

## New records of heterobranch sea slugs (Mollusca: Gastropoda) from Isla del Coco National Park, Costa Rica

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**Abstract:** The molluscan fauna of Isla del Coco has recently been well documented, but the heterobranch sea slugs, traditionally called “opisthobranchs”, remain poorly known. We report 13 new records, increasing the total to 40 species. Of the 13 newly discovered species, the following species had not been previously recorded along the Pacific Costa Rican mainland: *Berthella californica* (Dall, 1900), *Peltodoris rubra* (Bergh, 1905), *Dendrodoris albobrunnea* Allan, 1933, *Doriopsilla* cf. *spaldingi* Valdés & Behrens, 1998, *Glaucus* cf. *marginatus* (Reinhardt & Bergh, 1864), and *Flabellina* sp. Additionally, we report *Peltodoris rubra*, previously known from the Indo-Pacific, for the first time in the Eastern Tropical Pacific. Rev. Biol. Trop. 64 (Suppl. 1): S205-S219. Epub 2016 February 01.

**Key words:** Heterobranchia, Nudipleura, Sacoglossa, Aplysiomorpha, opisthobranch, biodiversity, new records, Isla del Coco, Cocos Island.

Among the marine species recently reported for Isla del Coco (also known as Cocos Island), the mollusks represent the most species-rich group with 490 species (Cortés, 2012). Despite the high diversity, the heterobranch molluscan fauna, traditionally referred to as “opisthobranchs”, is poorly known.

The first records of the Isla del Coco opisthobranch fauna came from a molluscan checklist published by Montoya (1983). Montoya reported the cephalaspidean *Bulla punctulata* A. Adams in Sowerby, 1850, and four pelagic pteropods: *Diacavolinia longirostris* (Blainville 1821, reported as *Cavolinia longirostris*), *Diacria quadridentata* (Blainville 1821), *Creseis virgula* (Rang, 1828), and *Heliconoides inflatus* (d’Orbigny, 1834, reported as *Limacina inflata*). A decade later, Mulliner (1993), reported the pteropods *Cavolinia uncinata* (d’Orbigny, 1834), *Diacria quadridentata*

(Blainville 1821), *Creseis clava* (Rang, 1828, reported as *Creseis acicula*), *Heliconoides inflatus* (d’Orbigny, 1834, reported as *Limacina inflata*), *Limacina bulimoides* (d’Orbigny, 1834), and *Limacina trochiformis* (d’Orbigny, 1834), all specimens were non-living animals but the shells were collected from rock-shaken substrate. The rest of the opisthobranchs collected by Mulliner were: two anaspideans *Dolabella auricularia* (Lightfoot, 1786), and *Dolabrifera dolabrifera* (Rang, 1828), two side-gilled slugs, *Pleurobranchus digueti* Rochebrune, 1895 (reported as *Pleurobranchus areolatus* Mörch, 1863), and *Berthellina ilisima* Marcus & Marcus, 1967 (reported as *B. engeli* Gardiner, 1936). The umbrella shell *Tyrodina fungina* Gabb 1865, and two sacoglossans *Julia thecaphora* (Carpenter, 1857) and *Elysia diomedea* (Bergh, 1894) (reported as *Tridachella diomedea*). Among the dorid nudibranchs,



he also reported *Dendrodoris krebsii* (Mörch, 1863), which is probably *D. fumata*, and *Felimida baumanni* (Bertsch, 1970, reported as *Chromodoris baumanni* Bertsch, 1970).

Valdés, & Camacho-García (2004) reported four species of cephalaspideans from Isla del Coco: *Cylichnella defuncta* (Baker & Hanna, 1972, reported as *Atys defuncta*), *Navanax aenigmaticus* (Bergh, 1893), *Cylichna atahualpa* (Dall, 1908) and *Volvulella catharia* Dall, 1919.

Camacho-García (2009) reported 11 benthic opisthobranchs for Isla del Coco. Among the species reported that are not included in the previous studies mentioned above, are: *Felimida sphoni* Ev. Marcus, 1971 (reported as *Chromodoris sphoni*), *Phestilla lugubris* (Bergh, 1870), and *Tambja abdere* (Farmer, 1978). According to Carmona et al. (2014) *Anteaeolidiella indica* (Bergh, 1888), also reported in Camacho-García (2009) corresponds to *Anteaeolidiella ireneae*. Finally, Sibaja-Cordero,

García-Méndez, & Troncoso (2013) reported the two nudibranchs *Onchidoris* sp. and an aeolid identified as *Aeolidioidea* indet., which were collected from sandy bottoms around the Island.

All of the previous studies bring the number of opisthobranchs of Isla del Coco to 27 species. The present study updates the knowledge on this group. We include new reports, extended distributional ranges, morphological data and illustrate some of the more relevant species for Isla del Coco.

