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Additions to the mollusk checklist of Cocos Island National Park, Costa Rica (Eastern Tropical Pacific)

Adiciones al catalogo de los moluscos del Parque Nacional Isla del Coco, Costa Rica (Pacífico Tropical Este)

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Recibido el 9-I-2013. Aceptado el 1-VII-2013

ABSTRACT

During an expedition aimed to study the benthos of subtidal sand bottoms (3-75 m) of Isla del Coco National Park, on the Pacific Ocean side of Costa Rica, a total of 40 species of mollusks were collected and identified. The gastropods were the most diverse with 21 species, followed by the bivalves with 16 species. Also, one species of Polyplacophora, one species of Scaphopoda, and three specimens of Solenogastres (first record of the class in Central American waters) were found in the dredges. Eleven of these species are new additions to the island, and together with literature records, a total of 545 species of mollusks is now known from Isla del Coco. A new species of the genus *Caecum* is described.

RESUMEN

Durante una expedición para el estudio del bentos en el fondo de arena submareal (3-75 m) del Parque Nacional Isla del Coco, Océano Pacífico de Costa Rica, un total de 40 especies de moluscos fue encontrado. Los gasterópodos fueron los más diversos, con 21 especies, seguidos por los bivalvos con 16 especies. También, una especie de Polyplacophora, una especie de Scaphopoda, y 3 ejemplares de Solenogastres (primer registro en aguas de América Central) se encontraron en las dragas. Once de estas especies son nuevas adiciones para la Isla y junto con otras especies citadas en la literatura, suponen un total de 545 especies de moluscos presentes en la Isla del Coco. Se describe una nueva especie del género *Caecum*.

INTRODUCTION

Knowledge of the malacofauna of the Tropical Eastern Pacific Ocean started with material identified during the 19th century, by taxonomists such as d'Orbigny, Broderip, Sowerby I, Lesson, Hinds, Adams,

Carpenter, and Dall. During the 20th century, authors like Hertlein and Strong and Olsson published several works. Later, the species of the region were compiled by KEEN (1971) with a taxonomic key, and

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Coan and VALENTICH-SCOTT (2012) presented a handbook of the Bivalves with these references and others. In the first decade of the present century, several authors also published taxonomic work on sea slugs (e.g. CAMACHO-GARCÍA, GOSLINER AND VALDÉS, 2005).

Within the Tropical Eastern Pacific, the oceanic islands of Revillagigedo (Mexico), Clipperton (French possession), Isla Malpelo (Colombia), Galapagos (Ecuador) and Isla del Coco (Costa Rica) are sites of exceptional interest for the study of marine mollusks (KAISER AND BRYCE 2001). Due to their geographic position as emerged points of the oceanic sea-floor, these islands are isolated places, with a steep bathymetric gradient, and exposed to changes in intensity and direction of marine currents around the year (Fig. 1).

Studies on the malacofauna of these islands have become more numerous in the last decades. For example, KAISER AND BRYCE (2001) studied the mollusks of Isla Malpelo, and mentioned the references of the first expeditions that collected mollusks: Allan Hancock's Pacific Expedition on *Velero III* in 1931, Smithsonian Tropical Research Institute expedition of 1972, and the *Thornin* expedition in 1990. KAISER AND BRYCE (2001) found several new records of micromollusks for this island during their study (1988 to 2000). In the Galapagos, several researchers visited or studied the mollusks with contributions listed in the compilations of FINET (1991) and FINET, CHIRIBOGA, RUIZ, BANKS AND TIRADO (2011). EMERSON (1994, 1995) and KAISER (2007), also studied the mollusks of Revillagigedo and Clipperton. CORTÉS (2008, 2009), mentioned several studies of marine mollusks in Isla del Coco, for example, those of BIOLLEY (1935), SHASKY (1987), FERREIRA (1987), CHANEY (1992), KAISER (1998), HERTZ AND KAISER (1998). Specimens collected in the majority of studies in Parque Nacional Isla del Coco (PNIC), were obtained from occasional surveys, during dives, mostly on rocky and coral reefs. MONTOYA (1988) did some dredging and netting at random sites around the island during the *Victoria af Carlstat*

expeditions between 1983-1989, with the collaboration of Shasky and Kaiser and increased the fauna from surveys in different habitats, producing more than 50 taxonomic publications (CORTÉS, 2008; 2009). Recently we have had access to an unpublished manuscript based on these expeditions to the island, by Montoya, Shasky and Kaiser (unpublished manuscript, 1988), with title: "The marine Mollusca of Isla del Coco, Costa Rica".

The present study used a quantitative sampling, employing a van Veen grab and 500 μm mesh sieves to retain macro and micromollusks. The main goals of the project were to collect specimens and identify them to the lowest taxonomic level possible in order to increase the number of species reported from Isla del Coco National Park, to describe new species if appropriate, and to understand the biogeographic affinity of the species found, compared to other sites of the Tropical Pacific Ocean.

MATERIAL AND METHODS

The Isla del Coco National Park was visited during the UCR-UNA-COCO-I expedition on board the *M/V Argo* from 19 to 29 April 2010. Isla del Coco is about 500 km from the mainland of Costa Rica, and more than 630 km from Isla Malpelo and the Galapagos Islands (LIZANO, 2001) (Fig. 1, Fig. 2). At each of 27 sampling stations, between 3 and 75 m depth (Fig. 2 and Table I), five sediment samples were collected with a van Veen grab (total sampling area per station: 0.31 m^2) (SIBAJA-CORDERO, TRONCOSO AND CORTÉS, 2012). Organisms were stained with rose bengal and preserved with formalin diluted to 5% in sea water. The samples were later sieved through a 500 μm mesh and the sorted material stored in glass vials filled with 70% ethanol (VARGAS, 1987; SIBAJA-CORDERO *ET AL.*, 2012).

The species were identified using mainly the keys of KEEN (1971) and COAN AND VALENTICH-SCOTT (2012), as well as original descriptions, and illustrations on the web page of the Natural

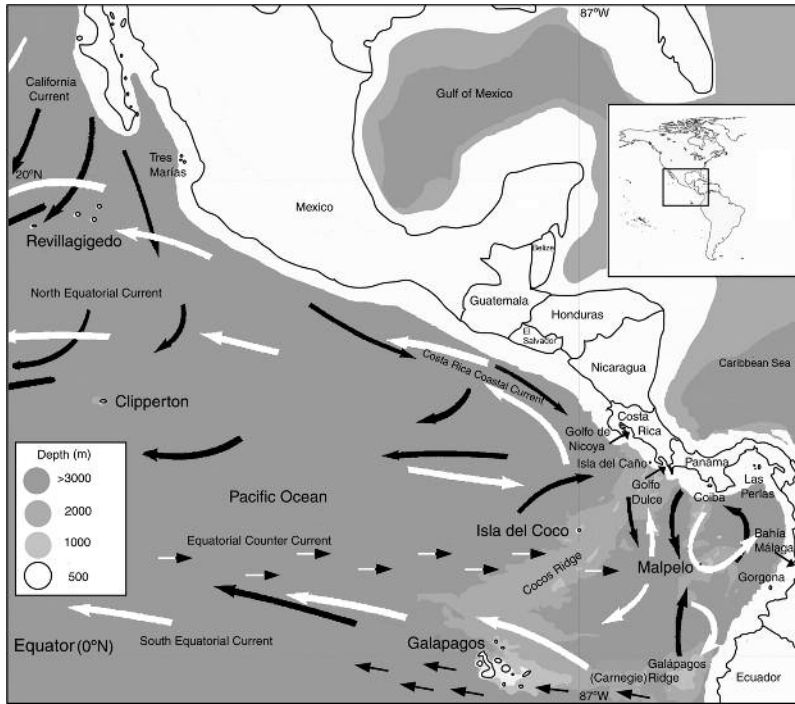


Figure 1. Eastern Tropical Pacific Ocean, showing the location of the main oceanic currents and islands. Black arrows indicate the direction of the currents in April, the white arrows in October, and black-white arrows indicate the direction of the Equatorial Countercurrent in October (Based on HENDRICKX, 1995; LIZANO, 2008).

Figura 1. Océano Pacífico Tropical Este, se muestra la ubicación de las principales Corrientes oceánicas e islas. Flechas negras indican la dirección de las corrientes en abril, las flechas blancas en octubre, y las flechas blanco-negro indican la dirección de la Contracorriente Ecuatorial en octubre (Basado en HENDRICKX, 1995; LIZANO, 2008).

History Museum Rotterdam (www.nmr-pics.nl). The specimens were deposited in the Museo de Zoología (MZUCR), Escuela de Biología, Universidad de Costa Rica (UCR), Costa Rica. The sampling was part of a comprehensive study of the benthic community of the island (SIBAJA-CORDERO, 2012), therefore a code number was assigned to each species, and maintained for the species presented here (Codes 45 to 84). The code is part of the information in the museum label. The station (st.) and dredge (d.) in which each species was found, is also given.

Scanning Electron Microscopy (SEM) was necessary to identify the specimens of a gastropod of the genus *Caecum*. These shells have been cleaned

with distilled water, and remains of adhered tissue were removed with a fine forceps and an ultrasonic bath (20 sec). The shells were dried under an incandescent lamp (4 hr). Subsequently, using a double-sided tape, the specimens were placed on an aluminum stub for SEM; silver paint was added to the edges of this tape to increase the conductivity. The samples were covered with Pd/Pt alloy using an "ion coater" (Model Giko IB-3), for 4 min. The specimens were then examined in a SEM (Hitachi model S-570) and photomicrographs were taken of the complete shell (frontal and lateral view), the detail of the sculpture, and details of the septum, the aperture and the operculum.

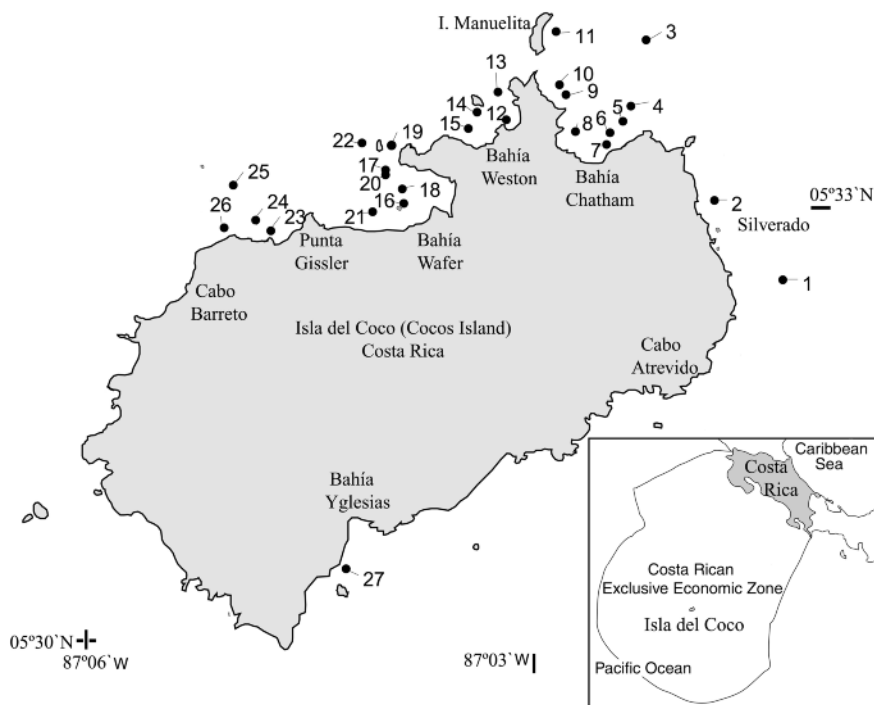


Figure 2. Sampling stations (1-27) around Isla del Coco, Costa Rica. April 2010.
 Figura 2. Estaciones de muestreo (1-27) alrededor de la Isla del Coco, Costa Rica. Abril 2010.

RESULTS

A total of 434 specimens of mollusks, distributed in 40 species, were found in the sediment of Isla del Coco, between 3 and 75 m depth. The gastropods were the most diverse with 21 species, followed by the bivalves with 16 species.

Also, one species of Polyplacophora, Scaphopoda, and Solenogastres were found in the dredges. The following paragraphs provide comments for each species, on their characteristics, habitat, and distribution.

Phylum MOLLUSCA

Class BIVALVIA Linnaeus, 1758

Subclass PTERIOMORPHIA Beurlen, 1944

Order PTERIOIDA Newell, 1965

Family PTERIIDAE Gray, 1847 (1820)

Genus *Isognomon* Lightfoot, 1786

Isognomon (Melina) janus P. P. Carpenter, 1857 (Figure 3; Code 45)

Isognomon janus P.P. Carpenter, 1857: 151-152; Brann, 1966: pl. 17, fig. 206-689.

Isognomon (Melina) janus P.P. Carpenter, 1857 – Coan and Valentich-Scott, 2012: 220, pl. 72.

Material studied: Bahía Wafer: st. 19, d. 4, 20 m. 3 ind.

Table I. Latitude, longitude and depth at low tide level (0 m) of the sampling stations. Isla del Coco, Costa Rica.

Tabla I. Latitud, longitud y profundidad al nivel de marea baja (0 m) de las estaciones de muestreo. Isla del Coco, Costa Rica.

Locality	Station	Latitude (N)	Longitude (W)	Depth (m)
El Arco	1	5°32'11.0"	87°01'22.5"	60.1
Silverado	2	5°32'40.2"	87°01'47.7"	9.7
Bahía Chatham	3	5°33'39.4"	87°02'13"	74.8
Bahía Chatham	4	5°33'15.0"	87°02'18.6"	34.8
Bahía Chatham	5	5°33'09.3"	87°02'21.6"	16.0
Bahía Chatham	6	5°33'5.20"	87°02'26.4"	8.4
Bahía Chatham	7	5°33'00.8"	87°02'27.6"	4.6
Bahía Chatham	8	5°33'05.6"	87°02'39.1"	2.6
Bahía Chatham	9	5°33'19.2"	87°02'42.6"	10.0
Bahía Chatham	10	5°33'22.9"	87°02'45"	10.6
Bahía Chatham	11	5°33'42.6"	87°02'46.2"	15.0
Bahía Weston	12	5°33'09.9"	87°03'4.6"	9.9
Bahía Weston	13	5°33'20.2"	87°03'7.7"	42.1
Bahía Weston	14	5°33'12.7"	87°03'15.4"	18.5
Bahía Weston	15	5°33'06.7"	87°03'18.6"	12.2
Bahía Wafer	16	5°32'39.1"	87°03'42.6"	3.5
Bahía Wafer	17	5°32'51.5"	87°03'49.2"	23.0
Bahía Wafer	18	5°32'44.4"	87°03'43"	7.8
Bahía Wafer	19	5°33'00.4"	87°03'46.9"	24.2
Bahía Wafer	20	5°32'49.7"	87°03'49.2"	39.8
Bahía Wafer	21	5°32'36.1"	87°03'54"	7.2
Bahía Wafer	22	5°33'01.3"	87°03'58"	70.9
Punta Gissler	23	5°32'29.0"	87°04'31.7"	11.2
Punta Gissler	24	5°32'32.9"	87°04'37.1"	15.8
Punta Gissler	25	5°32'45.9"	87°04'45.5"	53.2
Punta Gissler	26	5°32'30.2"	87°04'48.9"	12.6
Bahía Yglesias	27	5°30'24.4"	87°04'3.8"	12.5

Size: 2.6 × 2.0 mm.

Remarks: The specimens found are juveniles, similar to figure 163 in Keen (1971), and resembles the outline of the holotype (adult) in plate 72 of COAN AND VALENTICH-SCOTT (2012). The valves are tongue-shaped and have few pits along the hinge margin. The commarginal lamellae are thin in the margins (CARPENTER, 1857; KEEN, 1971; COAN AND VALENTICH-SCOTT, 2012).

