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Redescription of three trapanian nudibranchs (Nudibranchia, Goniodorididae) from Korea with a key to the species

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Three species belonging to the genus *Trapania* Pruvot-Fol, 1931 are redescribed from Korea in this paper: *Trapania euryeia* Gosliner & Fahey, 2008, *T. japonica* (Baba, 1935), and *T. toddi* Rudman, 1987. Among these species, *T. japonica* is newly added to Korean fauna. The genus *Trapania* is characterized by a pair of extra-rhinophoral appendages on each side of the head, tentacular foot corners, a pair of extra-branchial appendages present around the gill, radula formula N × 1.0.1. and consists of denticulated teeth, triaulic reproductive system, and minute spines on the armed penis. Herein, synonyms of the genus *Trapania* are summarized through a detailed literature review and the diagnostic characters of the genus *Trapania* are provided. Three species of the genus *Trapania* from Korea are distinguished from each other based on the color of extra-rhinoporal appendages and extra-branchial appendages, ground color, and distribution range of the brown markings on the dorsal surface. A taxonomic key to the genus *Trapania* in Korea is provided. In addition, the morphological characteristics of three trapanian nudibranchs in Korea are described and detailed photos of living animal are provided.

Keywords: Goniodorididae, Korea, Nudibranchia, *Trapania euryeia*, *Trapania japonica*, *Trapania toddi*

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Introduction

The genus *Trapania* Pruvot-Fol, 1931 comprises 47 valid species worldwide (MolluscaBase eds., 2021). Species of this genus are often found on red sponges, indicating that they feed on the entoprocts in symbiosis with these sponges (Gosliner *et al*., 2015). This genus was originally established by Lafont (1874) as *Drepania*. However, Pruvot-Fol (1931) considered *Drepania* to be a junior homonym of *Drepania* Hübner, 1816 (Insecta, Lepidoptera, Drepanida) and then replaced it with *Trapania*. MacFarland (1931) also confirmed that *Drepania* was a junior homonym and proposed to change to *Drepanida*. Rudman (1987) identified that Pruvot-Fol (1931) published a month earlier than *Drepanida* of MacFarland (1931) and recognized *Trapania* as the valid genus name.

The genus *Trapania* shows the following diagnostic characteristics: (1) body limaciform, the dorsal edge is not distinct; (2) a pair of curved extra-rhinophoral appendages and extra-branchial appendages are present; (3) non-retractile gill consists of trifoliated branchial leaves; (4) foot is narrow and tentacle-like foot corners present; (5) Radula formula N × 1.0.1 (Rudman, 1987; Gosliner and Fahey, 2008; Gosliner *et al*., 2015).

In Korean waters, two traphanian nudibranchs, *T. euryeia* and *T. toddi*, were reported by Kil *et al*. (2020) with underwater photos and diagnosis. During a continuous faunal study of Korean nudibranchs, *Trapania japonica* (Baba, 1935) was reported from Korea for the first time. In the present study, three species belonging to the genus *Trapania* are re-described, *Trapania euryeia* Gosliner & Fahey, 2008, *T. japonica* (Baba, 1935) and *T. toddi* Rudman, 1987. The species examined here are distinguished from each other by the color of the extra-rhinophoral appendages and extra-branchial appendages, the ground color, and the size of brown dorsal markings. Based on these characteristics, a taxonomic key is also provided. In addition, the diagnosis of the genus *Trapania* is presented.

Materials and Methods

The individuals examined in this study were collected

through scuba diving in the East Sea of Korea from 2018 to 2020. Living animals and their surroundings were photographed (Olympus Tough TG-6, Tokyo, Japan). The collected samples were anesthetized by gradually dropping 8% $MgCl_2$ solution into seawater, and the samples fixed in 95% ethyl alcohol. The external morphology was observed under a stereoscopic microscope (Olympus SZ-61, Tokyo, Japan). The voucher specimens were deposited in the National Institute of Biological Resources (NIBR), Incheon, Republic of Korea, and Korea Marine-Bio Laboratory (KMBL), Daejeon, Republic of Korea.

Systematic Accounts

Phylum Mollusca Linnaeus, 1758 연체동물문
Class Gastropoda Cuvier, 1797 복족강
Order Nudibranchia Cuvier, 1817 나새목
Family Goniodorididae H. Adams & A. Adams, 1854
불꽃갯민숭이달팽이과

***Genus *Trapania* Pruvot-Fol, 1931**
꼭지갯민숭달팽이속(신칭)
Drepania Lafont, 1874: 369, 370 (cited by Gosliner & Fahey, 2008; Not *Drepania* Huebner, 1816, Insecta, Lepidoptera).
Trapania Pruvot-Fol, 1931: 747, replacement name for *Drepania* Lafont, 1874.
Drepanida MacFarland, 1931: 31, 32, by original designation (cited by Gosliner & Fahey, 2008).
Type species. *Drepania fusca* Lafont, 1874.

