

Two New Records of *Eudistoma* (Aplousobranchia: Polycitoridae) from Korea

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ABSTRACT

Two colonial ascidians, *Eudistoma glaucum* and *Eudistoma purpureum*, are reported for the first time in Korean waters through taxonomic study on ascidians collected from a subtidal zone of Jeju Island. *Eudistoma glaucum* is distinguished by opaque green color of colony in living, massive colony with large corona, smooth surface of corona, sparse sand only at the peduncle, zooids in circle, about 8–10 stigmata of 3 stigmata rows and test process. *Eudistoma purpureum* is distinguished by brilliant, opaque, purple color of colony in living, less lobed colony form, smooth shiny surface, sparse sand only at the basal test, absence of symbionts, zooids in circle, no distinct bulging sphincter in siphon, long atrial siphon and about 20 stigmata of 3 stigmata rows. As a result of this study, four species of the genus *Eudistoma* are now recorded in Korean fauna.

Keywords: taxonomy, colonial ascidians, *Eudistoma*, Jeju Island, Korean fauna

INTRODUCTION

The genus *Eudistoma* Caullery, 1909 is known to be a large genus with 133 valid species worldwide (WoRMS, 2023). This genus has characteristically small zooids with three rows of stigmata, long oesophagus, longitudinal muscle bands from thorax to abdomen, smooth stomach in the posterior region of the abdomen, and larvae incubated in the atrial cavity (Van Name, 1945; Monniot, 1983; Kott, 1990; Oliveira et al., 2014). It is more reliable to use a combination of larval characters for species identification due to variable morphologies of colonies and very small size of zooids (Monniot, 1983; Kott, 1990; Oliveira et al., 2014).

This genus is mostly found in tropical or temperate waters. Thirty-four species have been previously recorded in the western Pacific including the Indonesian region (Tokio-ka, 1942, 1950, 1953, 1954, 1955, 1962, 1967; Rho, 1967; Tokioka and Nishikawa, 1975; Rho and Huh, 1984; Rho and Lee, 1989; Kott, 1990; Nishikawa, 1990; Monniot and Monniot, 2008). Only two species, *E. illotum* (Sluiter, 1898) and *E. viride* Tokio-ka, 1955, have been reported so far in Korea (Rho, 1967; Rho and Huh, 1984; Rho and Lee, 1989). Two unrecorded species, *Eudistoma glaucum* (Sluiter, 1909) and *Eudistoma purpureum* Kott, 1990, are now newly reported

for the first time in Korean waters with detailed descriptions and photographs for living forms in this study.

MATERIALS AND METHODS

Specimens of *Eudistoma glaucum* and *E. purpureum* examined in this study were collected from subtidal zones of Jeju Island in Korea by SCUBA diving. Images of collected living colonies were taken with a digital camera ILCE-7RM2 (Sony, Tokyo, Japan). After collection, all living specimens were anesthetized with menthol, fixed and preserved in 4% buffered formalin with seawater. For identification, the specimens were examined for morphological characteristics under a stereoscopic microscope (SMZ 745T; Nikon, Tokyo, Japan). Images of preserved specimens were taken with a microscopic camera (UHCCD05000KPA; Touptek Photonics, Zhejiang, China) and a digital camera (WG-4; Ricoh, Tokyo, Japan). The size of the zooid was then measured using an image analyzer (Toupterview 3.7; Touptek Photonics) and a ruler.

All specimens examined in this study were deposited at the National Marine Biodiversity Institute of Korea (MABIK IV00173556, MABIK IV00173557), Marine Tunicata Resources of Bank (MTRBK233, MTRBK235), and

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the Natural History Museum of Ewha Womans University (EWNHMAS4580).

SYSTEMATIC ACCOUNTS

Class Ascidiacea Blainville, 1824
Order Aplousobranchia Lahille, 1886
Family Polycitoridae Michaelsen, 1904
¹*Genus *Eudistoma* Caullery, 1909

²**Eudistoma glaucum* (Sluiter, 1909) (Fig. 1)

Polycitor glaucus Sluiter, 1909: 12 (type locality: Indonesia).

Eudistoma glaucus: Tokioka and Nishikawa, 1975: 331.