## MATERIALS AND METHODS

**Study site:** Isla del Coco National Park (5°30'–5°34' N - 87°01'–87°06' W) is located approximately 550 km southwest of Cabo Blanco, Costa Rica, and about 630 km northeast of the Galápagos Islands (Lizano, 2001) (Fig. 1). The Island is the only point above sea level of the Coco Volcanic Cordillera



**Fig. 1.** Collecting sites at Isla del Coco National Park.

that originates in the Galápagos Hotspot in the Eastern Tropical Pacific (Alvarado-Induni, 2000; Rojas, & Alvarado, 2012). The Island measures 4.4x7.6 km, with an area of 24 km<sup>2</sup> and the marine protected area is 1997 km<sup>2</sup> (Cortés, 2008).

**Sampling collection:** Sampling was carried out during the scientific Expeditions CIMAR-MONITOREO-COCO-I and II, between 12-20 July 2013 and 23 February 05 March 2014, respectively. The specimens were collected in subtidal areas during daylight hours at six different locations. These locations were surveyed by SCUBA diving to a depth of 15 m.

The specimens were obtained using indirect (collecting algae) and direct (collecting observed animals) methods. Specimens were brought to the laboratory on board the ship and photographed alive, then relaxed in a solution of MgCl<sub>2</sub> with saltwater. After relaxation, the specimens were preserved in 95 % ethanol. Some specimens were fixed in a Bouin's solution and then preserved in 70 % ethanol for morphological studies.

The external characters such as color and morphology were used for identification according to the literature available for the region (Behrens, & Hermosillo, 2005; Camacho-García, Gosliner, & Valdés, 2005; Hermosillo, Behrens, & Ríos-Jara, 2006; Gosliner, Behrens, & Valdés, 2008) and original descriptions (MacFarland, 1905; Valdés, & Behrens, 1998; Churchill, Valdés, & Foighil, 2014). All specimens were collected with a permit from the Sistema Nacional de Áreas de Conservación (065-2013-SINAC, ACMIC-I-2013-0004), and deposited at the Museo de Zoología, Universidad de Costa Rica (MZUCR).

Additionally, we included specimens already deposited at the Museo de Zoología that were collected on different expeditions to Isla del Coco carried out by the Santa Barbara Museum of Natural History and the Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), between 1997 (SBMNH), and 2007 to 2014 (CIMAR). Finally, we also

include specimens from deep waters that were filmed or photographed by the submersible *DeepSee* (Cortés, & Blum, 2008), although just a few of these records have a voucher specimen deposited at MZUCR.

## RESULTS

A total of 13 species were collected from Isla del Coco, increasing the total known opisthobranch fauna to 40 species. Of the 13 species, the following species represent new records for the Pacific Costa Rican mainland: *Berthella californica* (Dall, 1900), *Peltodoris rubra* (Bergh, 1905), *Dendrodoris albobrunea* Allan, 1933, *Doriopsilla* cf. *spaldingi* Valdés & Behrens, 1998, *Glaucus* cf. *marginatus* (Reinhardt & Bergh, 1864), and *Flabellina* sp. The record of *Peltodoris rubra* from Isla del Coco, represents an important range extension on the geographic distribution of this species, as it has never been reported in the Eastern Tropical Pacific.

## SYSTEMATICS

UMBRACULIDA Odhner, 1939

Family Umbraculidae Dall, 1889 (1827)

*Umbraculum umbraculum* (Lightfoot, 1786)

Fig. 2A

### Synonyms

*Parmophorus patelloide* Cantraine, 1835; *Patella ombracula* Blainville, 1819; *Patella sinica* Gmelin, 1791; *Patella umbraculum* Lightfoot, 1786; *Patella umbrellata* Delle Chiaje, 1830; *Umbraculum bermudense* (Mörch, 1875); *Umbraculum botanicum* Hedley, 1923; *Umbraculum chinense* Schumacher, 1817; *Umbraculum indicum* (Lamarck, 1819); *Umbraculum mediterraneum* (Lamarck, 1819); *Umbraculum ovalis* (Carpenter, 1856); *Umbraculum plicatulum* (Martens, 1881); *Umbraculum pulchrum* Lin, 1981; *Umbraculum sinicum* (Gmelin, 1791); *Umbrella indica* Lamarck, 1819; *Umbrella lamarckiana* Récluz, 1843; *Umbrella mediterranea* Lamarck, 1819.

## Material

Isla del Coco National Park, Bahía Weston, 14.07.2013, 1 specimen, 36 mm long by 27 mm wide, 10 m deep, under a rock, leg. Jeffrey Sibaja-Cordero (MZUCR9822-01, photo).

## Remarks

The genus *Umbraculum* Schumacher, 1817 is known from both temperate and tropical seas. According to Wägele, Vonnemann, & Rudman (2006), the genus *Umbraculum* comprises only one species with a worldwide distribution. The morphological and molecular data support *U. umbraculum* as the only species of the genus present in both tropical and temperate waters.

