

Short communication

## First Record of the Genus and Species, *Rhopalaea crassa* (Ascidiacea: Aplousobranchia: Diazonidae) in Korea

Su Yuan Seo\*

Natural History Museum, Ewha Womans University, Seoul 03760, Korea

### ABSTRACT

The genus *Rhopalaea* Philippi, 1843 is firstly recorded as a Korean fauna. It is distinct from other genera of Diazonidae in order Aplousobranchia by having solitary individuals or at most two embedded in a common test. Solitary ascidian, *Rhopalaea crassa* (Herdman, 1880), is also newly reported from Korean waters. *Rhopalaea crassa* has a club-shaped body, developed thorax, a vertical gut loop and yellow patches in transparent test. Specimens of *R. crassa* examined in this study were collected from the subtidal zone of Jeju-do Island by scuba diving. In this paper, detailed descriptions and photographs of specimens and living forms of *R. crassa* are provided.

**Keywords:** taxonomy, ascidian, *Rhopalaea*, Diazonidae, Korean fauna

### INTRODUCTION

The genus *Rhopalaea* Philippi, 1843 is a subgroup of Diazonidae. The family Diazonidae Seeliger, 1906 has been recently placed under order Aplousobranchia (Shenkar et al., 2016). The genus *Rhopalaea* is dissimilar to other genera in that its zooids are solitary individuals or at most two are embedded in a common test. It is characterized by having large branchial sac, internal longitudinal vessels, and numerous rows of stigmata (Kott, 1990).

In this study, the genus *Rhopalaea* Philippi, 1843 is firstly recorded in Korean waters. *Rhopalaea crassa* (Herdman, 1880) is also newly reported as Korean fauna with detailed descriptions and photographs for living forms.

Specimens of *R. crassa* examined in this study were collected from the subtidal zone of Munseom and Supseom in Jeju-do islands by scuba diving. They were preserved in 4% buffered formalin and 99% ethyl alcohol. For identification, each specimen was examined for morphological characteristics such as test coloration, thoracic muscles, branchial aperture, atrial aperture, branchial sac, stigmata, endostyle, dorsal lamina and gut loop under a stereomicroscope SMZ 745T (Nikon, Tokyo, Japan). The color of each part was recorded with a color code based on a color chart (Pantone color

formula guide 747XR). Images of the collected living colonies prior to fixation were taken with a digital camera ILCE-7RM2 (Sony, Tokyo, Japan). Images of zooids were taken with a stereomicroscope Eclipse C1 (Nikon) equipped with a camera UHCCD05000KPA (Touptek Photonics, Zhejiang, China). The size of the zooid was then measured using an image analyzer Touptekview 3.7 (Touptek Photonics) and a ruler.

Specimens examined in this study were deposited in the Natural History Museum, Ewha Womans University, Seoul (EWNHMAS3683, 3757, 4156) and National Marine Biodiversity Institute of Korea, Seochun (MABIK IV00170876-00170878).

### SYSTEMATIC ACCOUNTS

Class Ascidiacea Blainville, 1824  
Order Aplousobranchia Lahille, 1886  
Family Diazonidae Seeliger, 1906  
1\*Genus *Rhopalaea* Philippi, 1843

2\**Rhopalaea crassa* (Herdman, 1880) (Fig. 1)

*Ecteinascidia crassa* Herdman, 1880: 723 (type locality: Ki Island, 260 m, Indonesia); 1882: 240.

Korean name: 1\*초롱곤봉명게속 (신칭), 2\*금초롱곤봉명게 (신칭)

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

\*To whom correspondence should be addressed  
Tel: 82-2-3277-3426, Fax: 82-2-3277-3720  
E-mail: syseo@ewha.ac.kr

*Rhopalaea crassa* Beneden, 1887: 21; Tokioka, 1953: 62; Millar, 1975: 262; Kott and Goodbody, 1982: 506; Nishikawa, 1991: 25; Monniot and Monniot, 2001: 297.  
*Rhopalaea mutuensis* Oka, 1927: 683.

