

## Caryophyllidia-bearing Dorid Nudibranchs (Mollusca, Nudibranchia, Doridacea) from Costa Rica

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The tropical eastern Pacific dorid nudibranch *Taringa aivica* Ev. Marcus and Er. Marcus, 1967 is redescribed based on the examination of specimens collected from the Pacific coast of Costa Rica. The differences between *Taringa aivica timia* Ev. Marcus and Er. Marcus, 1967 and *Taringa aivica aivica* Ev. Marcus and Er. Marcus, 1967 are not consistent and do not justify the existence of two subspecies of *Taringa aivica*. Examination of the type material of *Peltodoris nayarita* Ortea and Llera 1981, another eastern Pacific species, confirmed that it is a synonym of *Peltodoris greeleyi* MacFarland, 1909, originally described from Brazil. The study of *Discodoris aurila* Marcus, 1976 from Panama and Costa Rica, shows that this species is characterized by the absence of jaw elements, the presence of hamate and smooth radular lateral teeth, and the innermost teeth hamate, elongated, and lacking denticles.

*Peltodoris greeleyi* and *Discodoris aurila* are transferred to the genus *Diaulula* based on the presence of caryophyllidia, low rhinophoral and branchial sheaths, a flattened prostate divided into two portions, penis and vagina unarmed, hamate radular teeth and smooth labial cuticle. The geographic range of *Diaulula greeleyi* is extended to Punta Uvita, Costa Rica and the geographic range of *Diaulula aurila* is extended from Mexico to Panama.

### RESUMEN

La especie de dórido nudibranquio del Pacífico Este tropical *Taringa aivica* Ev. Marcus y Er. Marcus, 1967 es redescrita en base al estudio de especímenes recolectados en la costa Pacífica de Costa Rica. Las diferencias entre *Taringa aivica timia* Ev. Marcus y Er. Marcus, 1967 y *Taringa aivica aivica* Ev. Marcus y Er. Marcus, 1967 no son consistentes y no justifican la existencia de dos subespecies diferentes de *Taringa aivica*. El estudio del material tipo de *Peltodoris nayarita* Ortea y Llera, 1981, otra especie del Pacífico Este, ha confirmado que ésta es un sinónimo de *Peltodoris greeleyi* MacFarland, 1909, que fue originalmente descrita de Brasil. El estudio de *Discodoris aurila* Marcus, 1976 de Panamá y Costa Rica, muestra que esta especie se caracteriza por la ausencia de uncinos, y la presencia de dientes laterales de la rádula ganchudos y lisos, dientes centrales ganchudos, alargados y sin denticulos. *Peltodoris greeleyi* y *Discodoris aurila* son transferidas al género *Diaulula* en base a la presencia de cariofilídeos, vainas rinofóricas y branquiales no elevadas, una próstata aplanada dividida en dos regiones, pene y vagina lisos, dientes de la rádula en forma de gancho y cutícula labial lisa. La distribución geográfica de *Diaulula greeleyi* es extendida hasta Punta Uvita, Costa Rica y la distribución geográfica de *Diaulula aurila* es extendida desde México hasta Panamá.

Intensive field work along the Pacific coast of Costa Rica has revealed the presence of three species of caryophyllidia-bearing dorids. The species, *Taringa aivica* Ev. Marcus and Er. Marcus, 1967, *Peltodoris nayarita* Ortea and Llera, 1981 and *Discodoris aurila* Marcus, 1976 have already been reported from other areas in the eastern Pacific, but their anatomy was poorly described and the presence of caryophyllidia had been overlooked.

Valdés and Gosliner (2001) recently studied the phylogenetic relationships of the caryophyllidia-bearing dorids, which according to these authors are a monophyletic group. They also synonymized several genera previously considered as valid or regarded as uncertain. Therefore, the caryophyllidia-bearing dorid species from Costa Rica need to be re-examined in light of the new evidence.

The objective of the present paper is to re-examine the three described species of the caryophyllidia-bearing dorids present in Costa Rica.

The material examined is deposited at the Department of Invertebrate Zoology and Geology, California Academy of Sciences, San Francisco (CASIZ), Instituto Nacional de Biodiversidad, Costa Rica (INBio), the Natural History Museum of Los Angeles County (LACM), Muséum National d'Histoire Naturelle, Paris (MNHN), and the National Museum of Natural History (USNM).

## SPECIES DESCRIPTION

### Genus *Taringa* Er. Marcus, 1955

Type species: *Taringa telopia* Er. Marcus, 1955

#### *Taringa aivica* Ev. Marcus and Er. Marcus, 1967

(Figs 1A–B, 2A–D, 3A–E)

*Taringa aivica* Marcus and Marcus, 1967:89–92, figs. 115–119.

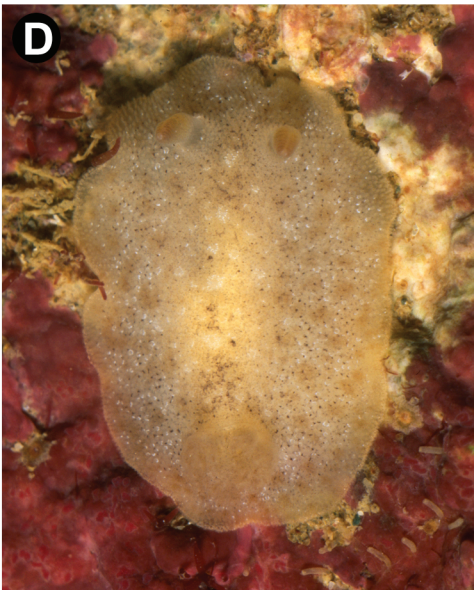
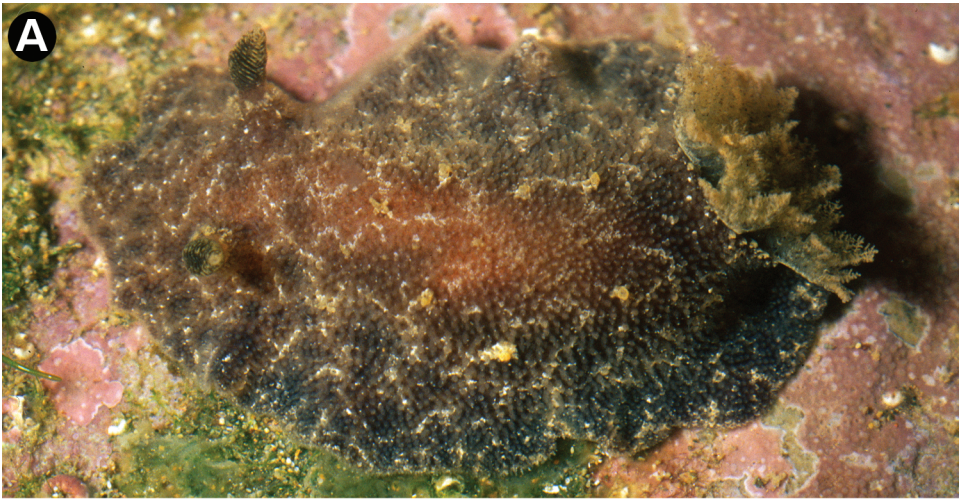
*Taringa aivica timia* Marcus and Marcus, 1967:189–191, figs. 47–51; Behrens and Henderson, 1982:197–199, figs.1–4.