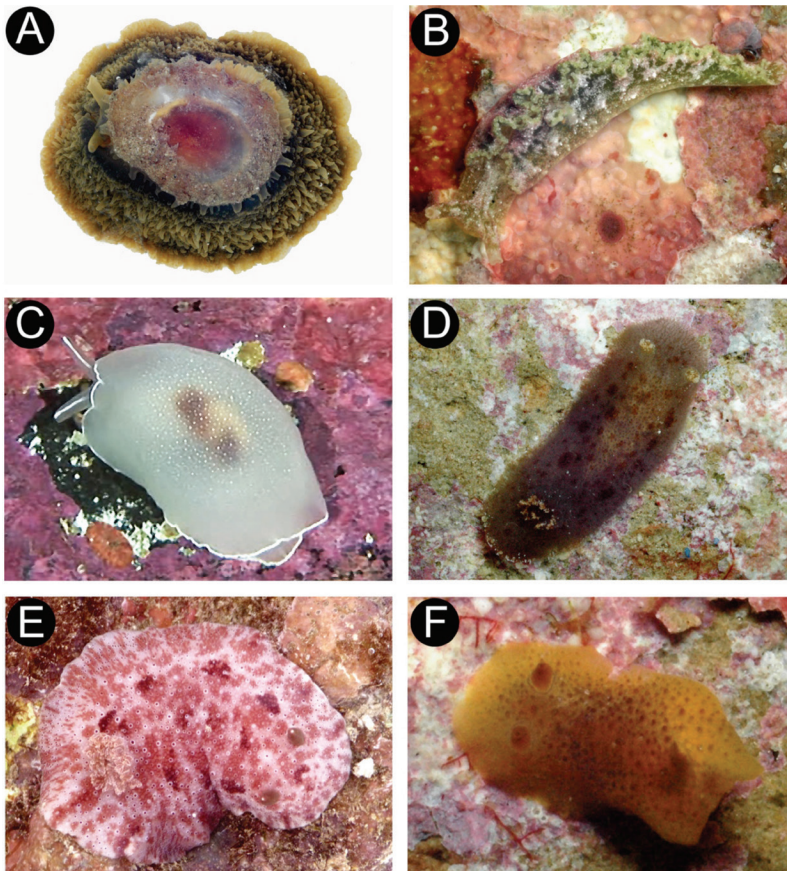
SACOGLOSSA Von Ihering, 1876  
Family Plakobranchidae Gray, 1840  
*Elysia* sp.  
Fig. 2B

## Synonyms

*Elysia* sp. 2 Camacho-García et al., 2005: 65, upper photo. *Elysia* sp. 1 Kaiser, 2007: 50, pl. 42, fig. 5.

## Material

Isla del Coco National Park, Canal Isla Ulloa, 01.03.2014, 7 specimens, 5-12 mm. preserved length, 5 m deep, leg. Kimberly García-Méndez (MZUCR9876-01, photo; MZUCR9876-02, photo; MZUCR9876-03,



**Fig. 2.** (A) *Umbraculum umbraculum* (B) *Elysia* sp. (C) *Berthella californica* (D) *Jorunna tempisqueensis* (E) *Peltodoris rubra* (F) *Geitodoris mavis*. Photos: Kimberly García-Méndez (A, B, D & F), Under Sea Hunter Group (C) and Jeffrey Sibaja-Cordero (E).

photo; MZUCR9876-04, photo; MZUCR9876-05, photo; MZUCR9876-06, photo; MZUCR9876-07, photo;); Isla del Coco National Park, Punta María, 26.02.2014, 9 specimens, 5-12mm preserved length, 7m deep, leg. Kimberly García-Méndez (MZUCR9872-01, photo; MZUCR9872-02, photo; MZUCR9872-03, photo; MZUCR9872-04, photo; MZUCR9872-05, photo; MZUCR9872-06, photo; MZUCR9872-07, photo; MZUCR9872-08, photo); Isla del Coco National Park, Punta Presidio, 25.02.2014, 2 specimens 5-6 mm, preserved length, 5-9 m deep, on green algae, leg. Kimberly García-Méndez (MZUCR9871-01, MZUCR9871-02).

### Morphological comments

The body is elongated and the parapodia completely fused, the edges of these are distinctly crenulated. The rhinophores are long and rolled. The body is olive green. The edges of the parapodia are light green with some white and pink spots that are also present on the rhinophores.

### Remarks

This is an undescribed species known from the Eastern Tropical Pacific, from Baja California to Costa Rica and Islas Revillagigedo (Camacho-García et al., 2005), including Clipperton Island (Kaiser, 2007). This species has also been collected in Panama (Camacho-García, in prep.) In Costa Rica, there are a few records of this species from the Pacific mainland found on the green algae *Codium isabelae* W.R. Taylor, 1945, *Halimeda discoidea* Decaisne, 1842, *Caulerpa* sp. and *Cladophora* sp. At Isla del Coco this species is very abundant on the filamentous green algae *Chlorodesmis caespitosa* J. Agardh 1887 (García-Méndez, 2015).

ANASPIDEA Fischer, 1883  
Family Aplysiidae Lamarck, 1809  
*Stylocheilus striatus* (Quoy & Gaimard, 1832)

### Synonyms

*Aplysia striata* Quoy & Gaimard, 1832;  
*Notarchus polyomma* Mörch, 1863; *Stylocheilus lineolatus* Gould, 1852.

