Okhotsk, Sakhalin Island, and Akkeshi Bay in Hokkaido, Japan. Of eight *Electra* species found in the Northwest Pacific Ocean, seven of *E. axialata*, *E. gracilis*, *E. inarmata*, *E. inermis*, *E. monilophora*, *E. pseudopilosa*, and *E. zhoushanica* are recorded from the East China Sea (Wang, 1988; Liu et al., 1999, 2001). The remaining, *E. asiatica*, is only known to be a wide boreal species (Grischenko et al., 2007). This study adds a new species, which is not a boreal species, to the bryozoan fauna of the Northwest Pacific Ocean.

Distribution. Korea (Yellow and Western South Seas).

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CONFLICTS OF INTEREST

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

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