## MATERIAL EXAMINED

San Miguel, Cabo Blanco, Costa Rica, May 16, 1998, 1 specimen, 12 mm preserved length, 2 m depth, leg. A. Berrocal (INB0001496644); San Miguel Station, Cabo Blanco, Costa Rica, January 28, 1999, 2 specimens, 30–31 mm preserved length, intertidal, leg. F. Alvarado (INB0001496686); San Miguel Station, Cabo Blanco, Costa Rica, January 28, 1999, 11 specimens, 10–20 mm preserved length, intertidal, leg. F. Alvarado (INB0001496491); San Miguel Station, Cabo Blanco, Costa Rica, January 22, 1999, 18 specimens, 9–23 mm preserved length, intertidal, leg. F. Alvarado (INB0001496522); San Miguel Station, Cabo Blanco, Costa Rica, May 17, 1999, 1 specimen, 4 mm preserved length, 2 m depth, leg. S. Ávila (INB0001496524); Playa Coralito, Peñón del Coral, Puntarenas, Costa Rica, January 29, 1999, 1 specimen, 12 mm preserved length, intertidal, leg. F. Alvarado (INB0001496675); Punta Uvita, Puntarenas, Costa Rica, January 15, 2000, 9 specimens, 4–12 mm preserved length, intertidal, leg. M. Calderón (INB0001496174); San Pedrillo, Osa Peninsula, Costa Rica, January 19, 2000, 1 specimen, 6 mm preserved length, intertidal, leg. A. Berrocal (INB0001496548); San Pedrillo, Osa Peninsula, Costa Rica, January 15, 2000, 1 specimen, 16 mm preserved length, intertidal, leg. M. Calderón (INB0001495952); San Pedrillo, Osa Peninsula, Costa Rica, February 27, 1998, 3 specimens, 9–10 mm preserved length,

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FIGURE 1. Living animals. A–B. *Taringa aivica* (INB0001496491); C. *Diaulula greeleyi* (INB0001496508); D. *Diaulula aurila* (INB0001495896).



intertidal, leg. A. Berrocal (INB000146490); San Pedrillo, Osa Peninsula, Costa Rica, February 27, 1998, 1 specimen, 9 mm preserved length, intertidal, leg. A. Berrocal (INB0001496489); Playa Gallardo, Golfo Dulce, Costa Rica, February 12, 1997, 1 specimen, 16 mm preserved length, intertidal, leg. S. Ávila (INB0001496523); Punta Larga, Golfo Dulce, Costa Rica, November 29, 1997, 6 specimens, 5–16 mm preserved length, intertidal, leg. M. Madrigal (INB0001496484); Punta Larga, Golfo Dulce, Costa Rica, November 27, 1997, 2 specimens, 14–18 mm preserved length, intertidal, leg. A. Berrocal (INB0001496525).

#### GEOGRAPHIC RANGE

From Palos Verdes, California (Behrens and Henderson, 1982) to Sonora, Mexico and the Canal Zone, Panama (Marcus and Marcus, 1967).

#### EXTERNAL MORPHOLOGY

The body is oval to elongate (Fig. 1A–B). The dorsum is covered with caryophyllidia about 0.15 mm long (Fig. 2D). There are some larger, conical tubercles arranged in two rows on both sides of the visceral hump. The dorsal color is variable ranging from pale yellow to dark brown. There is no correlation between the size of the animal and the dorsal color. Normally specimens have irregularly distributed darker patches on the dorsum; patches may be more densely arranged on the center of the dorsum. The larger tubercles are white or cream white in most specimens. There is a row of white patches on both sides of the dorsal hump, around the larger tubercles, that may be absent in some specimens and may be larger in others, almost occupying the entire mantle margin. The rhinophores are dark gray or black with numerous white or cream white spots on the club. The rhinophores have 17 lamellae. Occasionally there are white spots surrounding the rhinophoral sheath. The rhinophoral apex is white or cream-white. The gill is composed of six tripinnate branchial leaves. The leaves are yellowish or cream-white with minute dark spots. Ventrally, the anterior border of the foot is grooved and notched (Fig. 3E).

#### ANATOMY

The labial cuticle is smooth. The radular formula is  $32 \times (39.0.39)$  in a 26 mm preserved length specimen (INB0001496522). Rachidian teeth are absent (Fig. 2A). The innermost teeth are hamate with a wide base and denticles. The lateral teeth are hamate, having a narrow base and a very conspicuous prolongation on the upper side (Fig. 2B). There are four to nine denticles on each lateral tooth. These denticles decrease in number towards the central part of the radula. The lateral teeth increase in size gradually towards the medial portion of the half-row. There are three or four pectinate outermost teeth (Fig. 2C). The stomach is oval and connects distally to the long intestine that forms a loop and runs to the anal opening (Fig. 3A).

The ampulla is very long and convoluted in the middle portion (Fig. 3C). It enters the female glands near their nidamental opening. The deferent duct is long and convoluted, and enters the flattened prostate. The proximal end of the deferent duct opens into a common atrium with the vagina. The vagina is long and tubular in shape and almost as thick as the deferent duct. At its distal end, the vagina connects to the large and oval bursa copulatrix. Both, the duct that leads from the seminal receptacle to the bursa copulatrix and the vaginal duct, are joined. The pear-shaped seminal receptacle is smaller than the bursa copulatrix (Fig. 3D). It is connected to the bursa copulatrix by a long and coiled duct. The penial cuticle is conical or bell-shaped (Fig. 3B).

