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First records and two new species of sipunculans (Sipuncula) from the Southern Mexican Pacific

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Abstract. Sipunculans are a poorly studied group in the Tropical Eastern Pacific. For the Southern Mexican Pacific (SMP) there is only one record of a sipunculan species. The main objective of this work was to determine the species composition of the phylum Sipuncula present in the SMP. The study area covered three Mexican states: Guerrero, Oaxaca and Chiapas; specimens from 28 localities were examined from both intertidal and subtidal zones. A total of 551 specimens were reviewed, from which 11 species were identified. Five of them have previously been recorded in the Tropical Eastern Pacific (TEP): *Apionsoma* (*A.*) *hespera* comb. nov., *A.* (*Edmondsius*) *pectinatum, Aspidosiphon* (*A.*) *elegans*, *Phascolosoma* (*P.*) *puntarenae* and *Themiste* (*T.*) *hennahi*; four species are similar to nominal species: *Sipunculus* (*S.*) cf. *polymyotus*, *Siphonosoma* cf. *vastum*, *Siphonosoma* cf. *cumanense* and *Phascolosoma* (*P.*) cf. *perlucens*; and two new species are described: *Aspidosiphon* (*Paraspidosiphon*) *cutleri* sp. nov. and *Aspidosiphon* (*Paraspidosiphon*) *pastori* sp. nov. A checklist and an identification key for all sipunculan species from the TEP are presented. The checklist includes 53 taxa, 25 of which are questionable records. This work generated 11 new records of sipunculans in the SMP and five new records in the TEP.

Keywords. *Aspidosiphon*, Chiapas, Guerrero, Oaxaca, *Phascolosoma*.

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Introduction

Sipunculans are a small group of unsegmented vermiform, coelomate and protostome marine worms (Cutler 1994; Murina 1984) and are considered close to or even within the annelid group (Staton 2003;

Struck *et al.* 2007; Dordel *et al*. 2010). They are commonly known as 'peanut worms' or 'star worms' (Schulze *et al*. 2019), and they have a body divided in a retractable introvert and trunk. Sipuncula earlier comprised 320 species (sensu Stephen & Edmonds 1972); however, the revisions of Cutler & Cutler (Cutler 1979; Cutler & Cutler 1982, 1983, 1985a, 1985b, 1986, 1987, 1988, 1989, 1990) reduced the number to 150 valid species (Cutler 1994). Traditionally, the phylum has included two classes, four orders, six families and 17 genera (Cutler & Gibbs 1985; Gibbs & Cutler 1987) but Kawauchi *et al*. (2012) proposed a new classification based on a molecular phylogenetic analysis. Subsequently, Lemer *et al*. (2015) corroborated these results. The new classification now includes six families and 16 genera, leaving out the classes and orders.

In the Tropical Eastern Pacific (TEP), most sipunculan species are reported from northwestern Mexico and Costa Rica, as well as a few other few localities from Colombia, Panama and the Galapagos Islands (Gray 1828; Grube 1858; Keferstein 1866, 1867; Fischer 1895; Chamberlin 1920; Steinbeck & Ricketts 1941; Fisher 1952; Cutler & Cutler 1980; Salazar-Vallejo 1983; Fonseca & Cortés 1988; Cutler *et al*. 1992; Dean 2001; Cantera *et al*. 2003; Fonseca *et al*. 2005; Spongberg 2006; Yupanqui *et al*. 2007; Melwani & Kim 2008; Dean *et al*. 2010; Hermoso-Salazar *et al*. 2013; Morales-Zárate *et al*. 2016). Also, no identification key or updated list of the sipunculans from TEP exist. The presence of this group in the Southern Mexican Pacific (SMP) is completely unknown (Bastida-Zavala *et al*. 2013); a single record of one new species in the SMP was made by Silva-Morales *et al*. (2019). Therefore, the main objective of this work was to determine the composition of species of the phylum Sipuncula present in the study area.

Material and methods

The revised specimens are from the Laboratorio de Sistemática de Invertebrados Marinos (LABSIM), Universidad del Mar, campus Puerto Ángel, Oaxaca, Mexico. The totality of specimens is derived from 28 localities in three coastal Mexican states: Guerrero, Oaxaca and Chiapas (Table 1). Most of the material is from intertidal and subtidal zones and some was collected during free diving on different substrates such as sand and rock, mainly coralline rocks. Collected specimens were fixed in 10% formalin and preserved in 70% ethanol. To identify the species, the identification keys of Cutler (1994) and Fisher (1952) were used. Internal and external anatomy was observed and described using a Zeiss stereo microscope; to examine the hooks and papillae, semi-permanent slides were prepared and visualized in a Zeiss compound microscope. The specimens were deposited in the Sipunculan Section of the Scientific Collection with the accession number OAX-CC-249-11 of the Laboratorio de Sistemática de Invertebrados Marinos, Universidad del Mar (UMAR), campus Puerto Ángel, Oaxaca, Mexico. Additional specimens were examined from the Polychaeta Collection of the Laboratorio de Poliquetos (ECOSUR), Chetumal, Quintana Roo, Mexico with the number QNR.IN.021.0497. The checklist and identification keys were assembled following an exhaustive review of the literature.

Collector abbreviations

BMD = Betzabé Berenice Moreno Dávila
DC = Don Cadien
FRE = Fernando Ruíz Escobar
GGG = Gerardo Góngora-Garza
ILA = Ildefonso "Mikel" Liñero-Arana
ISM = Itzahí Silva-Morales
JDG = Jesús Ángel de León-González
JGV = Julio Daniel Gómez-Vásquez
JWC = John W. Chapman
KLT = Karina Marisol Lugo Trejo

Table 1. Geographic coordinates of localities. All localities are in Mexico.

Locality	Geographic coordinates
Coral Beach, Ixtapa Island, Guerrero	17°40′37.0″ N, 101°39′20.2″ W
Barra de Potosí, Guerrero	17°32′19.6″ N, 101°26′36.7″ W
La Quebrada, Acapulco, Guerrero	16°50′44.2″ N, 99°54′54.8″ W
Manzanillo Beach, Guerreo	16°50′31.4″ N, 99°54′38.4″ W
Roqueta Island, Guerrero	16°49′19.8″ N, 99°54′17.6″ W
Las Peñitas Beach, Marquelia, Guerrero	16°33′16.2″ N, 98°46′21.7″ W
Punta Maldonado Beach, Guerrero	16°19′39.2″ N, 98°34′15.2″ W
Chacahua, Oaxaca	15°58′07.4″ N, 97°32′09.7″ W
Cerro Hermoso Beach, Chacahua, Oaxaca	15°58′08.1″ N, 97°32′06.6″ W
Puerto Escondido, Oaxaca	15°51′34.7″ N, 97°03′50.8″ W
Santa Cruz Beach, Huatulco, Oaxaca	15°45′10.7″ N, 96°07′49.7″ W
La Montosa Island, Huatulco, Oaxaca	15°45′57.2″ N, 96°05′03.4″ W
Conejos Bay, Huatulco, Oaxaca	15°46′44.6″ N,, 96°03′51.7″ W
La Entrega Beach, Huatulco, Oaxaca	15°44′37.1″ N, 96°07′41.8″ W
Violín Beach, Huatulco, Oaxaca	15°44′24.4″ N, 96°07′38.3″ W
Agua Blanca Beach, Oaxaca	15°43′58.6″ N, 96°48′38.6″ W
Jicaral Beach, Chachacual Bay, Oaxaca	15°42′39.1″ N, 96°12′11.1″ W
Salchi Beach, Huatulco, Oaxaca	15°41′22.6″ N, 96°20′59.9″ W
San Agustin Bay, Huatulco, Oaxaca	15°41′21.1″ N,, 96°14′11.1″ W
La Tijera Beach, Puerto Ángel, Oaxaca	15°41′15.5″ N, 96°26′33.5″ W
Boquilla Beach, Puerto Ángel, Oaxaca	15°40′58.5″ N, 96°27′54.5″ W
Estacahuite Beach, Puerto Ángel, Oaxaca	15°40′05.2″ N, 96°28′53.5″ W
Playa del Amor, Zipolite, Oaxaca	15°39′36.0″ N, 96°30′35.3″ W
Panteón Beach, Puerto Ángel, Oaxaca	15°39′50.8″ N, 96°29′42.4″ W
Puerto Ángel Bay, Oaxaca	15°39′56.3″ N, 96°29′29.0″ W
Camarón Beach, Puerto Ángel, Oaxaca	15°39′45.3″ N, 96°31′33.0″ W
Zipolite, Oaxaca	15°39′37.0″ N, 96°30′38.8″ W
Puerto Chiapas, Chiapas	14°42′11.4″ N, 92°24′36.8″ W

LCP = Luis Fernando Carrera Parra
MLY = Monserrat López-Yllescas
NHH = Nadia Valeria Herrera Herrera
PHM = Paulina Hernández-Moreno
RBZ = José Rolando Bastida-Zavala
RGF = Rebeca Granja-Fernández
RRB = Raúl Ramírez-Barragán
RXP = Rodrigo Xavier-Pacheco
SGG = Sergio Guendulain-García
SGM = María del Socorro García-Madrigal
SS = Saúl Serrano
SSV = Sergio I. Salazar-Vallejo
TVG = Tulio F. Villalobos-Guerrero
VAR = Víctor Alvarado-Ruiz

Results

Phylum Sipuncula Sedgwick, 1898
Family Sipunculidae Rafinesque, 1814
Genus *Sipunculus* Linnaeus, 1766
Subgenus *Sipunculus* (*Sipunculus*) Linnaeus, 1766

Sipunculus* (*Sipunculus*)** cf. ***polymyotus Fisher, 1947
Figs 1–2

Type locality of nominal species

Key West, Florida (Fisher 1947: 354–358, pl. 10, fig. 24).

Material examined

MEXICO • 1; Oaxaca, Puerto Ángel, Boquilla Beach; 15°40′58″ N, 96°27′54″ W; 21 Mar. 2016; FRE leg.; depth 5 m, in sand; UMAR-SIPU 106.

Description

Trunk 80 mm in length (Fig. 1A). Introvert 10% of total length; with triangular papillae and associated microbivalves (Fig. 1B–D). Transparent and iridescent body. Tentacular membrane with two large ventral lobes and two smaller dorsal lobes with margin greatly subdivided (Fig. 1E). Longitudinal and circular musculature in bands, with 49 longitudinal muscle bands (LMBs). Gut with post-esophageal loop. Two pairs of retractor muscles, each ventral retractor muscle attached to six LMBs starting from second band after ventral nerve cord; each dorsal retractor muscle attached to five LMBs starting from 15th band after ventral nerve cord (Fig. 2A). Most LMBs split and double in posterior end. Brain with approximately ten digitate processes, large, conspicuous, leaf-like flaps and long strings (Fig. 2B). A pair of brownish nephridia with irregular knobby surfaces, about 10% of trunk length (Fig. 2C). Anus with small prominences surrounding its boundary (Fig. 2D). Nephridiopore anterior to anus. Spindle muscle not attached to body wall posteriorly.

Morphological remarks

The prominences of the anus are conspicuous. This morphological feature was not described by Cutler (1994), or even by Fisher (1947). The prominences are not related with the elevation of the anus or the fixation process.

Taxonomic remarks

Fisher (1947) described *Sipunculus polymyotus* from Key West, Florida and later *S. natans* Fisher, 1954 from Santa Inés Bay, on Gulf coast of Baja California, Mexico. Cutler (1994) synonymized *S. natans* with *S. polymyotus*. The principal morphological difference between the two species is the number of longitudinal muscle bands. *Sipunculus polymyotus* has 53–55 while *S. natans* has 49–52. The single specimen of *S.* cf. *polymyotus* from the Southern Mexican Pacific revised in this study has 49 LMB, i.e., more similar to conditions described for *S. natans* (Table 2).

Once more specimens of *Sipunculus* (*S.*) cf. *polymyotus* become available, the name *S. natans* could be revalidated. This hypothesis is based on some recent papers where the use of molecular data has rejected the supposed wide distribution of some species (Staton & Rice 1999; Kawauchi & Giribet 2010, 2014; Schulze *et al*. 2012; Johnson *et al*. 2016; Silva-Morales *et al*. 2019).

Habitat

Subtidal (5 m); in sand.

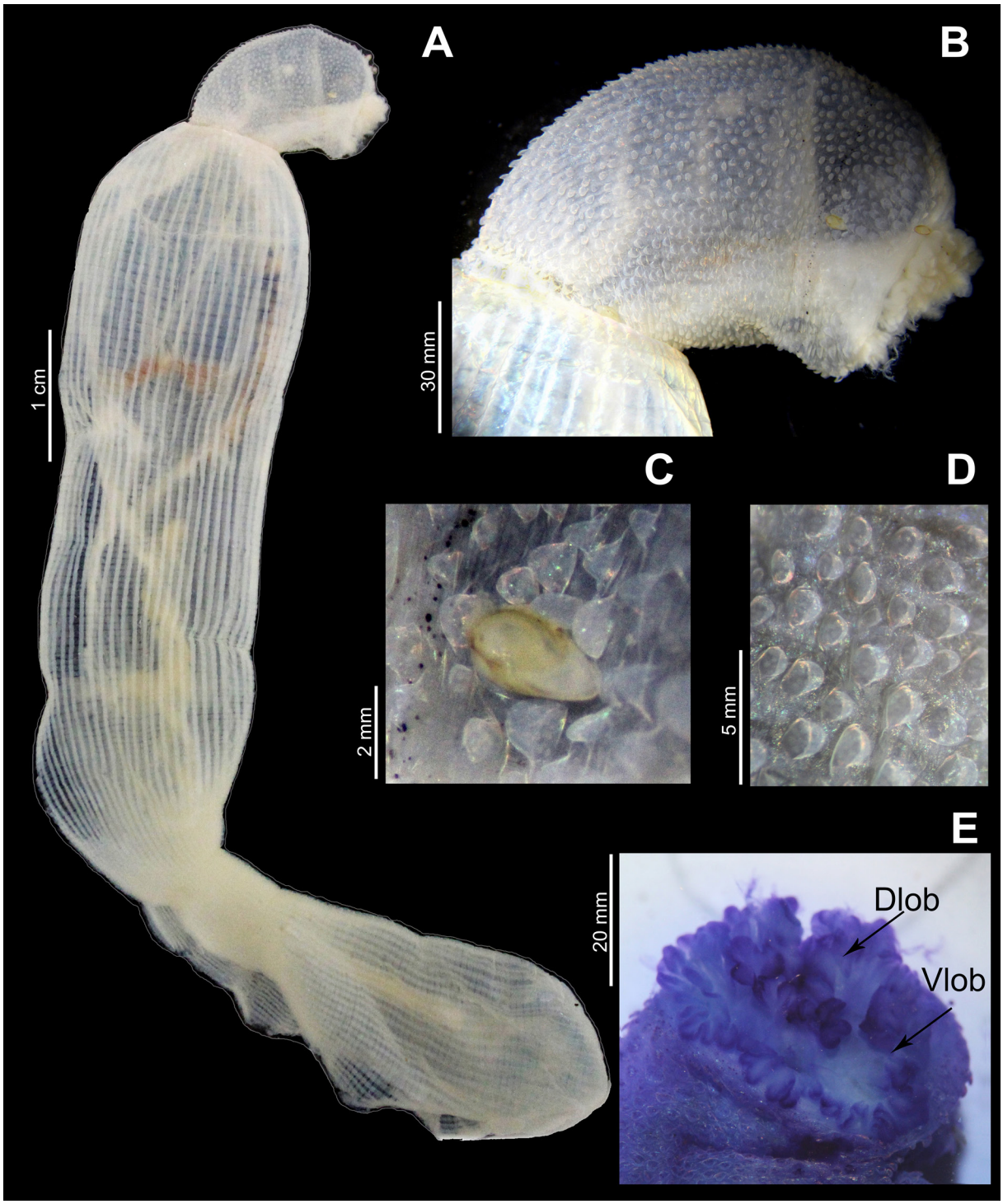

Fig. 1. *Sipunculus* cf. *polymyotus* Fisher, 1947 from Oaxaca, Mexico lateral view. **A**. External morphology. **B**. Introvert. **C**. Microbivalve associated with introvert papillae. **D**. Triangular introvert papillae. **E**. Peripheral tentacles stained in methyl blue. Abbreviations: Dlob = dorsal lobe; Vlob = ventral lobe.

