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Short communication

A Report on Five New Records of Nudibranch Molluscs from Korea

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ABSTRACT

The Korean nudibranch faunal study has been conducted since 2011 and five species including *Dermatobranchus otome* Baba, 1992, *Mexichromis festiva* (Angas, 1864), *Noumea nivalis* Baba, 1937, *Hoplodoris armata* (Baba, 1993), and *Okenia hiroi* (Baba, 1938) were newly reported with re-descriptions and figures. Also, *Noumea purpurea* Baba, 1949 was re-described with illustrations because previous records for this species were given without a description. Two congeneric species in the genus *Noumea* could be distinguished by ground color, dorsal markings, color of the mantle edge and gills, and mantle and dorsal marking. In addition, mitochondrial cytochrome c oxidase subunit I (COI) sequences of five species were provided for further molecular identification study. Consequently, a total of 43 species have been reported for the Korean nudibranch fauna.

Keywords: Nudibranchia, taxonomy, *Dermatobranchus otome, Mexichromis festiva, Noumea nivalis, Noumea purpurea, Hoplodoris armata, Okenia hiroi*, Korea

INTRODUCTION

Species in the order Nudibranchia are characterized by a lack of shell in adult stage, highly diverse body form and various mechanical and chemical defense mechanisms (Yonow, 2008). Nudibranchs include more than 6,000 species worldwide (Gosliner et al., 2008). Despite the high global diversity of nudibranchs, only 38 species have been reported in Korea (Choe, 1992; Choe and Lee, 1994, 1997; Lee and Min, 2002; Choi, 2003; Jung et al., 2013a, 2013b). Herein, we briefly describe five species as being new to Korean fauna: *Dermatobranchus otome* Baba, 1992, *Mexichromis festiva* (Angas, 1864), *Noumea nivalis* Baba, 1937, *Hoplodoris armata* (Baba, 1993) and *Okenia hiroi* (Baba, 1938). Also, *Noumea purpurea* Baba, 1949 previously reported in Korea without description (Lee and Min, 2002; Choi, 2003), was re-described in this study. In addition, mitochondrial cytochrome c oxidase subunit I (COI) sequences of the five species were provided for their molecular identification.

Specimens were collected by scuba diving in the sub-tidal zone of the Korean coast from January 2011 to August 2013. They were preserved in 10% neutral buffered formalin or 97 % ethanol. A stereoscopic microscope (Olympus SZ-61 with FuzhouTucsen TCA-3; Olympus, Tokyo, Japan) was used to examine the specimens. Body length was measured from the anterior end to the tip of the metapodium. The specimens examined were deposited at the National Institute of Biological Resources (NIBR), Incheon, Korea and Sangmyung University, Seoul, Korea. The specimen numbers for NIBR were indicated in the information for the corresponding specimens.

Genomic DNA was extracted from the foot of the animal by using the DNA AccuPrep Genomic DNA Extraction Kit (Bioneer, Daejeon, Korea). PCR amplification was executed for mitochondrial COI sequences using a metazoan universal primer set (LCO1490, HCO2198) (Folmer et al., 1994). PCR products were purified and sequenced using a 3730xl DNA Analyzer (Applied Biosystems, Foster City, CA, USA). Each primer was removed and, by translating the sequences, the numts were checked using Geneious pro 5.0.4 (Drummond et al., 2010). Mitochondrial COI sequences from the species examined were deposited in the GenBank (accession numbers: KF648916-20).

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SYSTEMATIC ACCOUNTS

Phylum Mollusca Linnaeus, 1758
Class Gastropoda Cuvier, 1795
Order Nudibranchia Cuvier, 1817
Family Arminidae Iredale and O'Donoghue, 1923
Genus *Dermatobranchus* van Hasselt, 1824

***Dermatobranchus otome* Baba, 1992 (Fig. 1)**

Pleuroleura striata: Eliot, 1913: 41, 42 (not *Dermatobranchus striatus* van Hasselt, 1824).