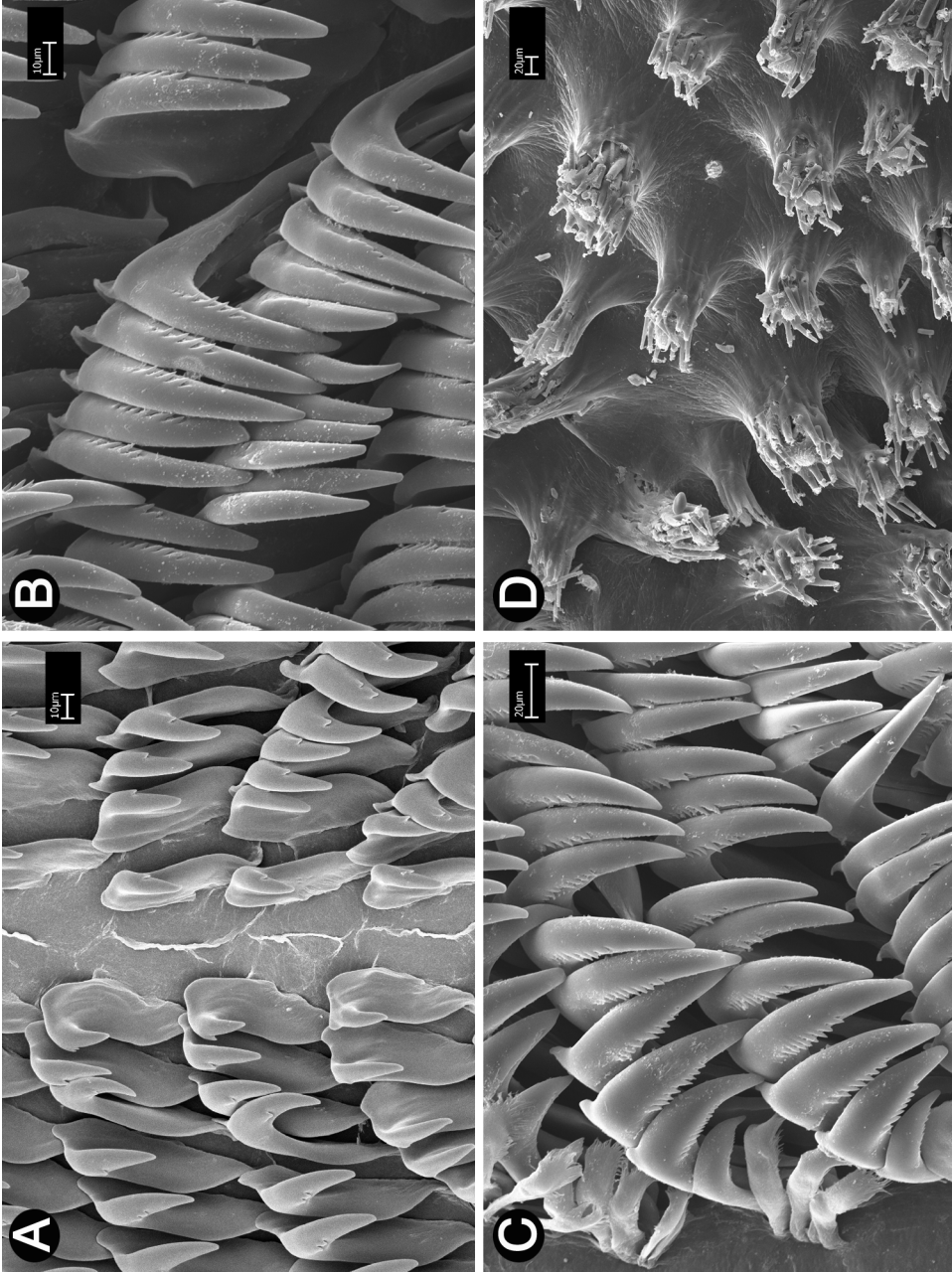


FIGURE 2. *Tarriaga arivica* (INB0001496522), SEM photographs. A. Inner lateral teeth, scale bar= 10μm; B. Lateral teeth, scale bar= 10μm. C. Outer lateral teeth, scale bar=20 μm. D. Caryophyllidia, scale bar= 20μm.

