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Unrecorded Phyllidiid Nudibranchs from Cheju Island Waters in Korea with Remarks on New Locality Data and Intraspecific Color Variations

Byung Lae Choe and Jongrak Lee

Department of Biology, Sung Kyun Kwan University, Suwon 440-746, Korea

= 국문요약 =

제주도근해의 한국 미기록 혹갯민숭이류 4종에 관한 종내색채변이와 분포범위

최병래 · 이종락

성균관대학교 생물학과

1990년 12월부터 1997년 7월까지 제주도의 8개 지점에서 4종(*Phyllidia ocellata, Fryeria menindie, Phyllidiella pustulosa, Phyllidiella cooraburrama*)의 혹갯민숭이과가 채집되어 이들의 색채변이 및 분포범위에 대하여 논하였다. 또한 원색 사진과 함께 재기재를 하였다. 혹갯민숭이류는 한국해역에서 새로이 기록되는 과이다.

Key words : Phyllidiidae, Nudibranchia, Korea

INTRODUCTION

The family Phyllidiidae has been considered to occur mostly throughout the tropical Indo-Pacific region, and partly the Mediterranean Sea and the tropical Atlantic (Brunckhorst, 1993). No previous report, however, has been made from the Korean coastal area.

This study provides newly recorded distributional data on the opisthobranch fauna of Korea and intraspecific color variations of phyllidiid nudibranchs.

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MATERIALS AND METHODS

Specimens were collected by authors, using SCUBA diving until about 35 meters in depth, at 8 localities of Cheju Island from Dec. 1989 to Jul. 1997. For narcotization, all the specimens were treated with a solution of 8% magnesium chloride by gradually adding to a small amount of sea water containing phyllidiid individuals prior to fixation in formalin solution, 10%, neutral buffered (Gosliner, 1987). Twenty-eight individuals of 4 species and their color photos were observed in order to compare the color patterns with those from Japan (Baba & Hamatani, 1975) and northern Australia (Brunckhorst, 1993) (see tables 1-3).

RESULTS

Family Phyllidiidae Rafinesque, 1814 혹갯민숭이과 (신칭)

Genus *Phyllidia* Cuvier, 1797 혹이랑갯민숭이속 (신칭)

***Phyllidia ocellata* Cuvier, 1804 혹고리갯민숭이** (신칭) (Figs. 1, 2; Table 1)

Phyllidia ocellata Cuvier, 1804, Annales du Muséum National d'Historie Naturelle, Paris 5, p. 269, pl. a, fig. 7 (cited from Brunckhorst, 1993); Baba & Hamatani, 1975, 176-178, fig. 4; Tan *et al.*, 1987, p. 76, fig. 4; Coleman, 1989, p. 47, fig; Baba, 1990, pp. 72, 157, pl. 29, fig. 108; Brunckhorst, 1993, pp. 35-37, figs. 25D-E, pls. 2D-H, 3A; Yonow, 1996, pp. 485-487, figs. 1A-G, 4A, tab. 1.

Phyllidia multituberculata Boettger, 1918, Abhandlungen Senckenbergischen Naturforschenden Gesellschaft, Frankfurt am-Main 35, pp. 129-130, pl. 8, figs. 4a-c (cited from Brunckhorst, 1993); Yonow, 1996, pp. 487-490, figs. 2A-E, 3A-G, 4B, tab. 1.

Phyllidia tuberculata Baba, 1930, pp. 117-118, pl. 4, figs. 1a-d (non Risbec, 1928; cited from Brunckhorst, 1993).

Phyllidia japonica Baba, 1937, p. 310; Baba, 1949, Opisthobranchia of Sagamy Bay, pp. 72, 157, pl. 29, fig. 108 (cited from Baba, 1990); Yonow, 1996, pp. 493-495, figs. 6A-F, tab. 1.

Phyllidia ocellata undula Yonow, 1986, Journal of Natural History 20(6), pp. 1411-1413, figs. 5, 12a, b (cited from Brunckhorst, 1993); Yonow, 1996, pp. 490-493, figs. 4C, 5A-F, tab. 1.