Diagnosis. Body narrow and elongate, mantle edge not distinct. A pair of extra-rhinophoral appendages present at the base of the rhinophores. Gill non-retractile and trifoliate. Extra-branchial appendages on each side of the gill. Foot narrow; tentacular foot corner present. Radula consists of denticulated teeth. Radula formula N × 1.0.1. Reproductive system triaulic, Penis armed with minute spines.

***Trapania euryeia* Gosliner & Fahey, 2008**
갈색꼭지갯민숭달팽이(Fig. 1)
Trapania euryeia Gosliner & Fahey, 2008: 75–78, figs. 1I, 18, 19, 35B; Gosliner *et al*., 2008: 133; 2015: 144; Kil *et al*., 2020: 230, 231.
Trapania brunnea Ono, 1999: 75.
Type locality. Madang, Papua New Guinea.

Distribution. Korea, Japan, Reunion, Indonesia, Papua New Guinea, Marshall Islands, USA (Midway Atoll and Hawaii), and Australia (Gosliner and Fahey, 2008; Gosli-

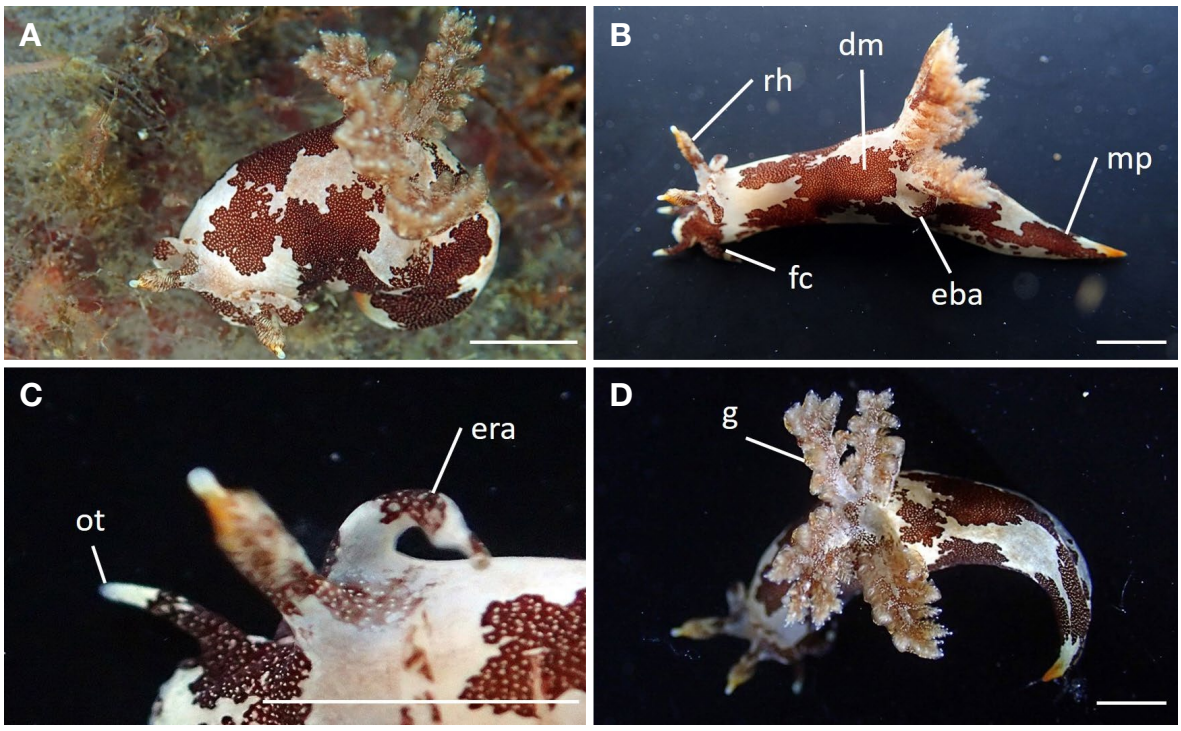

Fig. 1. *Trapania euryeia* Gosliner & Fahey, 2008. A. Dorsal view, living animal and its habitat; B. Dorso-lateral view; C. Rhinophore and extra-rhinophoral appendage on the right side of the head; D. Gill and metapodium; A–D. live animal photographs. Scale bars = 1 mm. Abbreviations: rh, rhinophore; era, extra-rhinophoral appendage; ot, oral tentacle; fc, foot corner; dm, dorsal marking; g, gills; eba, extra-branchial appendage; mp, metapodium.

ner *et al*., 2008; Kil *et al*., 2020).