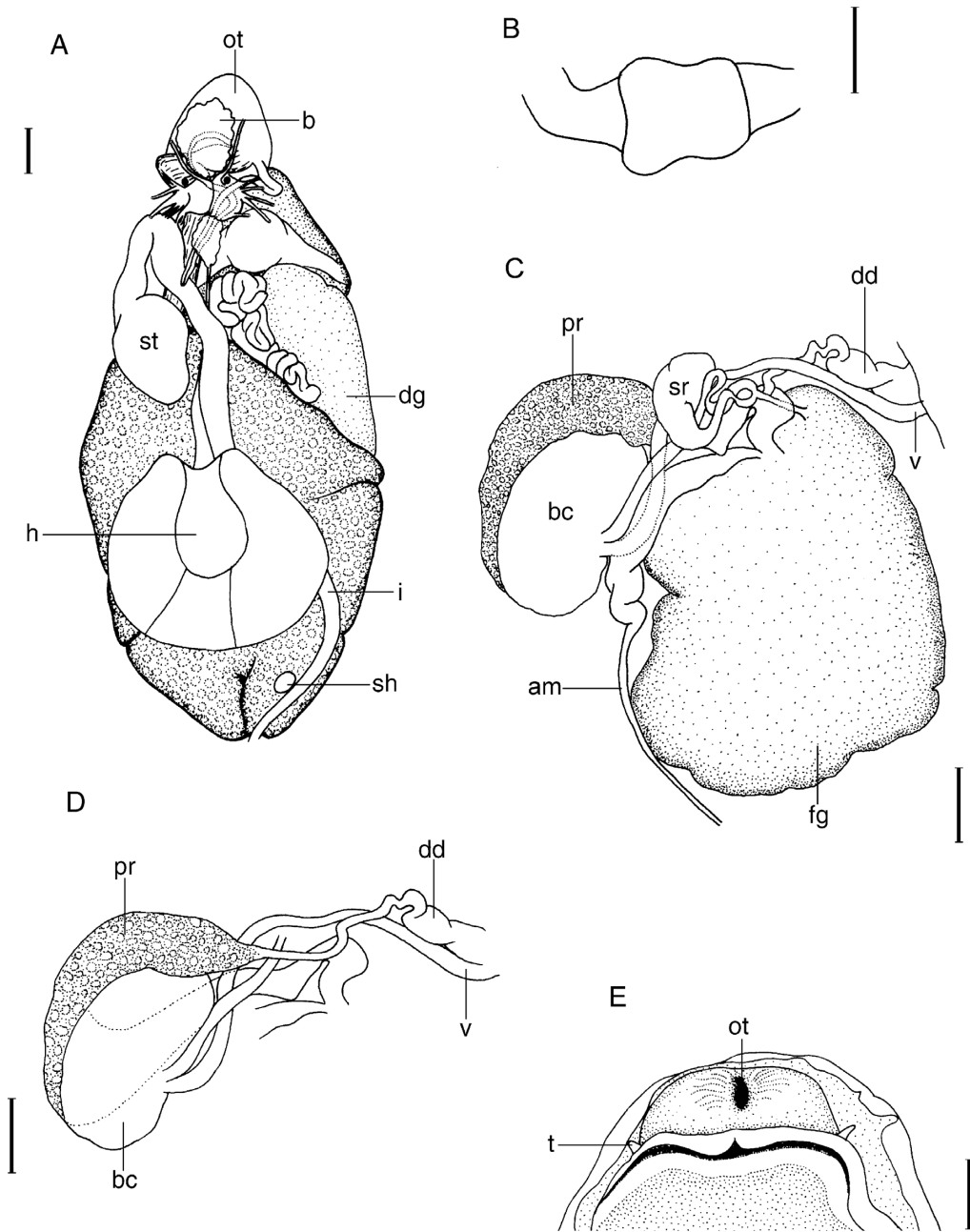


FIGURE 3. Anatomy of *Taringa aivica* (INB0001496522 ) A. Dorsal view of the internal organs, scale bar= 1mm; B. Penis, scale bar= 0.25 mm; C. Reproductive system, scale bar= 1mm; D. Detail of the reproductive system, scale bar=1mm; E. Ventral view of the mouth area, scale bar= 1mm. Abbreviations: am=ampulla; b=blood gland; bc=bursa copulatrix; dd=deferent duct; dg=digestive gland; fg=female gland; h=heart; i=intestine; ot=oral tube; pr=prostate; sh=syrinx; sr=seminal receptacle; st=stomach; t=oral tentacle; v=vagina.

## REMARKS

The study of several specimens and the review of the original description confirms that the external and internal features of this species fit with those of the genus *Taringa*. The presence of a flattened prostate with two portions, an unarmed vagina, a penis armed with a cuticular structure, inner and mid-lateral hamate radular teeth and pectinated outermost teeth are characteristics of this genus (Valdés and Gosliner 2001).

According to Marcus and Marcus (1967) the differences between *Taringa aivica aivica* and *Taringa aivica timia* are the presence of an outermost pectinated tooth with a broad spine in *Taringa aivica timia* that is not present in *T. aivica aivica* and the strong denticles of the lateral teeth in *T. aivica aivica*. Also, they found uniformly distributed caryophyllidia and sometimes bicuspid papillae in *Taringa aivica timia*, and very small caryophyllidia and conical papillae in *Taringa aivica*.

Behrens and Henderson (1982) reported *Taringa aivica timia* from Palos Verdes, California, and provided additional anatomical details. In this study Behrens and Henderson found a bell-shaped papilla in the penial cuticle and 5 to 10 pointed denticles on the outer side of their cusp, but apparently the broad spine mentioned by Marcus and Marcus (1967) is missing.

In the present study, we have found great variability in dorsal coloration as well as in the arrangement of the caryophyllidia and papillae (Figs. 1A–B). A spine on the outermost pectinated teeth was not found in the material study and is also absent in the specimens assigned to *Taringa aivica timia* by Behrens and Henderson (1982). The presence or absence of this spine as well as the shape of the penial cuticle are most likely due to intraspecific variation. We consider that the features mentioned by Marcus and Marcus (1967) are not enough to justify the existence of two different subspecies and *Taringa aivica timia* and *Taringa aivica aivica* should be synonymized.

**Genus *Diaulula* Bergh, 1878**

Type species: *Doris sandiegensis* Cooper, 1863

***Diaulula greeleyi* (MacFarland, 1909)**

(Figs. 1C, 4A–D, 5A–D)

*Peltodoris greeleyi* MacFarland, 1909:84–88, pl.15, figs. 77–82; Marcus, 1955; Marcus and Marcus, 1967; Eyster, 1980:588.

*Peltodoris nayarita* Ortea and Llera, 1981:47–51, figs. 1–4 (also cited as *Anisodoris*).

## MATERIAL EXAMINED

HOLOTYPE of *Peltodoris greeleyi*: Alagoas, Riacho Doce, Brazil, July 28, 1899, 1 specimen, 9 mm preserved length, leg. A.W. Greeley. (CASIZ 21021).

HOLOTYPE of *Peltodoris nayarita*: Isabel Island, Nayarit, Mexico (21°52' N, 105°54' W), 1 specimen, 22 mm preserved length, contracted and dissected (MNHN).

## ADDITIONAL MATERIAL EXAMINED

San Miguel Station, Cabo Blanco, Costa Rica, May 17, 1998, 1 specimen, 10 mm preserved length, 2 m depth, leg S. Ávila (INB0001500647); San Miguel Station, Cabo Blanco, Costa Rica, January 26, 1999, 22 specimens, 3–13 mm preserved length, intertidal, leg. F. Alvarado (INB0001496509); San Miguel Station, Cabo Blanco, Costa Rica, January 22, 1999, 39 specimens, 2–16 mm preserved length, intertidal, leg. F. Alvarado (INB0001496508); Ballena Island, Uvita,