Distribution

Boquilla Beach, Oaxaca, Mexico.

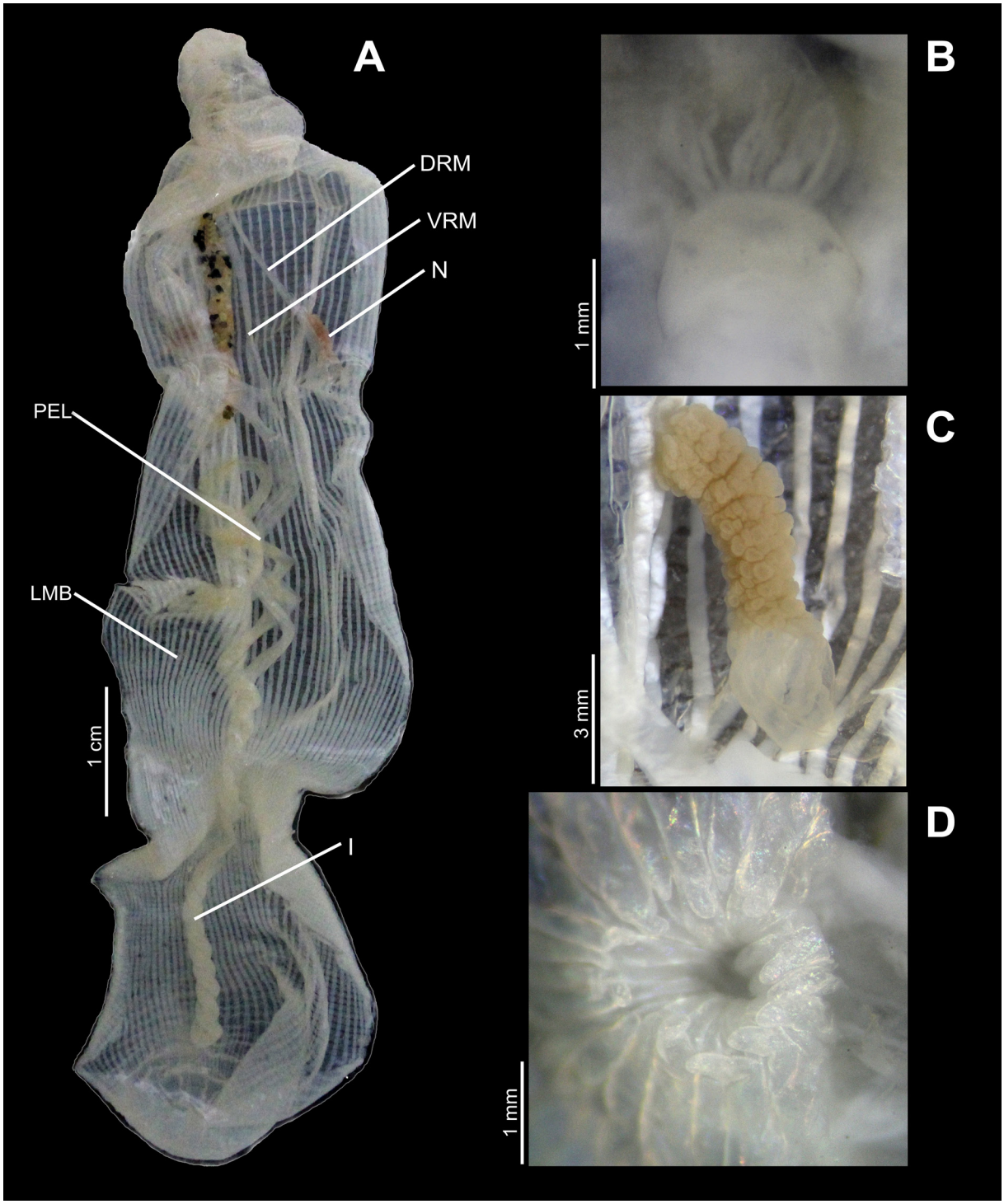

Fig. 2. *Sipunculus* cf. *polymyotus* Fisher, 1947 from Oaxaca, Mexico. **A**. Internal morphology. **B**. Digitate processes of brain. **C**. Nephridium. **D**. Anus (black row indicates the prominences of the anus). Abbreviations: DRM = dorsal retractor muscles; I = intestine; LMB = longitudinal muscle bands; N = nephridium; PEL = post esophageal loop; VRM = ventral retractor muscles.

Table 2. Comparison between some species of *Sipunculus* Linnaeus, 1766 from tropical America.

	S. polymyotus	***S. natans***	***S.* cf. *polymyotus***
Reference	Fisher (1947)	Fisher (1954)	this paper
Locality	Key West, Florida, USA	Santa Inez Bay, on Gulf coast of Baja California, Mexico	Boquilla Beach, Oaxaca, Mexico
Depth	?	?	5 m
Number of LMB	53–55	49–52	49
Trunk length	28 cm	15 cm	8 cm
Prominences of the anus	?	?	present

Family Siphonosomatidae Kawauchi, Sharma & Giribet, 2012
Genus *Siphonosoma* Spengel, 1912

Siphonosoma cf. ***cumanense*** (Keferstein, 1867)
Fig. 3

Type locality of nominal species

Cumana, Venezuela (Keferstein 1867: 53–55, pl. 6, figs 19–21).

Material examined

MEXICO • 1; Oaxaca, Huatulco, Santa Cruz Beach; 15°45′10″ N, 96°07′49″ W; 1 Dec. 2016; JGV leg.; depth 3 m, in sand; UMAR-SIPU 104.

Description

Pinkish and damaged trunk (Fig. 3A). Introvert and trunk with rectangular papillae (Fig. 3D). Approximately 80 peripheral tentacles of equal length (Fig. 3C). Without hooks. Musculature divided in 20 anastomosing longitudinal muscle bands (Fig. 3B). Two pairs of retractor muscles originating at same level along anterior-posterior axis. Dark brown nephridia occupying less than 10% of trunk. Villi present in contractile vessel. Spindle muscle attached to body wall posteriorly.

Remarks

This species is similar to *Siphonosoma cumanense* (Keferstein, 1867), but the widespread distribution is unlikely.

Habitat

Subtidal (3 m); in sand.

Distribution

Santa Cruz Beach, Oaxaca, Mexico.

Siphonosoma cf. ***vastum*** (Selenka & Bülow in Selenka, 1883)
Fig. 4

Type locality of nominal species

Jaluit, Marshall Islands (Selenka 1883: 103–104, pl. 12, fig. 171, pl. 13, fig. 179).

Material examined

MEXICO • 1; Oaxaca, San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 24 Oct. 2004; SCJ leg.; depth 3 m, under rock in sand; UMAR-SIPU 105.

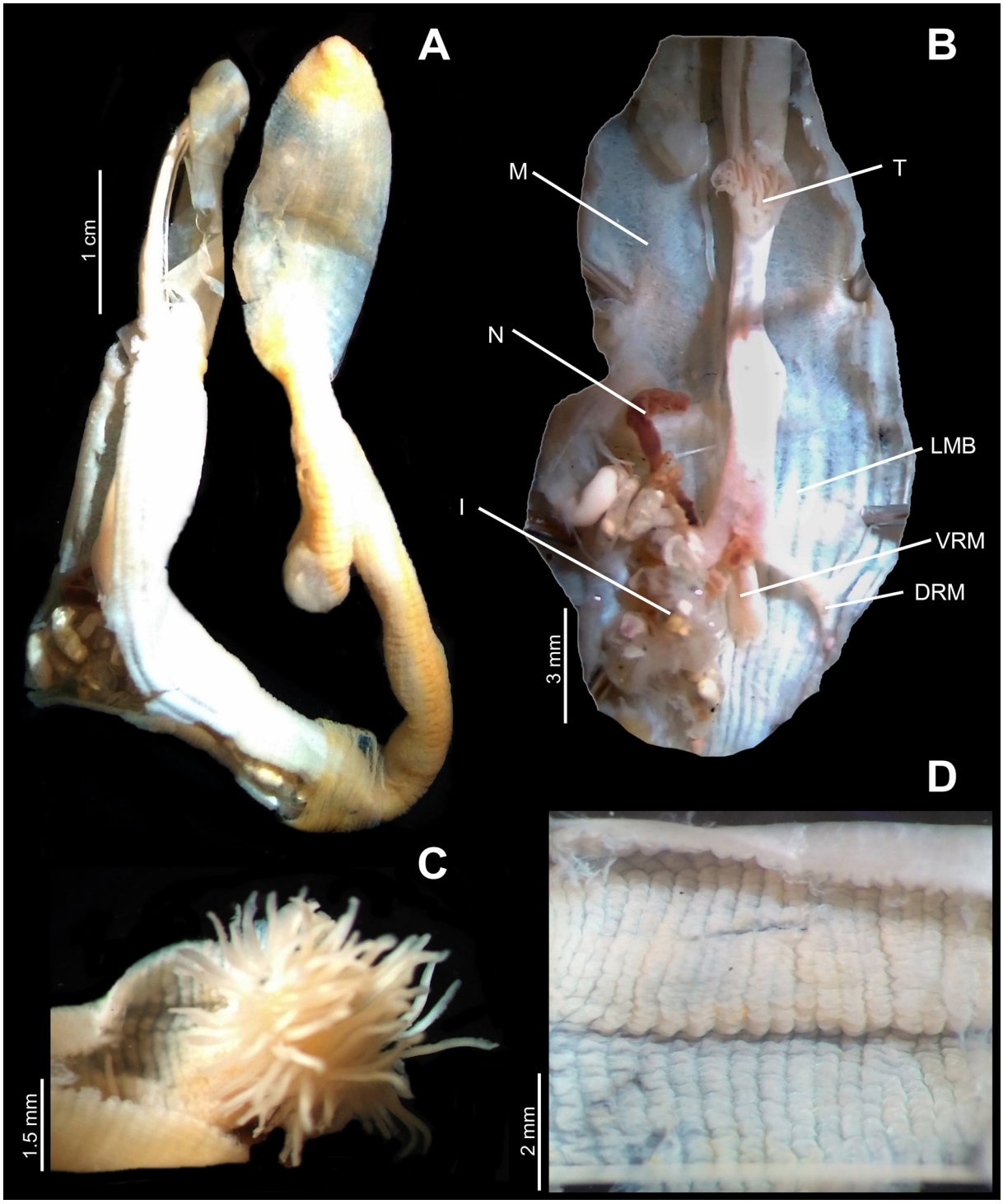

Fig. 3. *Siphonosoma* cf. *cumanense* (Keferstein, 1867) from Oaxaca, Mexico. **A**. External morphology. **B**. Internal morphology. **C**. Peripheral tentacles. **D**. Folds of the body wall. Abbreviations: DRM = dorsal retractor muscles; I = intestine; LMB = longitudinal muscle bands; M = membrane of musculature; N = nephridium; T = tentacles; VRM = ventral retractor muscles.

Description

Trunk 150 mm in length in preserved specimens (Fig. 4A), 300 mm in living specimens. More than 60 filiform tentacles. Introvert with dispersed orange papillae (Fig. 4C) and reddish region with rectangular

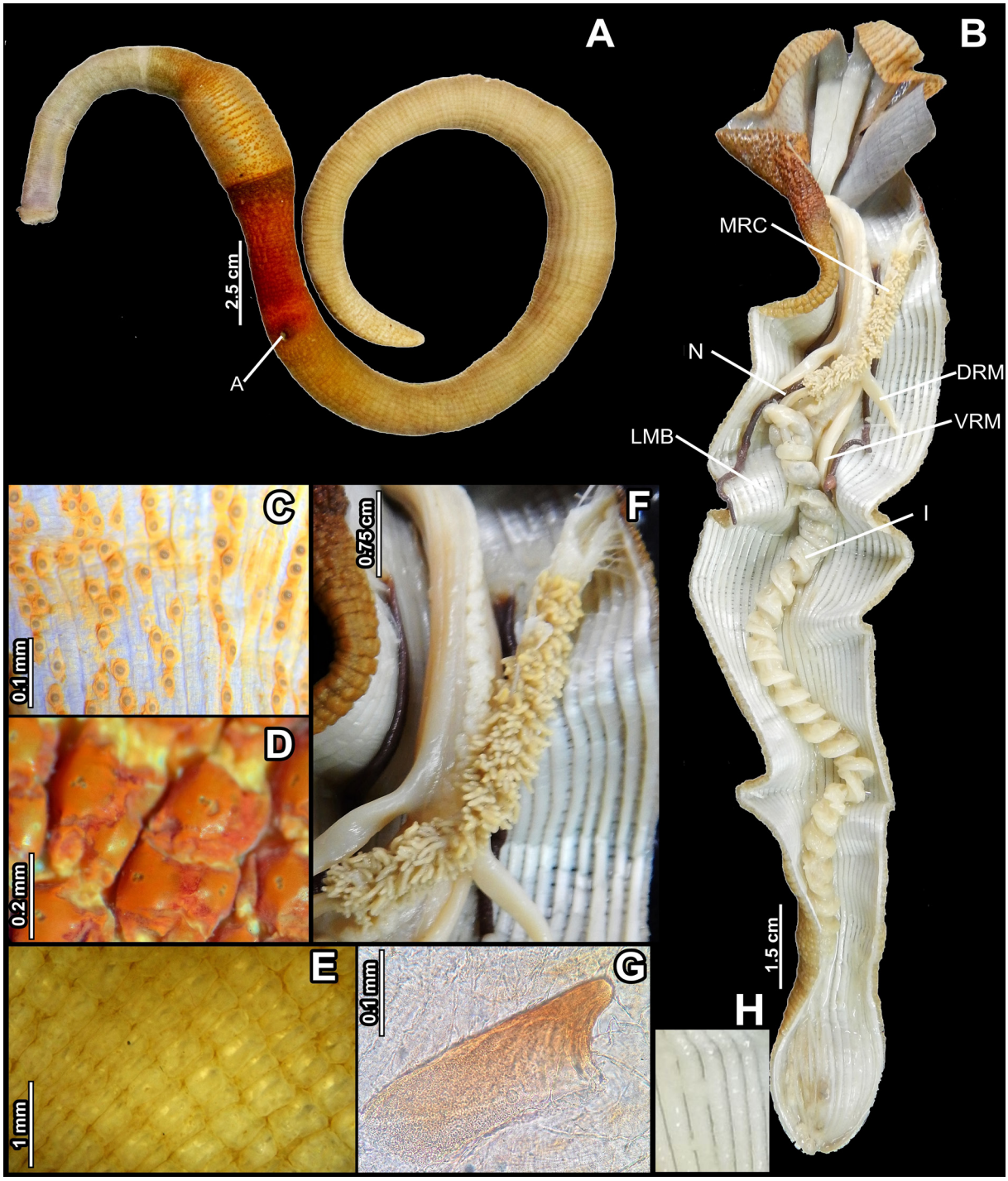

Fig. 4. *Siphonosoma* cf. *vastum* (Selenka & Bülow in Selenka, 1883) from Oaxaca, Mexico. **A**. External morphology. **B**. Internal morphology. **C**. Introvert papillae. **D**. Posterior introvert papillae. **E**. Trunk wall from the median region of the trunk. **F**. Multiple rectal caeca. **G**. Hook. **H**. Longitudinal muscle bands. Abbreviations: A = anus; DRM = dorsal retractor muscles; I = intestine; LMB = longitudinal muscle bands; MRC = multiple rectal caeca; N = nephridium; VRM = ventral retractor muscles.