Eudistoma rigida: Tokioka, 1955: 50; Kott, 1990.

Material examined. Korea: 2 colonies (MABIK IV00173 556, EWNHMAS4580), Jeju-do: Chujado Island, 33°59'22"N, 126°14'55"E, SCUBA diving at a depth of 30 m, 24 Jul 2023, coll. Park SW, Cho SH; 1 colony (MTRBK233), Chujado Island, 33°59'07"N, 126°14'58"E, SCUBA diving at a depth of 30 m, 13 Oct 2023, coll. Park SW, Cho SH.

Description. Colonial. Colony dark greenish with brownish yellow zooids in living (Fig. 1A). Colony out of water translucent with brownish yellow tint at zooid gathering part (Fig. 1B). Color of colony in preservative dark greenish gray (Fig. 1C). Colony massive with large corona like head and very thick peduncle like substrate. Large corona about 33.2 mm × 28.5 mm wide and about 17.2 mm thick. Peduncle about 20.8 mm × 18.0 mm wide and about 0.7–1.1 mm thick. New colony emerged from peduncle. Surface of corona smooth without foreign matters. Other substances such as ascidian, bryozoan, shell fragments and sands attached to thick peduncle and head border area. Test gelatinous, rather rigid and free from sand. Dark green coloration of colony due to pigmentation of test itself. System with 4–9 zooids circling atrial siphons in center distinct. But system in preserved specimens looks little indistinct, because many zooids contracted and went down to bottom of colony (Fig. 1A–C).

Zooids embedded in colony. Zooids about 10.43 mm in length on average in expanded condition (n = 5). Thorax about 1.98 mm long and abdomen 8.45 mm on average. Both apertures 6-lobed. Atrial aperture not noticeably long (about 0.53 mm). Oesophagus thin and long. Fine longitudinal muscle bands extend from thorax to abdomen. Many transverse muscle bands in thorax. Zooids with three rows of stigmata. Eight to ten stigmata in each stigmata row. Stig-

mata about 0.34 mm long. Smooth stomach in the posterior region of the abdomen. Anus opens at level of second stigmata row. Test process issued from posterior end of abdomen about 0.73 mm long and thin (Fig. 1D, E).

Larvae incubated in atrial cavity. In specimens collected in July, up to two embryos and three larvae observed in atrial cavity. Embryos 0.54 mm and 0.71 mm in diameter. Larvae, in order of development, 0.85 mm, 0.92 mm and 1.40 mm in length. Mature larval trunk 0.88 mm long with long tail. Short and thick stalk and expanded proximal part in adhesive organs. Epidermal ampullae alternate adhesive organs in midline (Fig. 1E, F).

Distribution. Korea (present study), Australia, Fiji, Indonesia, Japan, Palau.

Remarks. *Eudistoma glaucum* is similar to *Eudistoma viride* Tokioka, 1955 in that they are reported in the Western Pacific and the color of the colony is greenish. However, in the latter, the green pigments are mainly distributed in the mantle of zooids, the greenish zooids are visible through the translucent test, and zooid has about 20–25 stigmata of 3 stigmata row (Tokioka, 1955; Tokioka and Nishikawa, 1975; Rho and Huh, 1984; Kott, 1990). On the other hand, the present specimens have an opaque greenish test throughout, and zooids with about 8–10 stigmata of 3 stigmata row.

The number of stigmata in the present specimens is similar to that in *Polycitor glaucus* Sluiter, 1909 from the Siboga area and that in *Eudistoma glaucus* from the Okinawa. They are later synonymized as *Eudistoma glaucum* (Tokioka, 1955; Tokioka and Nishikawa, 1975). The form of colony in the present specimen is more similar to that in Kott (1990)'s description of *E. glaucum* than that in Tokioka (1955)'s description of *E. rigida* or in Tokioka and Nishikawa (1975)'s description of *E. glaucus*. Kott (1990) has synonymized *E. rigida* Tokioka, 1955 with *E. glaucum* because they are very similar in morphology with the same bluish-black color in the preservative, except for their different colors when alive.