### Material

Isla del Coco National Park, Bahía Chatham, 24.03.1997, 1 specimen, 12 mm preserved length, 0msnm, leg. Yolanda Camacho-García (MZUCR-INB0001498454); Isla del Coco National Park, Punta Presidio, 28.02.2014, 3 specimens 10-12 mm preserved length, 12 m deep, on a rock, leg. Kimberly García-Méndez (MZUCR9875-02, photo; MZUCR9875-03, photo; MZUCR9875-06, photo); Isla del Coco National Park, Punta María, 26.02.2014, 1 specimen, 6 mm preserved length, 7 m deep, on the red algae *Polysiphonia* sp. (García-Méndez, 2015), leg. Kimberly García-Méndez (MZUCR9873-01, photo).

### Remarks

This species has a circumtropical distribution (Camacho-García et al., 2005).

NUDIPLEURA Wägele & Willan, 2000  
PLEUROBRANCHOMORPHA  
Pelseneer, 1906  
Family Pleurobranchidae Gray, 1827  
*Berthella californica* (Dall, 1900)  
Fig. 2C

### Synonyms

*Pleurobranchus californicus* Dall, 1900;  
*Pleurobranchus californicus denticulatus* MacFarland, 1966.

## Material

Isla del Coco National Park, Everest, 18.01.2008, 1 specimen, 80-86 m deep, on encrusting red algae and rocks. There is no voucher specimen for this species, only a photograph taken by the DeepSee Submersible.

## Remarks

Known from Peter the Great Bay (Russia) to Point Craven in Alaska, Canada, Baja California (México) to Isla Coiba (Panamá), and the Galápagos Islands (Behrens, 2004; Hermosillo, 2004; Behrens, & Hermosillo, 2005; Camacho-García et al., 2005). This species has never been recorded on the Pacific Costa Rican mainland.

NUDIBRANCHIA Cuvier, 1817  
EUCTENIDIACEA Tardy, 1970  
Family Discodorididae Bergh, 1891  
*Geitodoris mavis* (Marcus & Marcus, 1967)  
Fig. 2F

## Synonyms

*Discodoris mavis* Marcus & Marcus, 1967, Camacho-García, & Gosliner, 2008.

## Material

Isla del Coco National Park, Bahía Yglesias, 27.02.2014, 1 specimen, 6 mm preserved length, 15 m deep, under a rock, leg. Kimberly García-Méndez (MZUCR9874-03, photo).

## Remarks

This species has been reported from Bahía de los Ángeles, Baja California (México) to Nayarit (México), the Pacific mainland of Costa Rica and Galápagos Islands (Camacho-García et al., 2005; Hermosillo et al., 2006; Camacho-García, & Gosliner, 2008; Bertsch, 2008; Bertsch, 2014). This is the first record for Isla del Coco.

*Jorunna tempisquensis*  
Camacho-García & Gosliner, 2008  
Fig. 2D

## Material

Isla del Coco National Park, Punta Presidio, 28.02.2014, 6 specimens, 5-10 mm preserved length, 12 m deep, under rocks, leg. Kimberly García-Méndez. (MZUCR9875-08, photo; MZUCR9875-09, photo; MZUCR9875-10, photo; MZUCR9875-11, photo; MZUCR9875-12, photo).

## Remarks

This species has been reported for Bahía de los Ángeles, Baja California (México), Bahía Banderas (México) and for the Pacific mainland of Costa Rica (Hermosillo et al., 2006; Camacho-García, & Gosliner, 2008; Camacho-García, 2009; Bertsch, 2014). This species represents a new record for Isla del Coco.

*Peltodoris rubra* (Bergh, 1905)  
Fig. 2E

## Synonyms

*Archidoris hawaiiensis* Kay & Young, 1969.

## Material

Isla del Coco National Park, Bahía Weston, 02.07.2011, 1 specimen, 58 mm preserved length, 10 m deep, under a rock, leg. Jeffrey Sibaja-Cordero (MZUCR8483, photo).

## Morphological comments

Body oval, elongate. Background color light pink to dark reddish brown. Dorsum with numerous red-brown patches, and spots of the same colors. Dorsum also covered with numerous small rounded white tubercles speckled with red on the tips. Rhinophores reddish brown, with white tips. Gill light pink with

whitish lines. Ventral mantle and foot with numerous dark red spots.

### Remarks

If we follow Dayrat (2010), the generic name for this species would be “*Monteireina*”. However, we decided not to follow this classification because this generic name represents a group of several species that cannot be characterized by any diagnostic character or geographic distribution. Due to the lack of consensus on the phylogenetic relationships of Discodoridae, which are unresolved until now, and in order to avoid any taxonomical confusion we prefer to use the generic name *Peltodoris* for this species. This species has been reported from the Indo-West Pacific and Central Pacific (Gosliner et al., 2008). This species is a new record for the Tropical Eastern Pacific. Considering that this is a substantial range extension, this record will need to be confirmed using morphological and molecular techniques.