Material examined. 1 individual (NIBRIV0000836104), Wangdolcho, Hupo-ri, Hupo-myeon, Uljin-gun, Gyeongsangbuk-do, Korea, 30 August 2018, coll. H.J. Kil, E. Nam and H. Kim, with SCUBA.

Description. Body limaciform, convex, and slightly widened around the gill. The body length of the preserved specimen 4 mm. Ground color milky white. Relatively large in size and irregular-shaped brown markings broadly cover the dorsal surface; numerous white specks present on the inside of these brown markings (Fig. 1A, B). The tip of rhinophores translucent white. Clavus with nine lamellae, the anterior part of the upper one-third of the clavus orange in color, the rest of the clavus opaque white with brown patches. Stalk smooth, thick, and translucent. A pair of extra-rhinophoral appendages present each side of the head, next to the rhinophores (Fig. 1C); smooth, long, blunt end, curved upward, translucent with brown patches and white specks. Gill relatively large, consists of four bipinnate branches (Fig. 1D). Branchial leaves pale brown with white specks. Branchial leave rachis translucent white. Extra-branchial appendages relatively short, smooth, blunt end, and bent backward. Oral tentacles smooth; the tip of oral tentacles translucent white. Tentacular foot corners smooth, pointed end. The length of oral tentacle and tentacular foot corners approximately same. Metapodium long, yellow marking present on metapodium end, the tip of metapodium pointed and translucent white.

Remarks. Gosliner & Fahey (2008) described that this species has seven to eight lamellae on clavus of rhinophore and three gill branches, while nine lamellae and four gill branches are observed in the specimen examined here. All other characteristics are consistent with those from the original description.

***Trapania japonica* (Baba, 1935)**

흰꼭지갯민숭달팽이(신칭) (Fig. 2)

Drepania japonica Baba, 1935: 336–338, text fig. 4 (cited from Baba, 1990).

Trapania japonica (Baba, 1935) Rudman, 1987: 197–201, figs. 3C, 7a, 8, 9; Baba, 1990: 8, 9, figs. 1–3.

Type locality. Mutsu Bay, Aomori, Japan.

Distribution. Korea, China (Hong Kong), Japan, Australia (Rudman, 1987; Baba, 1990).

Material examined. 1 individual (NIBRIV0000868685), Janggil-ri, Guryongpo-eup, Nam-gu, Pohang-si, Gyeongsangbuk-do, Korea, 8 August 2019, coll. C.Y. Park, with SCUBA.

Description. Body limaciform and convex (Fig. 2A, B). The body length of the preserved specimen 7 mm. Ground