³**Eudistoma purpureum* Kott, 1990 (Fig. 2)

Eudistoma purpureum Kott, 1990: 225 (type locality: Queensland).

Material examined. Korea: 2 colonies (MABIK IV00173 3557, EWNHMAS4455), Jeju-do: Seogwipo-si, Beomseom Islet, 33°13'28"N, 126°30'48"E, SCUBA diving at a depth of 24 m, 24 Nov 2022, coll. Park SW, Cho SH; 1 colony (MTRBK235), Seogwipo-si, Gapado Islands, 33°10'20"N, 126°17'30"E, SCUBA diving at a depth of 34 m, 29 May 2023, coll. Park SW, Cho SH.

Description. Colonial. Colony cushion shape fixed by flat

Korean name: ¹*세줄멍게속, ²*황록세줄멍게 (신칭), ³*보라세줄멍게 (신칭)

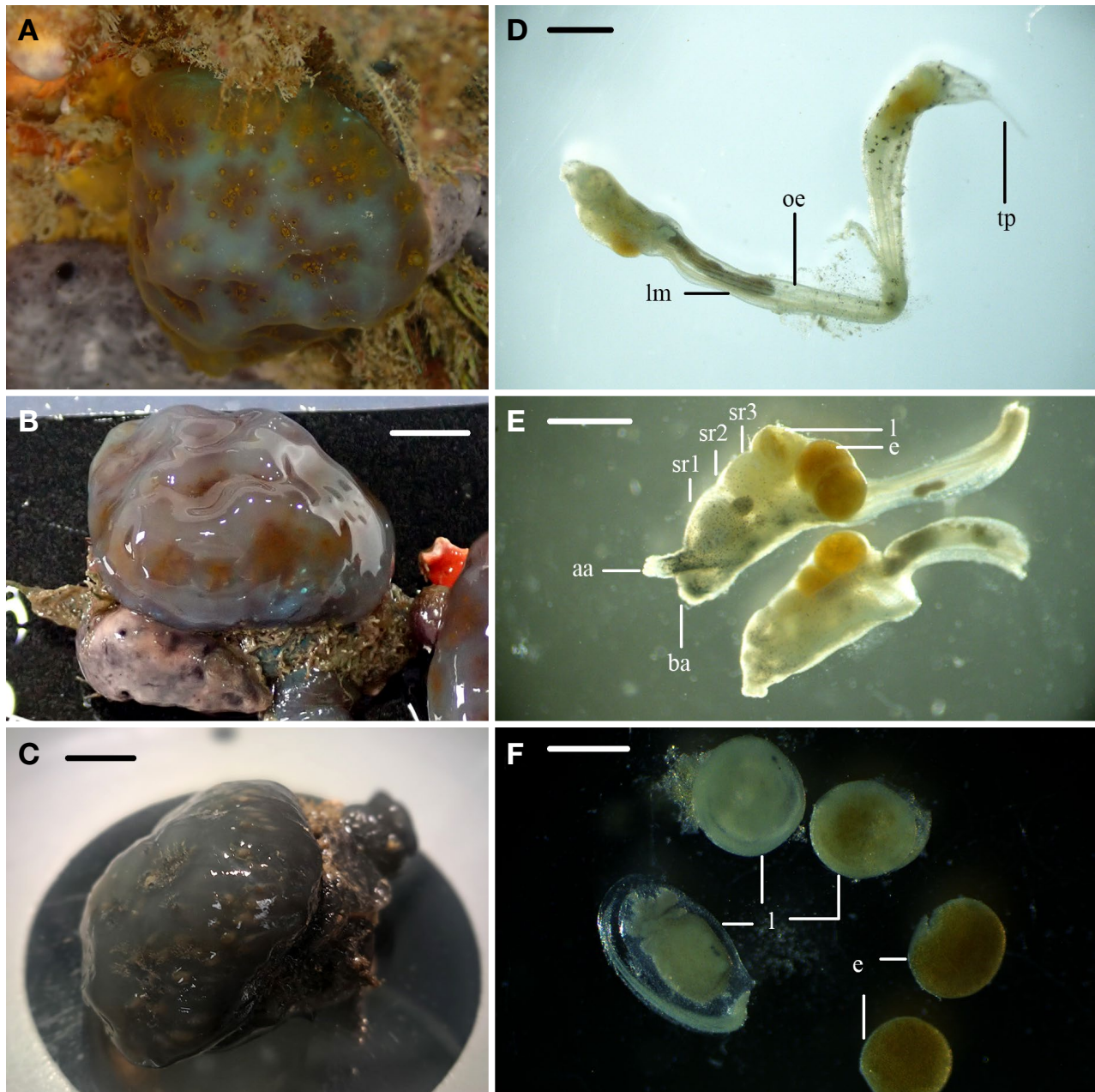


Fig. 1. *Eudistoma glaucum* (A-F). A, Colony in living; B, Colony out of water; C, Colony in preservative; D, E, Zooid; F, Embryos and larvae. aa, atria aperture; ba, branchial aperture; e, embryo; l, larvae; oe, oesophagus; lm, longitudinal muscle; sr, stigmatal row; tp, test process. Scale bars: B, C=10 mm, D, E=1 mm, F=0.5 mm.

base. Colony not divided into lobes on common base. In living, colony test has opaque bluish-purple color with fluorescent sky blue point around apertures of zooids (Fig. 2A). Out of water colony purple color with hyacinth-blue small pigments in opaque test. Zooids brown in color (Fig. 2B). Color of colony in preservative translucent and greenish gray. Colony 14.2 mm × 10.4 mm wide and 9–12 mm thick. Test thick and not solid. Surface of test smooth and shiny.

Top and side of colony has no other object including sand. Little sand only on lower basal test of colony. No symbiotic plant cells in test. Four to seven zooids form circular system with atrial apertures opening in center of circle. No depressions on surface where zooids gathered (Fig. 2C).

Zooids embedded in colony. Zooids about 2.22 mm in length on average in contracted condition (n=5). Thorax about 0.55 mm long and abdomen about 1.67 mm on aver-