Dermatobranchus striatus: Baba, 1937: 316, 317, Pl. 2, fig. 1, text-fig. 12; 1949: 73, 157, 158, Pl. 29, fig. 109, text-fig. 83; 1976: 4–6, figs. 1–2 (not *Dermatobranchus striatus* van Hasselt, 1824).

Dermatobranchus otome Baba, 1992: 242–245, figs. 3–5, Pl. 1, fig. 3; Okutani, 2000: 801; Gosliner and Fahey, 2011: 273–275, figs. 20–21.

Material examined. Korea: 1 individual, Jeollanam-do: Sinan-gun, Heuksan-myeon, Gageo-do, 13 Oct 2011; 5 individuals, Jeju-do: Jeju-si, Udo, 29 Jun 2013; 1 individual, Jeju-do, Jeju-si, Dodu-dong, 30 Jun 2013; 21 individuals, Jeju-si, Hangyeong-myeon, Gosan-ri, 12 Jul 2013 (KOSPIV000018 6276).

Description. Body elongate (length, 9–23 mm; width, 3–7 mm) and milky white to pale pink (Fig. 1A, B). Oral veil smooth and large, milky white; extend with rounded margin. Rhinophores locate behind the oral veil; red rhinophoral clubs with longitudinal lamellae, each tip of rhinophoral clubs bright red or white; stalk colorless and slightly narrower than club. Head veil indistinct. Whole dorsum covered with numerous longitudinal ridges, ridges extend in parallel; ridges white to pale pink; depression of between ridges lighter color than ridges. A transversal band of semilunar shape locate about two-fifths of body length from anterior end of dorsum, mostly dark brown to black (Fig. 1C); rarely weak gray. Numerous black spots surrounded by grayish pink ocellus on dorsal sur-