Material examined: 1 ind. (abbreviation of individual), Pŏmsŏm I. (abbreviation of Island), 12 Aug. 1990; 1 ind., Munsŏm I., 6 Jun. 1991; 1 ind., Sŏgwip'o, 25 Oct. 1993; 1 ind., Supsŏm I., 28 Sep. 1995; 1 ind. Dongil li, 30 Sep. 1995; 1 ind., Pŏmsŏm I., 29 Sep. 1995; 1 ind., Pŏmsŏm I., 1 Oct. 1995; 1 ind., Hyŏngjesŏm I., 2 Oct. 1995; 1 ind., Moslp'o, 5 Oct. 1995; 1 ind., Hyŏngjesŏm I., 7 Oct. 1995; 3 inds. (abbreviation of individuals), Marado I., 16 Oct. 1995; 1 ind., Supsŏm I., 29 Jul. 1997.

Habitat: At about 10 to 30 meters in depth on exposed area.

Type locality: Timor.

Distribution: Indo-West Pacific Ocean including Red Sea.

Remarks: Even though there are not especially paler in color variations of *Phyllidiella ocellata* between Korean and Japanese waters and which is a normal color range, the color pattern of subtropical region is obviously less vivid and/or paler than that of the typical specimens in the tropical (Table 1). And the locality data from Korea of *Phyllidiella ocellata* is the confirmation of the presence of an Indo-Pacific species towards the northern boundary of its natural distributional area.

Genus *Fryeria* Gray, 1853 둥글혹갯민숭이속 (신칭)

***Fryeria picta* (Pruvot-Fol) 반달혹갯민숭이** (신칭) (Fig. 3; Table 2)

Table 1. Comparison of color pattern of *Phyllidia ocellata* between their localities.

Characters	Cheju Island, Korea (present study)	Kii, Japan (Baba & Hamatani, 1975)	northern Australia (Brunckhorst, 1993)
ground	brightly yellow	deep yellow	gold
rhinophores	orange	orange	gold
tubercles / rings	milky white tops, brightly yellow bases / deep blue bordered with pale blue	opaque white tops, yellow bases / black bordered with bluish white	gold both tops and bases / black bordered with white

Table 2. Comparison of color pattern of *Fryeria picta* between their localities.

Characters	Cheju Island, Korea (present study)	Kii, Japan (Baba & Hamatani, 1975)	northern Australia (Brunckhorst, 1993)
ground color	deep blue	deep black	black
rhinophores	ivory	yellow	gold
tubercles	ivory in both apexes and bases	yellow in apexes, bluish white in bases	gold in apexes, blue in bases

Phyllidia picta Pruvot-Fol, 1957, J. de. Conchy. 97, pp. 110-111, figs. 5-12 (cited from Yonow, 1996).

Fryeria menindie Brunckhorst, 1993, pp. 47-49, fig. 26B, pls. 4G, 5A.

Fryeria rüppelli Pruvot-Fol, 1957, Journale de Conchyliologie, Paris 97, pp. 114-115, pl. 1, figs. 2-3 (non *Fryeria rueppelli* Bergh, 1869) (cited from Brunckhorst, 1993).

Fryeria rueppelli Baba & Hamatani, 1975, pp. 178-179, fig. 5 (non *Fryeria rueppelli* Bergh, 1869).

Fryeria ruppelli(sic): Tan *et al.*, 1987, p. 75, fig. 1 (non *Fryeria rueppelli* Bergh, 1869).

Fryeria picta: Yonow, 1996, pp. 511-513, figs. 14A-K, tab. 3.

Material examined: 1 ind., Udo I., ? Sep. 1995.

Habitat: At about 18 meters in depth on exposed area.

Type locality: Unknown (cited from Yonow, 1996).

Distribution: Western Pacific Ocean.