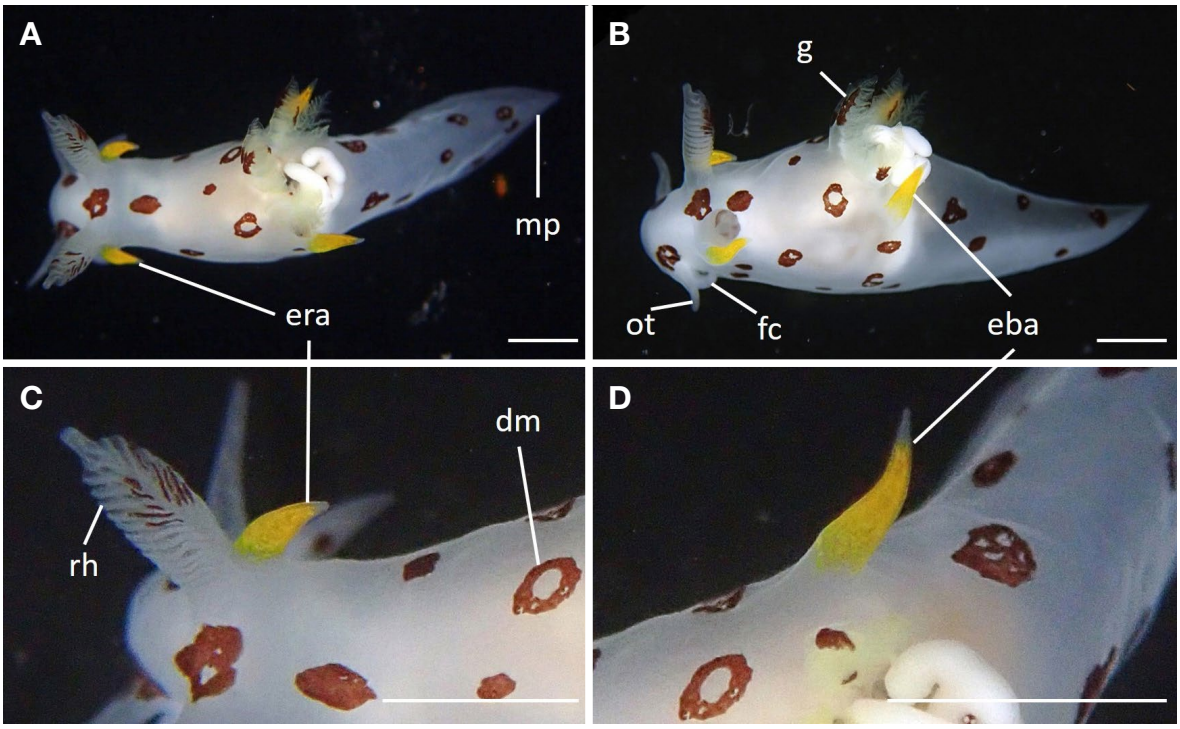

Fig. 2. *Trapania japonica* (Baba, 1935). A. Dorsal view; B. Dorso-lateral view; C. Rhinophore and extra-rhinophoral appendage on the right side of the head; D. Extra-branchial appendage; A–D. live animal photographs. Scale bars = 1 mm. Abbreviations are same to those in the Fig. 1. Photo by Chan-yong Park.

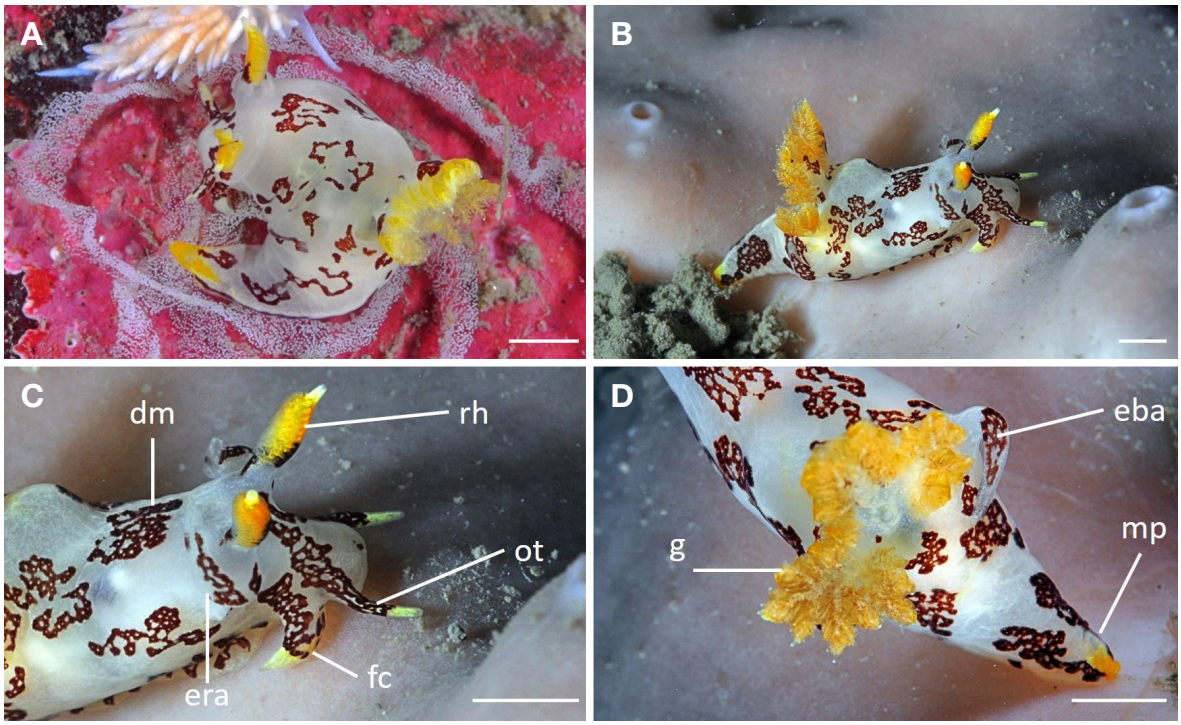

Fig. 3. *Trapania toddi* Rudman, 1987. A. Dorsal view, living animal and its egg mass; B. Dorso-lateral view; C. Head; D. Gill and metapodium; A–D. live animal photographs. Scale bars = 1 mm. Abbreviations are same to those in the Fig. 1. Photo by Seung-goo Ra.