Table 3. Comparison between the species of *Siphonosoma* Spengel, 1912 from the Pacific Ocean.

	S. australe	***S. vastum***	***S.* cf. *vastum***
Reference	Keferstein (1865)	Selenka *et al*. (1883)	this paper
Type locality	Sydney, Australia	Jaluit, Marshall Islands	Oaxaca, Mexico
Depth	?	?	3 m
Multiple rectal caeca	absent	present in 60% of rectum	present in 90% of rectum
Number of longitudinal muscle bands	15–20	27	26
Trunk length	200 mm	95 mm	200 mm
Live coloration of body	transparent	gray to yellow	light brown to red
Attachment of ventral muscles	?	left 2–5 left 2–6	right 2–6 right 2–5,6
Attachment of dorsal muscles	?	left 9 left 9–10	right 8–9 right 10

papillae (Fig. 4D). Trunk with light brown body wall (Fig. 4E). More than 100 rings of claw-shaped hooks (Fig. 4G). Twenty-six anastomosing longitudinal muscle bands (Fig. 4H). Two long, tiny and dark brown free nephridia occupying 40% of trunk, about 35% attached to body wall. Two pairs of retractor muscles; dorsal pair attached to five bands starting from second band after ventral nerve cord, ventral pair attached to nine bands (Fig. 4B). Multiple rectal caeca covering 90% of rectum (Fig. 4F). Spindle muscle attached posteriorly. Nephridiopore almost at same level of anus.

Remarks

The species is similar to *Siphonosoma australe australe* (Keferstein, 1865), described from Sydney, Australia, and to *S. vastum* (Selenka & Bülow in Selenka, 1883), described from Jaluit, Marshall Islands (Table 3). *Siphonosoma* cf. *vastum* differs from *S. australe australe* in that the former species has multiple rectal caeca in 90% of the rectum, which are absent in the latter. According to Cutler *et al*. (1992), *S. vastum* is able to disperse across the entire Tropical Pacific Ocean. However, the nominal species is different from *S.* cf. *vastum* from Mexico in many diagnostic characters, mainly the coverage of the multiple rectal caeca in the rectum and the attachment of the muscles in the body wall (Table 2). This species is a possibly a new species; however, more specimens are needed to describe it.

Habitat

Subtidal (3 m); in sand.

Distribution

San Agustín Bay, Oaxaca, Mexico.

Family Golfingiidae Stephen & Edmonds, 1972
Genus *Themiste* Gray, 1828
Subgenus *Themiste* (*Themiste*) Gray, 1828

Themiste* (*Themiste*) *hennahi Gray, 1828
Fig. 5

Themiste hennahi Gray, 1828: 8, pl. 6, fig. 4–4a (type locality: Peru).

Dendrostoma zostericola Chamberlin, 1920: 30 (type locality: Laguna Beach, California).
Dendrostomum schmitti Fisher, 1952: 422, fig. 87f (type locality: Independencia Bay, Peru).

Dendrostoma zostericola – Fisher 1952: 411–415, fig. 87a, pl. 30, fig. 1, pls 31–32 (Ensenada, Baja California, Mexico).

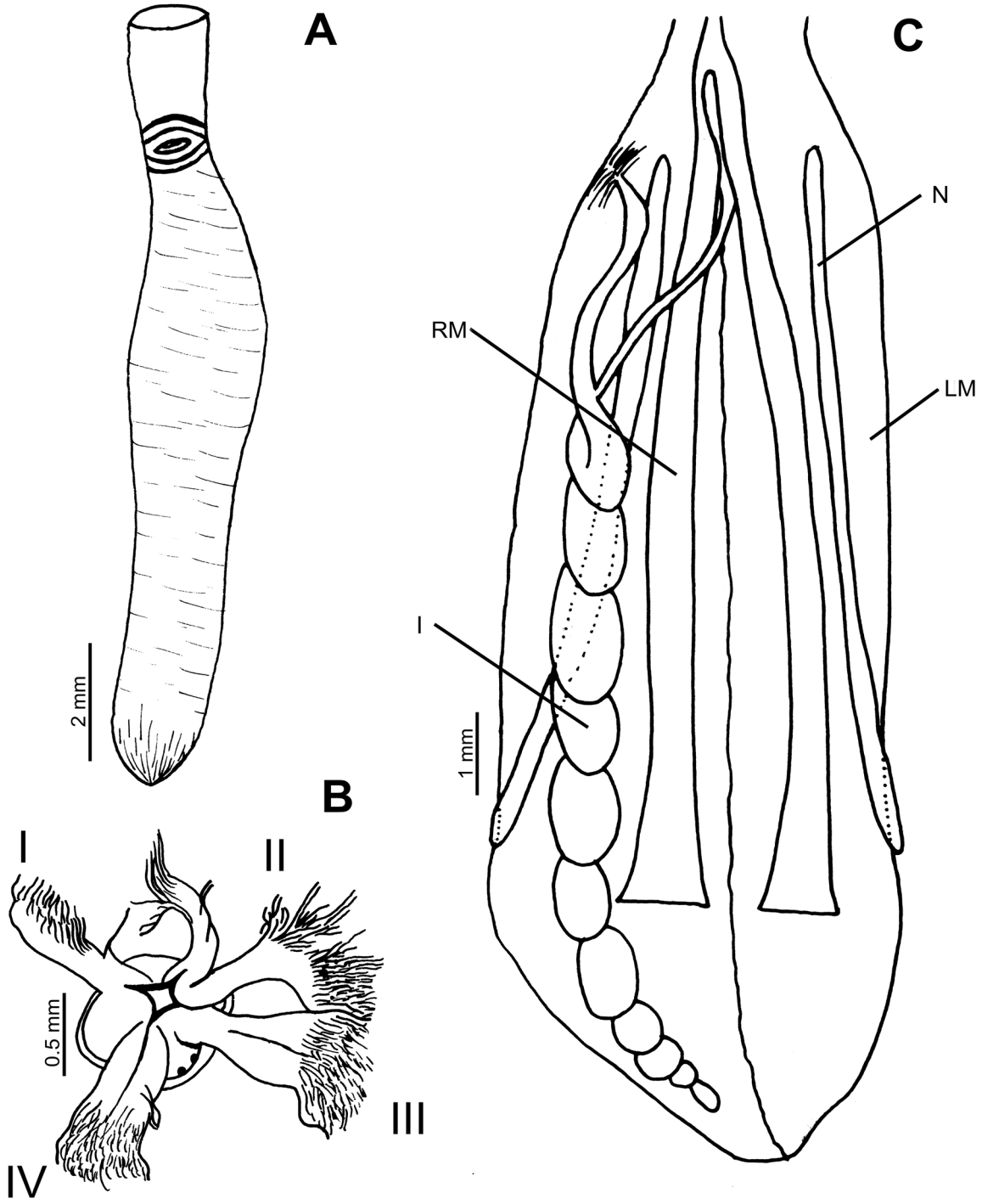

Fig. 5. *Themiste* (*Themiste*) *hennahi* Gray, 1828 from Oaxaca, Mexico. **A**. External morphology. **B**. Tentacular crown. **C**. Internal morphology. Abbreviations: I = intestine; LM = longitudinal muscle; N = nephridium; RM = retractor muscles.

Material examined

MEXICO • 1; Oaxaca, San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 10 Feb. 2007; depth 2 m, in *Porites*; UMAR-SIPU 103.

Description

Specimen damaged. Trunk white in color, 15 mm in length (Fig. 5A). Introvert 5 mm in length, without hooks or pigmented collar. Tentacular crown with four asymmetrical stems, giving appearance of six primary stems (Fig. 5B). Peripheral tentacles with pigment spots. Longitudinal muscle of body wall gathered in uniform continuous layer. Nephridiopores opening at level of anus. A pair of retractor muscles attached to body wall at 75% of trunk length (Fig. 5C). Five tubular extensions, very fragile (not illustrated but observed).

Remarks

The type locality from *Themiste hennahi* is Peru. Unfortunately, Gray (1828) did not specify the locality. The species has also been recorded from Laguna Beach, Southern California, and Ensenada, Baja California (Fisher 1952), under different names (Cutler 1994). We advise the revision of the specimens from the Subtropical Eastern Pacific to confirm the widespread distribution of *T. hennahi*.

Habitat

Subtidal (2 m); in dead coral (*Porites*).

Distribution

Southern California, Baja California and Tropical Eastern Pacific (Oaxaca and Peru).

Family Phascolosomatidae Stephen & Edmonds, 1972
Genus *Phascolosoma* Leuckart, 1828
Subgenus *Phascolosoma* (*Phascolosoma*) Leuckart, 1828

Phascolosoma* (*Phascolosoma*)** cf. ***perlucens Baird, 1868
Fig. 6

Type locality of nominal species

Jamaica (Baird 1868: 90–91, pl. 10, fig. 2–2a).

Material examined

MEXICO – **Guerrero** • 2; La Quebrada; 16°50′44″ N, 99°54′54″ W; 21 Sep. 2001; depth 15–20 m, in *Pinctada mazatlanica* (Hanley, 1856); UMAR-SIPU 036 • 4; Ixtapa Island, Coral Beach; 17°40′37″ N, 101°39′20″ W; 19 Sep. 2007; in dead coral with algae; UMAR-SIPU 037 • 52; Ixtapa Island; 17°40′37″ N, 101°39′20″ W; 24 Sep. 2007; SGM leg.; in pier piles; UMAR-SIPU 038 • 8; Punta Maldonado Beach; 16°19′39″ N, 98°34′15″ W; 23 Sep. 2007; SGM leg.; in algae; UMAR-SIPU 039 • 8; Marquelia, Las Peñitas Beach; 16°33′16″ N, 98°46′21″ W; 22 Sep. 2007; SGM leg.; UMAR-SIPU 040 • 8; Manzanillo Beach; 16°50′31″ N, 99°54′38″ W; 22 Sep. 2007; in pier piles with sponge; SGM leg.; UMAR-041 • 3; Barra de Potosí; 17°32′19″ N, 101°26′36″ W; 3 Dec. 2010; SGG leg.; UMAR-SIPU 042. – **Oaxaca** • 2; La Tijera Beach; 15°41′15″ N, 96°26′33″ W; 24 May 2004; RBR leg.; in rock; UMAR-SIPU 043 • 18; Estacahuite Beach; 15°40′05″ N, 96°28′53″ W; 18 Apr. 2005; SGM leg.; in rocks with carbonate; UMAR-SIPU 044 • 19; La Tijera Beach; 15°41′15″ N, 96°26′33″ W; 30 Apr. 2005; UMAR-SIPU 045 • 12; Estacahuite Beach; 15°40′05″ N, 96°28′53″ W; 10 Sep. 2005; in dead coral; UMAR-SIPU 046 •

2; La Tijera Beach; 15°41′15″ N, 96°26′33″ W; 12 Sep. 2006; depth 4 m, in dead coral; UMAR-SIPU 048 • 3; Chachacual Bay, Jicaral Beach; 15°42′39″ N, 96°12′11″ W; 10 Feb. 2007; depth 5.6 m, in *Porites* sp.; UMAR-SIPU 049 • 2; San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 24 Feb. 2007; UMAR-SIPU 050 • 2; Chacahua; 15°58′07″ N, 97°32′09″ W; 13 Apr. 2007; in rocks; UMAR-SIPU 052 • 45; Chacahua; 15°58′07″ N, 97°32′09″ W; 14 Apr. 2007; SGM leg.; in artificial monticule; UMAR-SIPU 053 • 3; Huatulco, Conejos Bay; 15°46′44″ N, 96°03′51″ W; 5 May 2007; in algae; UMAR-SIPU 054 • 1; Zipolite, Playa del Amor; 15°39′37″ N, 96°30′38″ W; 13 Apr. 2007; UMAR-SIPU 055 • 1; Chacahua; 15°58′07″ N, 97°32′09″ W; 10 Nov. 2007, PHM and RBZ leg.; UMAR-SIPU 056 • 1; Huatulco, Santa Cruz Beach; 15°45′10″ N, 96°07′49″ W; 14 Dec. 2007; BMD and PHM leg.; depth 0.5 m, in pier piles; UMAR-SIPU 057 • 4; Panteón Beach; 15°39′50″ N, 96°29′42″ W; 16 Apr. 2008; JDG and GGG leg.; depth 3 m, in dead coral; UMAR-SIPU 058 • 1; La Montosa Island; 15°45′57″ N, 96°05′03″ W; 22 Feb. 2010; RGF and SGG leg.; depth 3.6 m, in *Pocillopora damicornis* (Linnaeus, 1758); UMAR-SIPU 059 • 36; Puerto Ángel Bay; 15°39′56″ N, 96°29′29″ W; 10 Jun. 2011; RBR leg.; depth 0.5 m, in pier piles; UMAR-SIPU 060 • 4; Agua Blanca Beach; 15°43′58″ N, 96°48′38″ W; 27 Apr. 2012; KLT leg.; UMAR-SIPU 061 • 9; Puerto Ángel Bay; 15°39′56″ N, 96°29′29″ W; 28 May 2014; ISM and JGV leg.; in pier piles; UMAR-SIPU 062 • 4; Puerto Ángel Bay; 15°39′56″ N, 96°29′29″ W; 8 Jun. 2014; ISM and JGV leg.; in pier piles; UMAR-SIPU 063 • 3; Chacahua, Cerro Hermoso Beach; 15°58′08″ N, 97°32′06″ W; 30 Apr. 2014; in mangrove root; UMAR-SIPU 064 • 5; Agua Blanca Beach; 15°43′58″ N, 96°48′38″ W; 30 Apr. 2014; UMAR-SIPU 065 • 8; Boquilla Beach; 15°40′58″ N, 96°27′54″ W; 22 May 2014; UMAR-SIPU 066 • 1; Huatulco, Santa Cruz Beach; 15°45′10″ N, 96°07′49″ W; 16 Dec. 2016; JGV leg.; in sand, UMAR-SIPU 067 • 3; Violín Beach; 15°44′24″ N, 96°07′38″ W; 1 Dec. 2016; JGV leg.; UMAR-SIPU 068 • 22; San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 2 Dec. 2016; JGV leg.; UMAR-SIPU 069 • 1; La Montosa Island; 15°45′57″ N, 96°05′03″ W; 22 Feb. 2010; SGM leg.; depth 4.6 m, in *Porites* sp.; UMAR-SIPU 070. – **Chiapas** • 19; Puerto Chiapas; 14°42′11″ N, 92°24′36″ W; 20 Sep. 2011; RBZ leg.; in pier piles, in rock with oyster; UMAR-SIPU 051.

Description

Trunk 3–18 mm in length. Introvert as long as trunk (Fig. 6A), with patches of dark brown pigment in dorsal part. Reddish conical papillae on dorsal base of introvert, posterior to anus (Fig. 6E–F). Introvert bears 15 rings of hooks (Fig. 6D). Hooks with secondary tooth and basal triangle (Fig. 6C). Fourteen digitiform tentacles encircling nuchal organ (Fig. 6D). Longitudinal muscles of body wall combined into bands. Four retractor muscles. Two brown nephridia occupy 30% of trunk (Fig. 6B). Spindle muscle attached posteriorly.

Remarks

Although there are no morphological characters to support that the populations of *Phascolosoma perlucens* from the Caribbean and the Eastern Pacific are different species, the molecular data provides strong evidence of a differentiation between both populations (Kawauchi & Giribet 2010); therefore, we propose to consider this species as being near to the nominal species. It is possible that the specimens recorded here and other records from the Tropical Eastern Pacific (Fisher 1952; Dean 2001; Dean *et al*. 2010) are a new species.