Distribution: This species is widely distributed in the Tropical Eastern Pacific (KEEN, 1971; MAGAÑA-CUBILLO AND ESPINOSA, 2009) and was previously reported

along the Pacific of Costa Rica (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009). It also occurs in oceanic islands of the Tropical eastern Pacific: Revillagegido, Clipperton, Isla del Coco, Malpelo, and Galapagos (MAGAÑA-CUBILLO AND ESPINOSA, 2009; FINET *ET AL.*, 2011; COAN AND VALENTICH-SCOTT, 2012). The specimens were attached to a small fragment of rhodolith within the sand bottom. MAGAÑA-CUBILLO AND ESPINOSA (2009) report the species as subtidal in rubble or sand, and SOLANO (2011) had already found this species in a rhodolith bed at 20 m depth in Punta Ulloa, PNIC.

Order ARCOIDA Stoliczka, 1871
Family GLYCYMERIDIDAE Dall, 1908 (1847)
Genus *Tucetona* Iredale, 1931

Tucetona strigilata (G.B. Sowerby I, 1833) (Figure 4 a-c, Code 46)

Pectunculus strigilatus G.B. Sowerby I, 1833, *Proc. Comm. Sc. Corresp. Zool. Soc. London*, 2: 196.

Pectunculus tessellatus G.B. Sowerby I, 1833, *Proc. Comm. Sc. Corresp. Zool. Soc. London*, 2: 196.

Glycymeris (Tucetona) strigilata (Sowerby, 1833) – Keen, 1971: 57.

Tucetona strigilata (G.B. Sowerby I, 1833) – Huber, 2010: 156, 584; Coan and Valentich-Scott, 2012: 199, pl. 65.

Material studied: El Arco: st. 1, d. 2, 61 m. 4 juvenile ind.

Size: 8.0 × 8.0 – 22.1 × 22.2 mm.

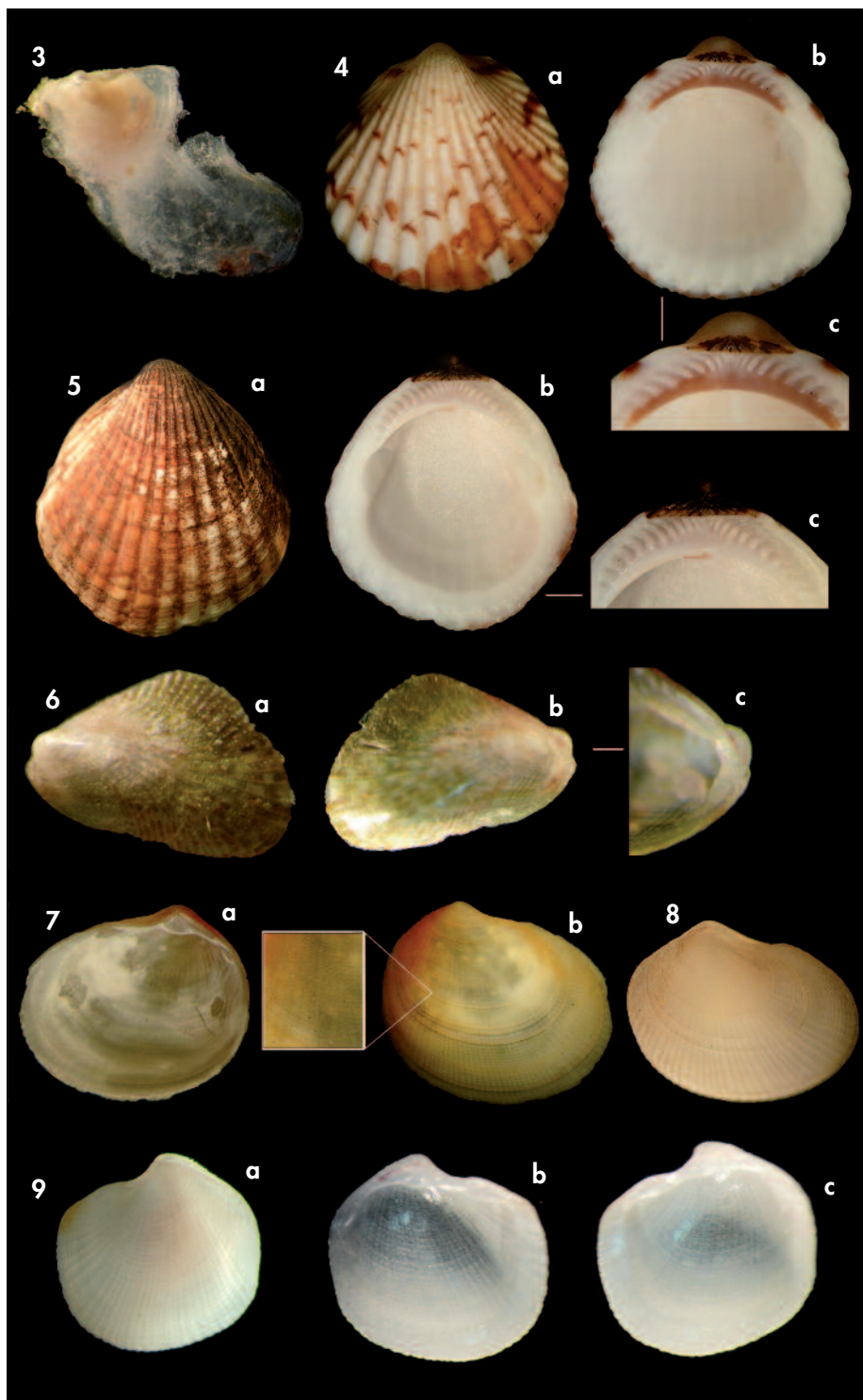
Remarks: The valves are comparable to Fig. 117 of KEEN (1971) and to the picture of a specimen from Sinaloa, Mexico (catalogue number NMR 19662) in Natural History Museum Rotterdam (NMR). Moreover, there is some degree of variation in the outline as compared with fig 65 of COAN AND VALENTICH-SCOTT (2012). *Tucetona multicostrata* G.B. Sowerby I, 1833 is similar, but the specimen in PNIC, has 25 wider ribs (Fig. 4a), within the range reported for *T. strigilata*, while *T. multicostrata* would have have 31-43 radial ribs (COAN AND VALENTICH-SCOTT, 2012). These ribs in specimens of PNIC are not bifurcate, and the valves have spots of brown or reddish color. The hinge is linear near the umbo like Fig. 10 of VALENTICH-

SCOTT AND GARFINKLE (2011). The margins are not heavily crenulated in contrast with *T. multicostrata*. The specimens in Isla del Coco presented a brown or white wide region below the teeth (Fig. 4b). The number of 12-15 anterior and 13-18 posterior teeth were reported for *T. strigilata* (COAN AND VALENTICH-SCOTT, 2012), but in specimens of PNIC, they range between 6-10 anterior and 6-11 posterior (Fig. 4c), the tooth number increasing with shell size.

Distribution: From Baja California to Ecuador (KEEN, 1971). Present along the Pacific Coast of Costa Rica, and Isla del Coco (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009). The species also occurs on the continental island of Gorgona (UAESPNN, 2005, Appendix III).

(Right page) Figure 3. *Isognomon janus* Carpenter, 1857, 2.6 × 2.0 mm, st. 19. Figure 4. *Tucetona strigilata* (G. B. Sowerby I, 1833), a: valve, exterior view; b: interior view; c: detail of the hinge, 22.1 × 22.2 mm, st. 1. Figure 5. *Tucetona* sp., a: valve, exterior view; b: interior view; c: detail of the hinge, 22.6 × 20.5 mm, st. 3. Figure 6. *Septifer zeteki* Hertlein and Strong, 1946, a: valve, exterior view; b: interior view and detail of the hinge, 1.4 × 1.5 mm, st. 11. Figure 7. *Ctena clarionensis* Hertlein and Strong, 1946, a: interior view; b: exterior view and detail of the sculpture, 5.2 × 5.3 mm, st. 19. Figure 8. *Ctena mexicana* (Dall, 1901), 2.3 × 3.0 mm, st. 26. Figure 9. *Parvilucina mazatlanica* (Carpenter, 1857), a: exterior view; b: interior view of the valves, 3.5 × 3.6 mm, st. 18.

(Página derecha) Figura 3. *Isognomon janus* Carpenter, 1857, 2,6 × 2,0 mm, est. 19. Figura 4. *Tucetona strigilata* (G. B. Sowerby I, 1833), a: valva, vista exterior; b: vista interior; c: detalle de la charnela, 22,1 × 22,2 mm, est. 1. Figura 5. *Tucetona* sp., a: valva, vista exterior; b: vista interior; c: detalle de la charnela, 22,6 × 20,5 mm, est. 3. Figura 6. *Septifer zeteki* Hertlein y Strong, 1946, a: valva, vista exterior; b: vista interior y detalle de la charnela, 1,4 × 1,5 mm, est. 11. Figura 7. *Ctena clarionensis* Hertlein y Strong, 1946, a: vista interior; b: vista exterior y detalle de la escultura, 5,2 × 5,3 mm, est. 19. Figura 8. *Ctena mexicana* (Dall, 1901), 2,3 × 3,0 mm, est. 26. Figura 9. *Parvilucina mazatlanica* (Carpenter, 1857), a: vista exterior; b: vista interior de las valvas, 3,5 × 3,6 mm, est. 18.



Tucetona sp. (Figure 5 a-c, Code 47)

Material studied: Bahía Chatham: st. 3, d. 1, 74m. 1 ind.

Size: 22.6 × 20.5 mm.

Remarks: This bivalve resembles *T. strigilata* in the outline, number of radial ribs (25), number of teeth (11 anterior, and 11 posterior). On the other hand, the specimen has a reddish-brown periostracum and narrow radial ribs, marked commarginal ribs spaced along the shell and several commarginal striae marked ventrally. The specimen is similar in sculpture to *Tucetona canoa* (Pilsbry and Olsson, 1941), which

COAN AND VALENTICH-SCOTT (2012) synonymized with *T. strigilata*, but differs in the marked commarginal ribs and exterior brown color without chevrons, bands or blotches. More sampling is required to determine the identity of this specimen.

Distribution: Other species are present in the Tropical Eastern Pacific (COAN AND VALENTICH-SCOTT, 2012), but differ in several characteristics from this individual.

Order MYTILOIDA Ferussac, 1822
Family MYTILIDAE Rafinesque, 1815
Genus *Septifer* Dunker, 1855

Septifer zeteki Hertlein and Strong, 1946 (Figure 6 a-c, Code 48)

Septifer zeteki Hertlein and Strong, 1946, *Zoologica: Sci. Contr. New York Zool. Soc.*, 31: 71, pl. 1 figs. 1-2.; Coan and Valentich-Scott, 2012: 151, pl. 49.

Material studied: Manuelita: st. 11, d. 1, 13.6m. 1 ind.

Size: 1.4 × 1.5 mm.

Remarks: Species of *Septifer* are similar to *Brachidontes* but with a shelly septum on the tip of valve (Fig. 6c). The small valves of the specimen found are identified to *Septifer zeteki* Hertlein and Strong, 1946 as shown in figure 129 of KEEN (1971); they are greenish in color and with bifurcate ribs as in plate 49 of COAN AND VALENTICH-SCOTT (2012).

Distribution: This is the only species of *Septifer* reported from Baja California to Peru. Present in Revillagigedo (COAN AND VALENTICH-SCOTT, 2012), Isla del Coco (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009), Galapagos (FINET ET AL., 2011), Malpelo and Gorgona (UAESPNN, 2005, Appendix III; COAN AND VALENTICH-SCOTT, 2012). The specimen of PNIC was found attached by the byssus to a pebble in the sand bottom.

Subclass HETERODONTA Neumayr, 1884
Order LUCINOIDA Gray, 1854
Family LUCINIDAE Fleming, 1828
Genus *Ctena* Mörch, 1861

Ctena clarionensis Hertlein and Strong, 1946 (Figure 7 a-b, Code 49)

Ctena clarionensis Hertlein and Strong, 1946, *Zoologica: Sci. Contr. New York Zool. Soc.*, 31: 118; Coan and Valentich-Scott, 2012: 340, pl. 109.

Material studied: Bahía Wafer: st. 19, d. 1, 27.8m. 1 ind.

Size: 5.2 × 5.3 mm.

Remarks: The specimen is similar to figure 281 of KEEN (1971) and plate 109 of COAN AND VALENTICH-SCOTT (2012). This individual has 75 radial ribs with dense commarginal ribs in crossbars intersections (Fig. 7b). *Ctena clarionensis* is similar in outline to *Ctena mexicana* (Dall, 1901), but has valves with very fine and numerous radial ribs (about 80), while *C. mexicana* only has 30 to 50

radial ribs. The specimens of PNIC also presented the somewhat bifid posterior cardinal in the right valve (Fig. 7a).

Distribution: Baja California to Ecuador (KEEN, 1971). The species is present along the Pacific coast of Costa Rica mainland (INBIO, 1989). Reported from Revillagigedo, Clipperton, and Isla del Coco (KEEN, 1971; MAGAÑA-CUBILLO AND ESPINOSA, 2009; COAN AND VALENTICH-SCOTT, 2012).

Ctena mexicana (Dall 1901) (Figure 8, Code 50)

Lucina pectinata P.P. Carpenter, 1857: 98-99 (preoccupied name).

Codakia (Jagonia) mexicana Dall, 1901, *Proc. U.S. Nat. Mus.*, 23: 801, 822, pl. 40 fig. 6 (replacement name).

Ctena mexicana (Dall 1901) – Keen 1971: 125; Coan and Valentich-Scott, 2012: 341, pl. 110.

Material studied: Punta Gissler: st. 26, d. 2, 12.1m, 1 ind.

Size: 2.3 × 3.0 mm.

Remarks: In this small juvenile specimen, the shell is subovate, with the anterior end longer, and with 47 strong radial ribs extending to valve margin. The internal ventral margin looks denticulate. Commarginal striae are comparable to plate 110 of COAN AND VALENTICH-SCOTT (2012), and Fig. 284 of KEEN (1971). The internal characteristics of

both valves agree with the description of COAN AND VALENTICH-SCOTT (2012).

Distribution: Baja California to Colombia (COAN AND VALENTICH-SCOTT, 2012), Pacific coast of Costa Rica (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009, REVILLAGIGEDO, MALPELO (COAN AND VALENTICH-SCOTT, 2012), and Galapagos (FINET *ET AL.*, 2011). The species is a new record for Isla del Coco.

Genus *Parvilucina* Dall, 1901

Parvilucina mazatlanica (Carpenter, 1857) (Figure 9 a-c, Code 51)

Lucina mazatlanica Carpenter, 1857: 99-100; Brann, 1966, pl. 12, Fig. 144-472.

Lucina (Parvilucina) mazatlanica (Carpenter, 1857); Keen, 1971: 121.

Parvilucina mazatlanica (Carpenter, 1857); Odé, 1977, *Texas conchol.*, 14: 17; Coan and Valentich-Scott, 2012: 354, pl. 115 (redescription).

Material studied: Bahía Chatham: st. 4, d. 1, 33.8 m, 3 ind; st. 9, d. 3, 10 m, 1 ind; st. 9, d. 4, 10m, 1 ind; st. 9, d. 5, 9.9 m, 2 ind; st. 10, d. 3, 10.6 m, 1 ind; st. 10, d. 5, 10.7 m, 3 ind. – Bahía Wafer: st. 17, d. 4, 27.6m, 1 ind; st. 18, d. 5, 7.3 m, 1 ind; st. 20, d. 3, 38.1 m, 1 ind; st. 20, d. 4, 38.2 m, 1 ind.

Size: 1.1 × 1.2 - 3.5 × 3.6 mm.

Remarks: These are small specimens similar to Fig. 275 of KEEN (1971), with the reticular sculpture (Fig. 9a), radial ribs weak at the middle, the disposition of the lateral teeth, and the shape of the lunule (Fig. 9b-c). Also, matches with the

subquadrate shell outline in pl. 12, Fig. 144-472 of Brann, 1966, and plate 115 of COAN AND VALENTICH-SCOTT (2012).

Distribution: Gulf of California to Panama (KEEN, 1971). The species was known for the Pacific coast of mainland Costa Rica (INBIO, 1989; MAGAÑA-

CUBILLO AND ESPINOSA, 2009) but not reported from any other oceanic island

of the Tropical Eastern Pacific; it is a new record for Isla del Coco.