Remarks: This only specimen is juvenile which explains its pale coloration (by personal communication with Dr. R. Willan). The color pattern appears so simple that the paler color variation is easily noticed in comparison with those of Baba & Hamatani (1975) and Brunckhorst (1993) (Table 2). This species resembles *Fryeria rueppelli* but can be easily distinguished by that there is no such contrasting coloration to the mantle edge in *Fryeria picta* whereas *Fryeria rueppelli* is yellow-orange. And this new locality record of *Fryeria picta* from Korea is significant because this species was previously only known northward from Kii in Japan. However, more collections and observations should be required.

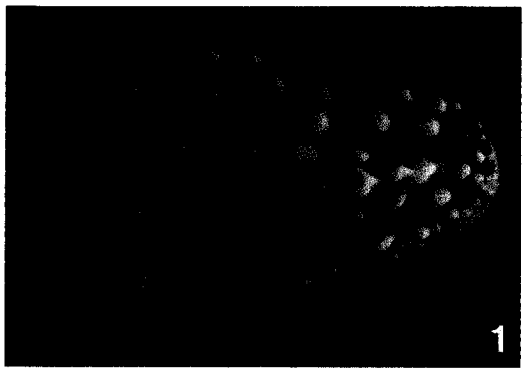
Genus *Phyllidiella* Bergh, 1869 흑투성이갯민숭이속 (신칭)

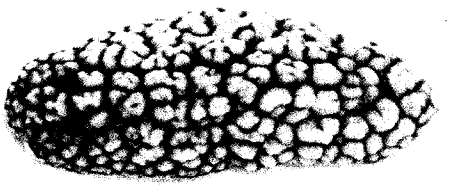
Phyllidiella pustulosa **(Cuvier) 흑투성이갯민숭이** (신칭) (Fig. 4, 5; Table 3)

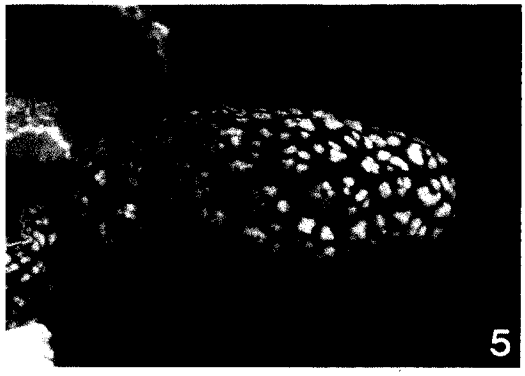
Phyllidia pustulosa Cuvier, 1804, Annales du Muséum National d'Historie Naturelle, Paris 5, p. 268, pl. a, fig. 8 (cited from Brunckhorst, 1993); Baba & Hamatani, 1975, 175-176, figs. 2-3; Bertsch & Johnson, 1981, pp. 76, 77; Tan *et al.*, 1987, p. 75, fig. 2; Baba, 1990, pp. 71-72, 156-157, pl. 29, fig. 107.

Table 3. Comparison of color pattern of *Phyllidiella pustulosa* between their localities.

Characters	Cheju Island, Korea (present study)	Kii, Japan (Baba & Hamatani, 1975)	northern Australia (Brunckhorst, 1993)
ground color	deep blue	deep black	black
rhinophores	deep blue	black	black
tubercles	milky white	pinkish white	pink







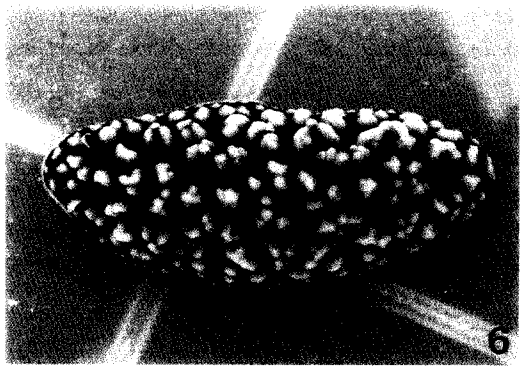


Fig. 1. *Phyllidia ocellata,* preserved specimen. Length of preserved specimen; 40.5 mm. Sŏgwip'o, 25 Oct. 1993

