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〈Original article〉

New Record of the Delesseriacean Parasitic Red Alga, *Asterocolax denticulatus* in Korea

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Abstract - The delesseriacean parasitic red algal *Asterocolax* species was collected from Jindo in the southern coast of Korea. This parasitic species found on *Pseudopolyneura japonica*. And it is distinct from other species of *Asterocolax* with more or less denticulate branches when matured. This Korean entity is identified as *Asterocolax denticulatus* (Tokida) Feldmann & Feldmann (Delesseriaceae, Rhodophyta) based on these features. This is the first record of *A. denticulatus* in Korea.

Key words : *Pseudopolyneura japonica*, first record, denticulate branches

INTRODUCTION

Red algal parasites are common on other red algae and have been described from at least eight orders within the Florideophyceae (Ng *et al*. 2014; Preuss and Zuccarello 2014). These parasites have little or no photosynthetic pigmentation, and use only other red algae as hosts. They are generally small and morphologically simple, composed of branching filaments of cells penetrating between cells of the pseudoparenchymatous host and a tissue mass that protrudes from the host thallus and bears reproductive structures (Ng *et al*. 2014). Moreover, they are highly host-specific and can be found on hosts that are morphologically considerably like the parasites (Goff *et al*. 1997). Until now, more than hundreds of taxa of parasitic red algae are known from all the world's oceans (Blouin and Lane 2012).

In Korea, only four parasitic red algal genera have been reported (Nam and Kang 2012, 2013; Kim *et al*. 2013). These include *Janczewskia* Solms-Laubach, on *Laurencia* sp., *Benzaitenia* Yendo on *Chondria* sp., *Kintokiocolax* T Tanaka & Y Nozawa on *Grateloupia* sp. and *Symphyocolax* MS Kim on *Symphyocladia* sp. Among them, three red algal parasitic genus, except for *Kintokiocolax*, belonging to the Rhodomelaceae have been reported from flora of Korea (Kim *et al*. 2013). During the survey of indigenous species in Korea, delesseriacean parasitic red algal species belonging to *Asterocolax* Feldmann & G Feldmann was collected from Jindo. Based on morphological data, this species was identified as *Asterocolax denticulatus* (Tokida) Feldmann & G Feldmann recorded newly in Korea.

MATERIALS AND METHODS

Specimens for this study were collected from Jindo (34°15′ N, 126°00′ E). Morphological and anatomical data were obtained from liquid-preserved specimens. Liquid-preserved materials were stored in a 5−10% formalin-seawater solution. Sections were made by hand using razor blades and pith stick, and transferred to a slide glass with distilled water. For permanent slides, 10−30% corn syrup was used as a mounting medium. Measurements are given as length and diameter. Photographs were taken with a CCD cam-