Order VENEROIDA Gray, 1854
Family MONTACUTIDAE W. Clark, 1855
Genus *Planktomya* Simroth, 1896

Planktomya cf. *henseni* Simroth, 1896 (Figure 10 a-d, Code 52)

?*Planktomya henseni* Simroth, 1896: *Ergebn. Plankton-Exped. Humboldt-Stiftung*, 2 (6): 28, pl. 1, Fig. 1A-C.; Coan and Valentich-Scott, 2012: 458, pl. 152.

Material studied: Silverado: st. 2, d. 1, 9.5 m, 1 ind; st. 2, d. 2, 9.5 m, 3 ind; st. 2, d. 4, 10.6 m, 1 ind. – Bahía Chatham: st. 4, d. 5, 34.9 m, 1 ind; st. 6, d. 5, 8.4 m, 1 ind. – Bahía Weston: st. 13, d. 5, 42.3 m, 2 ind; st. 14, d. 4, 18.6 m, 1 ind; st. 14, d. 5, 18.6 m, 1 ind. – Punta Gissler: st. 26, d. 2, 12.1 m, 1 ind. – Bahía Yglesias: st. 27, d. 4, 13.6 m, 2 ind.

Size: 0.3 × 0.4 mm.

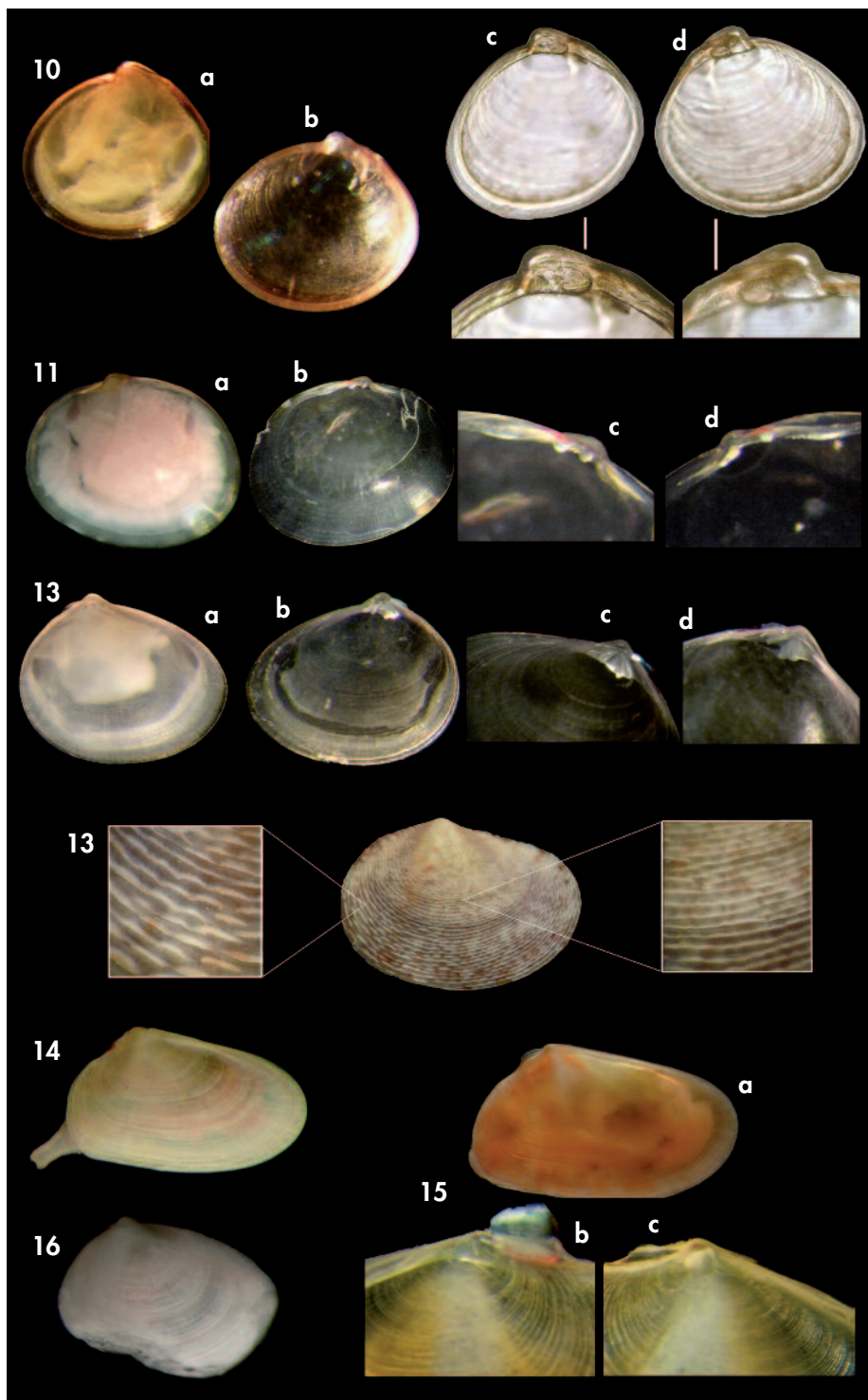
Remarks: Specimens have soft and orange shells, and possibly these had been recently fallen on the sea-bottom, however, several features are clearly seen in the specimens. The valves are very small, fragile, transparent, oblique, inequilateral, with anterior end longer, and with opisthogyrate umbos (Fig. 10a). They have no radial sculpture, but have weak commarginal lines that may be seen from the inside of the shell (Fig. 10b). The elements of ligament appear internally and the hinge has well developed cardinal teeth. In the right valve, the cardinal teeth are separate (Fig. 10c) while in the left valve are close toget-

her (Fig. 10d). The lateral teeth are small. These valves agree with most of the characters of *Planktomya henseni* Simroth, 1896 and resemble plate 152 of this species in COAN AND VALENTICH-SCOTT (2012). These authors point out the extensive planktonic life stage of this bivalve, and that in the adult stage it settles on the benthos.

Distribution: The type locality of this species is in the Caribbean Sea, but in the Tropical Eastern Pacific, this species occurs from Nayarit, Mexico to the Galapagos, including in its distribution a record from Isla Manuelita, Isla del Coco (COAN AND VALENTICH-SCOTT, 2012).

(Right page) Figure 10. *Planktomya* cf. *henseni* Simroth, 1896, a: exterior view; b: interior view; c: right valve; d: left valve, 0.3 × 0.4 mm, st. 14. Figure 11. *Diarmaidia jingchunae* Valentich-Scott, in Coan and Valentich-Scott, 2012, a: external view; b: internal view; c: teeth of the left valve; d: teeth of the right valve, 2.0 × 1.7 mm, st. 14. Figure 12. *Diplodonta* sp., a: exterior view; b: interior view; c: teeth of the right valve; d: teeth of the left valve, 1.3 × 1.7 mm, st. 14. Figure 13. *Semele* (*Amphidesma*) *formosa* (G. B. Sowerby I, 1833), 3.2 × 15.1 mm, st. 19. Figure 14. *Tellina* (*Moerella*) sp., 1.0 × 2.0 mm, st. 4. Figure 15. *Tellina* (*Moerella*) *coani* (Keen, 1971), a: external view; b: teeth of the right valve; c: teeth of the left valve, 2.6 × 4.5 mm, st. 25. Figure 16. *Tellina* (*Laciolina*) sp., 1.0 × 2.2 mm, st. 15. Isla del Coco. April 2010.

(Página derecha) Figura 10. *Planktomya* cf. *henseni* Simroth, 1896, a: vista exterior; b: vista interior; c: valva derecha; d: valva izquierda, 0,3 × 0,4 mm, est. 14. Figura 11. *Diarmaidia jingchunae* Valentich-Scott, en Coan y Valentich-Scott, 2012, a: vista externa; b: vista interna; c: dientes de la valva izquierda; d: dientes de la valva derecha, 2,0 × 1,7 mm, est. 14. Figura 12. *Diplodonta* sp., a: vista exterior; b: vista interior; c: dientes de la valva derecha; d: dientes de la valva izquierda, 1,3 × 1,7 mm, est. 14. Figura 13. *Semele* (*Amphidesma*) *formosa* (G. B. Sowerby I, 1833), 3,2 × 15,1 mm, est. 19. Figura 14. *Tellina* (*Moerella*) sp., 1,0 × 2,0 mm, est. 4. Figura 15. *Tellina* (*Moerella*) *coani* (Keen, 1971), a: vista externa; b: dientes de la valva derecha; c: dientes de la valva izquierda, 2,6 × 4,5 mm, est. 25. Figura 16. *Tellina* (*Laciolina*) sp., 1,0 × 2,2 mm, est. 15. Isla del Coco. Abril 2010.



Family LASAEIDAE J. E. Gray, 1842

Genus *Diarmaidia* Valentich-Scott, in Coan and Valentich-Scott, 2012

Diarmaidia jingchunae Valentich-Scott, in Coan and Valentich-Scott, 2012
(Figure 11 a-d, Code 53)

Diarmaidia jingchunae Valentich-Scott, in Coan and Valentich-Scott, 2012: 506, pl. 167.

Material studied: Bahía Weston: st. 14, d. 1, 18.5 m, 1 ind.

Size: 2.0 × 1.7 mm.

Remarks: The valves are almost ovate, much longer posteriorly (Fig. 11a), with cardinal teeth in a central position. They have few low radial ribs on the edges, visible from inside, and also a commarginal sculpture that can be seen from inside the shell (Fig. 11b). The ligament is mostly internal. The hinge has two small cardinal teeth. In the right valve, a small cardinal joins to a posterior lateral tooth (Fig. 11d). There are two lateral teeth, the posterior lateral

more pronounced than the anterior, in both valves (Fig. 11c-d). The specimen is similar to plate 167 in COAN AND VALENTICH-SCOTT (2012), and had many eggs in the mantle cavity. The valves were broken along the ventral margin during identification.

Distribution: Only known from the type locality, El Salvador (COAN AND VALENTICH-SCOTT, 2012). This is the first record after the original description, therefore, new for the PNIC and Costa Rica.

Family UNGULINIDAE J. E. Gray, 1854

Genus *Diplodonta* Bronn, 1831

Diplodonta sp. (Figure 12 a-d, Code 54)

Material studied: Silverado: st. 2, d. 1, 9.5 m, 1 ind. – Bahía Chatham: st. 8, d. 1, 2.5 m, 1 ind; st. 9, d. 2, 10.1 m, 1 ind. Manuelita: st. 11, d. 1, 13.6 m, 1 ind; st. 11, d. 5, 16.6 m, 1 ind. – Bahía Weston: st. 13, d. 4, 42.2 m, 1 ind; st. 14, d. 1, 18.5 m, 1 ind; st. 14, d. 2, 17.4 m, 6 ind; st. 14, d. 3, 19.5 m, 2 ind; st. 14, d. 4, 18.6 m, 1 ind. – Bahía Wafer: st. 19, d. 1, 27.8 m, 1 ind. – Punta Gissler: st. 25, d. 5, 52.6 m, 1 ind.

Size: 1.3 × 1.4 – 1.3 × 1.7 mm.

Remarks: These were small juvenile, fragile, and translucent shells (Fig. 12a-b). The anterior end is longer, and the hinge has two cardinal teeth (Fig. 12c-d). The right valve has a narrow anterior cardinal in dorsal location, and the posterior cardinal is bifid (Fig. 12c). The left valve has the anterior cardinal bifid, and the posterior cardinal is narrow (Fig. 12d). Without lateral teeth. Fine radial lines and commarginal sculpture. All these characters as indicated by COAN

AND VALENTICH-SCOTT (2012), for this genus, make us think that this is a juvenile of a species of the genus *Diplodonta*. It is possibly a new species, but more sampling is needed to collect grown juveniles and adults.

Distribution: There are eleven species in this genus reported for the mainland coast of Costa Rica (MAGAÑA-CUBILLO AND ESPINOSA, 2009; COAN AND VALENTICH-SCOTT, 2012), a single species in the Galapagos (FINET ET AL., 2011) and two in Gorgona (UAESPNN, 2005, Appendix III).

Family SEMELIDAE Stoliczka, 1870 (1825)

Genus *Semele* Schumacher, 1817

Semele (Amphidesma) formosa (G.B. Sowerby I, 1833) (Figure 13, Code 55)

Amphidesma formosum G.B. Sowerby I, 1833, *Proc. Comm. Sc. Corresp. Zool. Soc. London*, 2: 199, pl. 4, Fig. 27.

Semele formosa (G.B. Sowerby I, 1833) – Keen, 1971: 251.

Semele (*Amphidesma*) *formosa* (G.B. Sowerby I, 1833) – Coan, 1988, *The Veliger*, 31: 17-18; Coan and Valentich-Scott 2012: 715, pl. 220.

Semele verruculastra Keen, 1966, *Occas. Papers California Acad. Sci.*, 59: 32-33.

Semele verrucosa Mörch, 1860 [misidentification] – Hertlein and Strong, 1949, *Zoologica: Sci. Contr. New York Zool. Soc.*, 34 (4): 249, pl. 1, figs. 21, 24; Keen, 1958, *Sea shells trop. West Amer.*: 202, Fig. 504; Olsson, 1961, *Moll. Trop. East. Pac.*: 366, pl. 65, figs. 1-lb; Hertlein and Emerson, 1964, *Trans. San Diego Soc. Nat. Hist.*, 13: 359, figs. 3 i, j.

Material studied: Bahía Wafer: st. 19, d. 3, 23.6m, 1 ind.

Size: 3.2 × 15.1 mm.

Remarks: The specimen of PNIC was similar to *Semele verruculastra* Keen, 1966, as in Fig. 653 of KEEN (1971); this is a synonym of *Semele formosa* (G.B. Sowerby I, 1833). The shell was yellow to dark cream in colour, with brown-purple maculations. The inequilateral valves have a sculpture of commarginal ribs forming scalelike projections at both extremes while in the middle they are continuous. Also, the shell has fine radial striae in the interspaces

(KEEN, 1966; KEEN, 1971; COAN AND VALENTICH-SCOTT, 2012).

Distribution: Reports of *S. verruculastra* are from Gulf of California to Panama Bay, and as *S. formosa* includes Ecuador (KEEN, 1971). Both forms were reported in Gorgona, but none occurs in Galapagos or Malpelo (UAESPNN, 2005, Appendix III; FINET *ET AL.*, 2011). *Semele formosa* was found previously in Costa Rica mainland and in Isla del Coco (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009).

Family TELLINIDAE Blainville, 1814

Genus *Tellina* Linnaeus, 1758

Tellina (*Moerella*) sp. (Figure 14, Code 56)

Material studied: Bahía Chatham: st. 4, d. 2, 34.8 m, 1 ind.; st. 4, d. 3, 35.8 m, 1 ind. – Bahía Wafer: st. 19, d. 2, 24.7 m, 1 ind. – Punta Gissler: st.; st. 25, d. 5, 54.1 m, 1 ind.

Size: 0.4 × 1.0 – 1.0 × 2.0 mm.

Remarks: The valves are small and thin, white in color. The anterior end is more rounded and longer than the pointed posterior end. The specimens have very close commarginal ribs that become stronger posteriorly, and the ligament is conspicuous and external.

Distribution: Species of this subgenus were previously found in the Galapagos (FINET *ET AL.*, 2011) and from Gulf of California to Ecuador (KEEN, 1971; COAN AND VALENTICH-SCOTT, 2012) including the Costa Rica mainland (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009).

Tellina (*Moerella*) *coani* (Keen, 1971) (Figure 15 a-c, Code 57)

Tellina (*Angulus*) *coani* Keen, 1971: 211.

Tellina (*Moerella*) *coani* Keen, 1971 – Coan and Valentich-Scott, 2012: 649, Plate 199.

Material studied: Bahía Chatham: st. 4, d.1, 33.8 m, 1 ind.; – Punta Gissler: st. 25, d. 3, 52.4 m, 1 ind.

Size: 2.6 × 4.5 mm.

Remarks: Shells are solid with the anterior end much longer, with com-

marginal sculpture, and orange coloration in these specimens (Fig. 15a). The internal side of the valves presented two

orange lines from beaks to ventral margin. The anterior lateral tooth is more developed in the right valve (Fig. 15b), and there are two cardinal teeth per valve (KEEN, 1971; COAN AND VALENTICH-SCOTT, 2012). The outline is comparable to Fig. 512 of KEEN (1971) and the internal lines pattern, shape and

hinge to plate 199 of COAN AND VALENTICH-SCOTT (2012). These authors mentioned that specimens from Isla del Coco are colorful and smaller than individuals of the mainland.