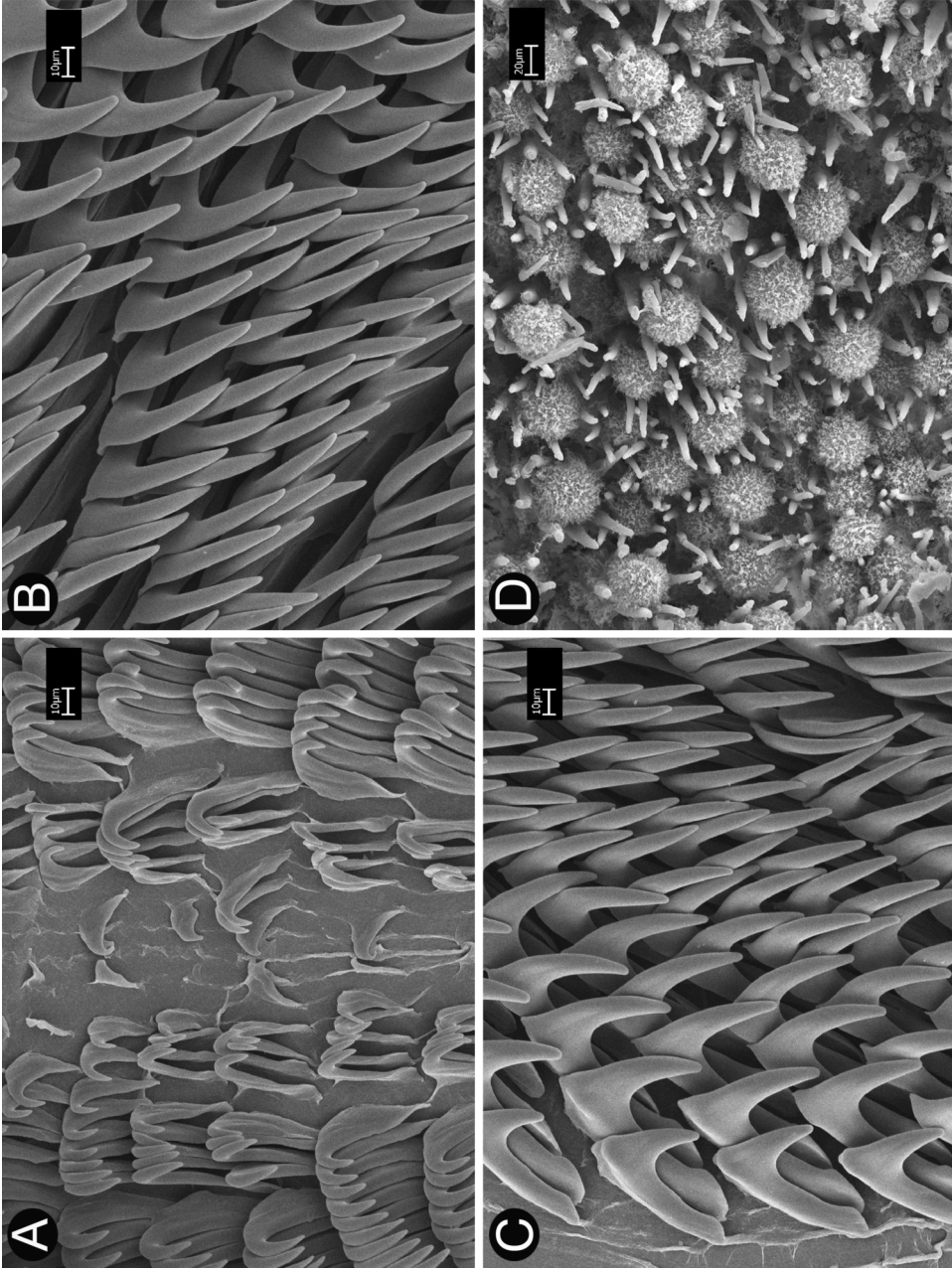


FIGURE 4. *Diatula grezleyi* (INB0001496508), SEM photographs. A. Inner lateral teeth, scale bar= 10 µm; B. Lateral teeth, scale bar= 10µm. C. Outer lateral teeth, scale bar= 10µm. D. Caryophyllidia, scale bar= 20µm.



Puntarenas, Costa Rica, January 16, 2000, 3 specimens, 2–6 mm preserved length, 6 m depth, leg. M. Calderón (INB0001496530); Punta Uvita, Puntarenas, Costa Rica, January 15, 2000, 7 specimens, 5–9 mm preserved length, intertidal, leg. M. Calderón (INB0001496515); Playa Ventanas, Puntarenas, Costa Rica, January 17, 2000, 5 specimens, 5–6 mm preserved length, intertidal, leg. M. Calderón (INB0001496529); San Pedrillo, Osa Peninsula, January 27, 1998, 1 specimen, 11 mm preserved length, intertidal, leg. A. Berrocal (INB0001496507); San Pedrillo, Osa Peninsula, Costa Rica, January 20, 2000, 2 specimens, 2–10 mm preserved length, intertidal, leg. M. Calderón (INB0001496521); San Pedrillo, Osa Peninsula, Costa Rica, January 19, 2000, 2 specimens, 10–11 mm preserved length, intertidal, leg. A. Berrocal (INB0001496516).

### GEOGRAPHIC RANGE

This species is found in Florida (Marcus and Marcus 1967), Brazil (Marcus 1955), South Carolina (Eyster 1980), Nayarit, Mexico (Ortea and Llera 1981), Punta Eugenia, Baja California, México (Bertsch et al. 2000) and the Pacific coast of Costa Rica.

### EXTERNAL MORPHOLOGY

The body is oval to elongate (Fig. 1C). The dorsum is covered with long caryophyllidia, about 100  $\mu$ m long (Fig. 4D). The body is pale yellow to orange. The dorsum is covered with a number of brown patches that may be darker in some specimens. These patches are more densely arranged near the mantle edge. On the mantle edge there are some large, opaque white patches. The rhinophoral sheaths are very inflated and pale cream white or white in color. The gill sheath is also pale or white and in some specimens it is edged by a thin brown line. The rhinophores are pale yellow, with the club brown and the apex opaque white or pale yellow. There are 13 lamellae present in the rhinophores. The gill is composed of 12 unipinnate branchial leaves. They are yellow to dark brown. In the living animal the branchial leaves are oriented inwards. Ventrally the anterior border of the foot is grooved and notched. The oral tentacles are short and conical (Fig. 5D).

### ANATOMY

The labial cuticle is smooth. The radular formula is 37 x (55.0.55) in a 10 mm preserved length specimen (INB0001496508). Rachidian teeth are absent (Fig. 4A). The lateral teeth are hamate, having a single cusp and lacking denticles (Fig. 4B). The teeth increase in size gradually towards the medial portion of the half-row. The outermost teeth are very small and elongate, also lacking denticles (Fig. 4C). The esophagus is long and connects directly to the stomach (Fig. 5A).

The ampulla is very long (Fig. 5B). It enters the female glands near their nidamental opening. The prostate is flattened and granular. It is divided into two different portions that are clearly distinguishable by their different texture and coloration. The deferent duct is long, and expands into the wide ejaculatory portion. The deferent duct opens into a common atrium with the vagina. There are no penial hooks. The vagina is long and wide. At its distal end, the vagina connects to the large and rounded bursa copulatrix. Another duct, which connects to the seminal receptacle and the uterine duct, leads from the bursa copulatrix. The bursa copulatrix is about ten times larger than the seminal receptacle (Fig. 5B–C).