Fig. 2, 3. Dorsal and ventral view of preserved *Fryeria picta.* Length of preserved specimen; 33.4 mm. Udo I., ? Sep. 1995

Fig. 4. *Phyllidiella pustulosa,* alive specimen. Length of preserved specimen; 55 mm. Dongil-li, 30 Sep. 1995

Fig. 5. *Phyllidiella pustulosa,* alive specimen. Length of preserved specimen; 65 mm. Marado I., 16 Oct. 1995

Fig. 6. *Phyllidiella cooraburrama,* alive specimen. Length of preserved specimen; 49.2 mm. (Munsŏm I., 19 Jan. 1997)

Phyllidia nobilis: Bergh, 1869, Naturhistorisk Tidsskrift (Kjobenhavn) Series B, 5, pp.485-492, 512-513, pl. 24b (cited from Brunckhorst, 1993); Baba, 1936, pp. 41-42, fig. 24; Coleman, 1989, p. 47, fig.

Phyllidiella pustulosa: Brunckhorst, 1993, pp. 49-54, figs. 3B, 9B D, 11-13, 27, 28A-C, pl. 5E-F; Wells & Bryce, 1993, p. 144, fig 187.

Material examined: 2 ind., Munsŏm I., 1 Jul. 1993; 1 ind. Dongil-li, 30 Sep. 1995; 1 ind., Hyŏngjesŏm I., 2 Oct. 1995; 2 inds., Marado I., 16 Oct. 1995.

Habitat: At about 10 to 30 meters in depth on exposed area.

Type locality: Timor, Baudin.

Distribution: Indo-West Pacific Ocean.

Remarks: This species is variable with the pattern of notal tubercles, which is owing to such differences as the separation and spreading out from the amalgamation of tubercles, and the distance between tubercles (fig. 4 and 5). This species is similar to *Phyllidiella cooraburrama* but differs in having the clusters of low and rounded tubercles. All individuals observed from the present study show a same color pattern. And more precise and complemental data could decipher the tendency of intraspecific paler color variation with the approach toward extreme region from the tropical (Table 3).

Phyllidiella cooraburrama **Brunckhorst, 1993**

흑뿔갯민숭이 (신칭) (Fig. 6)

Phyllidiella cooraburrama Brunckhorst, 1993, p. 59, figs. 28F-H, pl. 6H.

Material examined: 2 inds., Udo I., ? Sep. 1995; 1 ind., Pŏmsŏm I., 1 Oct. 1995; 1 ind., Moslp'o, 5 Oct. 1995; 1 ind., Hyŏngjesŏm I., 7 Oct. 1995; 1 inds., Marado I., 16 Oct. 1995; 1 ind., Munsŏm I., 19 Jan. 1997;.

Habitat: At about 10 to 30 meters in depth on exposed area.

Type locality: Bare Islet, AIMS, Townsville, Australia.

Distribution: The Great Barrier Reef, Northern Territory in Australia, Marshall Island, Fiji.

Remarks: The color of these specimens are typical of the species. This species is similar to *Phyllidiella pustulosa*, but differs in having large high sided, angular, and conical tubercles. The discovery of *Phyllidiella cooraburrama* in Korea is a very significant new locality record because the species was previously only known from the Great Barrier Reef, Northern Territory, marshall Island and Fiji.

DISCUSSION

Four species of Phyllidiidae were newly recorded with remarks on their intraspecific color variations and distributional data in the Korean opisthobranch fauna. The addition of these tropical species to the distributional data on Korean faunal region ascertains Cheju Island to be a subtropical region and the presumable tolerance of these species against less warm water. It is probable to report the coastal area of Cheju Island as the northern limits of phyllidiid species in Korean faunal region. The discovery of *Fryeria picta* and *Phyllidiella cooraburrama* in Korea is a significant new locality record, which implies the northward enlargement of the distributional data.

The color patterns of Korean phyllidiid nudibranchs, not unusually though, show less vivid and then paler coloration, which remains to be studied with more data such as feeding behavior and food preference of phyllidiid nudibranchs through *in situ* observations.

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