Habitat

Intertidal and subtidal (20 m); as epibionts of *Pinctada mazatlantica*, in dead coral, between the fouling of pier piles, in macroalgae, in a sabellariid reef, in mangrove roots and in sand.

Distribution

Southern Mexican Pacific, from Ixtapa, Guerrero to Puerto Chiapas.

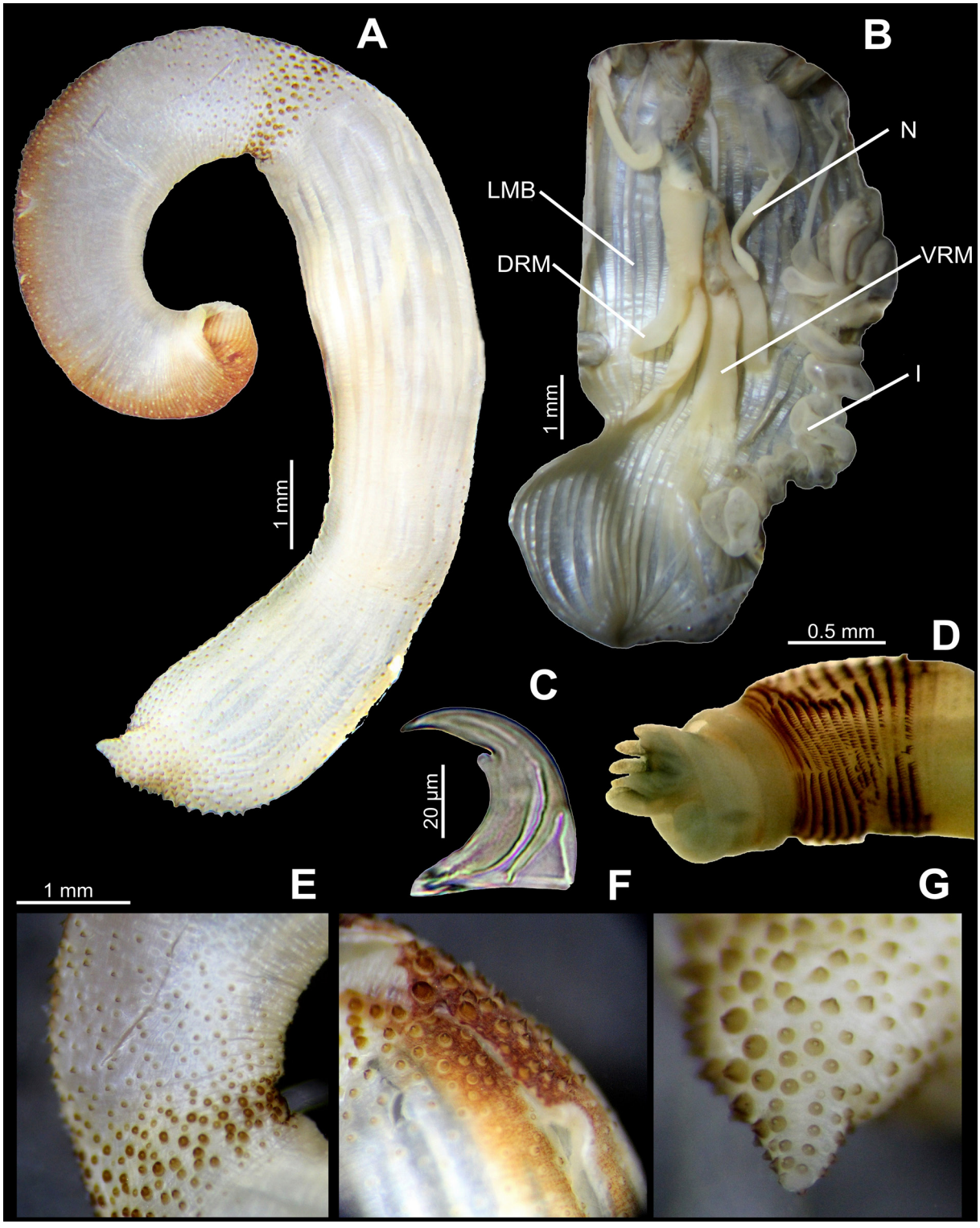

Fig. 6. *Phascolosoma* cf. *perlucens* Baird, 1868 from the Southern Mexican Pacific. **A**. External morphology. **B**. Internal morphology. **C**. Hook. **D**. Tentacles and rings of hooks. **E**. Preanal papillae, lateral view. **F**. Preanal papillae, dorsal view. **G**. Caudal papillae. Abbreviations: DRM = dorsal retractor muscles; I = intestine; LMB = longitudinal muscle bands; N = nephridium; VRM = ventral retractor muscles.

Phascolosoma* (*Phascolosoma*) *puntarenae (Grube & Örsted in Grube, 1858), reinstatement
Fig. 7

Phascolosoma puntarenae Grube & Örsted in Grube, 1858: 13 (type locality: Puntarenas, Costa Rica).

Phascolosoma puntarenae – Fisher 1952: 430–432, pl. 36, figs 1–2, pl. 37, figs 1–3, pl. 39, fig. 3 (from Gulf of California to Panama, in rocks).

Phascolosoma puntarena – Brusca 1980: 127 (Gulf of California, in rocks).

Phascolosoma nigrescens (non Keferstein, 1865) – Cutler *et al*. 1992: 154–156 (Costa Rica, in tidal pools and under rocks). — Dean 2001: 63 (Pacific of Costa Rica). — Dean *et al*. 2010: 63 (Cocos Island, Costa Rica, in calcareous rock, 0–15 m).

Material examined

MEXICO – **Guerrero** • 1; Roqueta Island; 16°49′19″ N, 99°54′17″ W; 21 Sep. 2006; in sabellariid tubes; UMAR-SIPU 021 • 1; La Quebrada; 16°50′44″ N, 99°54′54″ W; 26 Sep. 2007; depth 15 m, in *Pinctada mazatlantica*; SGM leg.; UMAR-SIPU 022 • 3; Barra de Potosí; 17°32′19″ N, 101°26′36″ W; 3 Dec. 2010; SGG leg.; UMAR-SIPU 023. – **Oaxaca** • 1; Puerto Escondido; 15°51′34″ N, 97°03′50″ W; 4 Jul. 2004; SS leg.; UMAR-SIPU 0242 • Estacahuite Beach; 15°40′05″N, 96°28′53″W; 10 Sep. 2005; in dead coral; UMAR-SIPU 025 • 1; Chachacual Bay, Jicaral Beach; 15°42′39″ N, 96°12′11″ W; 14 Dec. 2006; TRC leg.; depth 1 m, in dead coral; UMAR-SIPU 026 • 1; San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 10 Feb. 2007; depth 15.3 m, in *Porites*; UMAR-SIPU 027• 3; Puerto Ángel Bay; 15°39′56″ N, 96°29′29″ W; 28 Apr. 2008; TFG leg.; in dead coral; UMAR-SIPU 028 • 1; Panteón Beach; 15°39′50″ N, 96°29′42″ W; 27 May 2008; MLY leg.; depth 3 m; UMAR-SIPU 030 • 1; La Montosa Island; 15°45′57″ N, 96°05′03″ W; 22 Feb. 2010; RGF and SGG leg.; depth 3.5 m; UMAR-SIPU 031 • 3; Camarón Beach; 15°39′45″ N, 96°31′33″ W; 6 Apr. 2013; in dead coral; UMAR-SIPU 032 • 3; Cerro Hermoso Beach; 15°58′08″ N, 97°32′06″ W; 29 Apr. 2014; UMAR-SIPU 033.

Description

Trunk 10 mm in length (Fig. 7A). Light brown trunk with uniform dome-shaped papillae, some with black pigment randomly distributed (Fig. 7D–E). Introvert with bands of dark pigmentation and more than 100 complete and incomplete rings of hooks. Hooks with clear streak expanded near midpoint of vertical and middle of horizontal portions (Fig. 7F–G). Secondary tooth almost indistinct, protuberance of streak short. Fourteen tentacles encircling nuchal organ (Fig. 7C). Longitudinal muscles of body wall gathered into anastomosing bands. Four retractor muscles. Nephridia about 40% of trunk length, open at same level as anus (Fig. 7B). Spindle muscle attached posteriorly.

Remarks

Cutler & Cutler (1990) considered *Phascolosoma* (*P.*) *puntarenae* from Puntarenas, Costa Rica, as a synonym of *P.* (*P.*) *nigrescens* from Fiji. Nevertheless, we found a difference between the hooks of the type material of *P. nigrescens* illustrated by Selenka (1883) and those in the illustrations of Fisher (1952) of *P. puntarenae* from Baja California, Costa Rica and Panama. The hooks of *P. nigrescens* have a conspicuous secondary tooth and the protuberance of the streak is a sharp point, whereas the hooks of *P. puntarenae* do not have a well-developed secondary tooth and the protuberance of the streak is a flattened point (Fig. 8F–G).

Habitat

Intertidal to subtidal (15 m); in sabellariid tubes, as epibionts of *Pinctada mazatlanica*, in dead coral and in *Porites*.

Distribution

From the Gulf of California to Panama.

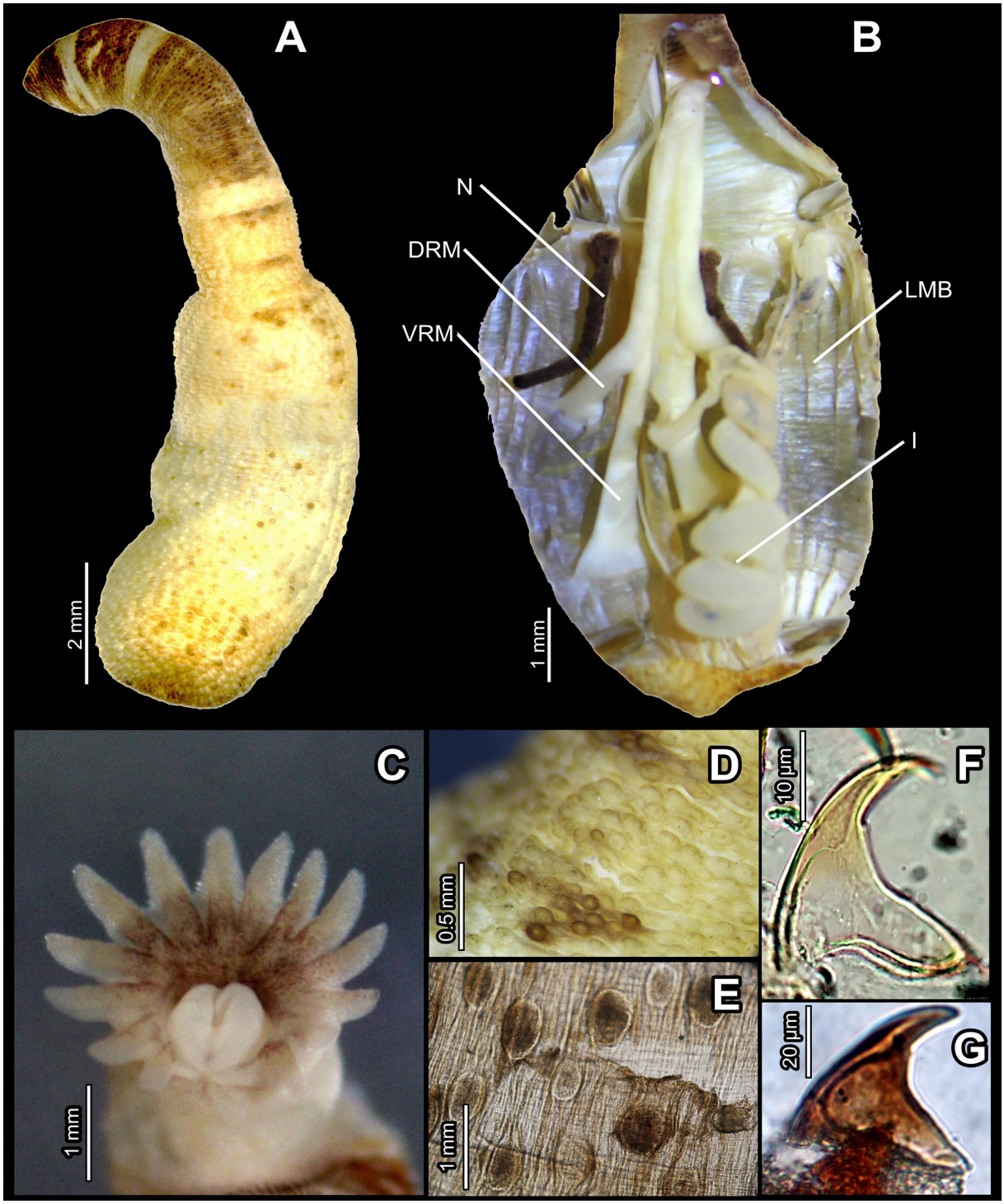

Fig. 7. *Phascolosoma* (*Phascolosoma*) *puntarenae* Grube & Örsted in Grube, 1858 from the Southern Mexican Pacific. **A**. External morphology. **B**. Internal morphology. **C**. Nuchal tentacles. **D**. Trunk papillae, macroscopic view. **E**. Trunk papillae, microscopic view. **F**. Hook of proximal rings. **G**. Hook of distal rings. Abbreviations: DRM = dorsal retractor muscles; I = intestine; LMB = longitudinal muscle bands; N = nephridium; VRM = ventral retractor muscles.

Genus *Apionsoma* Sluiter, 1902
Subgenus *Apionsoma* (*Apionsoma*) Sluiter, 1902

Apionsoma* (*Apionsoma*) *hespera (Chamberlin, 1920) comb. nov., reinstatement
Figs 8A–C, 9

Phascolosoma hespera Chamberlin, 1920: 31 (type locality: Balboa, Newport Bay, Orange County, California).

Golfingia hespera – Fisher 1952: 393–395, pl. 24, figs 1–5 (San Lucas Cove, southern Santa Rosalía, Gulf of California, commensals in *Cerianthus* Delle Chiaje, 1841 tubes; Balboa, Newport Bay, Orange County, California).

Golfingia (*Mitosiphon*) *hespera* – Amor 1975: 115–116, pl. 2, figs a–d (Ancón, Peru in *Phragmatopoma* Mörch, 1863 and *Perumytilus* Olsson, 1961, in rocks).

Material examined

MEXICO – **Oaxaca** • 1; Chacahua; 15°58′07″ N, 97°32′09″ W; 4 Apr. 4, 2007; artificial monticule, in rocks; UMAR-SIPU 101 • 3; Panteón Beach; 15°39′50″ N, 96°29′42″ W; 24 Apr. 2012; NVHH leg.; UMAR-SIPU 102.