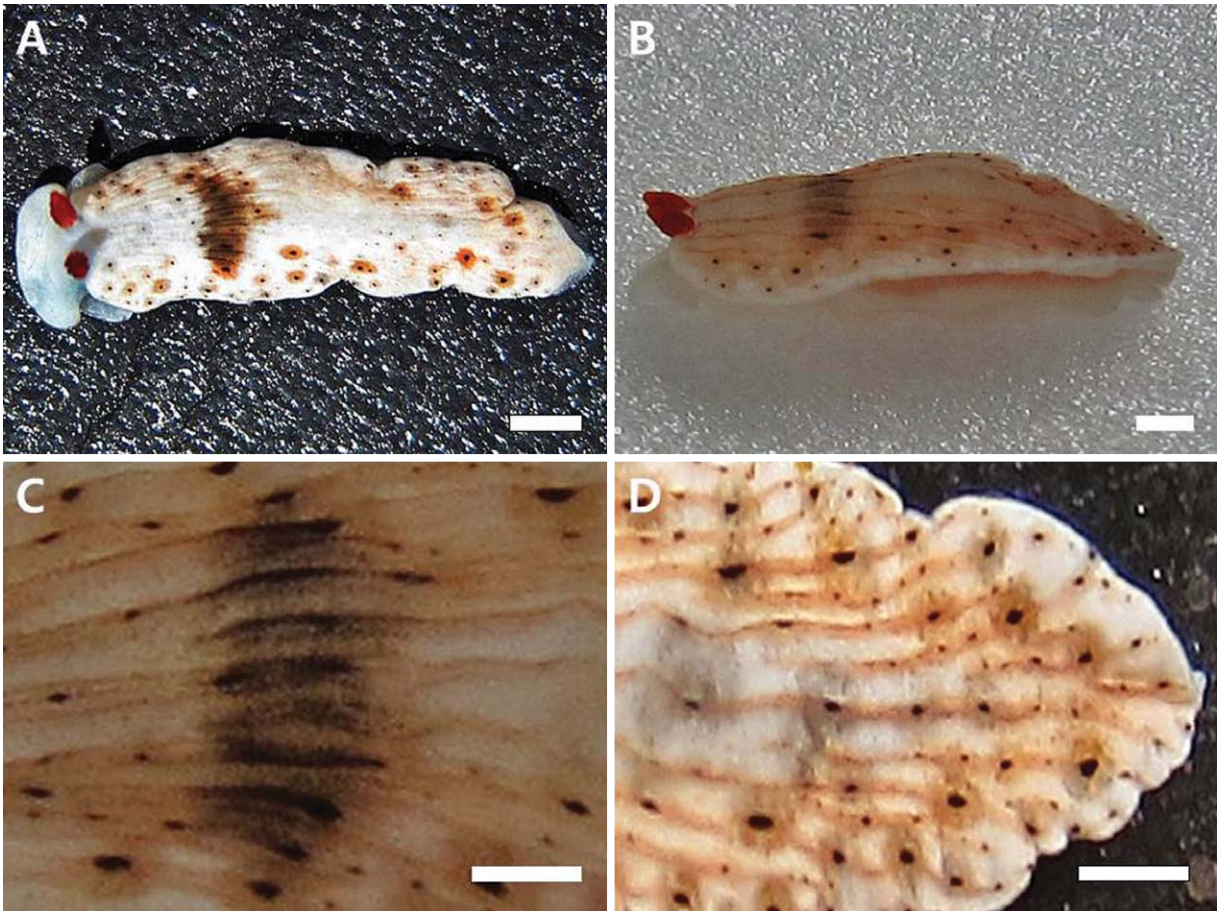

Fig. 1. *Dermatobranchus otome* Baba, 1992. A, Dorsal view, living animal (body length, 13 mm); B, Lateral view, preserved specimen; C, Dorsal transversal band; D, Black spots on dorsum. Scale bars: A–D=1 mm.

Fig. 2. *Mexichromis festiva* (Angas, 1864), living animal (body length, 19 mm). Scale bar=1 mm.

face (Fig. 1D). Ventral mantle and foot white. Lateral side of body smooth without lamellae. Genital orifices and anus locate on right side of body under the mantle; genital orifices situate about one-seventh of body length from anterior end. Anus locates two-fifth of body length from anterior end and beside the dorsal transversal band.

Distribution. Korea, Japan.

Remarks. Forty-one valid species have been recorded in the genus *Dermatobranchus* (Bouchet, 2013). *Dermatobranchus otome* is the only *Dermatobranchus* species which has been recorded in Korea until now. *Dermatobranchus otome* resembles closely to *Dermatobranchus primus* because two species have the black dorsal spots. They are distinguished by color of rhinophoral clubs and margin of oral veil. *Dermatobranchus otome* possesses red rhinophoral clubs and white border of oral veil, while *D. primus* shows black rhinophoral clubs and yellow border of oral veil (Baba, 1976).

Family Chromodorididae Bergh, 1891
Genus *Mexichromis* Bertsch, 1977

***Mexichromis festiva* (Angas, 1864) (Fig. 2)**

Goniodoris festiva Angas, 1864: 53–54, Pl. 4, fig. 12.

Hypselodoris festiva: Basedow and Hedley, 1905: 142 [not (*Hypselodoris festiva* Adams, 1861)] (cited from Rudman, 1983).

Chromodoris festiva: Bergh, 1893: 417–419, Pl. 4, figs. 18-22; Burn, 1965: 88; Rudman, 1973: 194, 196, table 1.

Mexichromis festiva: Rudman, 1983: 155–158, figs. 12G, 21, 23; Baba, 1989: 15–19, figs. 3–5; Debelius and Kuiter, 2007: 209.

Material examined. Korea: 1 individual, Gyeongsangbuk-do, Ulleung-gun, Seo-myeon, Namyang-ri, 2 Aug 2013 (KO SPIV0000186277).