Family Dendrodorididae O’Donoghue, 1924  
(1864)

*Dendrodoris albobrunnea* Allan, 1933  
Fig. 3A

### Material

Isla del Coco National Park, Punta Presidio, 18.07.2013, 1 specimen, 30 mm preserved length, 8-12 m deep, under a rock, leg. Kimberly García-Méndez. (MZUCR9824-02, photo).

### Remarks

This species has been reported from the western Indian Ocean of Tanzania to Papua New Guinea and Vanuatu; in the Eastern Tropical Pacific from Isla Coiba (Panamá) to Colombia, and Clipperton Island (Hermosillo, 2004; Camacho-García et al., 2005; Kaiser, 2007; Gosliner et al., 2008). *Dendrodoris albobrunnea* has never been found on the Pacific Costa Rican mainland.

*Doriopsilla janaina*  
Er. Marcus & Ev. Marcus, 1967

### Material

Isla del Coco National Park, Isla Pájara, 14.11.2014, 1 specimen, 23 mm preserved length, 9-12 m deep, under a rock, leg. Carolina Salas-Moya (MZUCR10119-02, photo).

### Remarks

This species has been reported from Bahía de los Ángeles, Baja California (México) to Bahía de Banderas (México), El Salvador, Costa Rica, Parque Nacional Coiba (Panamá), and Galápagos Islands (Gosliner, 1991; San Martín et al., 1997; Behrens, & Hermosillo, 2005; Camacho-García et al., 2005; Bertsch, 2008; Barraza, 2009).

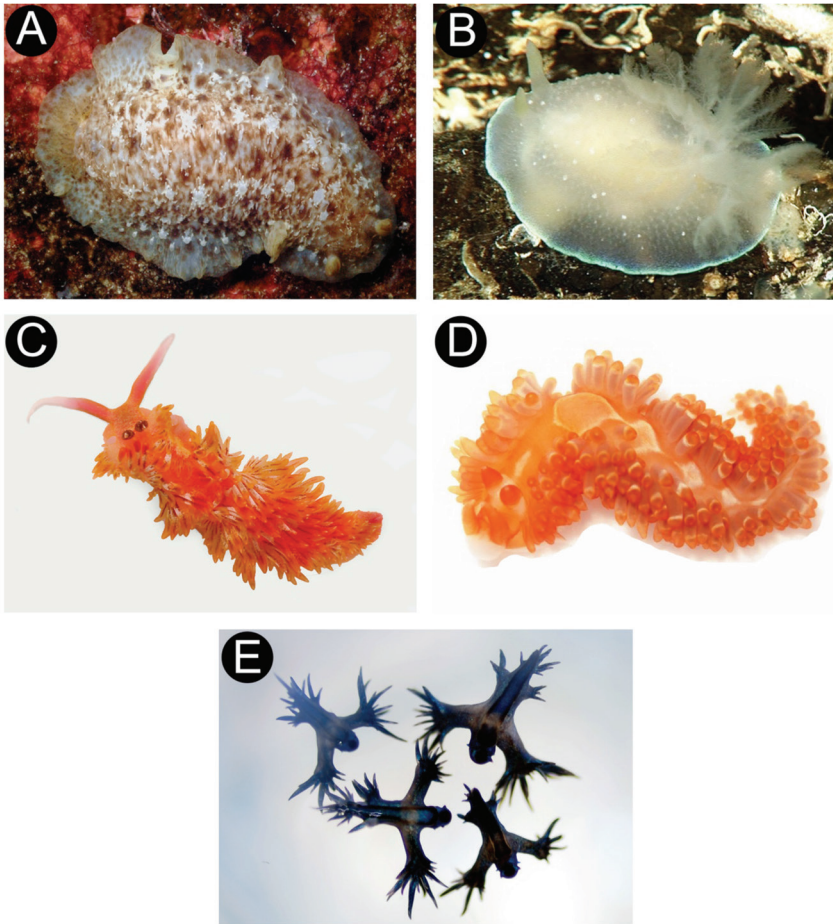
*Doriopsilla* cf. *spaldingi*  
Valdés & Behrens, 1998  
Fig. 3B

### Material

Isla del Coco National Park, Wall 0475, 1 specimen, 301-304 m deep. Isla del Coco National Park, Piedra Drop: 1 specimen, 300-308 m deep on rock. There are no voucher specimens for this species, only the *DeepSee* Submersible took several photographs during the following years: 11.03.2009, 14.05.2009, 03.11.2009, and 23.07.2010.

### Morphological comments

All the photographed specimens have a translucent white body, with conical tubercles on the dorsum, and a mantle margin with an iridescent blue band as in the original description (Valdés, & Behrens, 1998). In this description, the 4-5 branchial leaves are bipinnate, and the rhinophores and branchial leaves are short. In contrast, in our specimens, the rhinophores are relatively long and the 4-5 branchial leaves are tripinnate and spreading. Herein, in the absence



**Fig. 3.** (A) *Dendrodoris albobrunnea* (B) *Doriopsilla* cf. *spaldingi* (C) *Flabellina* sp. (D) *Antaeolidiella ireneae* (E) *Glaucus* cf. *marginatus*. Photos: Kimberly García-Méndez (A), Under Sea Hunter Group (B), Shmulik Blum (C), Juan Manuel Camargo (D) and Felipe López-Pozuelo (E).

of voucher specimens, we identify this species tentatively as *Doriopsilla* cf. *spaldingi*.