**Material examined.** Korea: Two solitary zooids (EWNH MAS3683), Munseom (33°13'39"N, 126°33'51"E) in Jeju-do Island, 30 m deep, 21 Oct 2020, 21°C, Park SW and Lee JH by SCUBA diving; 2 solitary zooids (MABIK IV00170876, EWNHMAS3757), Supseom (33°23'20"N, 126°59'96"E) in Jeju-do Island, 25 m deep, 19 Apr 2021, 17°C, Park SW and Woo YS by scuba diving; 1 solitary zooid (MABIK IV00170877), Supseom (33°23'22"N, 126°59'72"E) in Jeju-do Island, 25 m deep, 19 Apr 2021, 17°C, Park SW and Woo YS by scuba diving; 1 solitary zooids (MABIK IV00170878), Munseom (33°22'72"N, 126°56'88"E) in Jeju-do Island, 25 m deep, 2 Oct 2021, 24°C, Park SW by scuba diving; 4 solitary zooids (EWNHMAS4156), Munseom (33°13'39"N, 126°33'51"E) in Jeju-do Island, 20 m deep, 2 Oct 2021, 24°C, Park SW by scuba diving.

**Description** (Fig. 1). Zooids solitary. Body long, club-shape, clearly divided into thoracic region and abdominal region. Body length of living zooid about 38 mm (n=4). In preserved specimens, body about 36 mm in length (n=10). The thoracic region cylindrical, 14.23–35.26 mm in length and 6.50–8.85 mm in diameter. Abdominal region 8.34–12.51 mm in length. Thoracic test of living zooids smooth, delicate, transparent and colorless. Abdominal test opaque white, irregular and tough with hydrozoan, bryozoan and shell fragments. All specimens wedged into space of substrates by expanded abdominal test like thick plant root. Brilliant yellow pigments (Pantone 106C) between lobes of both apertures like dot, in test over dorsal ganglion and in anal lobes. White pigments densely colored around branchial aperture like ring and along upper part of dorsomedian line (Fig. 1A). Yellow pigments remain pale and white pigments disappear in zooids preserved in 5% formalin (Fig. 1B). Branchial aperture located at top of body. Atrial aperture opened upward low right next to branchial aperture. Each aperture has 6 lobes with smooth border. About 9–12 thin thoracic longitudinal muscles on each side of thorax. Thoracic longitudinal muscle band arise from both apertures and run two thirds of thorax. Six to eight longitudinal muscle ramify toward ventral border mainly and 2–3 longitudinal muscle ramify toward dorsal border. Short horizontal muscles along ventral border on one-third of the lower thorax and along dorsal border. Horizontal muscles mostly branched from longitudinal muscle and some of the connections are not confirmed in preserved specimen (Fig. 1C). Muscles not present on abdomen.