Description. Body elongately ovate (length, 19 mm; width, 9 mm), ground color translucent white. Rhinophoral clubs lamellate and reddish purple in color, stalks translucent white and slightly narrower than clubs. Gills 9 and unipinate, encircled anus, translucent white with reddish purple edge. Mantle margin golden yellow, sometimes broken. Submarginal band white. Small conical tubercles cover entire dorsum, translucent white or colorless. Several reddish purple mammillary tubercles round and low profile scattered dorsum. Metapodium end blunted. Weak purple striped submarginal band extends from both sides of head to tip of metapodium; posterior of the band darker than anterior. Sole opaque white. Oral tentacles digitiform, short, tips reddish purple. Genital orifices locate right side of body and about one-fifth of body length from anterior end.

Distribution. Korea, Japan, Hong Kong, Eastern Austrailia.

Remarks. *Mexichromis* includes 13 valid species (Bouchet and Caballer, 2013). *Mexichromis festiva* is the first reported species from Korea in the genus. *Mexichromis festiva* and *M. mariei* are very similar in body color, but they are distinguished by color of submargin of foot and shape of dorsal tubercles (Rudman, 1983). *Mexichromis festiva* shows fainted purple line on submargin of foot, while *M. mariei* has heavy

Table 1. Comparison of diagnostic characters distinguishing *Noumea nivalis* and *N. purpurea*

Character	Species	
	N. nivalis (Fig. 3A)	*N. purpurea* (Fig. 3B)
Ground color	White	Light purple
Dorsal marking	Absent or few orange spots	An white line from rhinophores to gills
Color of gills	White, sometimes orange tips	Vermilion

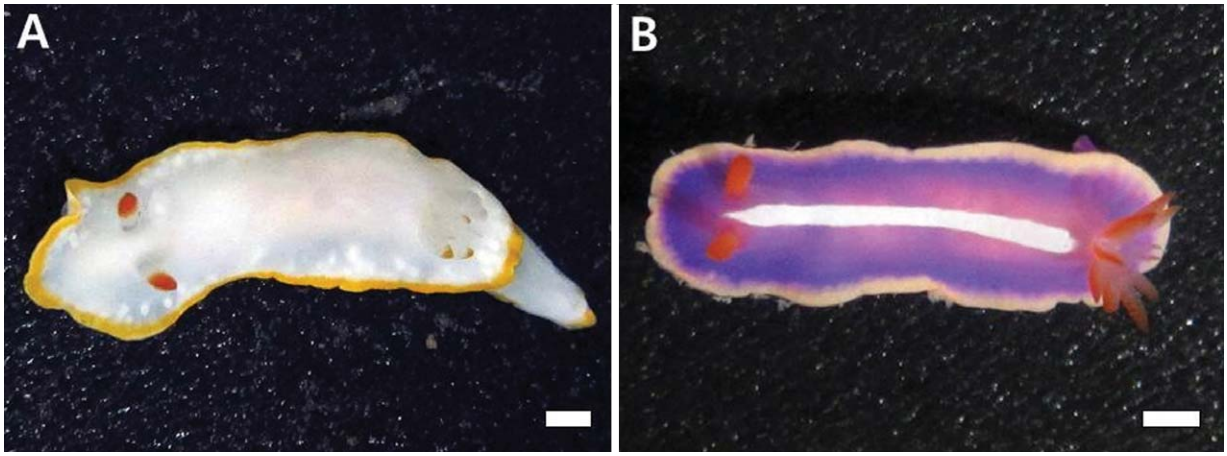

Fig. 3. Photographs of living animals. A, *Noumea nivalis* Baba, 1937 (body length, 13 mm); B, *Noumea purpurea* Baba, 1949 (body length, 10 mm). Scale bars: A, B=1 mm.

purple line (Rudman, 1983). In the shape of dorsal tubercles, *M. festiva* has rounded tubercles, whereas *M. mariei* shows pointed tubercles (Rudman, 1999).