Distribution: Gulf of California to Isla del Coco and Galapagos (COAN AND VALENTICH-SCOTT, 2012).

Tellina (Laciolina) sp. (Figure 16, Code 58)

Material studied: Bahía Weston: st. 15, d. 4, 12.3 m. 1 ind.

Size: 1.0 × 2.2 mm.

Remarks: *Tellina (Laciolina)* is the most similar in shape to the damaged juvenile specimen found, with a strong lateral tooth in the right valve (COAN AND VALENTICH-SCOTT, 2012). Sculpture of fine commarginal ribs, most marked in ventral margin. The valve differs in the outline from *T. (Moerella) amianta*, and *T. (M.) coani*. Other species of Tellinidae present in the sand bottom of Isla del Coco are *Tellina (Elliptotellina) pacifica* Dall, 1900, and *Tellina (Tellinella) cumingii* Hanley, 1844, but the first has heavy

radial ribs and the latter shows large anterior and posterior ends (COAN AND VALENTICH-SCOTT, 2012). The species *Tellina (Laciolina) ochracea* P.P. Carpenter, 1864, is present in PNIC, but it is not possible to attribute the present specimen to this species because of its damaged condition and juvenile stage.

Distribution: *Tellina (Laciolina) ochracea* is present from the Gulf of California to Isla del Coco and Galapagos, no other species of *Tellina (Laciolina)* are reported by COAN AND VALENTICH-SCOTT (2012).

Family VENERIDAE Rafinesque, 1815

Genus *Gouldia* C.B. Adams, 1847

Gouldia californica Dall, 1917 (Figure 17 a-j, Code 59)

Gouldia californica Dall, 1917, *Proc. U.S. Nat. Mus.*, 51: 579; Coan and Valentich-Scott, 2012: 786, Plate 243.

Material studied: El Arco: st. 1, d. 1, 58 m, 1 ind. – Slverado: st. 2, d. 1, 9.5 m, 2 ind; st. 2, d. 2, 9.5 m, 2 ind; st. 2, d. 4, 10.6 m, 1 ind; st. 2, d. 5, 9.6 m, 4 ind. – Punta Ulloa: st. 3, d. 1, 74 m, 1 ind. – Bahía Chatham: st. 4, d. 1, 33.8 m, 5 ind; st. 4, d. 2, 34.8 m, 15 ind; st. 4, d. 3, 35.8 m, 8 ind; st. 4, d. 4, 34.9 m, 13 ind; st. 4, d. 5, 34.9 m, 2 ind; st. 5, d. 1, 15.9 m, 15 ind; st. 5, d. 2, 16 m, 6 ind; st. 5, d. 3, 16 m, 14 ind; st. 5, d. 4, 16 m, 21 ind; st. 5, d. 5, 16.1 m, 16 ind; st. 6, d. 2, 9.2 m, 1 ind. – Manuelita: st. 11, d. 1, 13.6 m, 11 ind; st. 11, d. 2, 14.6 m, 8 ind; st. 11, d. 3, 14.6 m, 5 ind; st. 11, d. 4, 15.6 m, 3 ind; st. 11, d. 5, 16.6 m, 18 ind. – Bahía Weston: st. 13, d. 1, 41.9 m, 24 ind; st. 13, d. 2, 43 m, 7 ind; st. 13, d. 3, 41.1 m, 13 ind; st. 13, d. 4, 42.2 m, 6 ind; st. 13, d. 5, 42.3 m, 16 ind; st. 14, d. 1, 18.5 m, 3 ind; st. 14, d. 2, 17.4 m, 14 ind; st. 14, d. 3, 19.5 m, 10 ind; st. 14, d. 5, 18.6 m, 3 ind. – Bahía Wafer: st. 17, d. 2, 23.6 m, 2 ind; st. 19, d. 1, 27.8 m, 2 ind; st. 19, d. 4, 20.5 m, 1 ind; st. 20, d. 2, 39.1 m, 1 ind; st. 20, d. 4, 38.2 m, 1 ind. – Punta Gissler: st. 25, d. 3, 52.4 m, 1 ind. – Bahía Yglesias: st. 27, d. 1, 14 m, 1 ind; st. 27, d. 4, 13.6 m, 1 ind; st. 27, d. 5, 12.2 m, 1 ind.

Size: 3.0 × 3.0 – 6.4 × 7.1 mm.

Remarks: The anterior lateral tooth is large and prominent (Fig. 17a); the

lateral teeth and cardinal beaks are in a similar arrangement to that of plate 243 in COAN AND VALENTICH-SCOTT (2012).

Margins are smooth, the sculpture reticulate, with commarginal ribs prominent in the middle of the shell, and radial ribs prominent toward the ends of the valves (Fig. 17b, d-g). The pallial sinus is very small (Fig. 17b, h-j) (KEEN, 1971). The shell is extremely variable in the number of brown colour spots, and external colour ranges from cream to

dark tan (Fig. 17b-g), and some juvenile are white (Fig. 17c).

Distribution: From Gulf of California to Panama (KEEN, 1971). Previously in Pacific mainland of Costa Rica (INBIO, 1989; MAGAÑA-CUBILLO AND ESPINOSA, 2009), Galapagos (FINET *ET AL.*, 2011), and recently reported from Isla del Coco by COAN AND VALENTICH-SCOTT (2012).

Order ANOMALODESMATA Dall, 1889
Family VERTICORDIIDAE Stoliczka, 1870
Genus *Trigonulina* d'Orbigny, 1846

Trigonulina novemcostata (A. Adams and Reeve, 1850) (Figure 18 a-e, Code 60)

Hippagus novemcostatus A. Adams and Reeve, 1850, *Zool. Voy. Samarang*: 76.

Trigonulina novemcostata (A. Adams and Reeve, 1850) – Coan and Valentich-Scott, 2012: 1030, pl. 325.

Verticordia (*Trigonulina*) *hancocki* F.R. Bernard, 1969, *J. Fish. Res. Bd, Canada*, 26 (8): 2233.

Verticordia (*Verticordia*) *ornata* (d' Orbigny, 1846) [misidentification] – Keen, 1971: 302.

Trigonulina pacifica Jung, 1996, *Bull. Amer. Paleontol.*, 110 (351): 48-50, pl. 13-14.

Material studied: El Arco: st. 1, d. 2, 60.8 m, 1 ind. – Bahía Chatham: st. 3, d. 2, 73.9 m, 1 ind.

Size: 1.3 × 2.2 mm.

Remarks: *Trigonulina novemcostata* (A. Adams and Reeve, 1850) has an ovate shell and the valves are pearly within (Fig. 18c-d), similar to the individuals found. The specimens examined have 8-9 radial ribs (Fig. 18a-b). These bivalves are similar to Fig. 789 in KEEN (1971) as *Verticordia* (*Verticordia*) *ornata* (d' Orbigny, 1846), plate 13 and 14 of *Trigonulina pacifica* of Jung (1996), and plate 325 of *T. novemcostata* in COAN AND VALENTICH-SCOTT (2012), all species recognized as *T. novemcostata*. The surface of the valves is covered with rows of iridescent, scaly pustules (Fig. 18b). The hinge

and teeth are as described by KEEN (1971), with no cardinal tooth in the left valve, and a posterior lateral tooth prolonged in the right valve (Fig. 18e) as pointed out by JUNG (1996) and COAN AND VALENTICH-SCOTT (2012).

Distribution: Distributed from California to Peru. The species was collected in Costa Rica mainland (INBIO, 1989), Galapagos (FINET *ET AL.*, 2011), and Isla del Coco (COAN AND VALENTICH-SCOTT, 2012). Previous records of *T. ornata* or *T. pacifica* from these islands corresponded to specimens of *T. novemcostata*, as pointed out by COAN AND VALENTICH-SCOTT (2012).

Class GASTROPODA Cuvier, 1797
Subclass VETIGASTROPODA Salvini-Plawen, 1980
Family PHASIANELLIDAE Swainson, 1840
Genus *Tricolia* Risso, 1826

Tricolia diantha McLean, 1970 (Figure 19 a-d, Code 79)

Tricolia diantha McLean, 1970, *Malac. Rev.*, 2: 125-126 – Keen 1971: 356.

Material studied: Bahía Wafer: st. 18, d. 5, 7.3 m. 1 ind.

Size: 0.5 × 1.0 mm.

Remarks: The small specimen found (Fig. 19a) has radial striae in the outer margin of the operculum (Fig. 19c). The shell has brown maculation in the last whorls (Fig. 19b), and presented fine sculpture in the brown early whorls,

and fine spiral striae in the last whorl. The specimen is similar to the description in KEEN (1971). Another species reported in PNIC is *Tricolia variabilis* (Pease, 1861).

Distribution: Galapagos and Isla del Coco (KEEN, 1971, CORTÉS, 2012).

Subclass CAENOGASTROPODA Cox, 1960

Family EPITONIIDAE Berry, 1910

Genus *Epitonium* Röding, 1798

Epitonium replicatum (G.B. Sowerby II, 1844) (Figure 20, Code 61)

Scalaria replicata Sowerby, 1844, *Proc. Zool. Soc. London*, 1844: 11.

Epitonium (Hirtoscala) replicatum (G.B. Sowerby II, 1844) – Keen, 1971: 430.

Epitonium bialatum Dall, 1917, *Proc. U.S. Nat. Mus.*, 53 (2217): 417-88.

Epitonium wurtsbaughi Strong and Hertlein, 1939, *Allan Hancock Pac. Exp.*, 2: 177-245.

Epitonium arestrum Tinker, 1952, *Pacific sea shells*: 231.

Epitonium oerstedianum Hertlein and Strong, 1951, *Zoologica: Sci. Contr. New York Zool. Soc.* 36: 89, pl. 3 fig. 10.

Material studied: Bahía Weston: st. 13, d. 4, 42.2 m, 1 ind.

Size: 9.5 × 5.9 mm.

Remarks: The shell of *Epitonium replicatum* is shorter than other similar species in the Eastern Pacific such as *Epitonium reflexum* (Carpenter, 1856). White shell with costae strongly reflected, similar to Fig. 637 of gastropods in KEEN (1971).

Distribution: Gulf of California to Galapagos. The species is present in Costa Rica (INBIO, 1989; RODRÍGUEZ-SEVILLA, VARGAS AND CORTÉS, 2009) including the PNIC. Also, the species can be found in Galapagos and Gorgona (UAESPNN, 2005, APÉNDICE III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

Genus *Opalia* H. Adams and A. Adams, 1853

Opalia (Dentiscala) sp. (Figure 21, Code 62)

Material studied: Manuelita: st. 11, d. 1, 13.6 m, 1 ind.

Size: 3.4 × 1.4 mm.

Remarks: A small specimen, broken in their spire, is *Opalia (Dentiscala)* sp., and the most similar species is *Opalia (Dentiscala) mexicana* Dall, 1908, by the presence of deeper pits in the suture (Fig. 684 of KEEN, 1971). In contrast, the specimen of Isla del Coco presented a sculpture with marked punctuations between ribs, most angular shape, and their aperture is oval. The other species of the genus reported in Isla del Coco

and the region (*Opalia crystallina* (Carpenter, 1864), *Opalia infrequens* (C.B. Adams, 1852), *Opalia paulula* DuShane, 1974, *Opalia sanjuanensis* (Lowe, 1932)), lack the deeper pits in the suture (KEEN, 1971; RODRÍGUEZ-SEVILLA ET AL., 2009). The specimen possibly represents a new species but more material is needed.

Distribution: KEEN (1971), mentioned this species for Acapulco, Mexico, and also it was reported for Galapagos (FINET ET AL., 2011).



Figure 17. *Gouldia californica* Dall, 1917, a: teeth of the right and left valves; b: exterior and interior view of the valve of adult specimen; c-g: exterior view of the valves in small specimens; h-j: interior view of the valves in small specimens, $3,0 \times 3,0 - 6,4 \times 7,1$ mm, st. 2 and 11. Figure 18. *Trigonulina novemcostata* (A. Adams and Reeve, 1850), a: exterior view of right valve; b: exterior of left valve; c: interior of left valve; d: interior of right valve; e: detail of the teeth in the left and right valves, $1,3 \times 2,2$ mm, st. 1.

Figura 17. *Gouldia californica* Dall, 1917, a: dientes de las valvas derecha e izquierda; b: vista exterior e interior de la valva de un espécimen adulto; c-g: vista exterior de las valvas en especímenes pequeños; h-j: vista interior de las valvas en pequeños especímenes, $3,0 \times 3,0 - 6,4 \times 7,1$ mm, est. 2 y 11. Figura 18. *Trigonulina novemcostata* (A. Adams y Reeve, 1850), a: vista exterior de la valva derecha; b: exterior de la valva izquierda; c: interior de izquierda valva; d: interior de la valva derecha; e: detalle de los dientes en las the valvas izquierda y derecha, $1,3 \times 2,2$ mm, est. 1.

Orden LITTORINIMORPHA Golikov and Starobogatov, 1975

Family RISSOIDAE Gray, 1847

Genus *Schwartziella* G. Nevill, 1885

Schwartziella effusa (Mörch, 1860) (Figure 22, Code 67)

Rissoina effusa Mörch, 1860, *Malakozool. Blätter*, 7: 67-68.

Rissoina (Rissoina) effusa Mörch, 1860 – Keen, 1971: 374.

Schwartziella effusa (Mörch, 1860) – Sleurs, 1989, *Ann. Soc. Roy. Zool. Belgique*, 119 (2): 155-164.

Material studied: Bahía Wafer: st. 19, d. 5, 24.4 m, 1 ind.

Size: 3.3 × 2.1 mm.

Remarks: This small snail found in this study in a small rhodolith, in the sand bottom, resembles the specimen shown in Fig. 25 of KEEN (1966). *Schwartziella effusa* has 12 to 15 oblique axial ribs, compressed and thick, in a heavy shell (KEEN, 1966). The outer

margin of the aperture is thin (MÖRCH, 1860).

Distribution: Along Central American Pacific coast, Malpelo, Galapagos, and previously in Isla del Coco (KEEN, 1971; INBIO, 1989; UAESPNN, 2005, APÉNDICE III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

Genus *Alvania* Risso, 1826

Alvania sp. (Fig. 23, Code 68)

Material studied: Punta Gissler: st. 26, d. 2, 12.1 m, 1 ind.

Size: 2.6 × 1.0 mm.

Observations: This small gastropod resembles species of the genus *Alvania*, in terms of shape, spiral ribs and weak radial cords (KEEN, 1971).

Distribution: *Alvania inconspicua* C.B. Adams, 1852 (= *A. monserratisensis* Baker, Hanna & Strong, 1930) has been reported from Isla del Coco (RODRÍGUEZ-SEVILLA ET AL., 2009) but it is a very different species.

Family CAECIDAE Gray, 1850

Genus *Caecum* Fleming, 1813

Caecum cocoensis spec. nov. (Fig. 24 a-n, Code 63)

Type material: Holotype: Silverado: st. 2, d. 2, 9.5 m, 1 ind. Catalog number: MZUCR9740-01;

Paratype: Silverado: st. 2, d. 5, 9.6 m, 1 ind. Catalog number: MZUCR9741-01; Paratype: Punta Gissler: st. 26, d. 1, 13.1 m, 1 ind. Catalog number: MZUCR9742-01

Additional material: Bahía Yglesias: st. 27, d. 1, 14 m, 1 ind.

Type locality: Silverado, Parque Nacional Isla del Coco, Costa Rica.

Derivation of the name: This species name is based on the type locality, Isla del Coco.