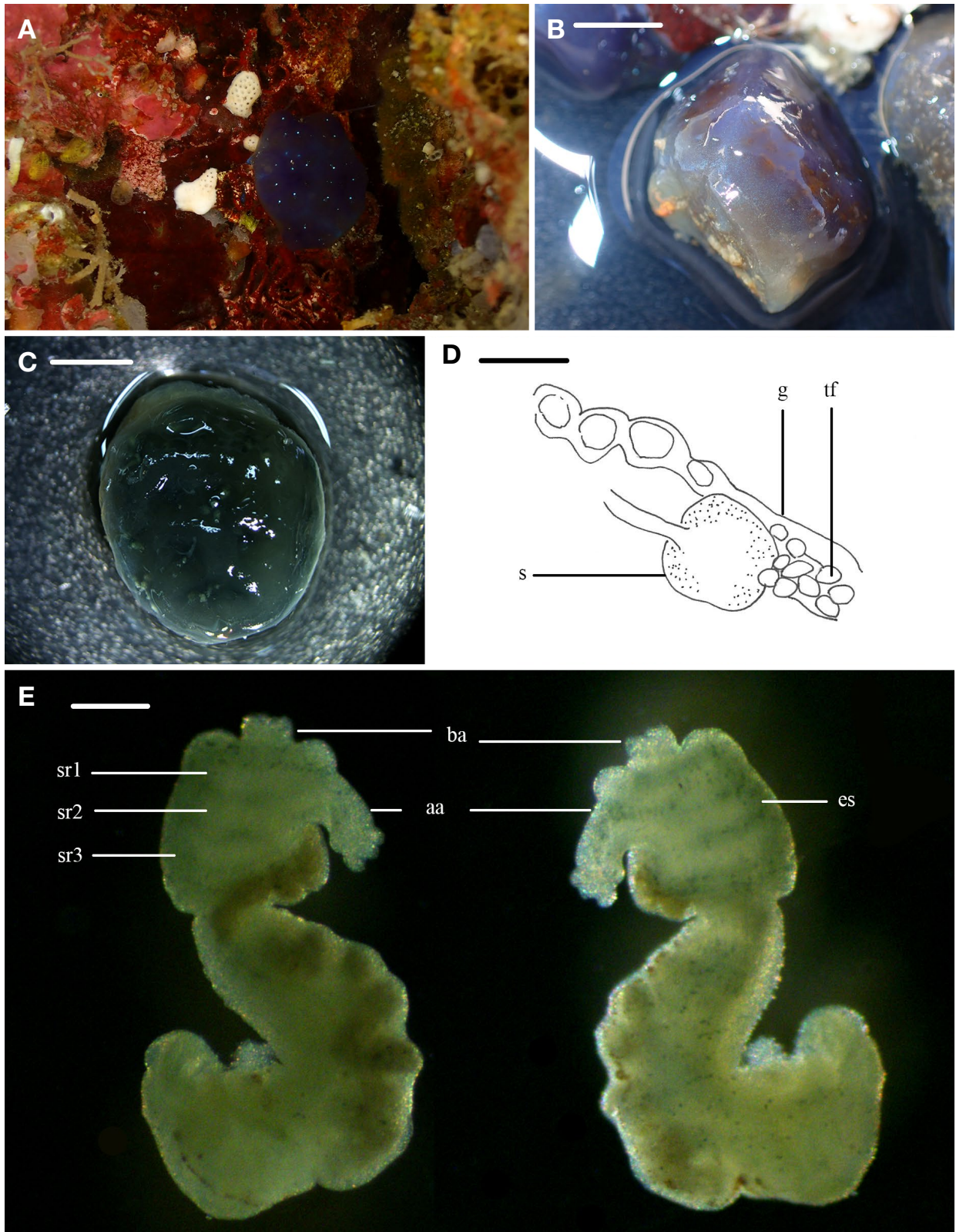


Fig. 2. *Eudistoma purpureum* (A-E). A, Colony in living; B, Colony out of water; C, Colony in preservative; D, Stomach and gut; E, Zooid. aa, atria aperture; ba, branchial aperture; es, endostyle; g, gut; s, stomach; sr, stigmatal row; tf, testis follicle. Scale bars: B, C=5 mm, D=0.4 mm, E=0.2 mm.

age in contracted zooids. Blackish green pigments particles scattered a little in mantle of zooid. No distinct bulging sphincter in siphon. Both apertures 6-lobed. Atrial aperture noticeably long (about 0.24 mm) and over 3 times length of branchial aperture. Circular muscles along each aperture. Oesophagus long. Longitudinal muscle bands extend from thorax to abdomen. Zooids with three rows of stigmata. Eighteen to twenty-one stigmata in each stigmata row. Stigmata about 0.34 mm long. Anus opens at level of second stigmata rows (Fig. 2E). Smooth stomach in the posterior region of the abdomen. Testis follicle in gut loop (Fig. 2D). Embryo and larvae not found.

Distribution. Korea (present study), Australia.

Remarks. *Eudistoma purpureum* is distinguished by brilliant, opaque, purple color, smooth shiny surface, less lobed colony form, absence of symbionts, no distinct bulging sphincter in siphon and sparse sand only at the basal test (Kott, 1990). The present specimen is distinguished from *E. amplum* (Sluiter, 1909) previously recorded in the in the Western Pacific by opaque purple of colony, cushion shape of colony, and the absence of symbionts. The present specimen is distinguished from *E. angolatum* (Michaelson, 1914) previously recorded in the Indo-West Pacific by cushion shape of colony, sparse sand only at the basal test, no distinct bulging sphincter in siphon and zooids in circle. The present specimen is different from *E. illotum* (Sluiter, 1898) recorded in Korea in that it has much smaller zooids and very long atrial aperture.

Key to the *Eudistoma* species from Korean waters

- 1. Atrial aperture over 3 times length of branchial aperture; about 18–21 stigmata; colony color bluish in living..... *purpureum* Kott
- Atrial aperture similar length of branchial aperture..... 2
- 2. Zooids up to 5 mm long; about 20–25 stigmata; colony color greenish in living *viride* Tokioka
- Zooids up to 14 mm long..... 3
- 3. Colony without peduncle *illotum* (Sluiter)
- Colony with thick peduncle; about 8–10 stigmata; colony color greenish in living *glaucum* (Sluiter)

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CONFLICTS OF INTEREST

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

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