### REMARKS

MacFarland (1909) described *Peltodoris greeleyi* from Brazil. Later, Marcus (1955) and Marcus (1967) redescribed this species from the same locality. According to these authors, the main

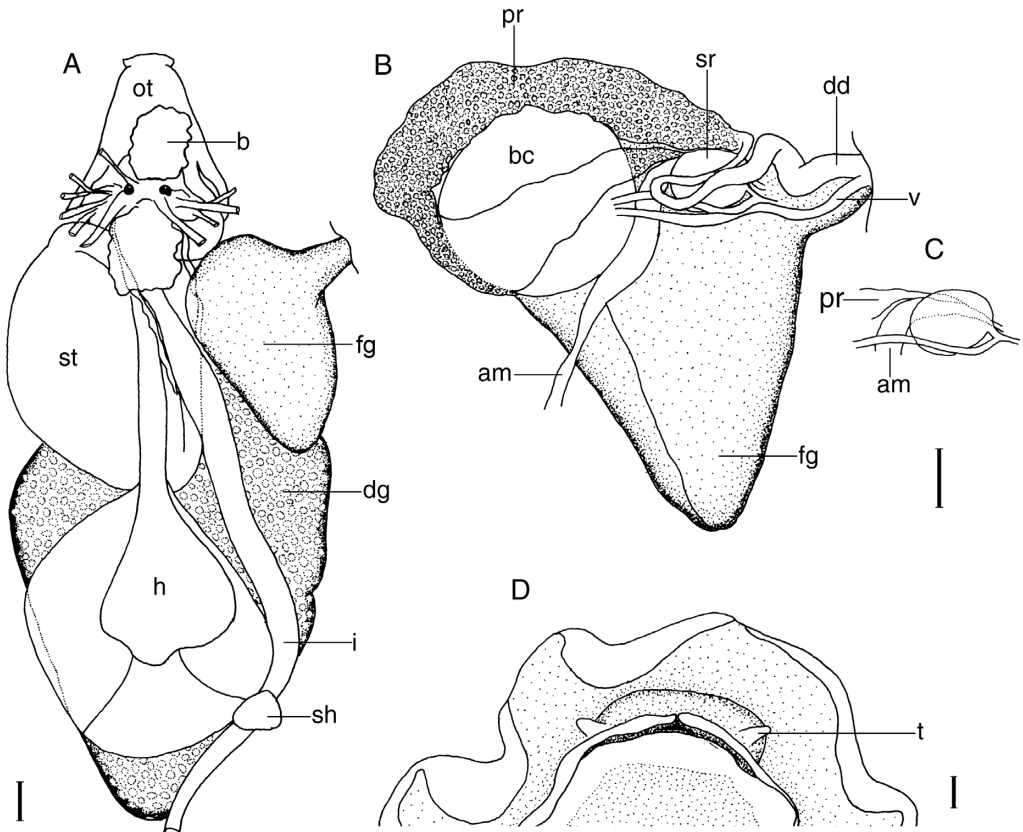


FIGURE 5. Anatomy of *Diaulula greeleyi* (INB0001496508). A. Dorsal view of the internal organs, scale bar= 1mm; B. Reproductive system, scale bar = 1mm; C. Detail of the reproductive system, scale bar= 1 mm; D. Ventral view of the mouth area, scale bar= 1mm. Abbreviations: am=ampulla; b=blood gland; bc=bursa copulatrix; dd=deferent duct; dg=digestive gland; fg=female gland; h=heart; i=intestine; ot=oral tube; pr=prostate; sh=syrinx; sr=seminal receptacle; st=stomach; t=oral tentacle; v=vagina.

distinctive features of this species are the yellowish to orange color of the living animals with some small brown spots on the center and sides, the prominent branchial and rhinophoral sheaths, the smooth labial cuticle, the absence of rachidian teeth, the unipinnate gills, the outermost tooth smaller than the remaining teeth, the absence of denticles and the outermost, and midlateral teeth with cups.

Ortea and Llera (1981) described the species *Peltodoris nayarita* from Nayarit, Mexico. *Peltodoris nayarita* is characterized by having a yellow mantle with small brown spots all over the dorsum and sometimes concentrated in the middle portion, high branchial and rhinophoral sheaths, smooth labial cuticle, unipinnate branchial leaves, outermost teeth smaller and outermost midlateral teeth with a cusp. Ortea and Llera (1981) placed this species in the genera *Peltodoris* and *Anisodoris* at the same time with no clear explanation. They also considered that *Peltodoris* and *Anisodoris* are synonyms.

By studying the type material of *Peltodoris greeleyi* and *Peltodoris nayarita*, we found that both species share the presence of a smaller outermost tooth with a single cusp and no denticles, hamate lateral teeth with no denticles and a single cusp, and outermost teeth smaller than the

remaining ones. There are several other features shared by the type specimens of these two taxa. The coloration of the living animals is orange to light brown with small brown spots covering the mantle, the gills are unipinnate, the labial cuticle is smooth and the rhinophores and branchial sheaths high (MacFarland 1909; Marcus 1955; Marcus and Marcus 1967; Ortea and Llera 1981).

In the reproductive system drawn by MacFarland (1909), Marcus and Marcus (1967) and our material from Costa Rica, the deferent duct has a loop and is longer than the slender vagina, the bursa copulatrix is larger than the seminal receptacle and both are rounded in shape. However, all of these features are difficult to observe in the incomplete drawing by Ortea and Llera (1981, fig 4).

When comparing all these features with the type material of *P. greeleyi*, *P. nayarita*, and the material studied from Costa Rica, we concluded that these two species are synonyms.

This species is transferred to the genus *Diaulula* due to a unique combination of features: the presence of caryophyllidia, the low rhinophoral and branchial sheaths, the penis and vagina unarmed, the labial cuticle smooth, and the radular teeth hamate and smooth (see Valdés and Gosliner 2001). *Diaulula greeleyi* is also different from *D. aurila* in radular morphology, external coloration, the presence of high rhinophoral and branchial sheaths and unipinnate branchial leaves.

### ***Diaulula aurila* (Marcus, 1976)**

(Figs 1D, 6A–D, 7A–D)

*Discodoris aurila* Marcus, 1976: 85–87; figs 108–111

#### MATERIAL EXAMINED

SYNTYPES of *Discodoris aurila*: Deale Beach (Ft. Kobbe Beach), Canal Zone, Panama, December 1962, 2 specimens 15–20 mm preserved length, leg. F. Bayer and R. Bayer (USNM 576268). Two microslides: F–814 (USNM 576268) and F–185 (USNM 576268).