Branchial tentacles about 17–20 with large ones (about

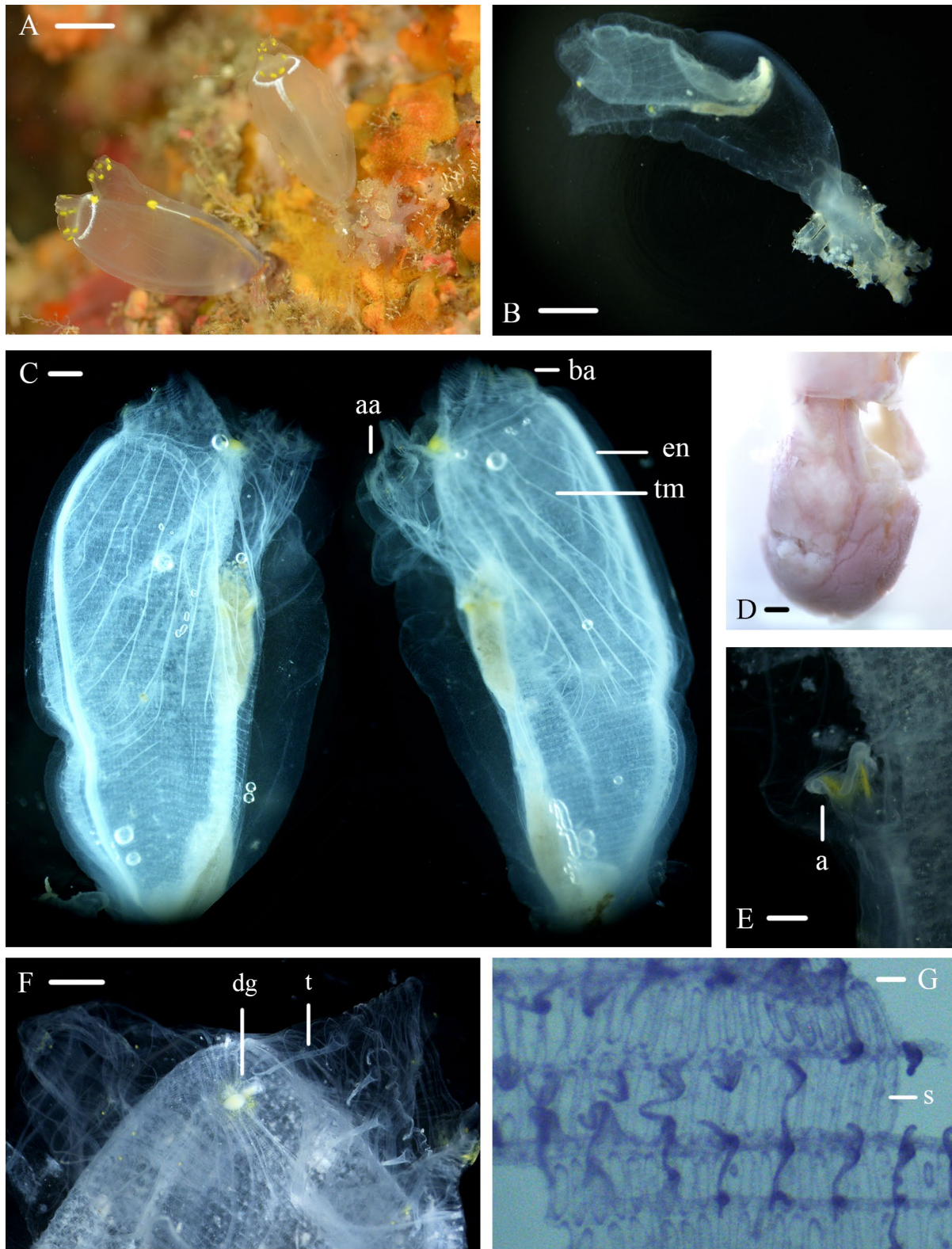
0.78 mm long) and small ones (about 0.32 mm long) alternately (Fig. 1F). Ciliated groove an oval slit. Branchial sac has 68–84 stigmata rows, 3–4 stigmata per mesh and 38–45 internal longitudinal vessels supported by simple conical process on each side of thorax. Stigmata long ellipse shape, about 0.12 mm long and about 0.02 mm wide (Fig. 1G). Dorsal languets fine pointed, flat and triangle shape. Abdomen tightly enclosed in thick test. Gut forms vertical loop (Fig. 1D). Oesophagus long. Elliptical stomach have surface with longitudinal plications and situated nearly in middle of abdomen. Rectum runs long next to oesophagus. Anus and gonoduct opening in anterior third of the branchial sac. Anus has two lobes with yellow patch and gonoduct white in living (Fig. 1E). Several ovaries and small testicular follicles situated densely in gut loop of Supseom's specimens collected on 19 Apr 2021.

**Distribution.** Korea (Jeju-do Island), Japan, Indonesia, Philippines, Hong Kong, Sri Lanka, Australia, Papua New Guinea.

**Remarks.** The present specimens are very similar to *Rhopalaea macrothorax* in solitary life style, developed thorax, transparent test, thoracic musculature, the presence of yellow dots on the dorsal ganglion and in anal lobes, and the presence of transverse muscles along the ventral border (Tokioka, 1953; Monniot and Monniot, 2008). But the present specimens and *R. macrothorax* differ in the numbers of stigmata rows and body length.

Tokioka has described that the characteristic of *R. macrothorax*, which is distinct from *R. crassa*, has 'many short transverse muscles arranged in a row in the endostyle' (Tokioka, 1953). However, according to Nishikawa's review, transverse muscles are a ramified part of thoracic longitudinal muscle. Thus this feature did not become the main key to dividing with *R. crassa* (Nishikawa, 1991). In the present study, thoracic horizontal muscles mostly branched from longitudinal muscle. It was observed that the horizontal muscle and the longitudinal muscle, which were connected while alive, was cut off after preservation treatment. Therefore, short muscle bands should not be the main feature to distinguish *R. macrothorax* from *R. crassa*.