Description: Shell length: 2.10 mm ± 0.20; width min: 0.47 mm ± 0.01, and width max: 0.50 mm ± 0.03. The shell is slightly arched and translucent, with some tan colour (Fig. 24a). The form of the septum is mammillate, tapering, and constant (Fig. 24g-j). There is no mucro

present in the specimens collected. The sculpture is formed by rings more widely spaced and well marked distally, becoming near the aperture narrower and less well-marked. The shell presented some porosity with minute holes in the rings and marked pits in the inter

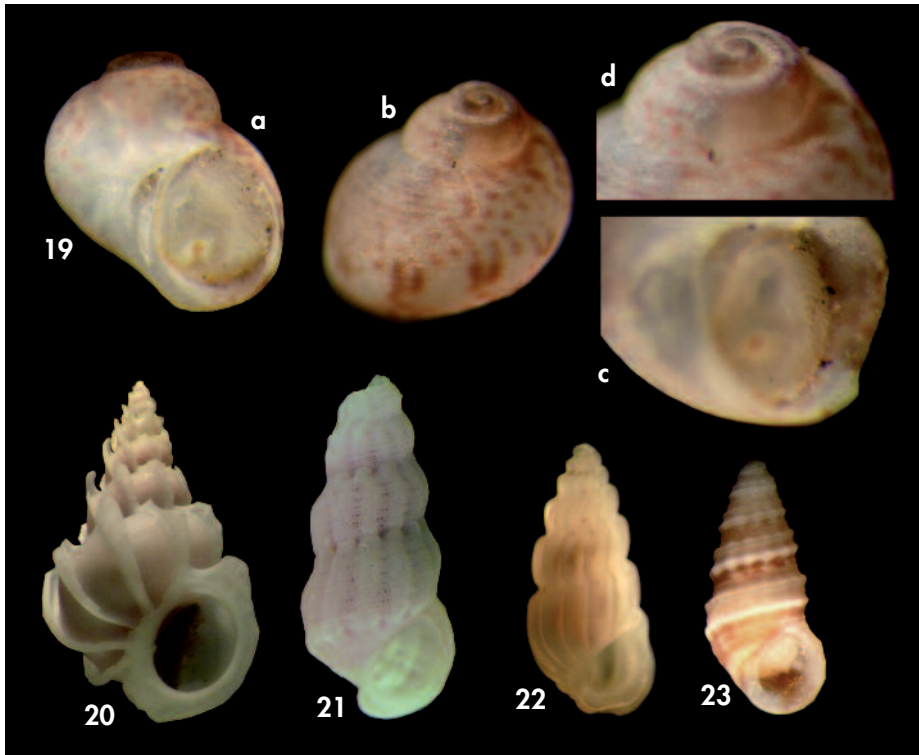


Figure 19. *Tricolia diantha* McLean, 1970, a: aperture view; b: operculum detail; c: view of the sculpture and coloration, d: first whorls, 0.5 × 1.0 mm, st. 18. Figure 20. *Epitonium replicatum* (G. B. Sowerby II, 1844), 9.5 × 5.9 mm, st. 13. Figure 21. *Opalia (Dentiscalia)* sp., 3.4 × 1.4 mm, st. 11. Figure 22. *Schwartziella effusa* (Mörch, 1860), 3.3 × 2.1 mm, st. 19. Figure 23. *Alvania* sp., 2.6 × 1.0 mm, st. 26.

Figura 19. *Tricolia diantha* McLean, 1970, a: vista de la apertura; b: detalle del opérculo; c: vista de la escultura y coloración, d: primeras vueltas, 0,5 × 1,0 mm, est. 18. Figura 20. *Epitonium replicatum* (G. B. Sowerby II, 1844), 9,5 × 5,9 mm, est. 13. Figura 21. *Opalia (Dentiscalia)* sp., 3,4 × 1,4 mm, est. 11. Figura 22. *Schwartziella effusa* (Mörch, 1860), 3,3 × 2,1 mm, est. 19. Figura 23. *Alvania* sp., 2,6 × 1,0 mm, est. 26.

ring spaces (Fig. 24l-n). Moreover, subadult traits are present in some sections of the tube of the specimens, where the ringed sculpture appears to be interrupted by incised lines (Fig. 24d, e, k, m), representing a transitional zone between the teleoconch growth stages. The aperture is smooth and underdeveloped, another indication of a subadult stage; and the operculum is brown, flat, and presents a heavy concentric sculpture (Fig. 24b, c, f). Finally a hole or deep depression is present in the septum of the specimens (Fig. 24g-j).

Remarks: Four subadult individuals were found of a new species of the genus *Caecum*. The specimen of st. 27, d. 1, was dissected to extract the operculum. The specimens of st. 2, d. 2, and st. 2, d. 5, were used in SEM photos, frontal and lateral view, respectively.

The species *Caecum glabriforme* Carpenter, 1857 is reported from the Costa Rica mainland (INBIO, 1989; RODRÍGUEZ-SEVILLA *ET AL.*, 2009), Malpelo, and Panamá (KEEN, 1971) and shows a septum much more swollen in adult specimens as in figure 374-1546 of BRANN

(1966). Moreover, *C. glabriforme* has a smooth surface and lacks rings (KEEN, 1971) but in specimens of *C. cocoensis* found in PNIC, the sculpture is well marked. Other species present in Isla del Coco and Galapagos (e.g. *Caecum eburneum* C. B. Adams, 1852), have very coarse rings but with an unguulate or mucronate septum (LIGHTFOOT, 1993a, 1993b). The sculpture pattern of *Caecum eburneum* C.B. Adams [not de Folin, 1879] in plate 17, Fig. 3 of TURNER (1956) is clearly different from the species found in Isla del Coco. The mammillate shape and tapering of the septum of the new species

is very similar to *Caecum subquadratum* Carpenter, 1859, as well as to *Caecum venustum* de Folin, 1867 (West Panama), but both species lack the marked ringed sculpture. To summarize, the specimens of *C. cocoensis* by the combination of a mammillate septum and marked ringed sculpture are not similar to the other species in the Tropical Eastern Pacific (KEEN, 1971; LIGHTFOOT, 1993A; LIGHTFOOT, 1993B; KAISER AND BRYCE, 2001; KAISER, 2007; MCLEAN, 2007; PIZZINI, RAINES AND NOFRONI, 2007).

Distribution: Only found in Isla del Coco, Costa Rica in the present study.

Family NATICIDAE Forbes, 1838

Genus *Natica* Scopoli, 1777

Natica idiopoma Pilsbry and Lowe, 1932 (Fig. 25, Code 64)

Natica idiopoma Pilsbry and Lowe, 1932, *Proc. Acad. Nat. Sci.*, 84: 84. pl. 9, Fig. 9-11.

Natica (Natica) idiopoma Pilsbry and Lowe, 1932 – Keen, 1971: 475.

Material studied: Bahía Weston: st. 13, d. 2, 43 m, 1 ind.

Size: 5.0 × 6.5 mm.

Remarks: This snail is characterized by having three spiral ribs in the operculum (Fig. 864 in KEEN, 1971), the outer rib is doubled and bound by radial rods (PILSBRY AND LOWE, 1932; KEEN, 1971). The umbilicus is open, with a small callus next to the middle

inner lip. The shell is brown and whitish.

Distribution: Previously known for the Pacific of Nicaragua and Costa Rica, Isla del Coco, Galapagos, and Gorgona (KEEN, 1971; UAESPNN, 2005, Apéndice III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

Genus *Natica* Scopoli, 1777

Natica grayi Philippi, 1852 (Fig. 26, Code 65)

Natica depressa Gray, 1839: *Zool. Capt. Beechey's Voy.*, 136, pl. 36 fig. 2 (preoccupied name).

Natica catenata Philippi, 1851, *Proc. Zool. Soc. London*, 19: 233; Philippi, 1852, *Syst. Conch.-Cab.*

Martini und Chemnitz, 2 (1): 130, n° 153, t 18, Fig. 11.

Natica grayi Philippi, 1852, *Syst. Conch.-Cab. Martini und Chemnitz*, 2 (1): 74-75, n° 88, pl 11 Fig. 13.

Material studied: Punta Gissler: st. 25, d. 3, 52.4 m, 1 ind.

Size: 5.9 × 4.7 mm.

Remarks: This brown snail has a white operculum with radial laminations, and a characteristic outer groove. Our specimen is similar to Fig. 863 in KEEN (1971) for *Natica grayi* Philippi, 1852.

Distribution: Gulf of California to Ecuador. The species was previously found in Isla del Coco, Galapagos, Gorgona (KEEN, 1971; UAESPNN, 2005, APÉNDICE III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

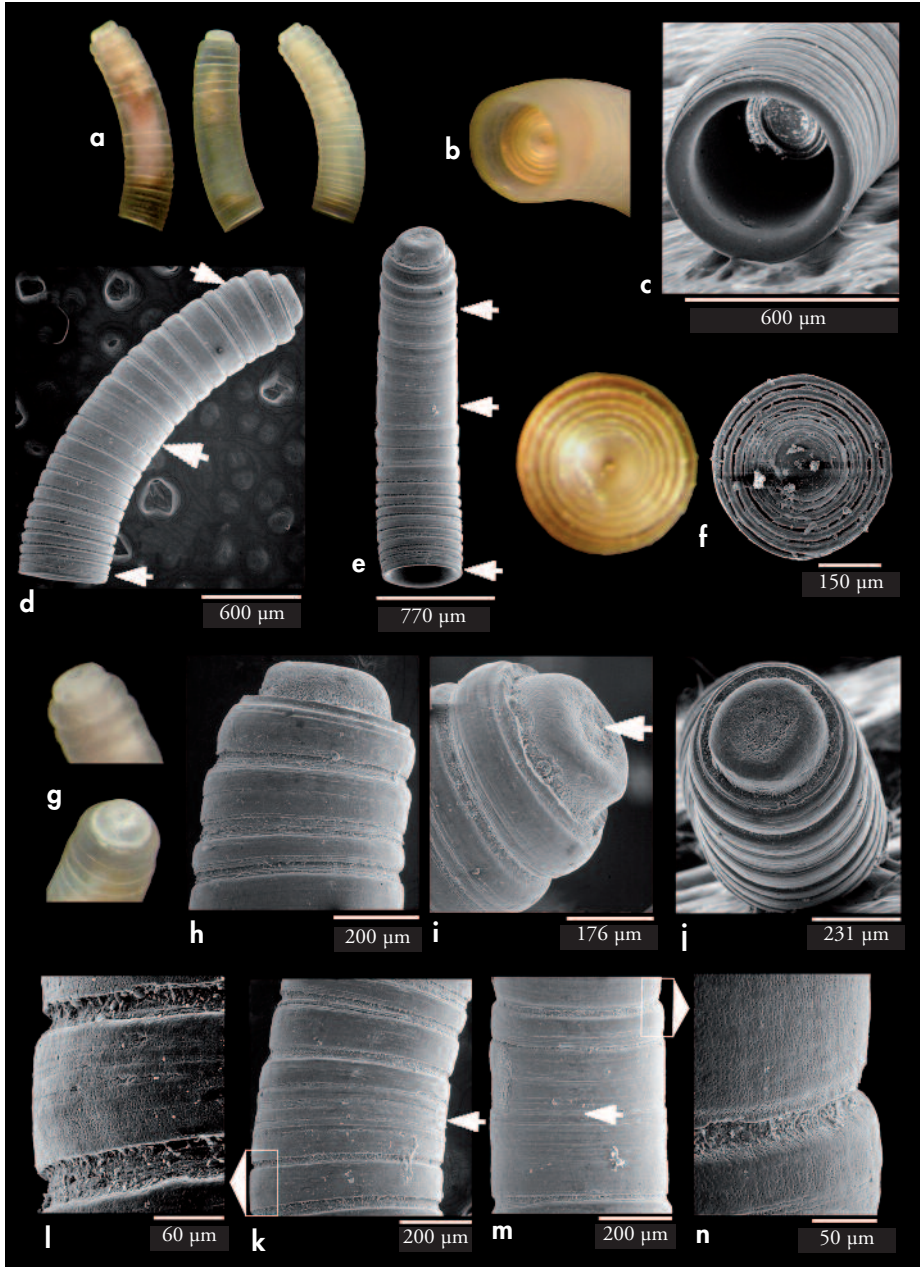


Figure 24. *Caecum cocoensis* spec. nov. a, d, e: specimens of sand bottom; b, c: detail of the aperture; f: operculum; g-j: detail apical end; k, m: detail of the rings sculpture; l, n: detail of the pits in the surface and interspaces of the rings, st. 2, 26 and 27. The arrows indicate subadult traits.

Figura 24. *Caecum cocoensis* spec. nov. a, d, e: especímenes del fondo arenoso; b, c: detalle de la apertura; f: opérculo; g-j: detalle de la región apical; k, m: detalle de los anillos de la escultura; l, n: detalle de los hoyos en la superficie y entre los anillos, est. 2, 26 y 27. Las flechas indican características del estado sub-adulto.

Genus *Mammilla* Schumacher, 1817

Mammilla simiae (Deshayes, 1838) (Fig. 27, Code 66)

- Natica sigaretina* Menke, 1828, *Synops. Moll. Mus. Menkeano*: 26 (preoccupied name).
Natica simiae Deshayes, 1838, *Hist. Nat. Anim. sans Vert.*: 652; Philippi, 1852: *Syst. Conch.-Cab. Martini und Chemnitz*, 2 (1): 35, pl. 4 Fig. 17; Reeve, 1855, *Conch. Icon.*, 9: pl. 17 figs. 76a, b; pl. 22, figs. 98a, b; Tryon, 1886, *Man. Conch.*, 8: 51, pl. 21 figs. 19-20.
Mammilla simiae (Deshayes, 1838) – Kabat, 2000, *Zool. Mededelingen*, 73 (25): 357.
Polinices simiae (Deshayes, 1838) – Kay, 1979, *Hawaiian Mar. Sh.*: 210, figs. 73G, H.
Polinices (Mammilla) simiae (Deshayes, 1838); Cernohorsky, 1971, *Rec. Auckland Inst. Mus.* 8: 199, Fig. 68; Cernohorsky, 1972, *Mar. Sh. Pacific*: 102, pl. 27 Fig. 2; Powell, 1979, *New Zeal. Moll.*: 156, pl. 32 figs. 14, 15.
Natica samarensis Récluz, 1844: 214; Philippi, 1853, *Syst. Conch.-Cab. Martini und Chemnitz*, 2 (1): 149.
Mammilla propesimiae Iredale, 1929, *Austr. Zool.* 5 (4): 340, pl. 38 fig. 5.

Material studied: Bahía Yglesias: st. 27, d. 5, 12.2 m, 1 ind.

Size: 5.5 × 6.1 mm.

Remarks: The shell is white with broken axial lines, forming irregular maculations (KABAT, 2000). The specimen of PNIC is a juvenile, characterized by the color of the protoconch and the dark line that borders the suture of the last whorls of this species (CHANEY, 1996). The specimen found is similar to the immature specimens of Panama and West Pacific (CHANEY, 1996; HOLLMAMM, 1996). The callus is prominent and tongue-shaped. The umbilicus has a brown line running into it from the base. The aperture is white inside, and the species has a horny operculum, reddish-brown in color (HOLLMAMM, 1996).

Distribution: The distribution is mainly in the West Pacific (KABAT,

2000), but it occurs in Hawaii and has been found in Clipperton, and Isla del Coco. The species is apparently absent from the Galapagos (FINET ET AL., 2011) and Pacific mainland except for Isla Ladrones, Gulf of Chiriqui, Panama (CHANEY, 1996; KABAT, 2000). The first specimen in PNIC was collected in Isla Nuez (Isla Manuelita), at 55-91 m on rocky and coralline substrate by the Allan Hancock Expedition of *Velero III* in 1938. Shasky found the species on sand bottom in Isla Manuelita at 17 m in 1986 and in Bahía Chatham at 20-25 m in 1989. Kim Hutsell found it in sand bottom at 15-20 m in Bahía Wafer in 1992. All of these specimens were identified by HOLLMAMM (1996).

Family RANELLIDAE Gray, 1854

Monoplex Perry, 1810

Monoplex sp. (Fig. 28 a-c, Code 69)

Material studied: Bahía Chatham: st. 9, d. 1, 10.2 m; 1 ind. – Bahía Wafer: st. 18, d. 5, 7.3 m, 1 ind. – Bahía Yglesias: st. 27, d. 4, 13.6 m, 1 ind.

Size: 2.4 × 1.1 mm.