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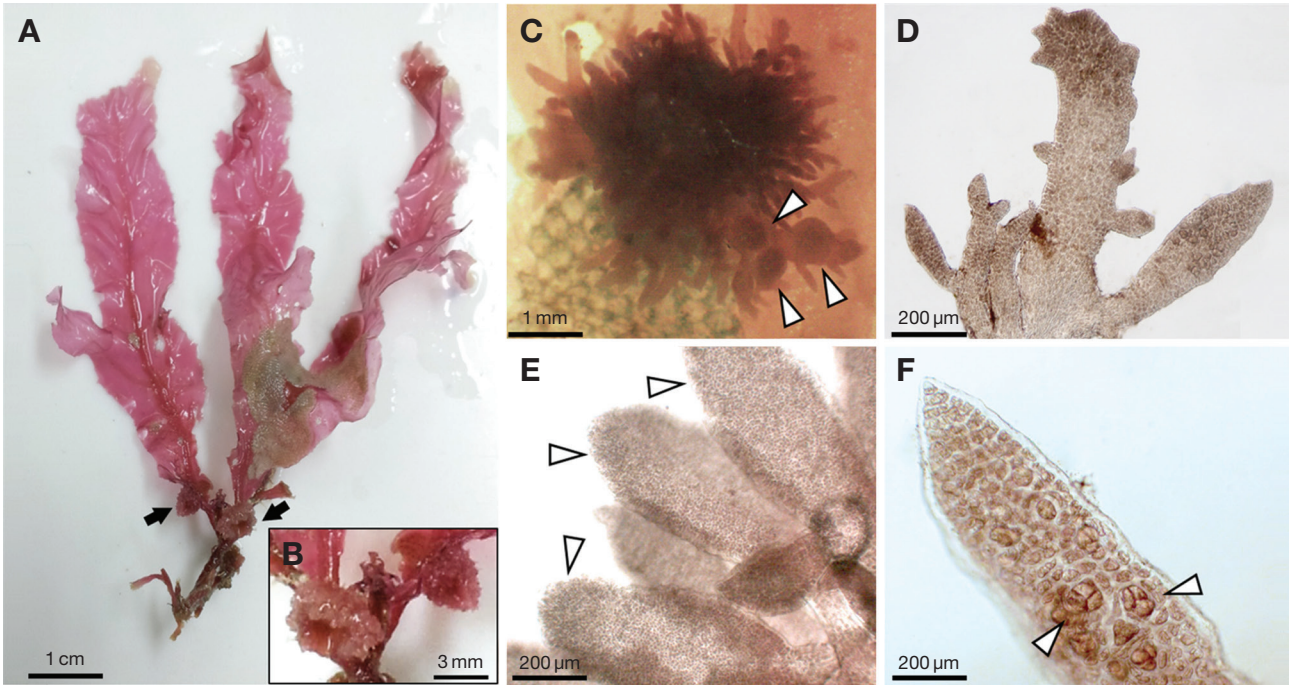

Fig. 1. *Asterocolax denticulatus* (Tokida) Feldmann & Feldmann A, parasitic *A. denticulatus* (arrows) on host *Pseudopolyneura japonica* (Yamada) KW Nam & PJ Kang; B, details of *A. denticulatus*; C, female gametophyte with cystocarps (arrow heads); D, denticulate blades; E, male gametophyte with spermatangial branches (arrow heads); F, tetrasporophyte with tetrasporangia (arrow heads).

era (MicroPublisher 5.0, Qimaging, Canada) and a digital camera (TG-4, Olympus, Japan) attached to a microscope (DMLB, Leica, Germany). All specimens examined in this study are now deposited in the herbarium of the Department of Marine Biotechnology, Kunsan National University, Gunsan, Korea.

RESULTS AND DISCUSSION

***Asterocolax denticulatus* (Tokida) Feldmann & G Feldmann 1951: 1138**

Basionym: *Polycoryne denticulata* Tokida (1934)

Type locality: Robben Island, Saghalien Islands, Russia

Korean name: Top-ni-bo-ra-ip-deo-bu-sal-i nom. nov. (신칭: 톱니보라잎더부살이).

Specimens examined: KSNU000010059-KSNU000010060 (♀), KSNU000010061 (♂), KSNU000010062-KSNU000010063 (⊕), KSNU000010064-KSNU000010066 (Vegetative plants) (Jindo, Jeonnam: 13.viii.2012).

Habitat: Parasite on *Pseudopolyneura japonica*.

Morphology: Thalli parasitic on *Pseudopolyneura japonica* (Fig. 1A), pale pink to pink, forming a pulvinate mass 3–5 mm in diameter (Fig. 1B, C); dozens of needlelike or clavate blades in a dense cluster (Fig. 1C); individual axes up to 3 mm long. Blades flattened, with a smooth surface while young, more or less denticulate when matured (Fig. 1D). Spermatangia (Fig. 1E) and tetrasporangia (Fig. 1F) entirely covering male and tetrasporic blades respectively; tetrasporangia tetrahedrally divided, 25–35 μm in diameter. Female branches bearing one cystocarp to subapical in position (Fig. 1C); cystocarps globose, to 500 μm in diameter; carpospores catenate.