#### ADDITIONAL MATERIAL EXAMINED

San Miguel Station, Cabo Blanco, Costa Rica, January 28, 1999, 3 specimens, 6–14 mm preserved length, intertidal, leg. F. Alvarado (INB0001482472); San Miguel Station, Cabo Blanco, Costa Rica, January 26, 1999, 1 specimen, 12 mm preserved length, intertidal, leg. F. Alvarado (INB0001496506). San Miguel Station, Cabo Blanco, Costa Rica, January 26, 1999, 1 specimen, 9 mm preserved length, intertidal, leg. F. Alvarado (CASIZ 159788); San Miguel Station, Cabo Blanco, Costa Rica, January 26, 1999, 1 specimen, 7 mm preserved length, intertidal, leg. F. Alvarado (INB0001496505); Playa Ventanas, Puntarenas, Costa Rica, January 17, 2000, 1 specimen, 12 mm preserved length, intertidal, leg. M. Calderón (LACM 2922); Ballena Island, Uvita, Puntarenas, Costa Rica, January 16, 2000, 13 specimens, 6–10 mm preserved length, 6 m depth, leg. M. Calderón (INB0001495896); Punta Uvita, Puntarenas, Costa Rica, January 15, 2000, 1 specimen, 8 mm preserved length, intertidal, leg. M. Calderón (INB0001496574); Playa Coralito, Peñón del Coral, Costa Rica, January 29, 1999, 1 specimen, 14 mm preserved length, intertidal, leg. F. Alvarado (INB0001496280); Punta Voladera, Golfo Dulce, Costa Rica, February 12, 1997, 2 specimens, 8 mm preserved length, 6 m depth, leg. M. Calderón (INB0001496510); Punta Voladera, Golfo Dulce, Costa Rica, February 11, 1997, 2 specimens, 7–9 mm preserved length, intertidal, leg. Manuel Lobo (INB0001487296); San Pedrillo, Osa Peninsula, Costa Rica, January 21, 2000, 1 specimen, 10 mm preserved length, intertidal, leg. M. Calderón (INB0001495947).

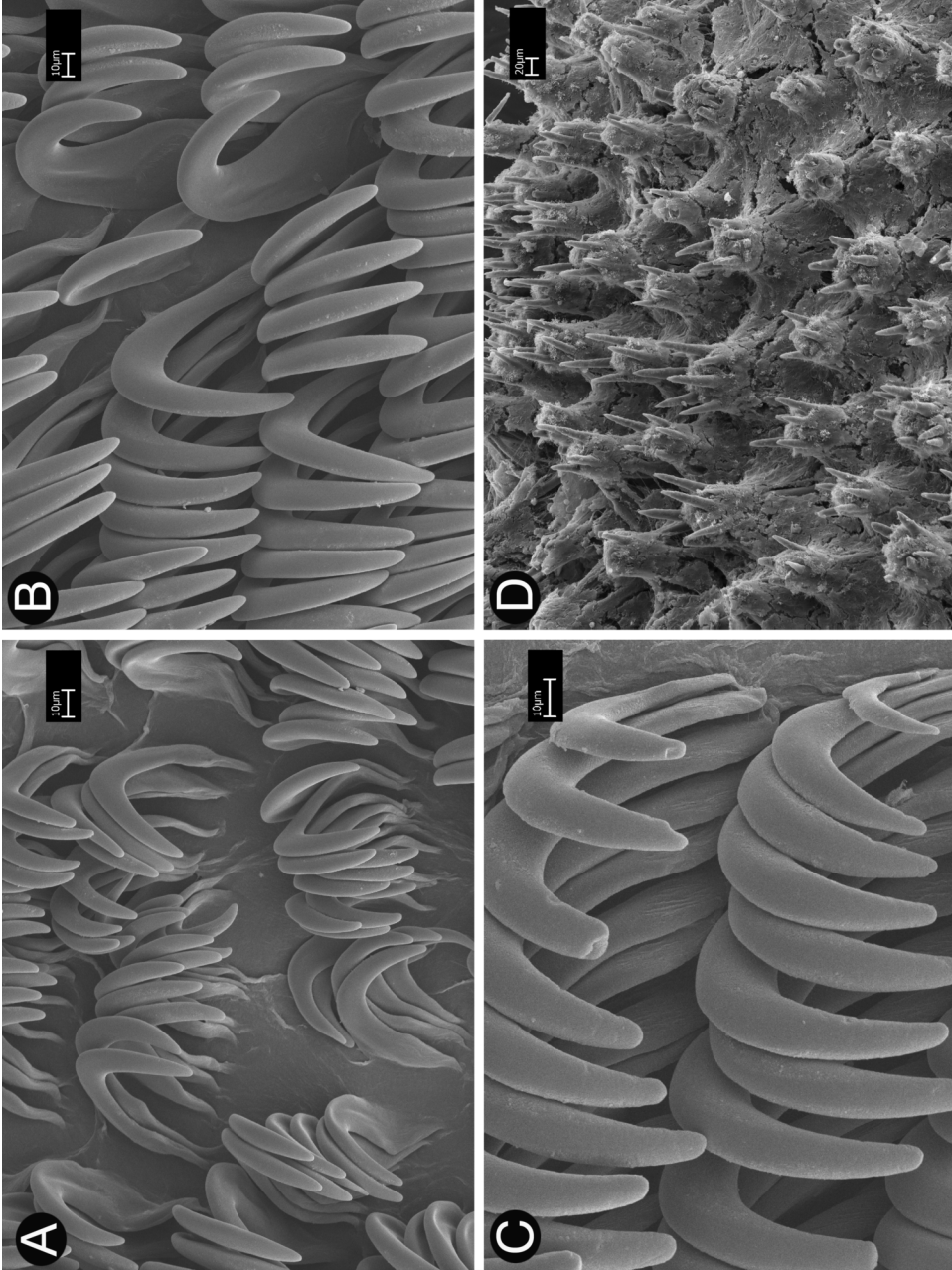


FIGURE 6. *Dicaulula aurita* (INB0001482472), SEM photographs. A. Inner lateral teeth, scale bar= 10µm; B. Lateral teeth, scale bar= 10µm. C. Outer lateral teeth, scale bar= 10µm D. Caryophyllidia, scale bar=20µm