Remarks: The specimens found are larval stage of a ranellid, of the genus *Monoplex*. These large protoconchs are smooth orange with the early whorls with some radial sculpture (Fig. 28 b). The shape of the aperture is elon-

gated (Fig. 28 a). It may possibly correspond to *Monoplex aquatilis* (Reeve, 1844), present in Isla del Coco (CORTÉS 2012).

Distribution: There are nine species of this group in Isla del Coco (CORTÉS 2012).

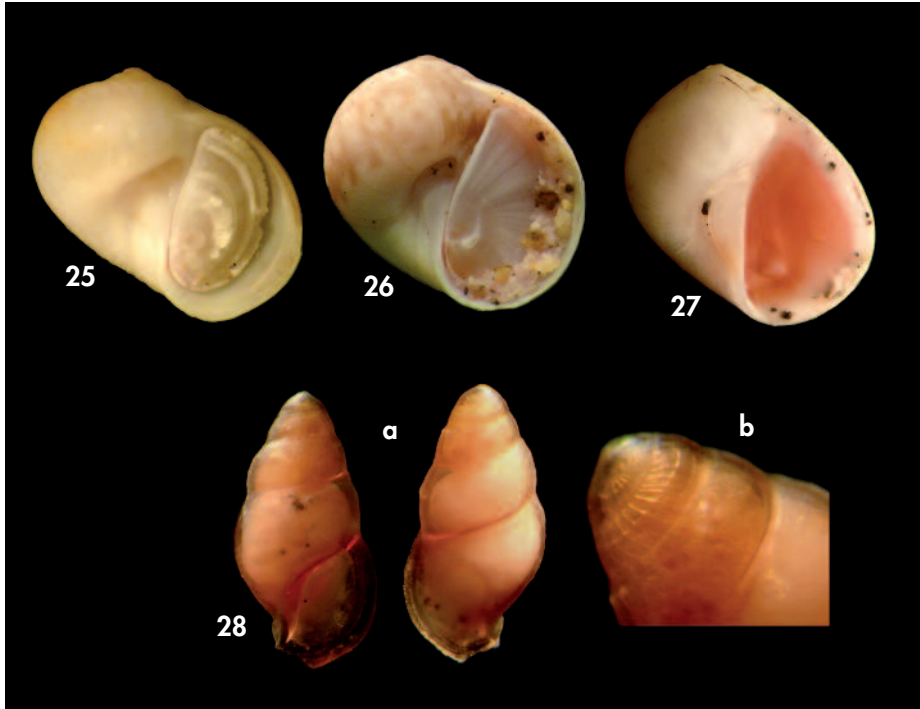


Figure 25. *Natica idiopoma* Pilsbry and Lowe, 1932, 5.0 × 6.5 mm, st. 13. Figure 26. *Natica grayi* Philippi, 1852, 5.9 × 4.7 mm, st. 25. Figure 27. *Mammilla simiae* (Deshayes, 1838), 5.5 × 6.1 mm, st. 27. Figure 28. *Monoplex* sp., a, b: larval stage, 2.4 × 1.1 mm, st. 9.
 Figura 25. *Natica idiopoma* Pilsbry y Lowe, 1932, 5,0 × 6,5 mm, est. 13. Figura 26. *Natica grayi* Philippi, 1852, 5,9 × 4,7 mm, est. 25. Figura 27. *Mammilla simiae* (Deshayes, 1838), 5,5 × 6,1 mm, est. 27. Figura 28. *Monoplex* sp., a, b: concha larvaria, 2,4 × 1,1 mm, est. 9.

Family BUCCINIDAE Rafinesque, 1815
 Genus *Phos* Montfort, 1810

Phos (Metaphos) articulatus Hinds, 1844 (Fig. 29, Code 70)

Phos articulatus Hinds, 1844, *Zool. Voy. "Sulphur"*: 38, pl. 10, Fig. 7 and 8.

Phos (Metaphos) articulatus Hinds, 1844 – Keen, 1971: 569.

Phos cocosensis Dall, 1896, *Proc. U. S. Nat. Mus.*, 18: 11.

Material studied: Bahía Chatham: st. 3, d. 5, 75.3 m, 2 ind.

Size: 39.8 × 16.1 mm.

Remarks: The shell is clouded with brown, has marked axial ribs and a spiral sculpture of several sharp striae. The aperture is longer than wide, and the outer lip is internally lirate. The operculum is horny, smooth-edged and red in colour (DALL,

1896; KEEN, 1971). Similar to some specimens showed in Fig. 1144 of KEEN (1971) of *Phos (Metaphos) articulatus* Hinds, 1844.

Distribution: From California to Perú, also present in Isla del Coco and Galapagos (KEEN, 1971; RODRÍGUEZ-SEVILLA *ET AL.*, 2009; FINET *ET AL.*, 2011).

Family CYSTISCIDAE Stimpson, 1865

Genus *Gibberula* Swainson, 1840

Gibberula achenea (Roth and Coan, 1971) (Fig. 30, Code 71)

Granula achenea, Roth and Coan, 1971, *Proc. Cal. Acad. Sci.*, 37: 578-580. Fig. 3.

Material studied: Bahía Chatham: st. 4, d. 2, 34.8 m, 1 ind.; st. 6, d. 2, 9.2 m, 1 ind.

Size: 2.2 × 1.7 mm.

Remarks: Coover and Coover, 1995 placed *Granula Jousseaume*, 1875 in synonymy of *Gibberula* Swainson, 1840. The shell is small and white, almost transparent, unsculptured, but with a surface ornamentation of fine lines uncommon in this family. The outer lip has tiny denticles inside the aperture as in Fig. 1412 in KEEN (1971) of an unnamed *Granula* of Isla del Coco, later described as *Granula achenea*, Roth and Coan, 1971. Several characters of the specimens match this species; moreover,

they show dark spots on the mantle in the preserved material.

Distribution: The first specimen was collected in Bahía Chatham by Pilsbry in 1929, also during the President Cruise expedition in 1938, and Waldo L. Schmitt, collected more specimens in 1941. ROTH AND COAN (1971) point out that *G. achenea* is common in Isla del Coco, and they questioned the presence in the island of *G. minor* (C.B. Adams, 1852), as possibly a misidentification of *G. achenea* specimens. Reported from Isla del Coco and Galapagos (ROTH AND COAN, 1971; FINET ET AL., 2011).

Gibberula cf. insularum (Roth and Coan, 1971) (Fig. 31 a-b, Code 72)

Granula insularum, Roth and Coan, 1971, *Proc. Cal. Acad. Sci.*, 37: 580-582. Fig. 4.

Material studied: Bahía Chatham: st. 4, d. 3, 35.8 m, 1 ind. – Manuelita: st. 11, d. 1, 13.6 m, 2 ind.; st. 11, d. 3, 14.6 m, 1 ind.

Size: 2.6 × 1.1 mm.

Remarks: The species is similar to *G. achenea* but lacks the ornamentation on the shell. It differs from *G. minor* and *G. polita* (Carpenter, 1857) in that the outer lip is smooth in *G. insularum* while in *G. minor* it is conspicuously denticulate and in *G. polita*, faintly denticulate. Additionally, *G. minor* is almost conical, while *G. insularum*

is elongate-ovate. The living specimens found do not show a dark spot on the mantle as *G. achenea*. Figure 1413 in KEEN (1971) corresponds to *G. insularum* in Fig. 4 of ROTH AND COAN (1971).

Distribution: Previously only known from the Galapagos Islands (ROTH AND COAN, 1971). The species is a new record for Isla del Coco.

Family MITRIDAE Swainson, 1829

Genus *Subcancilla* Olsson and Harbison, 1953

Subcancilla sulcata (Swainson in Sowerby, 1825) (Fig. 32, Code 74)

Mitra sulcata Swainson in Sowerby, 1825, *Cat. Tankerville*: App. xxvi.

Mitra (Subcancilla) sulcata (Swainson in Sowerby, 1825) – Olsson and Harbison, 1953, *Acad. Nat. Sci. Phil. Monogr.*, 8: 190.

Subcancilla sulcata (Swainson in Sowerby, 1825) – Keen, 1971. 645; Cernohorsky, 1991, *Monogr. Mar. Mol.*, 4: 86.

Material studied: Bahía Chatham: st. 4, d. 3, 35.8 m, 2 ind. – Bahía Weston: st. 13, d. 1, 41.9 m, 1 ind.; st. 13, d. 3, 41.1 m, 1 ind. – Bahía Wafer: st. 17, d. 3, 27.6 m, 1 ind.; st. 20, d. 3, 38.1 m, 1 ind.

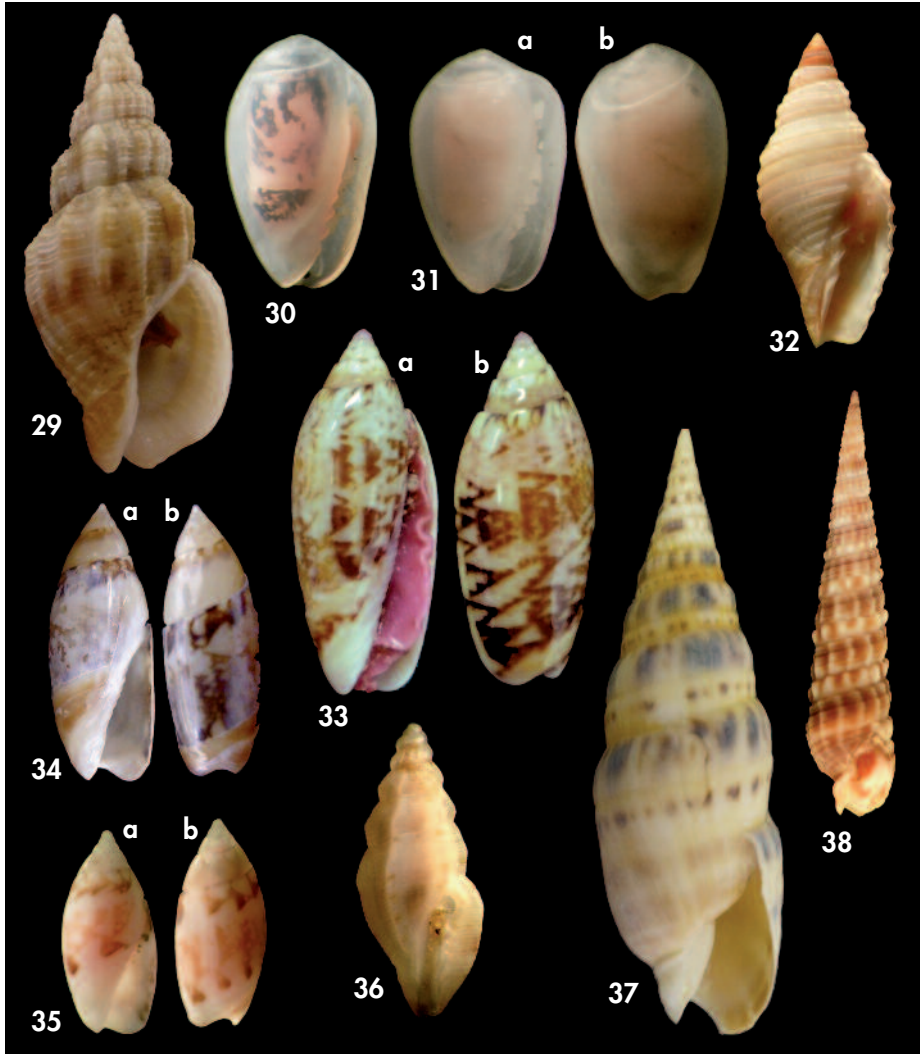


Figure 29. *Phos (Metaphos) articulatus* Hinds, 1844, 39.8 × 16.1 mm, st. 3. Figure 30. *Gibberula achenea* (Roth and Coan, 1971), 2.2 × 1.7 mm, st. 4. Figure 31 a, b. *Gibberula* cf. *insularum* (Roth and Coan, 1971), 2.6 × 1.1 mm, st. 11. Figure 32. *Subcancilla sulcata* (Swainson en Sowerby, 1825), 18.8 × 7.1 mm, st. 4. Figure 33 a, b. *Oliva foxi* Stingley, 1984, 20.6 × 10.5 mm, st. 1. Figure 34 a, b. *Olivella (Olivella) cocosensis* Olsson, 1956, adult, 12.2 × 4.4 mm, st. 2. Figure 35 a, b. *O.(O) cocosensis* Olsson, 1956, juvenile, st. 2. Figure 36. *Ithycythara penelope* (Dall, 1919), 3.6 × 1.4 mm, st. 4. Figure 37. *Oxymeris maculata* (Linnaeus, 1758), 90.0 × 26.2 mm, st. 11. Figure 38. *Pristiterebra glauca* (Hinds, 1844), 25.3 × 4.6 mm, st. 4.

Figura 29. *Phos (Metaphos) articulatus* Hinds, 1844, 39,8 × 16,1 mm, est. 3. Figura 30. *Gibberula achenea* (Roth y Coan, 1971), 2,2 × 1,7 mm, est. 4. Figura 31 a, b. *Gibberula* cf. *insularum* (Roth y Coan, 1971), 2,6 × 1,1 mm, est. 11. Figura 32. *Subcancilla sulcata* (Swainson en Sowerby, 1825), 18,8 × 7,1 mm, est. 4. Figura 33 a, b. *Oliva foxi* Stingley, 1984, 20,6 × 10,5 mm, est. 1. Figura 34 a, b. *Olivella (Olivella) cocosensis* Olsson, 1956, adulto, 12,2 × 4,4 mm, est. 2. Figura 35 a, b. *O.(O) cocosensis* Olsson, 1956, juvenil, est. 2. Figura 36. *Ithycythara penelope* (Dall, 1919), 3,6 × 1,4 mm, est. 4. Figura 37. *Oxymeris maculata* (Linnaeus, 1758), 90,0 × 26,2 mm, est. 11. Figura 38. *Pristiterebra glauca* (Hinds, 1844), 25,3 × 4,6 mm, est. 4.

Size: 6.4 × 2.0 - 18.8 × 7.1 mm.

Remarks: The shell is white to light brown, crossed by deeply impressed striae, with colorless spiral ribs (KEEN, 1971). The aperture is longer than the spire (SOWERBY, 1825).

Distribution: From California to Ecuador. The species was previously reported for Isla del Coco, Gorgona, and Galapagos (INBIO, 1989; UAESPNN, 2005, Apéndice III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

Family OLIVIDAE Latreille, 1825

Genus *Oliva* Bruguière, 1789

Oliva foxi Stingley, 1984 (Fig. 33 a-b, Code 75)

Oliva foxi Stingley, 1984, *La Conchiglia*, 16: 28.

Material studied: El Arco: st. 1, d. 1, 58 m, 1 ind.

Size: 20.6 × 10.5 mm.

Remarks: A single specimen found, similar to the picture of shells of Isla del Coco in SHASKY (1984) and STERBA (2003). Shell is smooth and glossy, oblong-cylindrical, and with spire acuminate. Color yellow with bold and weak zig zag markings of dark brown. The aperture is yellow (STINGLEY, 1984; SHASKY, 1984), and the protoconch is pink (STERBA, 2003).

Distribution: The species *Oliva foxi* Stingley, 1984 was discovered for the

first time by Alfred C. and Eva Fox, by dredging and scuba diving between 50-60 feet off Isla del Coco, Costa Rica (STINGLEY, 1984). SHASKY (1984) re-described it with 21 specimens of Isla del Coco. *O. foxi* was considered endemic to Isla del Coco, Costa Rica, however KAISER (1999) mentioned their occurrence in Isla Montuosa, Panamá. There is no record for the Pacific mainland coast of America.

Genus *Olivella* Swainson, 1831

Olivella (Olivella) cocosensis Olsson, 1956 (Fig. 34 a-b, 35 a-b, Code 76)

Olivella (Olivella) cocosensis Olsson, 1956, *Proc. Acad. Nat. Phil.*, 108: 180, pl. 14, fig 9 and 9a.