Four genera of parasitic Delesseriaceae are now recognized (Wynne 1970): *Gonimophyllum* Batters, *Gonimocolax* Kylin, *Polycoryne* Stottsberg, and *Asterocolax* Feldmann & G Feldmann. Among them, *Asterocolax* was characterized by Feldmann and Feldmann (1951) as growing by means of one apical cell undergoing transverse divisions. In genus *Asterocolax*, four species are now recognized (Guiry and Guiry 2017). These species occurred as a parasite on several delesseriacean hosts (Table 1). Type species of this genus, *A. erythroglossi* Feldmann & G Feldmann, was illustrated (Feldmann 1958, fig. 23) with a stellate clump of a few

Table 1. Host, distribution and size information of *Asterocolax* species.

Parasite species	Host species	Distribution	Size (diameter)	Reference
Asterocolax erythroglossi	*Erythroglossum laciniatum* (Lightfoot) Maggs & Hommersand	British Isles to NW France	nd	Feldmann and Feldmann 1951; Feldmann 1958; Maggs and Hommersand 1993
Asterocolax hypophyllophila	*Mikamiella ruprechtiana* (Zinova) Wynne	Amchitka, USA	6 mm	Wynne 1970
Asterocolax gardneri	*Phycodrys*, *Nienburgia*, *Polyneura*	Washington, California from Duxbury Reef to San Diego, USA	2–3 mm	Abbott and Hollenberg 1976
Asterocolax denticulatus	*Phycodrys fimbriata* (Dela Pyli) Kylin	Japan; Saghalien, Russia	3 mm	Tokida 1934
Asterocolax denticulatus	*Pseudopolyneura japonica* (Yamada) KW Nam & PJ Kang	Jindo, Korea	3–5 mm	This study

nd, no data

short, terete blades. This species occurred as a parasite on *Erythroglossum laciniatum* (Lightfoot) Maggs & Hommersand (Table 1). *Asterocolax gardneri* (Setchell) Feldmann & G Feldmann has been described with needle-like blades (Smith 1944) and a cluster of small club-like blades (Wagner 1954) 2–3 mm in diameter (Abbott and Hollenberg 1976). *A. gardneri* occurred as a parasite on several delesseriacean hosts (*Phycodrys*, *Nienburgia* and *Polyneura*) (Table 1). Although Setchell (1923) described the cystocarps of *A. gardneri* as being situated in basal parts of blades, Wynne's material reveals them to be median to subapical in position, between the narrow stalk and pointed apex (Wynne 1970). Also, Wagner (1954) illustrated cystocarp located closer to the apex. *A. hypophyllophila* Wynne differ from the other species by its larger size (6 mm in diameter) (Table 1) and the greater number of blades in a cluster, and forming flat blades (Wynne 1970). This species occurred as a parasite on *Mikamiella ruprechtiana* (Zinova) Wynne. *A. denticulatus* was initially described as *Polycoryne denticulata* a parasite on *Phycodrys fimbriata* (Dela Pyli) Kylin by Tokida (1934). Later this species was transferred to genus *Asterocolax* by Feldmann and Feldmann (1951). Its distribution in Japan and Russia was known in previous reports (Tokida 1934; Yoshida *et al*. 1990; Perestenko 1994; Yoshida 1998; Guiry and Guiry 2017). Our specimens are characterized by more or less denticulate branches when matured (Fig. 1). According to Tokida (1934), *A. denticulatus* (as *Polycoryne denticulata*) differs from either of the other *Asterocolax* species in that it has denticulate or ramulose branches. This trait of our specimens fits well with Tokida's previous description. So, these Korean specimens are identified as *A. denticulatus* based on those features, although flattened rather than cylindrical blades were observed. This is the first record of the delesseriacean parasitic red alga *A. denticulatus* in Korea.

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