#### Remarks

This species is distributed along the Pacific coast of the United States and Mexico, from Carmel California to Punta Banda, Baja California, and Guaymas, Sonora (Valdés, & Behrens, 1998; Hermosillo et al., 2006). This species has not been recorded from the Pacific Costa Rican mainland.

CLADOBRANCHIA Willan & Morton, 1984

Family Flabellinidae Bergh, 1889

*Flabellina* cf. *marcusorum*

Gosliner & Kuzirian, 1990

#### Material

Isla del Coco National Park, Yglesias Bahía, 27.02.2014, 1 specimen, 4 mm preserved length, 15 m deep, under rocks, leg. Kimberly García-Méndez (MZUCR9874-02, photo); Isla del Coco National Park, Punta



Presidio, 28.02.2014, 3 specimens, 3-4 mm preserved length, 12 m deep, under rocks, leg. Kimberly García-Méndez (MZUCR9875-01, photo; MZUCR9875-05, photo; MZUCR9875-07, photo).

### Remarks

This species has been reported from Isla Cedros off Baja California to Sayulita and Bahía Banderas, Nayarit (México) (Gosliner, & Kuzirian, 1990), El Salvador, Pacific mainland of Costa Rica to Islas Galápagos (Sánchez, 2000; Camacho-García et al., 2005; Hermosillo et al., 2006; Barraza, 2009), and Guayaquil, Perú (Nakamura, 2006). Another population has been reported from the Caribbean coast of South America to Brazil (Camacho-García et al., 2005; García-García, Domínguez, Troncoso, 2008). Molecular research on this species should be done in order to clarify the identity of the two Pacific and Caribbean populations.

*Flabellina* sp.  
Fig. 3C

### Synonyms

*Flabellina* sp. Gosliner, 1991; Camacho-García et al., 2005: 100, lower photo.

### Material

Isla del Coco National Park, Everest, 18.10.2013, 1 specimen, 27 mm preserved length, 80 m deep, on top of coral, leg. Jorge Cortés (MZUCR9888-01, photo). Additionally, there are nine photographic records taken by the DeepSee Submersible from the Everest and The Wall during 2007 to 2010.

### Morphological comments

The general body color is bright red to orange. The oral tentacles are similarly colored and have an opaque white tip. Rhinophores are

brown and white tipped. Cerata orange with brown, with some whitish pigment.

### Remarks

This is an undescribed species from the Eastern Tropical Pacific. It has been reported only from Galápagos (Gosliner, 1991; Camacho-García et al., 2005), and it has not been recorded on the Pacific Costa Rican mainland.

Family Aeolidiidae Gray, 1827

*Anteaeolidiella ireneae* Carmona et al., 2014  
Fig. 3D

### Synonyms

*Aeolidiella indica* Camacho-García et al., 2005: 110: upper photo. *Anteaeolidiella* sp. A Carmona, Pola, Gosliner, & Cervera, 2013: 6.

### Material

Isla del Coco National Park, Isla Pájara, 14.11.2014, 1 specimen, 17 mm preserved length, 9-12 m deep, under rock, leg. Carolina Salas-Moya (MZUCR10119-01, photo).

### Morphological comments

For a complete description, see Carmona et al. (2014).

### Remarks

Recently Carmona et al. (2014), conducted a systematic review of the genus *Anteaeolidiella* based on morphological and molecular data. They concluded that what had been called *Aeolidiella indica* from the Eastern Tropical Pacific is a new species they named *Anteaeolidiella ireneae*. *Anteaeolidiella ireneae* is reported from Clipperton Island, Isla Canal de Afuera (Panamá), Bahía de San Marte (México), Isla Socorro (México), and the Pacific coast of Costa Rica. The identity of *Anteaeolidiella indica* remains unclear.

Family Glaucidae Gray, 1827

*Glaucus* cf. *marginatus*  
(Reinhardt & Bergh, 1864)  
Fig. 3G

### Synonyms

*Glaucilla briareus* Reinhardt & Bergh, 1864; *Glaucilla marginata* Reinhardt & Bergh, 1864.

### Material

Provided here is a photographic record of this species taken at Isla del Coco National Park on 25.01.2008. The four living specimens were found washed up on the beach.

### Morphological comments

For a complete description, see Churchill et al. (2014). The specimens in the photograph match the description from Churchill et al. (2014) identified as *Glaucus marginatus*. This species belongs to the informal group 'Marginatus' (Churchill, Alejandrino, Valdés, & Foighil, 2013; Churchill et al., 2014).