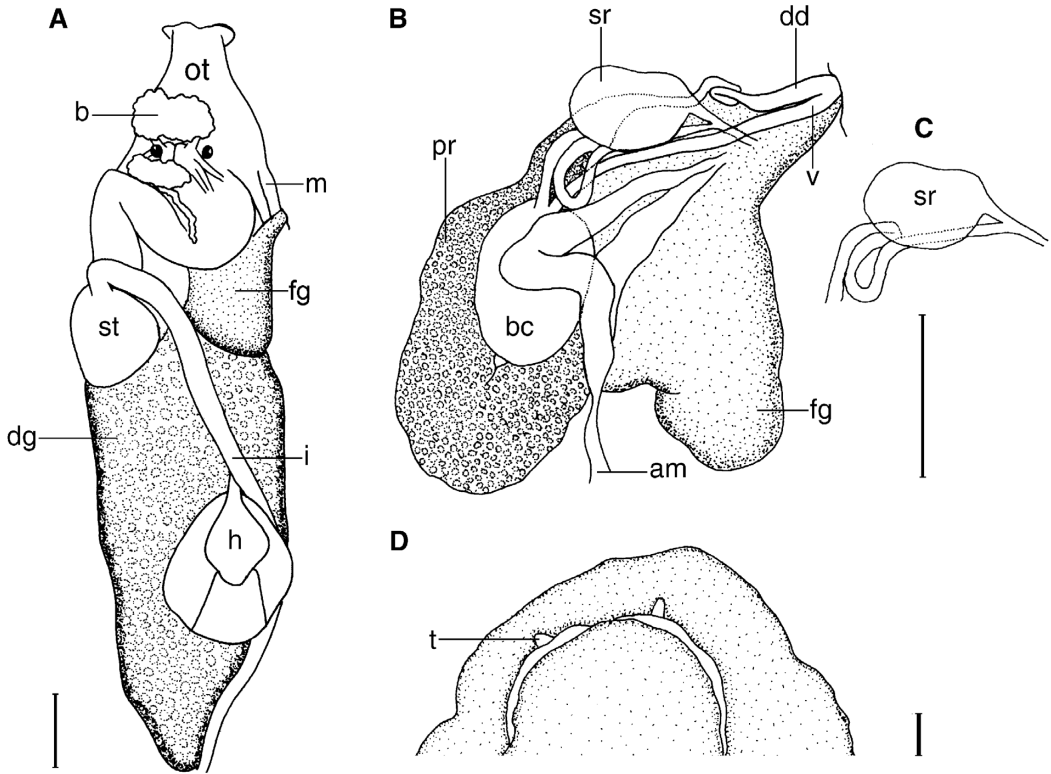


FIGURE 7. Anatomy of *Diaulula aurila* (INB0001482472). A. Dorsal view of the internal organs, scale bar= 1mm; B. Reproductive system, scale bar= 1mm; C. Detail of the reproductive system, scale bar= 1mm; D. Ventral view of the mouth area, scale bar= 1mm. Abbreviations: am=ampulla; b=blood gland; bc=bursa copulatrix; dd=deferent duct; dg=digestive gland; fg=female gland; h=heart; i=intestine; m=retractor muscle; ot=oral tube; pr=prostate; sh=syrinx; sr=seminal receptacle; st=stomach; t=oral tentacle; v=vagina.

### GEOGRAPHIC RANGE

This species is known from the Pacific coast of Costa Rica (present study) and Panama (Marcus, 1976).

### EXTERNAL MORPHOLOGY

The body is oval (Fig. 1D). The dorsum is covered with long caryophyllidia, about 190  $\mu$ m long (Fig. 6D). The body is pale gray, with a diffuse, thick, black line in the middle of the dorsum, running from the rhinophores to the gill. This line is composed of a number of small black dots. The viscera are visible as a pale brown patch in the center of the dorsum. There are some black dots and numerous white dots on the mantle margin. In some specimens the black dots may line up to form longitudinal, diffuse lines. The rhinophores have 17 lamellae. They are translucent white with the club dark yellow and the apex and rachis opaque white. The gill is composed of 6 tripinnate branchial leaves. They are gray to dirty yellow with some orange, apparently glandular spots. Ventrally the anterior border of the foot is grooved and notched. The oral tentacles are short and slender (Fig. 7D).

## ANATOMY

The labial cuticle is smooth. The radular formula is  $20 \times (39.0.30)$  in a 15 mm preserved length specimen (INB000148247). The radula has no rachidian teeth (Fig. 6A). The lateral teeth are hamate and smooth (Fig. 6B). The innermost teeth are also hamate and very elongated, lacking denticles. The outermost teeth are small, elongated and smooth. However, sometimes the tooth has up to 5 denticles (Fig. 6C). The esophagus is long and connects directly to the stomach (Fig. 7A).

The ampulla is very long and convoluted in the middle portion and divides into the short oviduct and prostate (Fig. 7B). It enters the female glands near the middle of the mass. The prostate is large, flattened and granular. It narrows into the short and coiled deferent duct, which expands again into the muscular and wide ejaculatory portion. The deferent duct opens into a common atrium with the vagina. The vagina is long and tubular. The penis is unarmed. The uterine duct is short and thin, and opens near the center of the female gland mass. The seminal receptacle is slightly oval, almost as large as the pyriform bursa copulatrix (Fig. 7C).

## REMARKS

The anatomical examinations indicate that this species should be placed in the genus *Diaulula*, which is characterized by the presence of a dorsum covered with elongated caryophyllidia, low rhinophoral and branchial sheaths, a flattened prostate divided into two portions, penis and vagina unarmed, radular teeth hamate and smooth, and a labial cuticle smooth (see Valdés and Gosliner 2001). Marcus (1967) described *Discodoris aurila* as having jaw elements; however in the specimens studied here from Costa Rica and the microslide of the syntype (F-184) mounted by Marcus herself, the labial cuticle is smooth.

Other species of *Diaulula* from the eastern Pacific are *Diaulula punctuolata* (D'Orbigny 1837), *Diaulula sandiegensis* (Cooper 1863) and *Diaulula greeleyi* (MacFarland 1909). *Diaulula aurila* is different from *D. punctuolata* and *D. sandiegensis* in the external coloration. The general color of the body of *Diaulula aurila* is pale gray, with a line in the middle of the dorsum composed of a number of small black dots as well as black or white dots on the mantle margin. In *Diaulula punctuolata* the dorsum is white to yellowish and has two rows of small dots between the rhinophores and gill. These small dots can be light or dark in color (Schrödl 1996). In *Diaulula sandiegensis*, the general color of the living animals varies from white to pale brown. The dorsum has several dark brown or dark rings of various sizes often aligned in two longitudinal rows, one on either side of the body (Valdés and Gosliner 2001). According to Behrens and Valdés (2001) *Diaulula sandiegensis* sometimes has denticles on the two outermost lateral teeth, a feature that is not always present. As in *D. sandiegensis*, we have found some denticles on the outermost teeth in some specimens of *D. aurila*. *Diaulula aurila* is also different from *D. greeleyi* in radular morphology, external coloration, presence of low rhinophoral and branchial sheaths and tripinnate branchial leaves.

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