Genus *Noumea* Risbec, 1928

***Noumea nivalis* Baba, 1937 (Table 1, Fig. 3A)**

Noumea nivalis Baba, 1937: 298, 299, text-fig. 4; 1949: 54, 144, text-fig. 61, Pl. 19, fig. 68; 1987: 23; Rudman, 1985: 250–254, figs. 1, 6, 7A; Rudman and Darvell, 1990: 55, Pl. 5D; Okutani, 2000: 791; Debelius and Kuiter, 2007: 205; Gosliner et al., 2008: 249.

Noumea decussata: Abe, 1964: 49, 50, fig. 18, Pl. 22, fig. 80 (not *Noumea decussata* Risbec, 1928).

Chromodoris alba: Orr, 1981: 31 (not *Doris alba* van Hasselt, 1824) (cited from Rudman and Darvell, 1990).

Material examined. Korea: 9 individuals, Jeju-do: Jeju-si, Hangyeong-myeon, Gosan-ri, 12 Jul 2013; 1 individual, Gyeongsangbuk-do: Ulleung-gun, Seo-myeon, Namyang-ri, 2 Aug 2013 (KOSPIV0000186278).

Description. Body elongately ovate (length, 8–13 mm; width, 5–8 mm). Ground color milky white. Rhinophores lamellate, clubs reddish orange, stalks colorless. Gills 7–9 and unipinate, form a circle surrounding anus, translucent white, sometimes one or more tips with an orange spot. Mantle narrow, thin, slightly undulated. Mantle with a yellow marginal band. Numerous white mantle glands locate inside the marginal band. Few orange spots on dorsal surface in few specimens. Metapodium with blunted end, translucent white, sometimes with yellow tip. Ventral side of mantle, oral tentacles, and sole translucent white. Oral tentacles digitiform. Genital orifices locate right side of body and one-fourth of body length from anterior end.

Distribution. Korea, Japan, Hong Kong.

Remarks. This species is similar to *Noumea purpurea* which was previously recorded in Korea in the body size and external shape, but it can be easily distinguished by the following characteristics (Table 1).

***Noumea purpurea* Baba, 1949 (Table 1, Fig. 3B)**

Noumea purpurea Baba, 1949: 55, 144, 145, Pl. 19, fig. 70, text-fig. 63; Rudman, 1986: 311–316, figs. 1–3; Okutani, 2000: 791; Lee and Min, 2002: 145; Choi, 2003: 35, 36; Debelius and Kuiter, 2007: 203; Gosliner et al., 2008: 245.

Noumea gloriosa: Abe, 1964: 50, Pl. 23, fig. 81 (not *Chromodoris gloriosa* Bergh, 1874).

Noumea norba Marcus and Marcus, 1970: 161–163, figs. 19–22; Rudman, 1984: 143, fig. 17D, E.

Thorunna gloriosa: Bertsch and Johnson, 1981: 60 (top photo

only; not *Chromodoris gloriosa* Bergh, 1874).

Material examined. Korea: 1 individual, Jeju-do: Seogwipo-si, Seogwi-dong, 27 Jun 2013; 1 individual, Jeju-si, Dodu-dong, 1 Jul 2013.
Description. Body elongate, ovate (length, 7–10 mm; width, 4–5 mm). Body light pinkish purple. Rhinophores lamellate, clubs and stalks vermilion. Gills 10 and unipinate, form a circle surrounding anus, same color as rhinophores. Mantle narrow and thin. Mantle marginal band weak yellow to apricot. Mantle submarginal band deep purple. A thick white line on middle of dorsum extends from rhinophores to gills. Metapodium light pinkish purple with pointed end. Ventral side of mantle, oral tentacles, and sole deep pinkish purple. Oral tentacles digitiform. Genital orifices locate right side of body and one-fifth of body length from anterior end.
Distribution. Korea, Japan, Hawaii, Marshall Islands, Fiji, Australia.
Remarks. *Noumea purpurea* is re-described in this study. This species has been reported previously in Korea without description (Lee and Min, 2002; Choi, 2003).