### Remarks

Recently, morphological and molecular phylogenetic studies on the genus *Glaucus* revealed that *Glaucus atlanticus* Forster, 1777

is a cosmopolitan species, whereas the informal clade 'Marginatus' is constituted by four cryptic species with Indo-Pacific distribution. This clade includes *Glaucus marginatus* (Reinhardt & Bergh, 1864) from the tropical and subtropical Indo-Pacific region, *Glaucus bennettiae* Churchill, Valdés & Ó Foighil, 2014, which occurs only in the South Pacific; *Glaucus thompsoni* Churchill, Valdés & Ó Foighil, 2014, and *Glaucus mcfarlanei* Churchill, Valdés & Ó Foighil, 2014, from the North Pacific Ocean (Churchill et al., 2013; 2014). In our case, the specimens are consistent with the external morphology of the clade 'Marginatus', possibly *G. marginatus*, *G. thompsoni* or *G. mcfarlanei* mainly due to their geographic distribution. There is one photographic record for this species and identification through morphological and molecular techniques is not possible.

### DISCUSSION

Studies of the opisthobranch fauna from the eastern Pacific oceanic islands are scarce; the majority of research has been done in the Galápagos Islands (Gosliner, 1991). In the present study, the number of opisthobranch species reported from Isla del Coco increase by 13 species, from 27 to 40, a 32 % increase (Table 1). Excluding the eight species of pelagic thecosomes, which have different distributional

TABLE 1  
Heterobranch sea slugs recorded from Isla del Coco National Park

Taxon*	Distribution
ORDER CEPHALASPIDEA	
Family Bullidae	
<i>Bulla punctulata</i> A. Adams in Sowerby, 1850	EP
Family Cylichnidae	
<i>Cylichnella defuncta</i> (Baker & Hanna, 1972)	EP
<i>Cylichna atahualpa</i> (Dall, 1908)	EP
Family Rhizoridae	
<i>Volvulella catharia</i> Dall, 1919	EP
Family Aglajidae	
<i>Navanax aenigmaticus</i> (Bergh, 1893)	EP
ORDER THECOSOMATA	
Family Cavoliniidae	
<i>Diacavolinia longirostris</i> (Blainville, 1821)	P

TABLE 1 (Continued)

Taxon*	Distribution
<i>Diacria quadridentata</i> (Blainville, 1821)	P
<i>Cavolinia uncinata</i> (d'Orbigny, 1834)	P
Family Creseidae	
<i>Creseis virgula</i> (Rang, 1828)	P
<i>Creseis clava</i> (Rang, 1828)	P
Family Limacinidae	
<i>Heliconoides inflatus</i> (d'Orbigny, 1834)	P
<i>Limacina bulimoides</i> (d'Orbigny, 1834)	P
<i>Limacina trochiformis</i> (d'Orbigny, 1834)	P
ORDER ANASPIDEA	
Family Aplysiidae	
<i>Dolabella auricularia</i> (Lightfoot, 1786)	CT
<i>Dolabrifera dolabrifera</i> (Rang, 1828)	CT
<b><i>Stylocheilus striatus</i> (Quoy &amp; Gaimard, 1832)</b>	CT
ORDER SACOGLOSSA	
Family Juliidae	
<i>Julia thecaphora</i> (Carpenter, 1857)	EP
Family Plakobranchidae	
<i>Elysia diomedea</i> (Bergh, 1894)	EP
<b><i>Elysia</i> sp.</b>	EP
ORDER UMBRACULIDA	
Family Umbraculidae	
<b><i>Umbraculum umbraculum</i> (Lightfoot, 1786)</b>	CT
Family Tylodinidae	
<i>Tyrodina fungina</i> Gabb, 1865	EP
ORDER PLEUROBRANCHOMORPHA	
Family Pleurobranchidae	
<i>Pleurobranchus digueti</i> Rochebrune, 1895	EP
<i>Berthellina ilisima</i> Marcus & Marcus, 1967	EP
<b><i>Berthella californica</i> (Dall, 1900)</b>	NP, EP
ORDER NUDIBRANCHIA	
Suborder DORIDACEA	
Family Polyceratidae	
<i>Tambja abdere</i> (Farmer, 1978)	EP
Family Dendrodorididae	
<b><i>Dendrodoris albobrunnea</i> Allan, 1933</b>	IP, EP
<i>Dendrodoris fumata</i> (Mörch, 1863)	IP, EP
<b><i>Doriopsilla janaina</i> Er. Marcus &amp; Ev. Marcus, 1967</b>	EP
<b><i>Doriopsilla</i> cf. <i>spaldingi</i> Valdés &amp; Behrens, 1998</b>	NP
Family Chromodorididae	
<i>Felimida baumanni</i> (Bertsch, 1970)	EP
<i>Felimida sphoni</i> (Ev. Marcus, 1971)	EP
Family Discodorididae	
<b><i>Geitodoris mavis</i> (Marcus &amp; Marcus, 1967)</b>	EP
<b><i>Jorunna tempisquensis</i> Camacho-García &amp; Gosliner, 2008</b>	EP
<b><i>Peltodoris rubra</i> (Bergh, 1905)</b>	IP