Material studied: Silverado: st. 2, d. 2, 9.5 m, 3 ind; st. 2, d. 2, 9.5 m, 3 ind. – Bahía Chatham: st. 9, d. 1, 10.2 m, 1 ind; st. 9, d. 5, 9.9 m, 1 ind; st. 11, d. 1, 13.6 m, 2 ind. – Manuelita: st. 11, d. 4, 15.6 m, 1 ind; st. 11, d. 5, 16.6 m, 1 ind; st. 11, d. 5, 16.6 m, 1 ind. – Bahía Weston: st. 14, d. 2, 17.4 m, 2 ind; st. 15, d. 3, 12.3 m, 1 ind. – Bahía Wafer: st. 19, d. 3, 23.6 m, 1 ind. – Punta Gissler: st. 24, d. 4, 15 m, 2 ind; st. 26, d. 3, 12.2 m, 1 ind; st. 26, d. 5, 13.4 m, 2 ind. – Bahía Yglesias: st. 27, d. 2, 9.9 m, 1 ind; st. 27, d. 4, 13.6 m, 1 ind; st. 27, d. 5, 12.2 m, 1 ind.

Size: 2.3 × 0.8 – 12.2 × 4.4 mm.

Remarks: The species was found as adults (Fig. 34), and juvenile stage specimens (Fig. 35). This *Olivella* is common in the sand bottom of the island. STERBA (2003) mentioned the coloration and a distinctive groove in the inner lip that matches the specimens found. The pattern of coloration is white ground with amounts of brown suffusion (SHASKY, 1984). This olive snail has an

upper dark band bordering the suture and a lower dark band bordering the fasciole (OLSSON, 1956). The white porcellaneous section of the inner lip extends near the suture of the last whorl as in figures 9 and 9a of OLSSON (1956). This snail has a shorter spire.

Distribution: The main population is in Isla del Coco, but other specimens were reported in North Nicaragua (KEEN, 1971).

Family MANGELIIDAE P. Fischer, 1883

Genus *Ithythythara* Woodring, 1928

Ithythythara penelope (Dall, 1919) (Fig. 36, Code 73)

Cytherea (*Agathotoma*) *penelope* Dall, 1919, *Proc. U.S. Nat. Mus.*, 56: 80, pl. 24, Fig. 10.
Ithythythara penelope (Dall, 1919) – Keen 1971: 758.

Material studied: Bahía Chatham: st. 4, d. 2, 34.8 m, 1 ind.; st. 4, d. 3, 35.8 m, 1 ind. – Punta Gissler: st. 25, d. 5, 54.1 m, 1 ind.

Size: 3.6 × 1.4 mm.

Remarks: The shell is hexagonal in section, pale brownish. Spiral sculpture consists of fine close-set threads over the entire surface. The aperture is narrow. This is the only Eastern Pacific Mangeliidae with dentate outer lip (KEEN, 1971).

Distribution: Present from California to Ecuador (KEEN, 1971). The species has been previously collected in Pacific Costa Rica, Isla del Coco, and Galapagos (INBIO, 1989; RODRÍGUEZ-SEVILLA *ET AL.*, 2009; FINET *ET AL.*, 2011).

Family TEREBRIDAE Mörch, 1852

Genus *Oxymeris* Dall, 1903

Oxymeris maculata (Linnaeus, 1758) (Fig. 37, Code 77)

Buccinum maculatum Linnaeus, 1758: *Syst. Nat.*, ed. 10: 741

Terebra maculata (Linnaeus, 1758) – Kiener. 1834. *Spec. Gen. Icon. Coq. Viv.* 9: 4, pl. 1; Bratcher and Cernohorsky, 1987, *Living Terebras of the World*: 644, pl. 5, fig. 15a-c.

Terebra maculata maculata (Linnaeus, 1758) – Keen 1971: 680 [specimens of Isla del Coco].

Oxymeris maculata (Linnaeus, 1758) – Habe and Kosuge, 1967, *Stand. Book, Jap. Shell* col. 3: 102, pl. 40, Fig. 21.

Material studied: Silverado: st. 2, d. 1, 9.5 m, 1 ind. – Manuelita: st. 11, d. 3, 14.6 m, 1 ind.

Size: 14.5 × 5.4 – 90.0 × 26.2 mm.

Remarks: The specimens are a juvenile and an adult. The shell is similar to Fig. 1549 of Keen 1971 of a specimen from Isla del Coco. The coloration is dark cream with brown color spots. Spiral sculpture is absent. The species does not have axial ribs on later whorls. The shell can reach a large size ~20 cm,

as was observed during some dives in Bahía Chatham.

Distribution: This species has an Indo and Central Pacific distribution (BRATCHER AND CERNOHORSKY, 1987), and is reported only in Clipperton and Isla del Coco, in the Eastern Pacific (KEEN, 1971; MONTOYA AND KAISER, 1988); the record from Clipperton is spurious (see KAYSER, 2007).

Genus *Pristiterebra* Taki and Oyama, 1954

Pristiterebra glauca (Hinds, 1844) (Fig. 38, Code 78)

Terebra aspera Hinds, 1844, *Proc. Zool. Soc. London*, 1843 (11): 154 (preoccupied name).

Terebra radula Hinds, 1844, *Proc. Zool. Soc. London*, 1843 (11): 155 (preoccupied name).

Terebra glauca Hinds, 1844, *Proc. Zool. Soc. London*, 1843 (11): 155.

Pristiterebra glauca (Hinds, 1844) – Bratcher and Cernohorsky, 1987, *Living Terebras of the World*: 133/147; Terry, 2007, *Terebridae*: 26; pl. 38 figs 5-6; pl. 58.

Terebra petiveriana Deshayes, 1857, *J. Conchyl.*, 6: 85, pl. 5, Fig. 10.

Terebra dorothyae Bratcher and Burch, 1970, *The Veliger*, 12: 297.

Material studied: Bahía Chatham: st. 4, d. 1, 33.8 m, 1 ind; st. 4, d. 2, 34.8 m, 2 ind; st. 4, d. 3, 35.8 m, 2 ind; st. 4, d. 4, 34.9 m, 1 ind; st. 10, d. 2, 10.5 m, 1 ind; st. 10, d. 3, 10.6 m, 1 ind. – Bahía Weston: st. 15, d. 2, 12.2 m, 1 ind. – Bahía Wafer: st. 18, d. 2, 8.5 m, 1 ind; st. 18, d. 3, 7.4 m, 1 ind; st. 18, d. 5, 7.3 m, 1 ind; st. 20, d. 1, 44 m, 1 ind; st. 20, d. 3, 38.1 m, 1 ind. – Punta Gissler: st. 24, d. 4, 15 m, 1 ind; st. 25, d. 3, 52.4 m, 1 ind; st. 25, d. 5, 54.1 m, 1 ind.

Size: 3.4 × 1.0 – 25.3 × 4.6 mm.

Remarks: The suture with whitish tuberculate belt that is disposed in the shape of axial ribs. Moreover, a variety of coloration was found. Many specimens are dark brown, and other presented mostly pale coloration. The juveniles are mainly beige. KEEN (1971) points out that this is the most variable terebrid of the Panamic province. The

anterior canal is broad, short and recurved. The protoconch is coloured pink.

Distribution: From California to Ecuador, Pacific Costa Rica, the species was previously reported for PNIC and Galapagos, and Gorgona (KEEN, 1971; INBIO, 1989; UAESPNN, 2005, Apéndice III; RODRÍGUEZ-SEVILLA ET AL., 2009; FINET ET AL., 2011).

Subclass HETEROBRANCHIA Gray, 1840
Order NUDIBRANCHIA Cuvier, 1817
Superfamily AEOLIDIOIDEA Gray, 1827
Aeolidioidea indet. (Fig. 39, Code 80)

Material studied: Bahía Chatham: st. 4, d. 2, 34.8 m, 1 ind.

Size: 3.0 × 1.6 mm.

Remarks: With this specimen it was not possible to identify the species. But is a sea slug of the superfamily Aeolidioidea. The body of this slug is long and thin, with the foot slightly wider than the body. The lamellate rhinophores show brown pigment on the inner

side, and a row of cerata at each side of the body.

Distribution: MULLINER (1993) reported the presence of an unidentified Aeolid nudibranch collected in 1992 in the PNIC. The species reported in CAMACHO-GARCÍA (2009) from the sandy bottom of the island is *Aeolidiella indica* Bergh, 1888.

Superfamily ONCHIDORIDOIDEA Gray, 1827
Family ONCHIDORIDIDAE Gray, 1827
Genus *Onchidoris* Blainville, 1816
Onchidoris sp. (Fig. 40, Code 81)

Material studied: Bahía Wafer: st. 19, d. 3, 23.6 m, 1 ind.

Size: 1.0 × 0.5 mm.

Remarks: The specimen is a small juvenile stage, showing a pair of ocelli. The shape is oval and flattened. The rhinophore is laminated. The mantle edge extends beyond the body, and present several spicules in an overlapping pattern, in the edge. This pattern characterizes this group as indicated by DEBELIUS AND

KUITER (2007) for the family Onchidorididae. This nudibranch was found in a small rhodolith, on the sand bottom.

Distribution: MULLINER (1993) and CAMACHO-GARCÍA (2009) mentioned that there are five species of the family Dendrodorididae and Chromodorididae reported in the PNIC. New record of the genus from Isla del Coco.

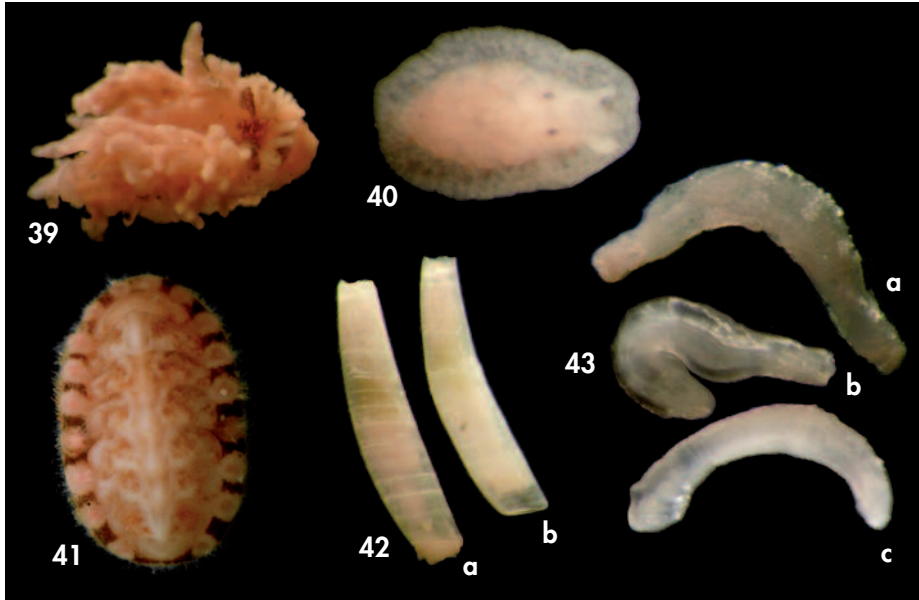


Figure 39. *Aeolidioidea* indet., 3.0 × 1.6 mm, st. 4. Figure 40. *Onchidoris* sp., 1.0 × 0.5 mm, st. 19. Figure 41. *Acanthochitona shaskyi* Ferreira, 1987, 3.5 × 2.2 mm, st. 1. Figure 42. *Gadila austinclarki* (Emerson, 1951), 3.5 × 0.1 mm, st. 3. Figure 43. *Solenogastres* indet., 2.0 × 0.4 mm, st. 1 and 3. Isla del Coco. April 2010.

Figura 39. Aeolidioidea indet., 3,0 × 1,6 mm, est. 4. Figura 40. Onchidoris sp., 1,0 × 0,5 mm, est. 19. Figura 41. Acanthochitona shaskyi Ferreira, 1987, 3,5 × 2,2 mm, est. 1. Figura 42. Gadila austinclarki (Emerson, 1951), 3,5 × 0,1 mm, est. 3. Figura 43. Solenogastres indet., 2,0 × 0,4 mm, est. 1 y 3. Isla del Coco. April 2010.

Class POLYPLACOPHORA Gray, 1821
 Subclass NEOLORICATA Bergenhayn, 1955
 Order CHITONIDA Thiele, 1909
 Family ACANTHOCHITONIDAE Pilsbry, 1893
 Genus *Acanthochitona* Gray, 1821

Acanthochitona shaskyi Ferreira, 1987 (Fig. 41, Code 82)

Acanthochitona shaskyi Ferreira, 1987, *Bull. Southern Cal. Acad. Sci.*, 86: 41-53.

Material studied: El Arco: st. 1, d. 1, 58 m, 2 ind.

Size: 2.2 × 1.2 – 3.5 × 2.2 mm.

Remarks: The individuals collected in the present study (found on rubble within the sand bottom) are similar to figure 126 in SLIEKER (2000) of *Acanthochitona angelica* Dall, 1919. The individual in SLIEKER (2000) was collected in Bahía Chatham, Isla del Coco, from 20-120 m,

and the author mentioned that it is a paratype of *Acanthochitona shaskyi* Ferreira, 1987. *Acanthochitona angelica* was described from Angeles Bay, Gulf of California. FINET *ET AL.* (2011) mentioned that *A. angelica* was reported in Galapagos, with specimens from this archipelago originally classified as

Acanthochitona jacquelinae Smith and Ferreira, 1977. WATTERS (1990) synonymized both species with *A. angelica*, but EERNISSE (1993), studied the chitons of Donald R. Shasky and he maintained the species *A. shaskyi* as valid.

Distribution: EERNISSE (1993) mentioned that the distribution of *A. angelica* has

more northern type localities in Mexico. Therefore, the report of *A. angelica* for PNIC (SCHWABE AND WEHRTMANN, 2009) corresponds to *A. shaskyi*. *Acanthochitona angelica* has never been collected on the Costa Rica mainland (INBIO, 1989; SCHWABE AND WEHRTMANN, 2009). A genetic study is required for these species.

Class SCAPHOPODA Bronn, 1862
Order GADILIDA Starobogatov, 1974
Family GADILIDAE Steiner, 1992
Genus *Gadila* Gray, 1847

Gadila austinclarki (Emerson, 1951) (Fig. 42, Code 83)

Cadulus austinclarki Emerson, 1951, J. Wash. Acad. Sci., 41: 24-26.

Gadila austinclarki (Emerson, 1951) – Steiner and Kabat, 2004, *Zoosystema*, 26: 566.

Material studied: Bahía Chatham: st. 3, d. 5, 75.3 m, 2 ind.

Size: 3.5 × 0.1 mm.

Remarks: The two individuals found show apex with four broad, shallow notches and are concordant in shape outline with figure 20 of the Scaphopoda chapter in KEEN (1971) of *Cadulus* (*Platyschides*) *austinclarki* Emerson, 1951. The size of the specimens also matches. They present somewhat ringed sculpture. STEINER AND KABAT (2004) placed *C. austinclarki* in the genus *Gadila*.

Distribution: Gulf of California to Panama, and Galapagos (KEEN, 1971; FINET ET AL., 2011). Only one identified species of genus *Gadila* was reported for Costa Rica: *Gadila dominguensis* (d'Orbigny, 1853), but along the Caribbean coast (INBIO, 1989). Other indeter-

minate specimens of Gadilidae were also reported by INBIO (1989) for the Pacific coast of Costa Rica. The species is a new record for Isla del Coco and Costa Rica.

MONTOYA (1988) mentioned the presence of one Scaphopoda species in PNIC. Montoya, Shasky & Kaiser (unpublished manuscript, 1988) mention the presence of the Scaphopoda *Cadulus* (*Polyschides*) *nedallisoni* Emerson, 1978 (Siphonodentaliidae), now accepted as *Polyschides nedallisoni* (Emerson, 1978) (Gadilidae) in STEINER AND KABAT (2004). It was collected with a triangular dredge at 45 and 70 m outside Bahía Chatham. In this way, *G. austinclarki* is the second identified species of the class Scaphopoda from the island.

Class SOLENOGASTRES Gegenbaur, 1878
Solenogastres indet. (Fig. 43 a-c, Code 84)

Material studied: El Arco: st. 1, d. 4, 60.6 m, 1 ind. Bahía Chatham: st. 3, d. 5, 75.3 m, 2 ind.

Size: 2.0 × 0.4 mm.