Description

Trunk 8 mm in length, spindle-shaped (Fig. 9A). Introvert seven times trunk length. Posterior end of trunk with numerous distinctive papillae (Fig. 9C–D). More than 40 rings of hooks, with 7–8 basal spinelets. Spinelets longer than principal tooth (Fig. 9E). Body wall with continuous muscle layers. Four retractor muscles equidistant from ventral nerve cord near middle of trunk. Nephridia bilobed, with

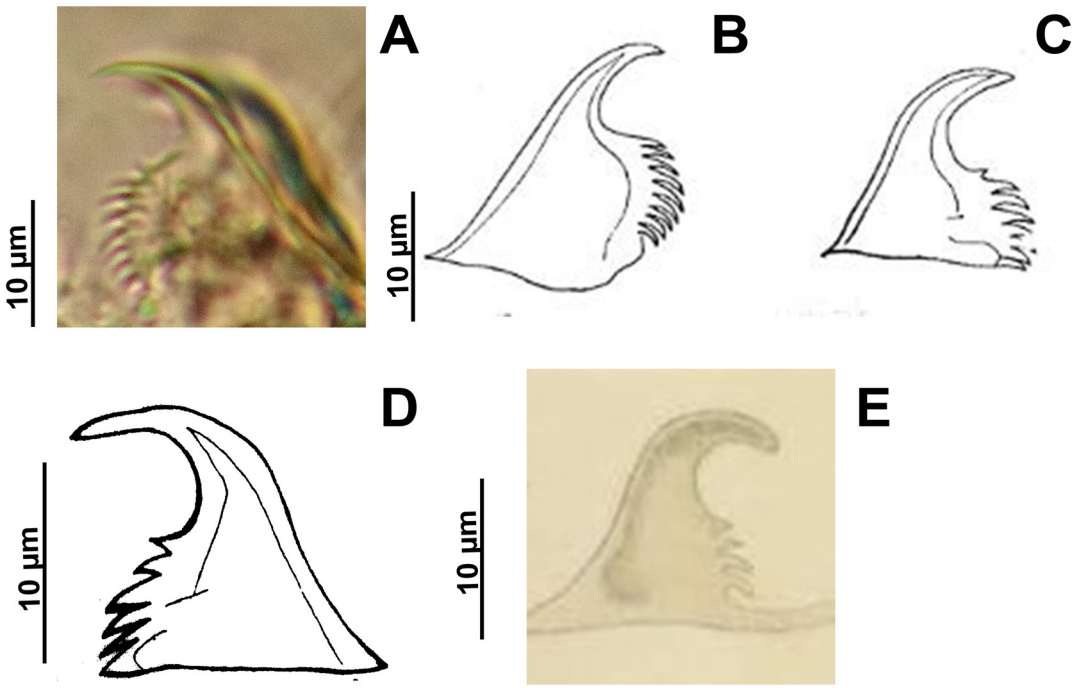

Fig. 8. – **A–C**. Hooks of *Apionsoma* (*Apionsoma*) *hespera* (Chamberlin, 1920) comb. nov. **A**. From Oaxaca, Mexico. **B–C**. From Peru. – **D–E**. Hooks of *Apionsoma misakianum* (Ikeda, 1904). **D**. From Misaki, Japan. **E**. From Japan. B–C: from Amor (1975); D: from Ikeda (1904); E: from Cutler *et al*. (1984).

unequal lobules occupying almost 90% of trunk length (Fig. 9B). Spindle muscle attached to body wall posteriorly.

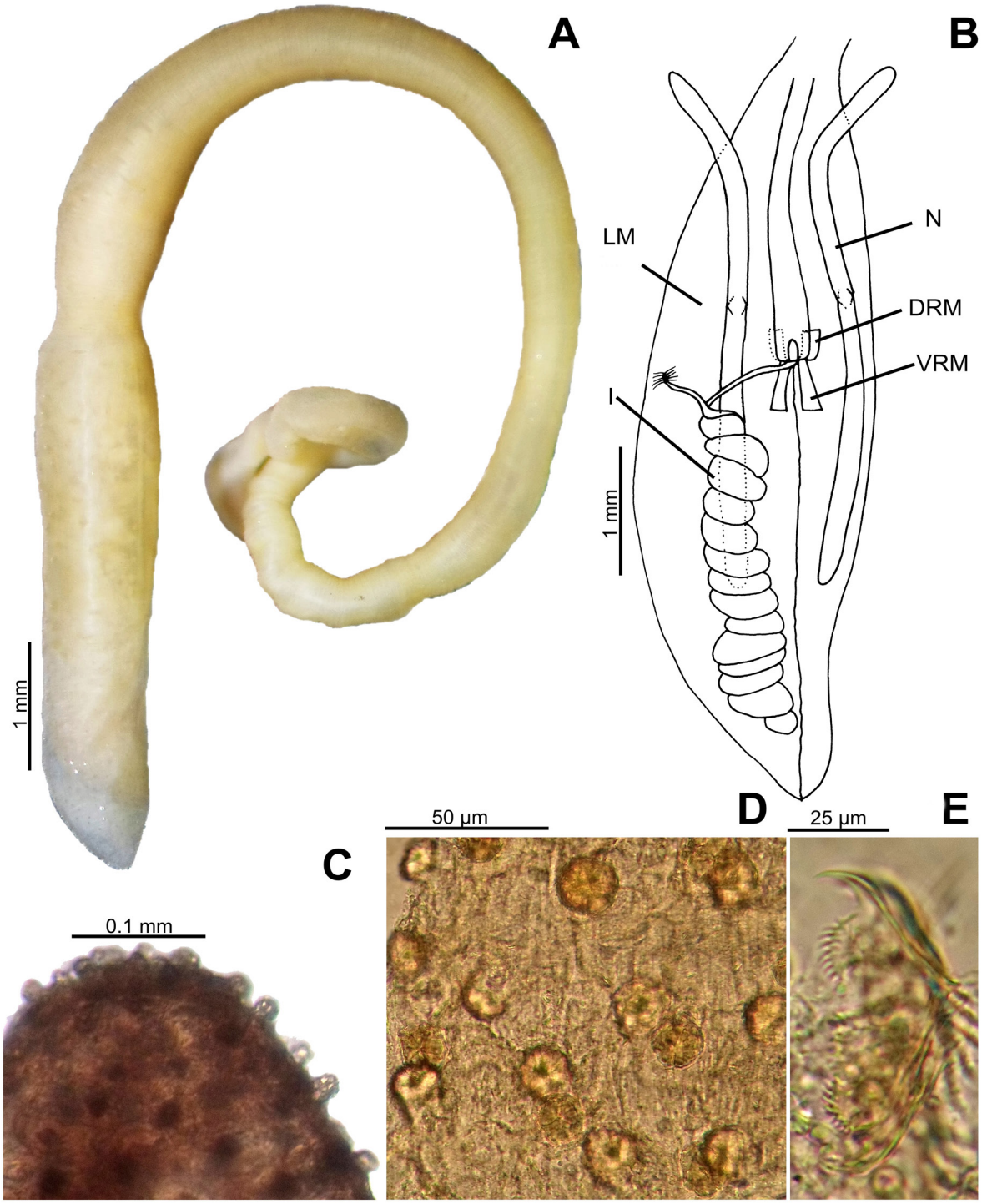

Fig. 9. *Apionsoma* (*Apionsoma*) *hespera* (Chamberlin, 1920) comb. nov. from the Southern Mexican Pacific. **A**. External morphology. **B**. Internal morphology. **C**. Caudal papillae. **D**. Caudal papillae, amplified view. **E**. Hooks. Abbreviations: DRM = dorsal retractor muscles; I = intestine; LM = longitudinal muscle; N = nephridium; VRM = ventral retractor muscles.

Table 4. Comparison between the species of *Apionsoma* Sluiter, 1902.

	Phascolosoma hespera	***Apionsoma* (*A.*) *misakianum***	***Apionsoma* (*A.*) *hespera* comb. nov.**
Reference	Chamberlin (1920)	Ikeda (1904)	this paper
Locality	Laguna Beach, California, USA	Misaki, Japan	Panteón Beach, Oaxaca, Mexico
Number of rings of hooks	30–50	60	40
Basal spinelets	**7**	4–5	7–8
Proportion between distance of dorsal to ventral muscle with respect to the trunk	10%	21%	10%
Nephridia extent	100% of trunk	< 50% of trunk	80% of trunk
Longitude of basal spinelets	longer than principal tooth	shorter than principal tooth	longer than principal tooth

Remarks

We reinstate the name *Phascolosoma hespera* in the correct genus as the new combination *Apionsoma* (*Apionsoma*) *hespera.* The most similar species to *A.* (*A.*) *hespera* comb. nov. is *A.* (*A.*) *misakianum* (Ikeda, 1904) from Misaki, Japan (Table 4). Fisher (1952) illustrated type material and he showed the morphological and ecological differences between the two species. Cutler (1979) considered *Phascolosoma hespera* Chamberlin, 1920 and *Golfingia hespera* sensu Fisher 1952 as synonyms of *A.* (*A.*) *misakianum*, but we believe that the morphological features are enough to consider *P. hespera* as a valid name with a distribution in the TEP. We compared the illustrations of the hooks of *A.* (*A.*) *misakinaum*, from Misaki (Ikeda 1904; Fig. 8D) and other localities of Japan (Cutler *et al*. 1984: 300–301; Fig. 8E), with the hooks of the specimens revised in this study (Fig. 8A) and those of specimens recorded from Peru as *Golfingia* (*Mitosiphon*) *hespera* (Amor 1975; Fig. 8B–C). Staton & Rice (1999) stated that there is strong reproductive isolation between the northern and southern populations of the *A. misakianum* species complex, another argument to consider that *A. hespera* is a valid species and likely could be part of this species complex.

Habitat

Intertidal, in *Cerianthus* tubes, in rocks with *Phragmatopoma* and *Perumytilus*.

Distribution

Laguna Beach, California; Tropical Eastern Pacific from Baja California Sur to Oaxaca; Ancón, Peru.

Subgenus *Apionsoma* (*Edmondsius*) Gibbs & Cutler, 1987

Apionsoma* (*Edmondsius*) *pectinatum (Keferstein, 1867)
Fig. 10

Phascolosoma pectinatum Keferstein, 1867: 47–48 (type locality: Pacific of Panama).
Siphonides rickettsi Fisher, 1952: 386–388, pl. 22 (type locality: near La Paz, Baja California, Mexico, under boulders).

Phascolosoma (*Satonus*) *pectinatum* – E. Cutler 1977: 150 (from Gulf of Panama, Panama).

Material examined

MEXICO • 21; Oaxaca, Zipolite; 15°39′37″ N, 96°30′38″ W; 16 Nov. 2016; FRE leg.; depth 2 m, in dead coral; UMAR-SIPU 011 • 8; Huatulco, San Agustín Bay; 15°41′21″ N, 96°14′11″ W; 17 Nov. 2016; JGV leg.; depth 2 m, in dead coral; UMAR-SIPU 012.

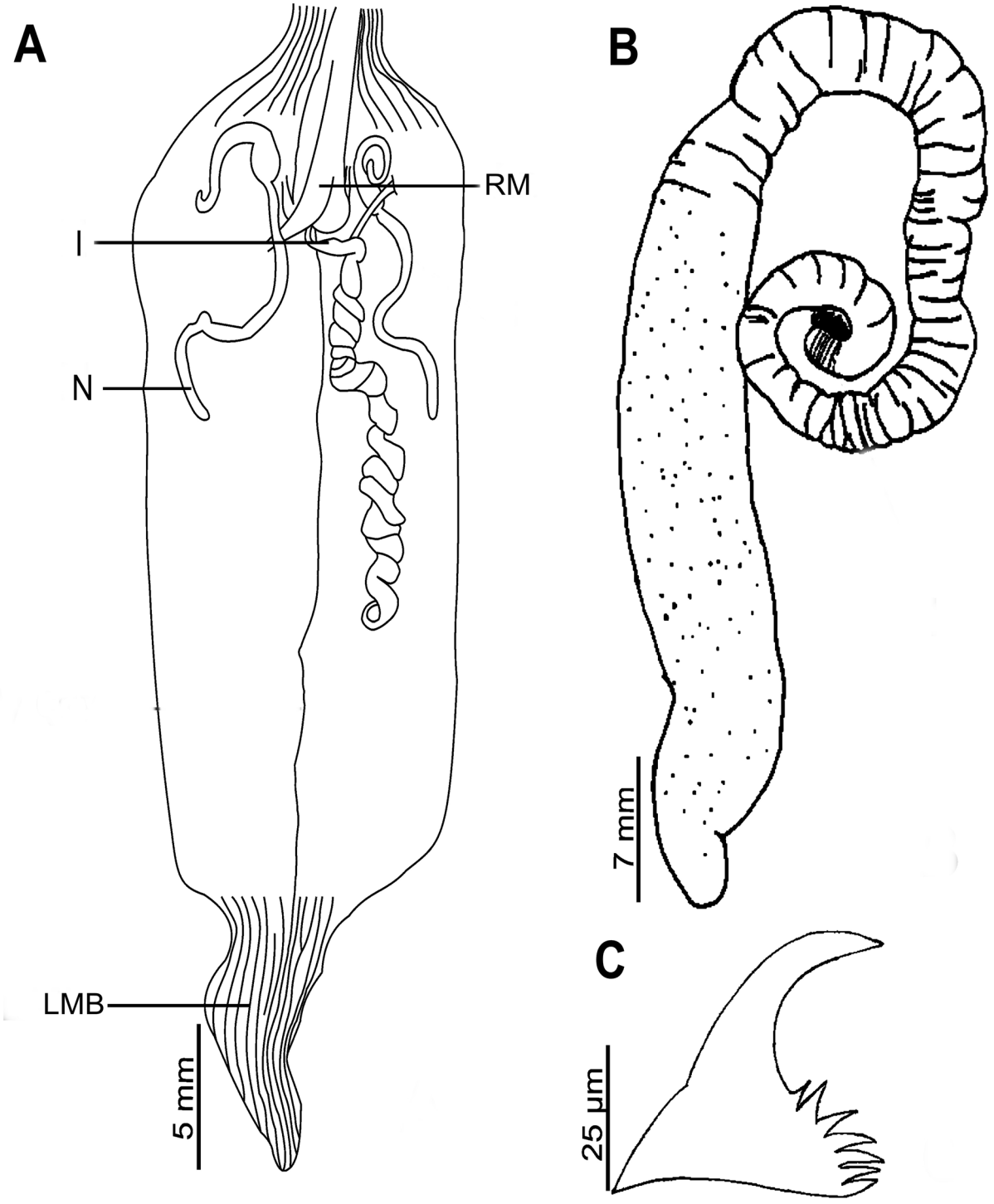

Fig. 10. *Apionsoma* (*Edmondsius*) *pectinatum* (Keferstein, 1867) from the Southern Mexican Pacific. **A**. Internal morphology. **B**. External morphology. **C**. Hook. Abbreviations: I = intestine; LMB = longitudinal muscle bands; N = nephridium; RM = retractor muscles.

Description

Trunk 20 mm in length (Fig. 10A). Trunk light yellowish to dark brown in color, with dome-shaped papillae around trunk and base of introvert, scattered on body. Body wall wrinkled, giving a rough appearance (Fig. 10B). Introvert 2–4 times as long as trunk. Tentacles digitiform, encircling nuchal organ. Thirty rings of hooks in anterior region of introvert, with seven basal spinelets (Fig. 10C). Two pairs of retractor muscles. A pair of bilobed nephridia. Longitudinal bands of body wall show slight anastomosis. Nephridia with 40% of trunk length. Spindle muscle not attached to posterior end of trunk (Fig. 10A).

Remarks

With only a few records at the time, Cutler (1994) concluded that the distribution of *Apionsoma* (*Edmondsius*) *pectinatum* in the Eastern Pacific went from Baja California to Panama, so its distribution in the rest of TEP could only be inferred. This new record from the Southern Mexican Pacific breaks the disjunctive distribution in the Tropical Eastern Pacific for this species.

Habitat

Subtidal (2 m); in dead coral.

Distribution

Tropical Eastern Pacific, from Baja California Sur, Mexico to Gulf of Panama.

Family Aspidosiphonidae Baird, 1868
Genus *Aspidosiphon* Diesing, 1851
Subgenus *Aspidosiphon* (*Aspidosiphon*) Diesing, 1851

Aspidosiphon* (*Aspidosiphon*) *elegans (Chamisso & Eysenhardt, 1821)
Fig. 11

Sternaspis elegans Chamisso & Eysenhardt, 1821: 351–352, pl. 24, fig. 5a–e (type locality: Radack, Marshall Islands).