TABLE 1 (Continued)

Taxon*	Distribution
Family ONCHIDORIDIDAE	
<i>Onchidoris</i> sp.	EP
Suborder AEOLIDACEA	
Family Flabellinidae	
<b><i>Flabellina</i> sp.</b>	EP
<b><i>Flabellina marcusorum</i> Gosliner &amp; Kuzirian, 1990</b>	Car, EP, WA
Family Tergipedidae	
<i>Phestilla lugubris</i> (Bergh, 1870)	IP, EP
Family Glaucidae	
<b><i>Glaucus</i> cf. <i>marginatus</i> (Reinhardt &amp; Bergh, 1864)</b>	NP, IP?
Family Aeoliidiidae	
<i>Antaeolidiella irenae</i> Carmona et al., 2014	EP

\*Taxa in **boldface type** = new records for Isla del Coco.

Distribution: Car=Caribbean; CT=circumtropical, EP=Eastern Pacific; IP=Indo-Pacific; NP=North Pacific; P=Planktonic; WA=Western Atlantic.

patterns than the benthic opisthobranchs (Lalli, & Gilmer, 1989; Klussmann-Kolb, & Dinapoli, 2006), Isla del Coco shows an increase of 23 species and a 18 % increase of the total of species recorded for the Pacific mainland of Costa Rica (126 spp., Camacho-García, 2009). Additionally, we are including 13 new records of opisthobranchs for Isla del Coco, where seven of these species are new distributional records from the Pacific Costa Rican mainland.

In comparison to Islas Galápagos, the number of opisthobranch species found at Isla del Coco is similar. In contrast to Galápagos, three species recorded at Isla del Coco have Indo-Pacific distributions: *Phestilla lugubris* (Bergh, 1870), *Dendrodoris albobrunnea* Allan, 1933, and *Peltodoris rubra* (Bergh, 1905). The last species had never been reported for the Eastern Tropical Pacific (Gosliner 1991). Overall, the geographical affinities of the Isla del Coco opisthobranch fauna are clearly most related to the Panamic Province. Its position as the first point of contact with the Northern Equatorial Countercurrent (Cortés, 1997), makes the island one of the first possible settlement areas for larvae transported by this current through the Pacific Ocean, before arriving to the eastern Pacific mainland.

The most diverse “opisthobranch” groups at Isla del Coco are both the nudibranch dorids and aeolids, comprising almost a third of the species, which corresponds to the general trend observed along the Pacific Costa Rican mainland (Camacho-García, 2009). It is noteworthy to mention that several common herbivorous species such as *Elysia pusilla* (Bergh, 1872), *Oxynoe panamensis* Pilsbry & Olson, 1943, and *Phyllaplysia padinae* (Williams & Gosliner, 1973), found along the Pacific Costa Rican mainland, appear to be absent at Isla del Coco. Both patterns are probably the result of habitat characteristics such as the presence of reef ecosystems that provide a three-dimensional habitat for sponges, tunicates, bryozoans and hydroids, which are the preferred prey for most nudibranch dorids, and aeolids (Bruno, & Bertness, 2001; Camacho-García, 2009). On the other hand, there is a low habitat complexity provided by macroalgae, due to the dominance of calcareous red algae and filamentous green algae (Fernández, 2008) that could be affecting the composition of the opisthobranch herbivorous species at the Island.

In conclusion, this study updates the knowledge of the opisthobranch fauna of Isla del Coco. We are convinced that the inventory of these mollusks is far from complete and

more studies are needed to enhance the knowledge of the opisthobranch fauna from Isla del Coco. Future surveys should include various sampling techniques designed to collect cryptic species, including nighttime surveys, deep-water exploration and ecological research. All of these techniques combined will help us to better understand the biodiversity of the opisthobranch fauna of Isla del Coco.

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## RESUMEN

**Nuevos registros de babosas marinas (Mollusca: Gastropoda) del Parque Nacional Isla del Coco, Costa Rica:** La fauna de moluscos de la Isla del Coco ha sido bien documentada; sin embargo, los moluscos heterobranquios o babosas marinas (tradicionalmente llamadas opisthobranquios) continúan siendo poco conocidos. Aquí agregamos 13 nuevos registros, incrementando el total a 40 especies. De estas 13 especies, las siguientes no han sido reportadas en la costa continental del Pacífico de Costa

Rica: *Berthella californica* (Dall, 1900), *Peltodoris rubra* (Bergh, 1905), *Dendrodoris albobrunnea* Allan, 1933, *Doriopsilla* cf. *spaldingi* Valdés & Behrens, 1998, *Glaucus* cf. *marginatus* (Reinhardt & Bergh, 1864) y *Flabellina* sp. Informamos por primera vez la presencia de *Peltodoris rubra* en el Pacífico Tropical Oriental.

**Palabras clave:** Heterobranchia, Nudipleura, Sacoglossa, Aplysiomorpha, opisthobranquios, biodiversidad, nuevos registros, Isla del Coco.

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