Kott & Goodbody has discussed color variations of *R. crassa*. The conspicuous yellow in the thoracic test indicates the presence of blood cells containing vanadium with organic oxidizing ligand. The transparent tunic of living and fixed specimens is due to a relatively small amount of bloods in the test (Kott and Goodbody, 1982; Kott, 1990). So, Kott and Goodbody (1982) and Nishikawa (1991) has described *R. macrothorax* is conspecific with *R. crassa*. However, Monniot and Monniot (2008) and Shenkar (2013) has described that long thorax, transparent tunic, six yellow points in both siphons and musculature are characteristics that distinguish



**Fig. 1.** *Rhopalaea crassa* (Herdman, 1880). A, Solitary zooids in living; B, Zooid in preservative; C, Thorax; D, Abdomen with test removed; E, Anus; F, Tentacle and Dorsal ganglion; G, Stigmata (aa, atrial aperture; ba, branchial aperture; en, endostyle; tm, thoracic muscle; a, anus; dg, dorsal ganglion; t, tentacle; s, stigmata). Scale bars: A=10 mm, B, E=5 mm, C, D, F=1 mm, G=0.05 mm.

*R. macrothorax* from other *Rhopalaea* species (Monniot and Monniot, 2008; Shenkar, 2013). *R. macrothorax* is not synonymised with *R. crassa* (Shenkar et al., 2021).

The present specimens and *Rhopalaea sagamiana* Oka, 1927 are similar, but there are differences in that *R. sagamiana* has apparently complete absence of longitudinal vessels and 2 stigmata per mesh (Oka, 1927).

## ORCID

Su Yuan Seo: <https://orcid.org/0000-0003-2597-2351>

## CONFLICTS OF INTEREST

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

## ACKNOWLEDGMENTS

This research was supported by National Marine Biodiversity Institute of Korea (2021M01100) and the Natural History Museum of Ewha Womans University in part.

## REFERENCES

- Beneden E. van, 1887. Les genres Ecteinascidia Herd., *Rhopalaea* Phil. et Sluiteria n.g. Note pour servir à la classification des Tuniciers. Bulletin de la Classe des Science, Academie Royale de Belgique, 14:19-44.
- Herdman WA, 1880. Preliminary report on the Tunicata of the Challenger expedition. Part 2. Proceedings of the Royal Society of Edinburgh, 10:714-726.
- Herdman WA, 1882. Report on the Tunicata collected during the voyage of H. M. S. Challenger during the years 1873-1876. Part I: Ascidiæ simplices. Report on the Scientific

- Results of the Voyage of HMS Challenger, 6:1-285.
- Kott P, 1990. The Australian Ascidiacea. Part 2. Aplousobranchia (1). Memoirs of Queensland Museum, 29:1-298.
- Kott P, Goodbody I, 1982. The ascidians of Hong Kong. In: Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China. Hong Kong, 1980 (Eds., Morton BS, Tseng CK). Hong Kong University Press, Hong Kong, pp. 503-554.
- Millar RH, 1975. Ascidiæ from the Indo West-Pacific region in the Zoological Museum, Copenhagen (Tunicata, Ascidiacea). Steenstrupia, 3:205-336.
- Monniot F, Monniot C, 2001. Ascidiæ from the tropical western Pacific. Zoosystema, 23:201-383.
- Monniot F, Monniot, C, 2008. Compléments sur la diversité des ascidies (Ascidiacea, Tunicata) de l'ouest Pacifique tropical. Zoosystema, 30:799-872.
- Nishikawa T, 1991. The ascidiæ of the Japan Sea. II. Publications of the Seto Marine Biological Laboratory, 35:25-170.
- Oka A, 1927. Ueber zwei neue Rhopalaea-Arten aus Japan. Proceedings Imperial Academy, 3:681-683.
- Shenkar N, 2013. A new species of the genus *Rhopalaea* (Class: Ascidiacea) from the Red Sea. Zootaxa, 3599:51-58. <https://doi.org/10.11646/zootaxa.3599.1.4>
- Shenkar N, Gittenberger A, Lambert G, Rius M, Moreira da Rocha R, Swalla BJ, Turon X, 2021. Ascidiacea World Database. *Diazona* Savigny, 1816 [Internet]. World Register of Marine Species, Accessed 14 Aug 2021, <<http://www.marinespecies.org/aphia.php?p=taxdetails&id=103489>>.
- Shenkar N, Koplovitz G, Dray L, Gissi C, Huchon D, 2016. Back to solitude: solving the phylogenetic position of the Diazonidae using molecular and developmental characters. Molecular Phylogenetics and Evolution, 100:51-56. <https://doi.org/10.1016/j.ympev.2016.04.001>
- Tokioka T, 1953. Ascidiæ of Sagami Bay. Iwanami Shoten, Tokyo, pp. 1-313.

Received October 17, 2021  
Revised October 20, 2021  
Accepted October 20, 2021