Material examined

MEXICO – **Guerrero** • 14; Ixtapa Island, Coral Beach; 17°40′37″ N, 101°39′20″ W; 19 Sep. 2007; SGM leg.; in algae; UMAR-SIPU 073. – **Oaxaca** • 8; La Tijera Beach; 15°41′15″ N, 96°26′33″ W; 30 Apr. 2005; UMAR-SIPU 074 • 1; same locality as for preceding but 12 Sep. 2006; UMAR-SIPU 078 • 3; Estacahuite Beach; 15°40′05″ N, 96°28′53″ W; 10 Sep. 2005; in dead coral; UMAR-SIPU 075 • 2; same locality as for preceding but 20 Sep. 2005; in dead coral; UMAR-SIPU 076 • 5; same locality as for preceding but 15 Aug. 2006; depth 4 m, in dead coral; UMAR-SIPU 077 • 2; Chachacual Bay, Jicaral Beach; 15°42′39″ N, 96°12′11″ W; 10 Feb. 2007; depth 6.1 m, in *Porites* sp.; UMAR-SIPU 079 • 5; Panteón Beach; 15°39′50″ N, 96°29′42″ W; 16 Apr. 2008; JDG and GGG leg.; depth 3 m, in dead coral; UMAR-SIPU 080 • 1; Puerto Ángel Bay; 15°39′56″ N, 96°29′29″ W; 16 Apr. 2008; depth 3 m; UMAR-SIPU-081.

Comparative material

MEXICO – **Quintana Roo** • 1; Xahuayxol; 26 Sep. 1996; ECOSUR-S0121 • 1; Contoy Island, Punta Sur; 2 Mar. 2001; in dead coral; ECOSUR-S0124 • 1; Mahahual; 22 Mar. 2000; in dead coral; ECOSUR-S0128 • 3; Nizuc; 30 Aug. 1999; depth 2.2 m, in rock with *Dyctiota*; ECOSUR-S0129.

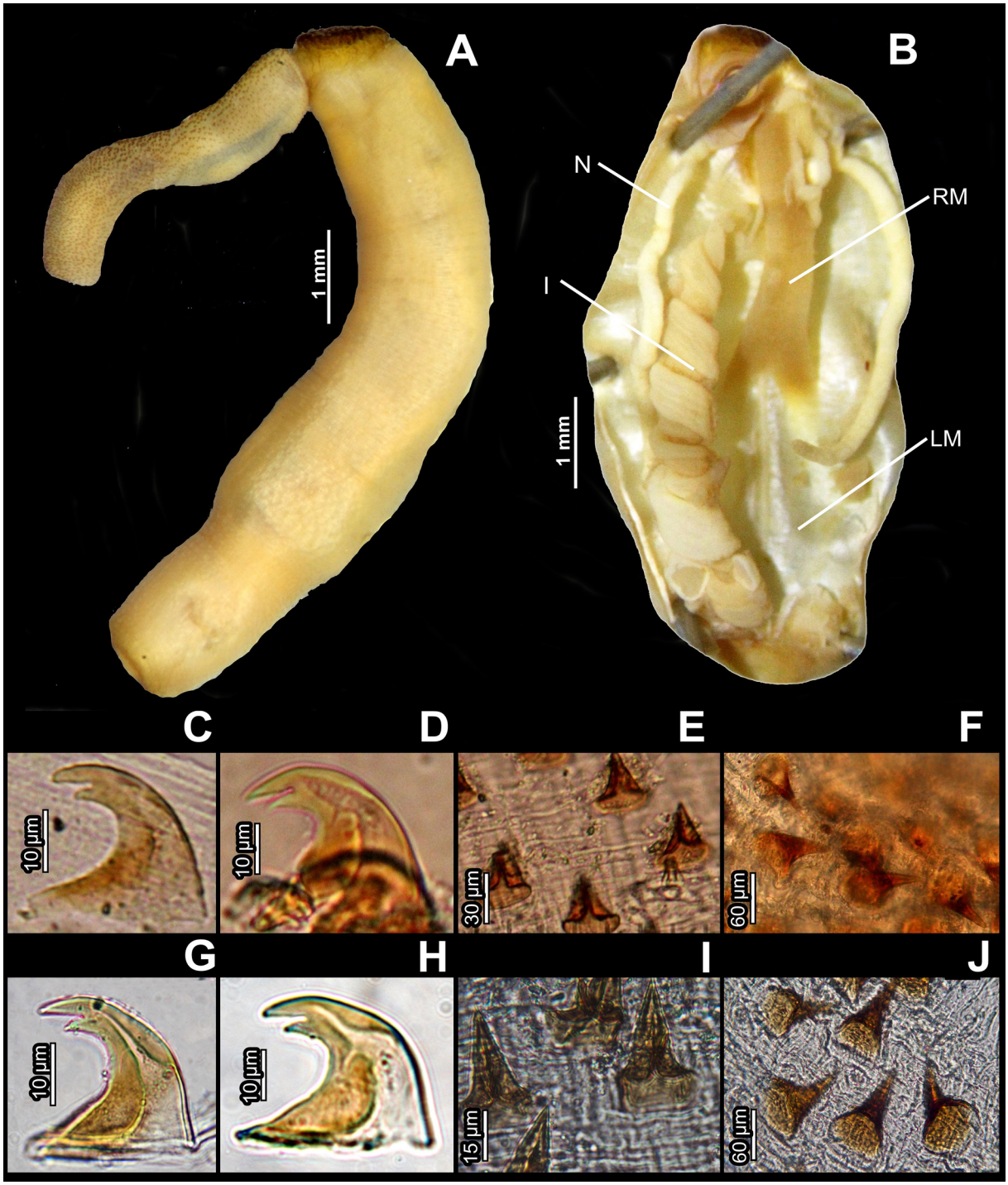

Fig. 11. *Aspidosiphon* (*Aspidosiphon*) *elegans* (Chamisso & Eysenhardt, 1821). **A–F**. From the Southern Mexican Pacific. **A**. External morphology. **B**. Internal morphology. **C**. Bidentate hooks of proximal rings. **D**. Bidentate hooks of distal rings. **E**. Anterior conical hooks. **F**. Posterior conical hooks. **G–J**. From the Mexican Caribbean. **G**. Bidentate hooks of proximal rings. **H**. Bidentate hooks of distal rings. **I**. Anterior conical hooks. **J**. Posterior conical hooks. Abbreviations: I = intestine; LM = longitudinal muscle; N = nephridium; RM = retractor muscles.

Description

Trunk 8 mm in length, white (Fig. 11A). Introvert three times the trunk length. Anal shield without grooves, caudal shield absent. Fourteen rings of bidentate compressed hooks (Fig. 11C–D) followed by scattered unidentate, dark, conical hooks (Fig. 11E–F). Longitudinal muscle of body wall in uniform continuous layer. A pair of retractor muscles originate at about 50% of trunk length. A pair of nephridia, unilobed, at 60% of trunk length. Spindle muscle attached posteriorly (Fig. 11B).

Remarks

The original description by Chamisso & Eysenhardt (1821) did not include a description of the hooks; thus, we cannot compare our specimens with the original description. Nevertheless, a revision is necessary because it is likely that the population of the Marshall Islands is different from the one of the SMP. This species has been recorded from Cocos Island, Costa Rica (Dean *et al*. 2010). We did not find differences between the species in the SMP and the Mexican Caribbean (Fig. 11G–J).

Habitat

Intertidal to subtidal (4 m); in algae and dead coral (*Porites*).

Distribution

Widespread and common in the Indian and western Pacific Oceans, from south-central Japan to northern Australia to Hawaii, the Red Sea, and Israel. In the Caribbean from northern Brazil to the Florida Keys and Bermuda (Cutler 1994). In the Eastern Pacific from the South Mexican Pacific to Costa Rica (Fonseca & Cortés 1998; Dean *et al*. 2010).

Subgenus *Aspidosiphon* (*Paraspidosiphon*) Stephen, 1965

Aspidosiphon* (*Paraspidosiphon*) *cutleri sp. nov.
urn:lsid:zoobank.org:act:48C0AFB4-02DD-4164-9223-BDA2CC1D0A43
Fig. 12

Etymology

In memory of Edward Cutler, expert in sipunculans and the principal source of inspiration for this work.

Material examined

Holotype

MEXICO • Oaxaca, Camarón Beach; 15°39′45″ N, 96°31′33″ W; 6 Apr. 2013; in dead coral; RXP and VAR leg.; UMAR-SIPU 082.

Paratypes

MEXICO • 1; same locality as for holotype; 16 Nov. 2016; JGV leg.; depth 2 m, in rocks, UMAR-SIPU 083 • 1; Oaxaca, San Agustin Bay; 15°41′21.1″ N, 96°14′11.1″ W; 18 Mar. 2018; depth 2 m, in rocks; UMAR-SIPU 107.

Description

Trunk 30 mm in length, white (Fig. 12A). Anal and caudal shield brown. Sixteen longitudinal grooves in anal shield. Caudal shield also with grooves (Fig. 12C–D). Units of anal region distributed in longitudinal lines (Fig. 12E). More than 100 rings of unidentate proximal hooks, smaller than distal hooks (Fig. 12F) followed by scattered pyramidal hooks. Longitudinal muscles of body wall gathered into anastomosing bands. A pair of retractor muscles, fused for most of their length. Nephridia unilobed, occupying 50% of the trunk. Spindle muscle bifurcated near its anterior end (Fig. 12B).

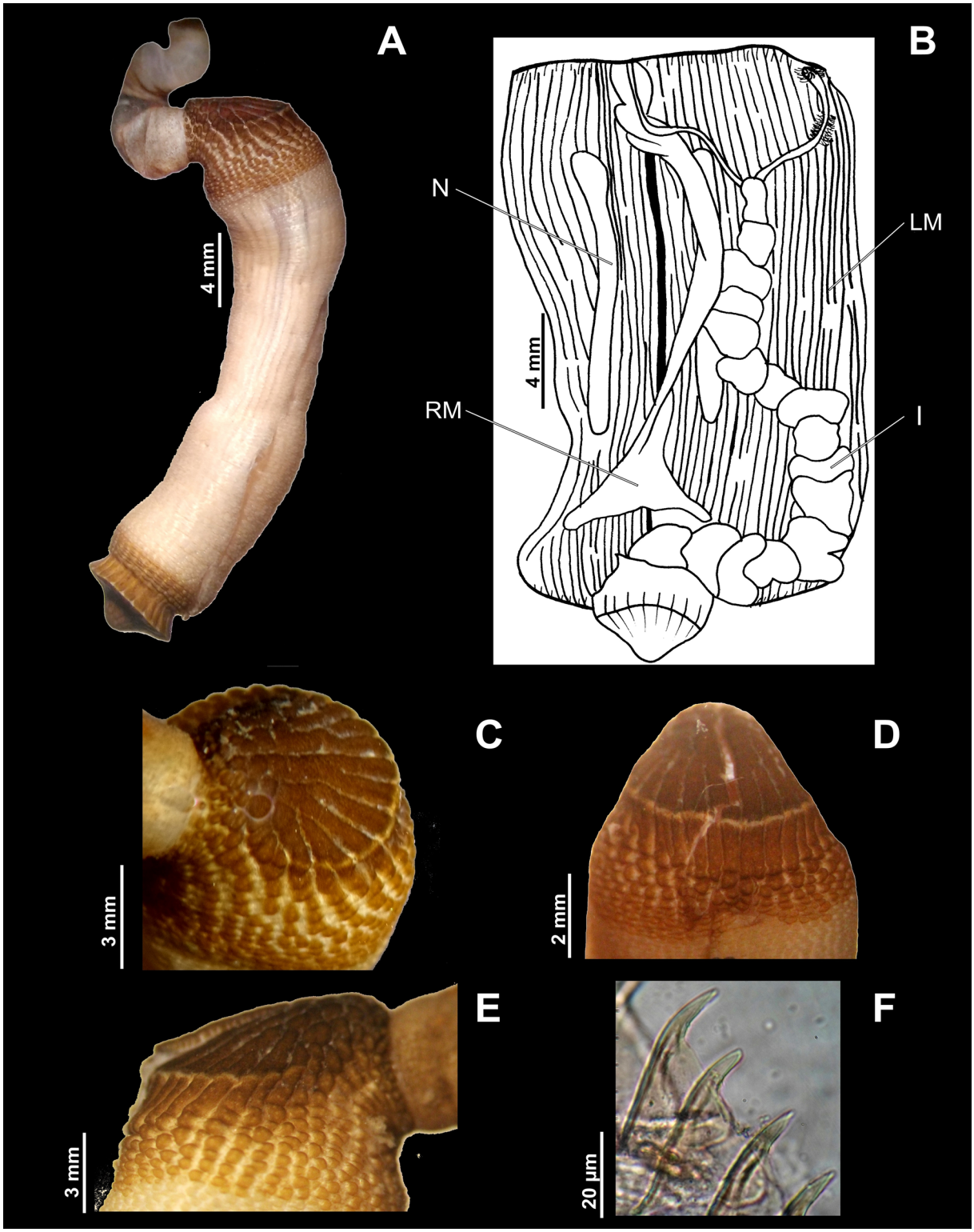

Fig. 12. *Aspidosiphon* (*Aspidosiphon*) *cutleri* sp. nov., holotype (UMAR-SIPU 082), from the Southern Mexican Pacific. **A**. External morphology. **B**. Internal morphology. **C**. Anal shield, dorsolateral view. **D**. Anal shield, dorsal view. **E**. Anal shield, lateral view. **F**. Distal unidentate hooks. Abbreviations: I = intestine; LM = longitudinal muscle; N = nephridium; RM = retractor muscles.

Remarks

The species that are most similar to *Aspidosiphon* (*Paraspidosiphon*) *cutleri* sp. nov. are *A*. (*P*.) *coyi* de Quatrefages, 1865, described from the Indian Ocean, and *A*. (*P*.) *laevis* de Quatrefages, 1865. The type material of these two species was described by Saiz-Salinas (1983). The main differences between these species are the following: *Aspidosiphon* (*P.*) *coyi* has bidentate hooks and disperse units in the anterior region of the trunk; *Aspidosiphon laevis* lacks bidentate hooks and the units on the anterior region of the trunk are dispersed; nephridiopores are at the same level as the anus in both these species; on the other hand, *A. (P.) cutleri* sp. nov. only has unidentate hooks and the units are distributed in lines on the anterior region of the trunk; the nephridiopores are posterior to the anus. It is likely that the record of *A*. (*P*.) *laevis* from Costa Rica (Dean *et al*. 2010) corresponds to this new species; however, it is necessary to review the specimens.

Habitat

Subtidal (2 m); in dead coral.

Distribution

Oaxaca, Mexico.

Aspidosiphon* (*Paraspidosiphon*) *pastori sp. nov.
urn:lsid:zoobank.org:act:F0F14077-9BB9-439E-AE38-A9EE4BEA0CBA
Fig. 13A–F

Etymology

This new species was named as "*pastori*" after Mr Pastor Silva Cruz, for his invaluable support and inspiration to work in the field of marine science.

Material examined

Holotype

MEXICO • Oaxaca, Panteón Beach; 15°39′50.8″ N, 96°29′42.4″ W; 28 Apr. 2012; NHH and KLT leg.; in rocks; UMAR-SIPU 128.

Paratypes

MEXICO – **Oaxaca** • 1; same collection data as for holotype; UMAR-SIPU 099 • 2; Panteón Beach; 15°39′50″ N, 96°29′42″ W; 30 Mar. 2017; JGV leg.; depth 2 m, in dead coral; UMAR-SIPU 100.