Family Discodorididae Bergh, 1891
Genus *Hoplodoris* Bergh, 1880

***Hoplodoris armata* (Baba, 1993) (Fig. 4)**
Carminodoris armata Baba, 1993: 223–226, figs. 1–6.
Hoplodoris armata: Domínguez et al., 2006: 153, table 1.

Material examined. Korea: 1 individual, Jeju-do: Seogwipo-si, Seongsan-eup, Seongsan-ri, 15 Jan 2011; 2 individuals, Gyeongsangnam-do: Tongyeong-si, Yokji-myeon, 7 May 2011; 1 individual, Gyeongsangbuk-do: Ulleung-gun, Ulleung-eup, Dokdo-ri, 4 Aug 2013; 1 individual, Ulleung-gun, Ulleung-eup, Dokdo-ri, 5 Aug 2013 (KOSPIV0000186279).
Description. Body ovate and swollen (length, 42–51 mm; width, 29–33 mm). Ground color yellowish brown (Fig. 4A). Rhinophoral clubs lamellate and dark brown; stalk opaque

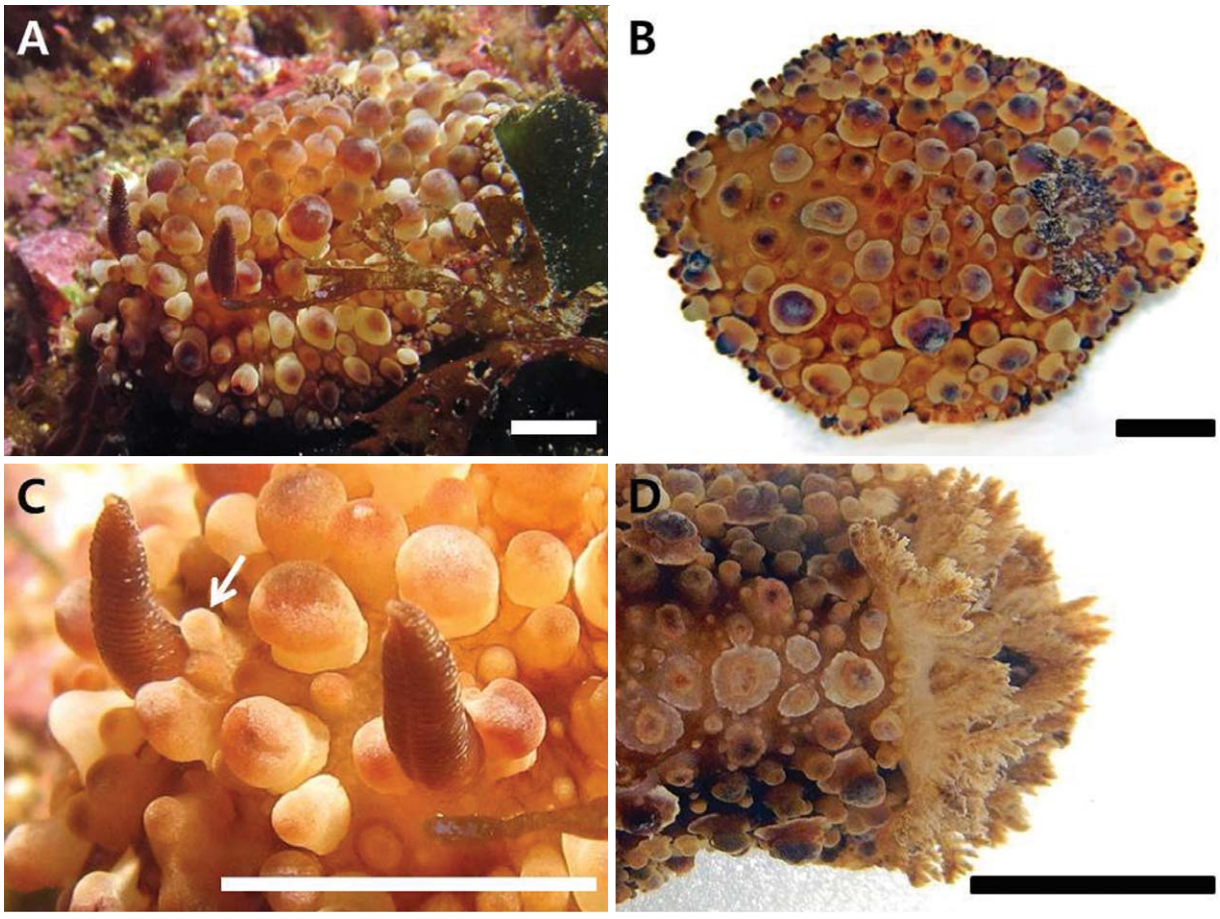

Fig. 4. *Hoplodoris armata* (Baba, 1993). A, Dorso-lateral view, living animal (body length, 51 mm); B, Dorsal view, preserved specimen; C, Rhinophores with Rhinophoral sheath; D, Gills. Scale bars: A–D=10 mm.

brown. Each rhinophoral sheath with a couple of large tubercles; sometimes supplemented with a small tubercle (Fig. 4C). Gills six and trippinate, form a circle surrounding anus. Marginal gill pocket tuberculate (Fig. 4D). Mantle wide and covers whole foot. Mammillary tubercles cover dorsum, single rounded and vary in size; several mammillary tubercles encircled by white to bright yellow ring (Fig. 4B); some tip of mammillary tubercles chocolate brown or dark gray. Ventral side of mantle, oral tentacles and sole opaque brown. Oral tentacles digitiform. Anterior foot bilabiate. Genital orifices locate right side of body and one-fourth of body length from anterior end.