color translucent white. Brown colored rounded or ringed patches present from head to metapodium except for the appendages and the foot. Rhinophores translucent white (Fig. 2C). Clavus with eleven lamellae. Stalk smooth, thick, and relatively short. A pair of extra-rhinophoral appendages present next to the rhinophores; smooth, long, pointed end, bent backward, and upper half yellow in color. Gill consists of three bipinnate branches and translucent. Extra-branchial appendages relatively short, smooth, pointed end, curved upward, and upper half yellow in color (Fig. 2D). Oral tentacles smooth and translucent white. Tentacular foot corners smooth and pointed end. Oral tentacle slightly longer than tentacular foot corner. Metapodium long, metapodium end pointed.

Remarks. Baba (1935) did not properly record the body color and pattern in the dorsal patches of *T. japonica* because of the use of fixed specimens. The specimens used in this study had the same characteristics as the original description, except for body color and pattern. Afterward, Rudman (1987) recorded the body color of *T. japonica* for the first time using specimens collected from Hong Kong and Australia. The specimen examined here is similar to the specimen obtained from Hong Kong rather than the Australian specimen by Rudman (1987) in that the brown markings on the dorsal surface are relatively small in size and light brown in color.

***Trapania toddi* Rudman, 1987**

노랑꼭지갯민숭달팽이 (Fig. 3)

Trapania toddi Rudman, 1987: 204–206, figs. 2E, 3D, 12C, 13; Gosliner *et al*., 2008: 138; 2015: 144.

Trapania cf. *toddi* Kil *et al*., 2020: 232, 233.

Type locality. Hong Kong (China).

Distribution. Korea, China (Hong Kong), Red Sea, Australia.

Material examined. 2 individuals (NIBRIV0000882625), Gonghyeonjin-ri, Jugwang-myeon, Goseong-gun, Gangwon-do, Korea, 17 July 2020, S.G. Ra, with SCUBA; 1 individual (KMBLND00117), Nagok-ri, Buk-myeon, Uljin-gun, Gyeongsangbuk-do, Korea, 31 May 2020, coll. D.-W. Jung, with SCUBA.

Description. Body limaciform and convex, the body length of the preserved specimen 5–9 mm. Ground color opaque white. Irregular-sized and reticulated patterned brown markings scattered on dorsal surface except the foot (Fig. 3A, B). Numerous white or pale-yellow specks present on the dorsum. The tip of rhinophores translucent with white specks. Clavus lamellated; upper half of the clavus pale orange to light brown in color and lower half opaque white. Stalk smooth, thick, short, and translucent (Fig. 3C). A pair of extra-rhinophoral appendages present next to the rhinophores, smooth, long, pointed end, curved backward or upward. Gill consists of three, bipinnate or

tripinnate branches (Fig. 3D). Branchial leaves pale yellow or light brown with white specks. Branchial leave rachis translucent white. Extra-branchial appendages long, smooth, pointed end, and curved toward the metapodium or upward. Oral tentacles smooth; the tip of oral tentacles translucent, thick yellow band present under the tip, Tentacular foot corners smooth, pointed end. Oral tentacle slightly longer than tentacular foot corner. Metapodium long, yellow marking present on metapodium end, the tip of metapodium pointed and translucent white in color.

Remarks. This species is similar to *T. euryeia* in the brown marking on dorsal surface and the brown patches on the extra-rhinophoral appendages and extra-branchial appendages. However, the brown markings on dorsum of *T. toddi* are characterized by relatively small in size and sparse distribution, whereas the dorsal brown markings of *T. euryeia* are relatively large and appear widely on the dorsal surface.

Key to the species of the genus *Trapania* Pruvot-Fol, 1931 from Korea

1. The color of extra-rhinophoral appendages and extra-branchial appendages same or similar as the ground color from translucent white to pale yellow ····· 2
- The color of the upper half of extra-rhinophoral appendages and extra-branchial appendages yellow ····· ·····*Trapania japonica*
2. Ground color milky white or pale yellow, and brown dorsal markings widely distributed on the body surface ·····*Trapania euryeia*
- Ground color translucent white, and brown dorsal markings relatively small and present sparsely ····· ····· *Trapania toddi*

Conflicts of Interest

The authors declare that there is no conflict of interest.

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