Remarks: These vermiform organisms do not have a shell, and the body is covered with calcareous elements or sclerites. The foot is apparently reduced to a ventral groove. The specimens

present an atrio-buccal area, and are without gills (GARCÍA-ÁLVAREZ AND URGORRI, 2003).

Distribution: This is a new record of these Mollusks for Central American waters.

DISCUSSION

In the present study 40 species of mollusks were found in the subtidal sand bottom of Isla del Coco. Eleven taxa are new records for the National Park; five were identified to the species level: *Ctena mexicana* (Dall 1901), *Parvilucina mazatlanica* (Carpenter, 1857), *Diarmaidia jingchunae* Valentich-Scott, in Coan and Valentich-Scott, 2012, *Gibberula* cf. *insularum* (Roth and Coan, 1971), *Gadila austinclarki* (Emerson, 1951); and *Caecum cocoensis* sp. nov. was described. Two species of nudibranchs were found but could not be identified. Specimens of Solenogastres are a new record of the class for Central American waters.

The *Diplodonta* sp. found is a possibly new species, and similar situation occurs with *Opalia* (*Dentiscalia*) sp. and *Tellina* (*Morella*) sp. More sampling is needed to obtain additional specimens of these genera. CORTÉS (2012) and COAN AND VALENTICH-SCOTT (2012), first reported the species *Diplodonta subquadrata* Carpenter, 1856 for the PNIC; but the specimens found in the present study are juvenile stages of this genus. Other mollusks such as *Gouldia californica* Dall, 1917, *Plaktomya* cf. *henseni* Simroth, 1896, and *Trigonulina novemcostata* (A. Adams and Reeve, 1850), are the second report of these species in Isla del Coco, after the recently published catalogue of bivalves of the Eastern Tropical Pacific by COAN AND VALENTICH-SCOTT (2012).

The number of species in the National Park increased with each expedition carried out (CORTÉS, 2008), in this way, BIOLLEY (1935) reported only 23 marine mollusks, MONTOYA (1983) and MONTOYA AND BARTSCH (1983) indicated a number of 118 species, and in a posterior publication MONTOYA (1988) indicates 429 species of mollusks in PNIC. Most of the records are the product of the malacological expeditions carried out between 1982 and 1989 on board the schooner *Victoria af Carlstad* with the participation of Donald R. Shasky, Kirstie L. Kaiser and Michel Montoya (CORTÉS, 2008). The number of marine

mollusks in the book of WEHRTMANN AND CORTÉS (2009) is 428 species, based on the lists by CAMACHO-GARCÍA (2009), HOCHBERG AND CAMACHO-GARCÍA (2009), MAGAÑA-CUBILLO AND ESPINOSA (2009), RODRÍGUEZ-SEVILLA *ET AL.* (2009), SCHWABE AND WEHRTMANN (2009). The total number reported in the review of biodiversity of the island by CORTÉS (2012) still increased to 490 species.

MULLINER (1993) and KAISER (2007) report several species of marine gastropods for the Isla del Coco, not mentioned in the previous species list: *Atlanta turriculata* d'Orbigny, 1836, *Attiliosa nodulosa* (A. Adams, 1855), *Cavolinia* cf. *tridentata* (Niebuhr, 1775), *Cavolinia uncinata* (Rang, 1829), *Creseis* cf. *acicula* (Rang, 1828), *Limacina bulimoides* (Orbigny, 1836), *Dolabella auricularia* (Lightfoot, 1786), *Dolabrifera dolabrifera* (Rang, 1828), *Elysia diomedea* (Bergh, 1894), *Janthina janthina* (Linnaeus, 1758), *Nassarius catallus* (Dall, 1908), *Oxygyrus keraudrenii* (Lesueur, 1817), *Pachystremiscus solitarius* (Hertlein and Allison, 1968), *Quoyula monodonta* (Blainville, 1832), *Scissurella kaiserae* Geiger, 2006, and *Tylodina fungina* Gabb, 1865. In addition KAISER (2007), presented plates with figures of several gastropods identified to genus or subfamily level found on Clipperton Island, that she mentioned also to occur in Isla del Coco: *Cerithium* sp. 2 (Plate 17, Fig. 1c,d), *Coralliophilinae* sp. 1. (Plate 31, Fig. 6, 7), *Elachisina* sp. 1 (Plate 14, Fig. 5), *Graphis* sp. 1 (Plate 18, Fig. 6), *Omalogyra* sp. 1 (Plate 36, Fig. 7), *Orbitestella* sp. 1 (Plate 39, Fig. 4), *Sinezona* sp. 1 (Plate 9, Fig. 1).

COAN AND VALENTICH-SCOTT (2012) made direct reference to 64 species of bivalves from Isla del Coco, and 20 of them are additional record to the list of CORTÉS (2012): *Amerycina mikkelsenae* Valentich-Scott, 2012, *Apiocardia obovale* (G.B. Sowerby I, 1833), *Cardita aviculina* Lamarck, 1819, *Cardites grayi* (Dall, 1903), *Caryocorbula ira* (Dall, 1908), *Chama echinata* Broderip, 1835, *Ctena chiquita* (Dall, 1901), *Gastrochaena ovata* G.B. Sowerby I, 1834, *Gouldia californica* Dall, 1917, *Hyotissa hyotis* (Linnaeus, 1758), *Hyotissa quercinus* (G.B. Sowerby II,

1871), *Limopsis tenella* Jeffreys, 1876, *Liralucina approximata* (Dall, 1901), *Pitar* (*Hyphantosoma*) *pollicaris* (Carpenter, 1864), *Planktonomya* cf. *henseni* Simroth, 1896, *Plectodon scaber* Carpenter, 1865, *Spondylus gloriosus* Dall, Bartsch and Rehder, 1938, *Trigoniocardia granifera* (Broderip and G.B. Sowerby I, 1829), *Trigonulina novemcostata* (A. Adams and Reeve, 1850) and *Tucetona multicostrata* (G.B. Sowerby I, 1833). Including the scaphopod *Polyschides nedallisoni* (Emerson, 1978) by Montoya, Shasky and Kaiser (unpublished manuscript, 1988), not mentioned in the others lists, brings the number to 534 species. Adding the eleven new records found in the present study, a grand total of 545 species of mollusks are present in Isla del Coco.

From this new total of species in PNIC, the percent of gastropods are 75% and bivalves only 19%. Moreover, only 180 (33%) inhabit in marine sediments (KAISER, 2007; WEHRMANN AND CORTÉS, 2009; COAN AND VALENTICH-SCOTT, 2012). Considering separately the sediments habitat of the PNIC, the contribution of gastropods is 57.8%, bivalves 38.3%, and other mollusks 3.9%. Therefore, the bivalves have a greater richness in soft bottom (69 species) than in the hard substrates (37 species) (WEHRMANN AND CORTÉS, 2009). These percentages are similar with the contribution found for soft bottoms in present study, with 52.5% of gastropods, 40% of bivalves, and 7.5% by other groups.

As is mentioned above, in PNIC the general data indicate an 75% of gastropods and 19% of bivalves (Fig. 44), while in the pacific coast of Costa Rica, the contribution of species of gastropods and bivalves, averaged between 64 and 67% and 30 to 34%, respectively, depending of the reference (INBIO, 1989; WERTHMANN AND CORTÉS, 2009). In other places of the pacific coast the percentage of bivalves is higher than 25%, in Gorgona (a continental island) the bivalves are 29% and the gastropods 69%, and Tres Mariás, Mexico (26% bivalves and 73% gastropods). Even so, the percentages of total species in Isla

del Coco (19% bivalves and 75% gastropod) are similar with the other oceanic islands of the region (Fig. 44) as Malpelo (18% bivalves and 79% gastropod), Galapagos (24% bivalves and 72% gastropod), Clipperton (13% bivalves, 86% gastropod) and Revillagigedo (14% bivalves, 83% gastropod) (STRONG AND HANNA, 1930A; STRONG AND HANNA, 1930b; UAESPNN, 2005, Apéndice III; KAISER, 2007; FINET ET AL. 2011). The gastropod group dominates, and the bivalves have a lesser percentage of representation in these oceanic islands than in mainland.

Despite the low number of 40 species found, the methodological survey used here is adequate to preserve the whole community of sand substrate, and the use of mesh sieves helped to retain the small specimens of several species, that resulted be new records for the island. The species distribution also changes with depth, so that possibly sampling at a greater depth of the sand bottom will increase the number of species for this habitat of the PNIC. In sedimentary habitats (sampled with grabs) of mainland of Central America, MAURER AND VARGAS (1984) only found 22 species of mollusks in Golfo de Nicoya (Costa Rica), MAIR, CUNNINGHAM, SIBAJA-CORDERO, GUZMÁN, ARROYO, MERINO, AND VARGAS (2009) found 33 taxa in the islands Las Perlas, Panamá.

In the oceanic islands of the Tropical Eastern Pacific the presence of marine mollusks from different biogeographic provinces, including species with Indo-Pacific affinities is documented (SHASKY, 1987; SHASKY, 1988; SCHELTEMA, 1988; FINET, 1991; KAISER, 2007). This situation is accentuated in Isla del Coco, by its geographic position at 5°N in the middle of the intertropical convergence zone, which in April is influenced by South and Central American currents and in October by the Equatorial Counter Current (Fig. 1), especially during El Niño year. This current would carry larvae to the island from different regions of the Tropical Pacific to the island (SHASKY, 1987; MONTOYA, 1988). MONTOYA (1988) indicated that the

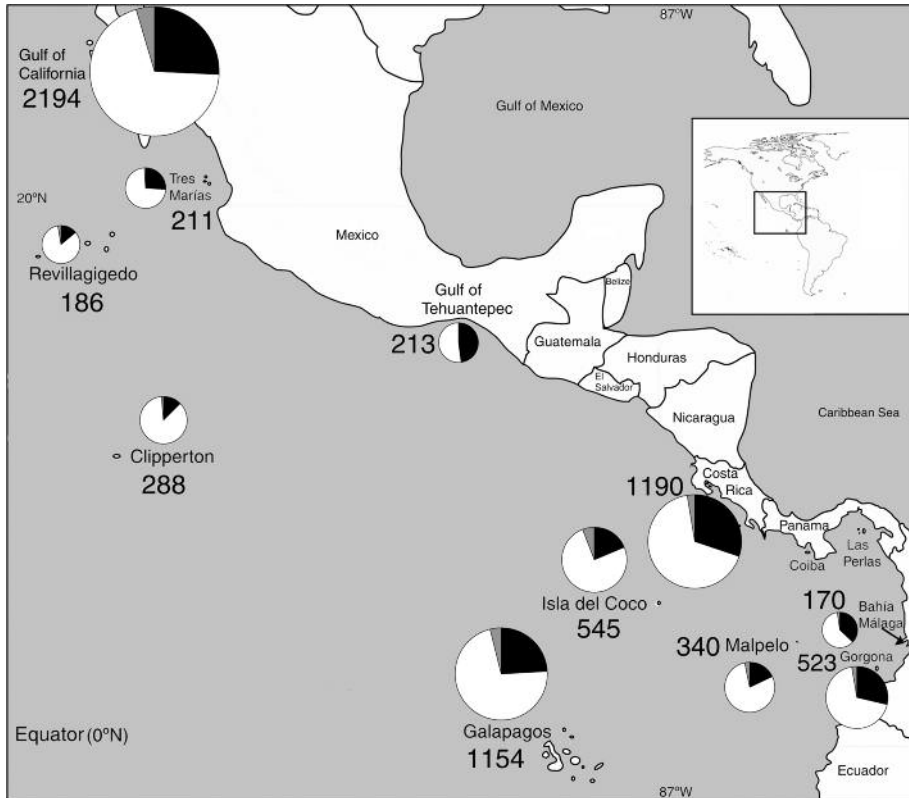


Figure 44. Number of marine mollusks species, and the percentual contribution of bivalves (black), gastropod (white) and other mollusks (gray) to species richness, by locality in the Eastern Tropical Pacific Ocean. Based on the references for Gulf of California, Mexico: Hendrickx, Brusca, Cordero and Ramírez, 2007. Islas Tres Marias, Mexico: STRONG AND HANNA, 1930b; Islas Revillagigedo, Mexico: STRONG AND HANNA, 1930a; MILLE-PAGAZA, PÉREZ-CHI AND HOLGUÍN-QUIÑONES, 1994; KAISER, 2007. Gulf of Tehuantepec, Mexico: RÍOS-JARA, NAVARRO-CARAVANTES, GALVÁN-VILLA AND LOPEZ-URIARTE, 2009. Isla Clipperton, French possession: KAISER, 2007. Pacific Coast of Costa Rica: WEHRMANN AND CORTÉS, 2009. Isla del Coco, Costa Rica: MULLINER 1993; KAISER, 2007; CORTÉS, 2012 and present study. Islas Malpelo and Gorgona, Colombia: UAESPNN, 2005, Apéndice III. Bahía Malaga, Colombia: GUEVARA-FLETCHER, CANTERA-KINTZ, MEJÍA-LADINO AND CORTÉS, 2011; LOZANO-CORTÉS, LONDOÑO-CRUZ, IZQUIERDO, ARIAS, BARONA AND ZAMBRANO, 2012. Islas Galapagos, Ecuador: FINET *ET AL.*, 2011.

Figura 44. Número de especies de moluscos marinos y la contribución porcentual de los bivalvos (negro), gasterópodos (blanco) y otros moluscos (gris) a la riqueza de especies, por localidad en el Océano Pacífico Tropical Este. Basado en las referencias para el Golfo de California, México: HENDRICKX, BRUSCA, CORDERO Y RAMÍREZ, 2007. Islas Tres Marias, México: STRONG Y HANNA, 1930b. Islas Revillagigedo, México: STRONG Y HANNA, 1930a; MILLE-PAGAZA, PÉREZ-CHI Y HOLGUÍN-QUIÑONES, 1994; KAISER, 2007. Golfo de Tehuantepec, México: RÍOS-JARA, NAVARRO-CARAVANTES, GALVÁN-VILLA Y LOPEZ-URIARTE, 2009. Isla Clipperton, posesión francesa: KAISER, 2007. Costa Pacífica de Costa Rica: WEHRMANN Y CORTÉS, 2009. Isla del Coco, Costa Rica: MULLINER 1993; KAISER, 2007; CORTÉS, 2012 y el estudio presente. Islas Malpelo y Gorgona, Colombia: UAESPNN, 2005, Apéndice III. Bahía Málaga, Colombia: GUEVARA-FLETCHER, CANTERA-KINTZ, MEJÍA-LADINO Y CORTÉS, 2011; LOZANO-CORTÉS, LONDOÑO-CRUZ, IZQUIERDO, ARIAS, BARONA Y ZAMBRANO, 2012. Islas Galápagos, Ecuador: FINET *ET AL.*, 2011.

molluscan assemblage of the island consisted of ~88% Panamic, 7.5% Indo-Pacific, and 2.3% cosmopolitan species.

Moreover, five of the species found here are also present in Revillagegido Islands (Mexico), four species also occurs in Clipperton (French colony); six species are present in Malpelo (Colombia); and 21 species are present also in Galapagos Islands (Ecuador). Several of the species also occurs in the Pacific Coast of Central America. The species *Oxymoris maculata* (Linnaeus, 1758) and *Mammilla simiae* (Deshayes, 1838), have a wide distribution in the Indo Central Pacific, and the gastropod *Gibberula cf. insularum* (Roth and Coan, 1971), was cited previously only for the Galapagos.

CONCLUSIONS

In the present study only 40 molluscan taxa were found in the sand bottom of Isla del Coco, among which eleven taxa are new records for this National Park, or represent new records for Costa

Rica and Central American waters. In addition, the malacofauna in the sandy bottom of these samples is a mix of species with distribution from different biogeographic provinces. The *Caecum* specimens found represent a new species.

The low number of species found could be explained by the tendency of species diversity to change with depth, and that the sampling was carried out within a narrow bathymetric range between 3 to 75 m. This finding indicates that with more sampling, at greater depth, the number of species present will increase. The total number of species reported in the region has been increased to 545, including the results of the present study and literature of the Tropical Eastern Pacific. The percent of bivalves is low in the island, because most of the habitats are hard substrates, like in the others islands of the region, but the information presented here suggests that the sand bottom of PNIC is rich in bivalves species, and that more sampling is needed.

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