Distribution. Korea, Japan.

Remarks. Baba (1993) suggested that *Hoplodoris armata* is differentiated from *H. bifurcata* by the morphology of the radula tooth. *Hoplodoris armata* has hamate and smooth lateral teeth, while *H. bifurcata* has a bicuspid tip on each of the first lateral teeth (Baba, 1993). Radula morphology of the present specimens observed by optical microscope matched with original description. All specimens examined in this study showed a small tubercle around each rhinophore sheath (Fig. 4C). This characteristic is considered to be intraspecific variation. Other characteristics shown in the present specimens matched well with the original description.

Family Goniodorididae H. Adams and A. Adams, 1854
Genus *Okenia* Menke, 1830

***Okenia hiroi* (Baba, 1938) (Fig. 5)**

Hokinsiella hiroi Baba, 1938: 10–11, fig. 7; 1949: 47, 48, 139, 140, Pl. 16, fig. 56, Text-fig. 49.
Hokinsia hiroi: Bouchet and Ortea, 1983: 231, 232; Rudman and Darvell, 1990: 38, Pl. 1G; Okutani, 2000: 779.
Okenia hiroi: Rudman, 2004: 42–45, figs. 20B, 21, 24D, 27B, 30B; Debelius and Kuiter, 2007: 21.

Material examined. Korea: 1 specimen, Gyeongsangnam-do: Goseong-gun, Jugwang-myeon, Munamjin-ri, 1 Mar 2013; 3 specimens, Jeju-do: Seogwipo-si, Seongsan-eup, Seongsan-ri, 28 Mar 2013 (KOSPIV0000180746).