Other material

MEXICO – **Guerrero** • 7; Ixtapa Island, Coral Beach; 19 Sep. 2007; SGM leg.; in dead coral; UMAR-SIPU 084 • 1; Acapulco, Roqueta Island; 21 Sep. 2007; SGM leg.; in sponge; UMAR-SIPU 085 • 1; Barra de Potosí; 3 Dec. 2010; UMAR-SIPU 086. – **Oaxaca** • 1; La Entrega Beach; Aug. 2004; SGM leg.; in *Spondylus limbatus* G.B. Sowerby II, 1847; UMAR-SIPU 087 • 1; Estacahuite Beach; 18 Apr. 2005; SGM leg.; in dead coral; UMAR-SIPU 088 • 3; Estacahuite Beach; 30 Apr. 2005; in dead coral; UMAR-SIPU 089 • 13; Estacahuite Beach; 10 Sep. 2005; SGM leg.; in dead coral; UMAR-SIPU 090 • 1; Estacahuite Beach; 15 Aug. 2006; depth 4 m, in dead coral; UMAR-SIPU 091 • La Tijera Beach; 12 Sep. 2006; depth 4 m, in dead coral, UMAR-SIPU 092 • 2; Chacahua; 14 Apr. 2007; SGM leg.; in artificial monticule; UMAR-SIPU 094 • 1; Chacahua; 3 Apr. 2008; in rocks; UMAR-SIPU 095 • 2; Panteón Beach; 21 May 2008; MLY leg.; depth 3 m, in rocks; UMAR-SIPU 096 • 1; La Tijera Beach; 6 May 2009; in rocks; UMAR-SIPU 097 • 2; Salchi Beach; 26 March 2010; depth 7 m; UMAR-SIPU 098.

Description

Trunk 10 mm in length, smooth and thin (Fig. 13A). Anal and caudal shields yellow, introvert light brown and trunk white (Fig. 13C). Introvert two times as long as trunk. Rings of compressed, bidentate

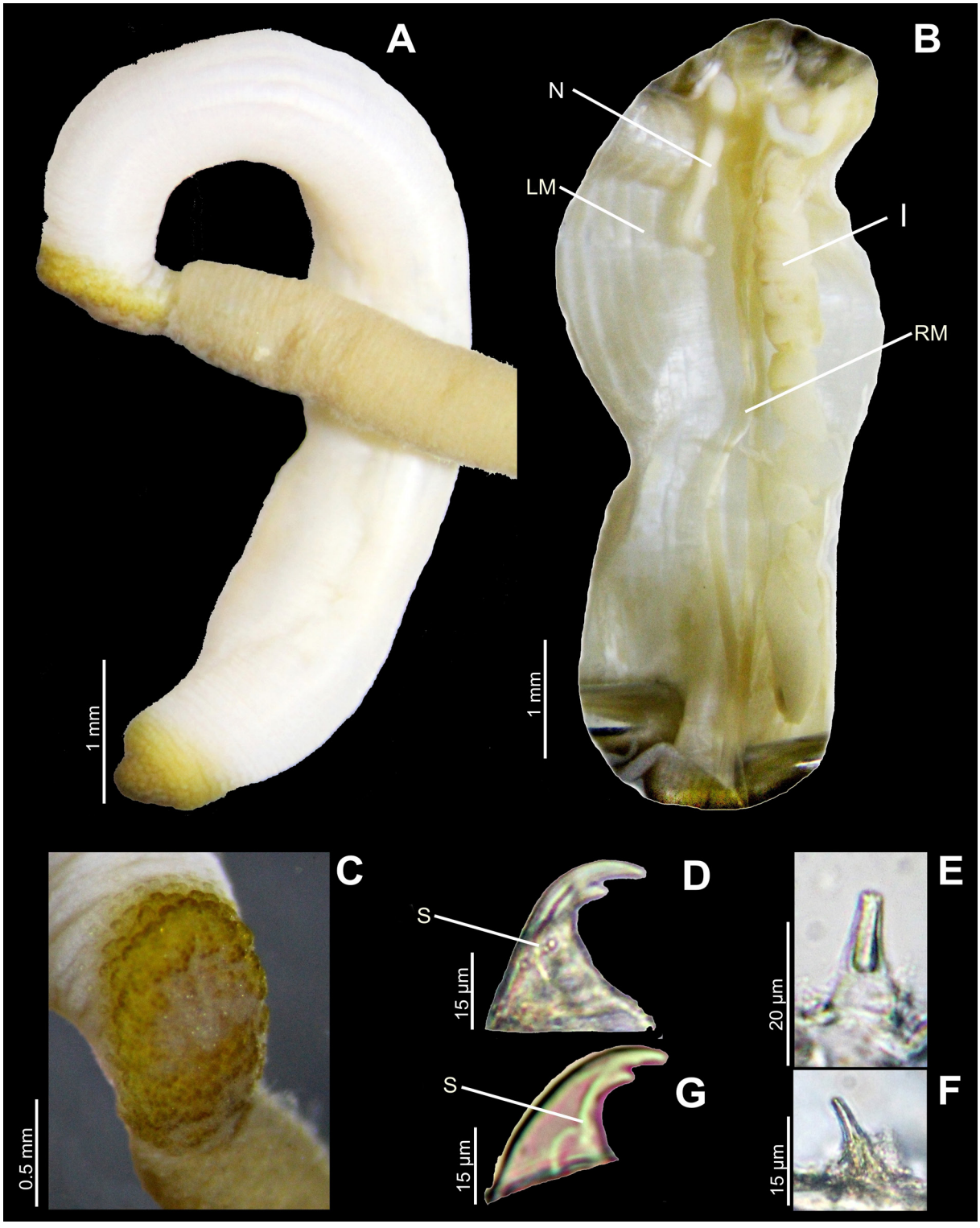

Fig. 13. – **A–F**. *Aspidosiphon* (*Paraspidosiphon*) *pastori* sp. nov., holotype (UMAR-SIPU 128). **A**. External morphology. **B**. Internal morphology. **C**. Anal shield. **D**. Bidentate hook. **E**. Papillae from introvert. **F**. Pyramidal hook. – **G**. Bidentate hook of *A.* (*P.*) *fischeri* ten Broeke, 1925 from the Mexican Caribbean. Abbreviations: I = intestine; LM = longitudinal muscle; N = nephridium; RM = retractor muscles; S = streak.

hooks, some hooks unidentate (Fig. 13D), followed by scattered and pyramidal hooks (Fig. 13F). Papillae present on entire introvert (Fig. 13E). Bidentate hooks with the streak oblique. Fifteen ill-defined anastomosed muscle bands. Two retractor muscles fused at 75% of trunk length and occupying 90% of trunk. Nephridia occupying 30% of trunk length, open posteriorly to anus (Fig. 13B).

Remarks

The species that is most similar to *Aspidosiphon* (*Paraspidosiphon*) *pastori* sp. nov. is *A.* (*P.*) *fischeri* (ten Broeke, 1925) from Caracas Bay, Venezuela; however, they are different in the shape of the hooks and the longitudinal muscle bands. *Aspidosiphon* (*Paraspidosiphon*) *pastori* sp. nov. has hooks with an oblique streak, while *A. fischeri* has hooks with a straight streak (Fig. 13G). *Aspidosiphon* (*Paraspidosiphon*) *pastori* sp. nov. has 14–16 longitudinal muscle bands, while *A. fischeri* has 18–19 LMB.

Habitat

Intertidal to subtidal (7 m); in dead coral, sponges, bivalves and rocks.

Distribution

South Mexican Pacific, from Ixtapa Island, Guerrero, to La Entrega Beach, Oaxaca.

Identification key to all families from the Tropical Eastern Pacific (modified from Cutler 1994)

1. Tentacles encircling the mouth (peripheral tentacles); hooks, when present, are scattered 2
– Tentacles encircling the nuchal organ (nuchal tentacles), peripheral tentacles absent; hooks, if present, arranged in rings 4

2. Longitudinal muscles of body wall in uniform continuous layer .....Golfingiidae
– Longitudinal muscles of body wall gathered into separate or anastomosing bands 3

3. Longitudinal and circular musculature with anastomosis; spindle muscle attached to the posterior trunk .....Siphonosomatidae
– Longitudinal and circular musculature in continuous bands; spindle muscle not attached to the posterior trunk .....Sipunculidae

4. Hooks absent; contractile vessel with villi .....
.....Antillesomatidae (*Antillesoma mexicanum* Silva-Morales *et al.*, 2019 [1])
– Hooks present; contractile vessel without villi 5

5. Anal shield present .....Aspidosiphonidae
– Anal shield absent .....Phascolosomatidae

[1] This species is separate from *Antillesoma antillarum* (Grube, 1859) because of differences in the length of the organisms and for the molecular divergences noted by Silva-Morales *et al.* (2019).

Identification keys to all species of sipunculans from the Tropical Eastern Pacific

Family Aspidosiphonidae

1. Hooks, if present, not in rings .....***Aspidosiphon* (*Akrikos*) *albus*** Murina, 1967
– Hooks in rings on the distal region of the introvert 2

2. Longitudinal muscle layer divided into separate (or anastomosing) bundles .....
.....*Aspidosiphon* (*Paraspidosiphon*).....3
– Longitudinal muscles in continuous layer (except under anal shield) .....
.....*Aspidosiphon* (*Aspidosiphon*).....7

3. Anal shield with grooves 4
– Anal shield without grooves 5

4. Papillae of anterior trunk scattered .....***Aspidosiphon* (*Paraspidosiphon*) *laevis*** de Quatrefages, 1865
– Papillae of anterior trunk in lines .....***Aspidosiphon* (*Paraspidosiphon*) *cutleri*** sp. nov.

5. Compressed hooks bidentate, followed by dark pyramidal hooks .....
.....***Aspidosiphon* (*Paraspidosiphon*) *steenstrupii*** Diesing, 1859
– Compressed hooks bidentate, followed by pale pyramidal hooks 6

6. Hooks bidentate, with streak vertical on the superior region .....
.....***Aspidosiphon* (*Paraspidosiphon*) *fischeri*** ten Broeke, 1925
– Hooks bidentate, with streak oblique on the superior region .....
.....***Aspidosiphon* (*Paraspidosiphon*) *pastori*** sp. nov.

7. Individual units form into longitudinal ridges over dorsal half of anal shield .....
.....***Aspidosiphon* (*Aspidosiphon*) *muelleri*** Diesing, 1851
– Without individual units that form into longitudinal ridges over dorsal half of anal shield 8

8. All hooks unidentate; ill-defined anal shield .....
.....***Aspidosiphon* (*Aspidosiphon*) *gracilis schnehageni*** Fischer, 1912
– Distal hooks bidentate; anal shield well-defined 9

9. All compressed hooks bidentate, followed by dark conical hooks .....
.....***Aspidosiphon* (*Aspidosiphon*) *elegans*** (Chamisso & Eysenhardt, 1821)
– Distal bidentate compressed hooks, followed by proximal unidentate ones 10

10. Gut helicoidal; lives in gastropod shells; anal shield units not tightly packed and of similar size .....***Aspidosiphon* (*Aspidosiphon*) *gosnoldi*** Cutler, 1981
– Gut coils loose or absent; does not occupy gastropod shells; anal shield more solid, with close-set, granular units of differing sizes .....***Aspidosiphon* (*Aspidosiphon*) *misakiensis*** Ikeda, 1904

Family Golfingiidae

1. Branched tentacles carried on four to eight stem-like outgrowths of oral disk .....*Themiste*.....2
– Tentacles not carried on stem-like outgrowths 3

2. Hooks present .....***Themiste* (*Themiste*) *pyroides*** (Chamberlin, 1919)
– Hooks absent .....***Themiste* (*Themiste*) *hennahi*** Gray, 1828

3. Two nephridia .....*Nephasoma*.....4
– One nephridium 5

4. Hooks present .....***Nephasoma* (*Nephasoma*) *pellucidum pellucidum*** (Keferstein, 1865)
– Hooks absent .....***Nephasoma* (*Nephasoma*) *elachea*** (Fisher, 1952)

5. Anus usually located on anterior trunk; epidermal holdfast or attachment papillae often present; retractor muscles highly fused but usually with 2–4 origin points .....*Phascolion*.....6
– Anus situated on distal half of introvert; epidermal attachment papillae absent; retractor muscles appear as single column, without separate origin points .....*Onchnesoma* 7

6. Tentacles reduced to lobes at the end of the introvert, which is about equal in length to the trunk .....***Phascolion* (*Montuga*) *pacificum*** Murina, 1957
– 10–30 well-developed tentacles usually present .....
.....***Phascolion* (*Phascolion*) *strombus*** (Montagu, 1804)

7. Cylindrical body, without papillae .....***Onchnesoma magnibathum*** Cutler, 1969
– Spherical or pear-shaped body, with papillae .....
.....***Onchnesoma steenstrupii steenstrupii*** Koren & Danielssen, 1876

Family Phascolosomatidae

1. Introvert much longer than twice the trunk length; hooks, if present, with basal spinelets; nephridia usually bilobed .....*Apionsoma*.....2
– Introvert less than twice trunk length; hooks without basal spinelets; nephridia unilobed .....
.....*Phascolosoma*.....4

2. Body wall muscles divided into separate bands .....
.....***Apionsoma* (*Edmonsius*) *pectinatum*** (Keferstein, 1867)
– Body wall with continuous muscle layers .....*Apionsoma* (*Apionsoma*).....3

3. Papillae, hooks and tentacles absent .....***Apionsoma* (*Apionsoma*) *trichocephalus*** Sluiter, 1902
– Papillae, hooks and tentacles present, 7–8 basal spinelets .....
.....***Apionsoma* (*Apionsoma*) *hespera*** (Chamberlin, 1920) comb. nov.

4. Protuberance of the hook streak less than twice the width of the hook .....
.....***Phascolosoma* (*Phascolosoma*) *puntarenae*** Grube & Örsted in Grube, 1858
– Hook without protuberance of the hook streak 5

5. Hook triangle indistinct or absent; preanal papillae not distinct from dome-shaped trunk papillae
.....***Phascolosoma* (*Phascolosoma*) *agassizii*** Keferstein, 1866
– Hook triangle well-defined; preanal papillae distinct 6

6. Preanal papillae dome- to mammiform-shaped at the base of the introvert .....
.....***Phascolosoma* (*Phascolosoma*) *scolops*** (Selenka & de Man in Selenka, 1883)
– Preanal papillae conical, posteriorly directed on the dorsal base of the introvert .....
.....***Phascolosoma* (*Phascolosoma*) *perlucens*** Baird, 1868

Family Sipunculidae

1. With a pair of protractor muscles .....***Xenosiphon branchiatus*** (Fischer, 1894)
– Protractor muscles absent .....*Sipunculus*.....2

2. With 42 or more LMB; digitate processes of the brain present .....
.....***Sipunculus* (*Sipunculus*)** cf. ***polymyotus*** Fisher, 1947
– With 41 or less LMB; digitate processes of the brain absent 3

3. With 34 or less LMB; nephridia partially attached .....
.....***Sipunculus* (*Sipunculus*) *nudus*** Linnaeus, 1766
– With 35–41 LMB; nephridia unattached .....
.....***Sipunculus* (*Sipunculus*) *phalloides phalloides*** (Pallas, 1774)

Family Siphonosomatidae

1. Rectum with multiple rectal caecae or diverticulae .....
.....***Siphonosoma*** cf. ***vastum*** (Selenka & Bülow in Selenka, 1883)
– Rectum without multiple rectal caecae or diverticulae and dorsal retractor muscles originate anterior to ventral pair .....***Siphonosoma cumanense*** (Keferstein, 1867)

Discussion

The taxonomy of Sipuncula remains complicated. There are too few morphological characters to easily separate species. The study of sipunculans requires caution when reviewing records of species from any locality. Cutler (1994) produced a list of 150 species, most of those cosmopolitan or of wide distribution, and a long list of synonyms. This led to cases of specimens from far distant populations being assigned the same name. For example, Dean (2001), Dean *et al.* (2010) and Hermoso-Salazar *et al.* (2013) recorded some species from Pacific Costa Rica and Mexico with names from Europe, the Indian Ocean, Western Pacific and Caribbean. The idea that most marine invertebrates have wide distributions has been questioned recently (Hutchings & Kupriyanova 2018). Regarding sipunculans, there are many studies rejecting these wide distributions, supported by careful morphological and molecular investigations (Staton & Rice 1999; Kawauchi & Giribet 2010, 2014; Schulze *et al.* 2012; Johnson *et al.* 2016; Silva-Morales *et al.* 2019; Silva-Morales 2020).