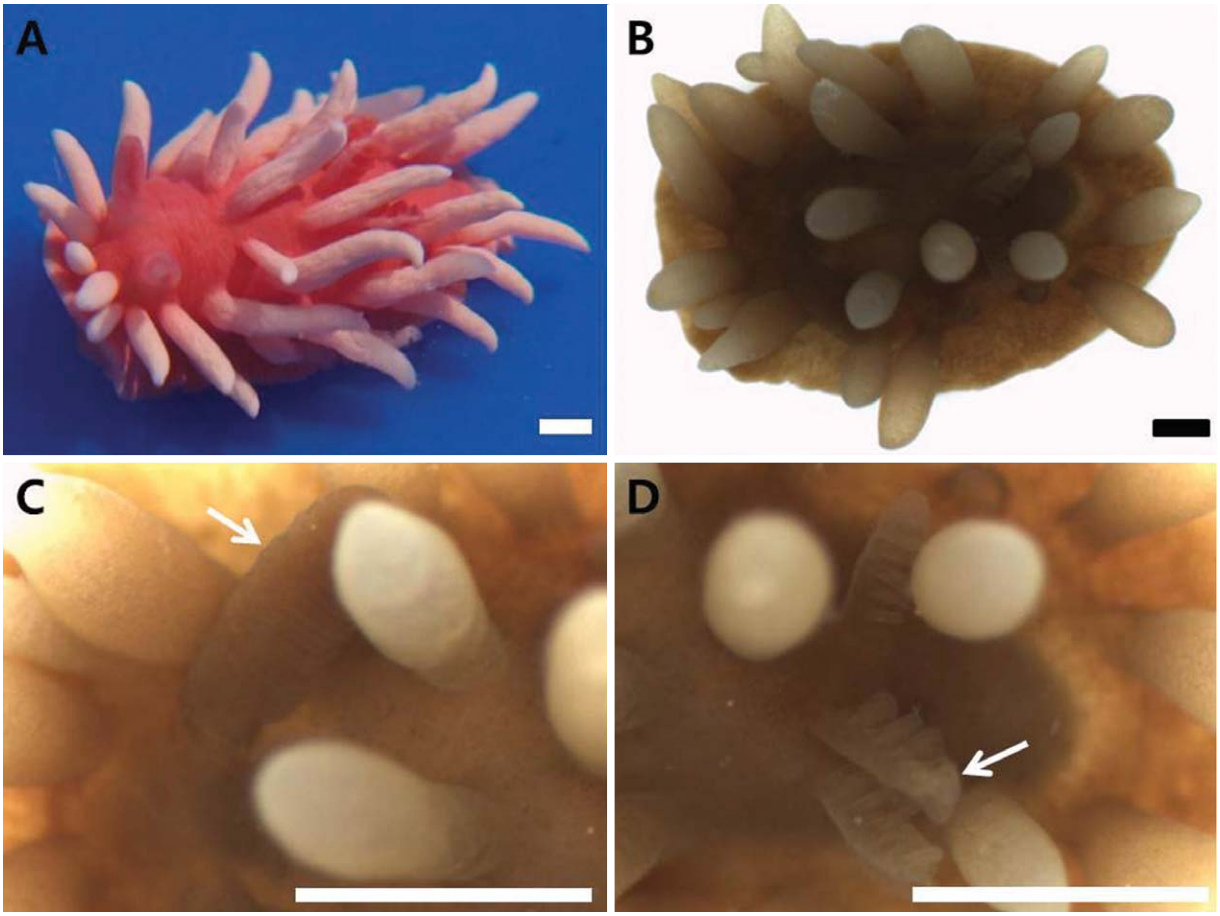

Fig. 5. *Okenia hiroi* (Baba, 1938). A, Dorso-lateral view, living animal (body length, 10 mm); B, Dorsal view, preserved specimen; C, Rhinophores; D, Gills. Scale bars: A–D=1 mm.

Description. Body ovate and flat (length, 5–10 mm; width, 3–8 mm). Ground color pale pink to deep red. Head, mantle and foot combined (Fig. 5A, B). Rhinophores short, rounded end, with 12–16 lamellae; lamellae absent in frontal part (Fig. 5C). Gills 3–5, short, arched in front of anus (Fig. 5D). Dorsal papillae 23–34, digitiform, asymmetry, pale pink to deep red, white tips. Oral tentacles absent. Ventral groove presents between head and foot. Genital orifices locate right side of body and one-third of body length from anterior end.
Distribution. Korea, Hong Kong, Japan.
Remarks. *Okenia hiroi* is easily separated from other congeneric species by asymmetrical papillae. The present specimens show color variations of papillae ranging from pale pink to red.

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