The importance of being cautious implies giving due importance to the type locality in the records of species. In this study, the records of *Themiste* (*T.*) *hennahi* and *Apionsoma* (*Edmonsius*) *pectinatum* were based on the correspondence of the diagnostic characters with the original description and the proximity of the type locality with the sample locality. In the case of *Aspidosiphon* (*A.*) *elegans* we recorded the nominal species; nevertheless, we suggest other types of studies to confirm or reject this wide distribution because we did not find any morphological distinction. With *Siphonosoma* cf. *vastum*, *Sipunculus* (*S.*) cf. *polymyotus* and *Phascolosoma* (*P.*) cf. *perlucens* we found morphological differences or molecular data to consider them "confer" and not the nominal species; the possibility remains that these could be new species for the tropical eastern Pacific. On the other hand, two names were reestablished: *Apionsoma* (*A.*) *hespera* comb. nov. and *Phascolosoma* (*P.*) *puntarenae*. For similar cases we suggest reviewing the 320 previously existing species names (e.g., Stephen & Edmonds 1972), because other valid names could be buried in the synonyms of presumed widely distributed species. The new species, *Aspidosiphon* (*P.*) *cutleri* sp. nov. and *A.* (*P.*) *pastori* sp. nov. can be easily separated from the others of the same genus and subgenus by observing the internal characteristics of the hooks and the longitudinal muscle bands.

This study is the first work about sipunculans in the Southern Mexican Pacific, more than 1000 km of coastline for which no records of this phylum existed (Bastida-Zavala *et al.* 2013). This work will improve our knowledge of the sipunculans in the Tropical Eastern Pacific because it gathers information that was scattered, with a commented list and an identification key to help future studies.

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Appendix

Commented list of all sipunculan species from the Tropical Eastern Pacific

We found records of 53 taxa of sipunculans of which five names are similar to other nominal species, 25 records are considered questionable because the type locality and/or native distribution of the nominal species is far away from the TEP, two are new species and the rest are records of nominal species previously found in the TEP.

Phylum Sipuncula Rafinesque, 1814
Family *Antillesomatidae* Kawauchi, Sharma & Giribet, 2012
Genus ***Antillesoma*** Stephen & Edmonds, 1972

Antillesoma antillarum (Grube & Örsted in Grube, 1858): 117–118, as *Phascolosoma antillarum*; type locality: Saint Croix, Virgin Islands. — Cutler *et al.* 1992: 156 (Conchal Beach, Brasilito Bay; Murcielagos Island, Gulf of Papagayo; Point Morales, Gulf of Nicoya; Point Judas; Mal País, Cabo Blanco; Sámara Beach, Costa Rica). — Dean 2001: 87–88 (Conchal Beach, Brasilito Bay; Point Morales, Gulf of Nicoya; Sámara Beach; Mal País; Cabo Blanco; Point Judas; Murcielagos Islands, Gulf of Papagayo; Rincón de Osa, Golfo Dulce, Costa Rica). — Spongberg 2006: 30, fig. 1b (Culebra Bay, Costa Rica). — Dean *et al.* 2010: 62 (Chatham Bay, Costa Rica). **Questionable records in the TEP.**

Antillesoma mexicanum Silva-Morales *et al*., 2019: 105–106, fig. 2 (Southern Mexican Pacific, intertidal and subtidal, 3 m, in dead coral and pier piles).

Family Aspidosiphonidae Baird, 1868
Genus *Aspidosiphon* Diesing, 1851
Subgenus ***Aspidosiphon* (*Akrikos*)** Cutler & Cutler, 1989

Aspidosiphon* (*Akrikos*) *albus Murina, 1967: 1330–1331, fig. 2, as *Aspidosiphon albus*; type locality: Cuba, 22°56′ N, 83°23′ W, 14 m. — Hermoso-Salazar *et al.* 2013: 331–332 (Wagner and Consag Basins, Gulf of California, Mexico, sandy loam bottom, 59–121 m). **Questionable record in the TEP.**

Aspidosiphon cf. ***albus*** in Salazar-Vallejo 1983: 32–33 (Manzanillo Bay, Colima, Mexico, 20–70 m, in muddy-sandy sediments).

Subgenus ***Aspidosiphon* (*Aspidosiphon*)** Diesing, 1851

Aspidosiphon (***Aspidosiphon***) ***elegans*** (Chamisso & Eysenhardt, 1821): 351–352, pl. 24, fig. 5a–e, as *Sternaspis elegans*; type locality: Radack, Marshall Islands. — Fonseca & Cortés 1988: 172–173, as *A. elegans* (Pacific of Costa Rica). — Dean 2001: 89 (Golfo Dulce, Costa Rica, in dead coral). — Dean *et al.* 2010: 63–64, as *A. elegans* (Chatham Bay, Point Ulloa and Wafer Bay, Cocos Island, Costa Rica). **Questionable records in the TEP.**

Aspidosiphon* (*Aspidosiphon*) *gosnoldi Cutler, 1981: 445–449, as *Aspidosiphon gosnoldi*; type locality: Eastern Florida, United States, USGS, 29°30′ N, 80°29′ W, 32 m). — Dean *et al*. 2010: 64, as *A. gosnoldi* (Chatham Bay, Wafer Bay, Manuelita Island and Point Ulloa, Cocos Island, Costa Rica, specimens removed from shell). **Questionable record in the TEP.**

Aspidosiphon* (*Aspidosiphon*) *gracilis schnehageni (Fischer, 1913): 99–100, pl. 30, figs 4–6, as *Aspidosiphon schnehageni*; type locality: Chile, in shell of *Epitonium* Röding, 1798. — Dean 2001: 89 (Gulf of Nicoya, Costa Rica, muddy sand). **Questionable record in the TEP.**

Aspidosiphon* (*Aspidosiphon*) *misakiensis Ikeda, 1904: 41–43, pl. 1, fig. 9, pl. 3, figs 68–72, as *Aspidosiphon misakiensis*; type locality: Misaki, Japan, on rocky coast. — Dean *et al.* 2010: 64, as *A. misakiensis* (Silverado, Cocos Island, Costa Rica, subtidal calcareous rock, 11 m). **Questionable record in the TEP.**

Aspidosiphon* (*Aspidosiphon*) *muelleri Diesing, 1851: 68, as *Aspidosiphon muelleri*; type locality: Palermo, Sicily, Italy). — Dean 2001: 89 (Gulf of Nicoya, Costa Rica, muddy sand). **Questionable record in the TEP.**

Subgenus ***Aspidosiphon* (*Paraspidosiphon*)** (Stephen, 1965)

Aspidosiphon* (*Paraspidosiphon*) *coyi Quatrefages, 1865: 608–609, as *Aspidosiphon coyi*; type locality: Indian Ocean. — Keferstein 1867: 50–53, pl. 6, figs 15–18, as *Phascolosoma truncatum* (probably Panama and Galapagos Islands, without specification by the author). **Questionable record in the TEP.**

Aspidosiphon* (*Paraspidosiphon*) *cutleri sp. nov. (this paper): Fig. 12A–F (Oaxaca, subtidal, 2 m, in dead coral).

Aspidosiphon* (*Paraspidosiphon*) *fischeri ten Broeke, 1925: 92–93, figs 21–22, as *Aspidosiphon fischeri*; type locality: Caracas Bay, Venezuela. — Dean *et al.* 2010: 65 (Chatham Bay, Ulloa Point, Manuelita Island, and Silverado, Cocos Island, Costa Rica, in calcareous rocks). **Questionable record in the TEP.**

Aspidosiphon* (*Paraspidosiphon*) *laevis Quatrefages, 1865: 609, pl. 20, figs 23–24, as *Aspidosiphon laeve*; type locality: probably Indian Ocean. — Cantera *et al.* 2003: 212, as *A. laevis* (in dead *Pocillopora damicornis*, Gorgona Island, Colombia). — Fonseca *et al.* 2005: 102 (Golfo Dulce, Costa Rica). — Dean *et al.* 2010: 65 (Chatham Bay, María Point, Ulloa Point, and Silverado, Cocos Island, Costa Rica, in calcareous rocks). **Questionable records in the TEP.**

Aspidosiphon* (*Paraspidosiphon*) *pastori sp. nov. (this paper): Fig. 13A–F (Guerrero and Oaxaca, Mexico, intertidal and subtidal, 7 m, in dead coral, sponge, epibionts of *Spondylus limbatus*).

Aspidosiphon* (*Paraspidosiphon*) *steenstrupii Diesing, 1859: 767, as *Aspidosiphon steenstrupii*; type locality: Saint Thomas, Virgin Islands. — Fonseca *et al.* 2005: 107 (Golfo Dulce, Costa Rica). — Cantera *et al.* 2003: 212 (in dead *Pocillopora damicornis*, Gorgona Island, Colombia). **Questionable records in the TEP.**

Aspidosiphon sp. in Cantera *et al.* 2003: 212 (living *Pocillopora damicornis*, Gorgona Island, Colombia).

Family Golfingiidae Stephen & Edmonds, 1972
Genus ***Golfingia*** Lankester, 1885

Golfingia sp. in Morales-Zárate *et al*. 2016: 741 (Guerrero Negro lagoon, Baja California Sur, Mexico).

Genus *Nephasoma* Pergament, 1940
Subgenus **(*Nephasoma*)** Pergament, 1940

Nephasoma* (*Nephasoma*) *eremita Sars, 1851. — Fisher 1952: 399–400, pl. 25, figs 1–3, as *Golfingia elachea* (Point Lobos, Espíritu Santo Island, near La Paz, Baja California Sur, Mexico). **Questionable name.**

Nephasoma* (*Nephasoma*) *pellucidum pellucidum (Keferstein, 1865): 433, pl. 23, figs 26–27, as *Phascolosoma pellucidum*; type locality: Saint Thomas, Virgin Islands (0.6 m, in debris coral). — Dean 2001: 87 (Puntarenas, Gulf of Nicoya; Playa Conchal, Brasilito Bay; Sándalo, Golfo Dulce, Costa Rica, intertidal zone, under boulders). **Questionable record in the TEP.**

Nephasoma sp. in Hermoso-Salazar *et al.* 2013: 329 (Wagner and Consag Basins, Gulf of California, Mexico, 150–162 m, sandy loam bottom).

Genus ***Onchnesoma*** Koren & Danielssen, 1875

Onchnesoma magnibathum Cutler 1969: 71–76, as *Onchnesoma magnibatha*; type locality: NW Atlantic Ocean, 33°57′ N, 65°47′ W, 4795 m). — Cutler & Cutler 1980: 204–205 (Pacific of Costa Rica, Peru and Nicaragua, R/V *Vema*, Peru, 2270–3523 m). **Questionable record in the TEP.**

Onchnesoma steenstrupii steenstrupii Koren & Danielssen, 1875: 133, pl. 15, figs 28–36; type locality: N Atlantic Ocean. — Hermoso-Salazar *et al.* 2013: 330 (Wagner and Consag Basins, Gulf of California, 128–185 m, sandy loam bottom). **Questionable record in the TEP.**

Genus *Phascolion* Théel, 1875
Subgenus ***Phascolion* (*Montuga*)** Gibbs, 1985

Phascolion* (*Montuga*) *pacificum Murina, 1957: 1777–1781, figs 2a–b, 3a–e, as *Phascolion pacificum*; type locality: Kuril Trench. — Cutler & Cutler 1980: 194 (R/V *Vema*, Peru). **Questionable record in the TEP.**

Subgenus ***Phascolion* (*Phascolion*)** Théel, 1875

Phascolion* (*Phascolion*) *strombus (Montagu, 1804): 74–76, as *Sipunculus strombus*; type locality: S coast of Devonshire, UK. — Dean 2001: 87 (Gulf of Nicoya, 18 m, muddy sand, in an empty gastropod shell). **Questionable record in the TEP.**

Phascolion sp. in Hermoso-Salazar *et al.* 2013: 330–331 (Wagner and Consag Basins, Gulf of California, Mexico, 101–179 m, sandy loam bottom).

Genus ***Phascolopsis*** (Fisher, 1950)

Phascolopsis cf. ***gouldii*** (de Pourtalès, 1851). — Steinbeck & Ricketts 1941: 345, as *Phascolosoma gouldii* (under boulders, Point Lobos, Espíritu Santo Island, Baja California Sur, Mexico).

Genus *Themiste* Gray, 1828
Subgenus *Themiste* (*Themiste*) Gray, 1828

Themiste* (*Themiste*) *hennahi Gray, 1828: 8, pl. 6, fig. 4–4a, as *Themiste hennahi*; type locality: Peru. — Fisher 1952: 411–415, pl. 30, fig. 1, pl. 30, pl. 31, as *Dendrostomum zostericolum* (Ensenada, Baja California, Mexico, among eelgrass roots; in gravel and sand under boulders; rocky tide flats, in sandy mud at lowest part of intertidal zone). — Fisher 1952: 419–422, pl. 35, as *Dendrostomum lissum* (San Carlos Bay, Baja California; Puerto Peñasco; Miramar Beach, Guaymas, Sonora, Mexico). — Brusca 1980: 126, as *Themiste lissum* (Gulf of California, Mexico). — Present paper (San Agustín Bay, Oaxaca, Mexico, inhabiting *Porites*).

Themiste sp. in Morales-Zárate *et al*. 2016: 741 (Guerrero Negro Lagoon, Baja California Sur, Mexico).

Golfingiidae sp. in Hermoso-Salazar *et al*. 2013: 329–330 (Wagner and Consag Basins, Gulf of California, Mexico, 59–119 m, sandy loam bottom).

Family Phascolosomatidae Stephen & Edmonds, 1972
Genus *Apionsoma* Sluiter, 1902
Subgenus ***Apionsoma* (*Apionsoma*)** Sluiter, 1902

Apionsoma* (*Apionsoma*) *hespera Chamberlin, 1920 comb. nov.: 31, as *Phascolosoma hespera*; type locality: Laguna Beach, California. — Steinbeck & Ricketts 1941: 345, as *Phascolosoma hesperum* (abundant as commensals of tubes of *Cerianthus*, Cabo San Lucas, Baja California Sur, Mexico). — Fisher 1952: 393–395, pl. 24, figs 1–5, as *Golfingia hespera* (Cabo San Lucas and S coast of Santa Rosalía, Baja California Sur, Mexico, inhabiting tubes of *Cerianthus*). — Brusca 1980: 125–126, as *Golfingia hespera* (Gulf of California, Mexico). — Amor 1975: 115–116 (Peru). [*Phascolosoma hespera* (Chamberlin, 1920) was previously regarded as a synonym of *A. (A.) misakianum* (Ikeda, 1904): 7–9, pl. 1, fig. 3, pl. 2, figs 30–33, as *Phascolosoma misakianum,*; type locality: Misaki, Japan.] **Reinstatement of name and proposal of a new combination.**

Apionsoma* (*Apionsoma*) *trichocephalus Sluiter, 1902: 42–44, pl. 4, figs 8–11, as *Apionsoma trichocephalus*; type locality: Philippines, 7°25′ S, 113°16′ E, Siboga expedition, in gray mud. — Cutler *et al.* 1992: 156, as *Apionsoma trichocephala* (Gulf of Nicoya, Costa Rica). — Dean 2001: 88 (Gulf of Nicoya, Costa Rica, in sandy mud). **Questionable records in the TEP.**

***Apionsoma* (*Apionsoma*)** sp. in Hermoso-Salazar *et al.* 2013: 331 (Wagner and Consag Basins, Gulf of California, 88–217 m, sandy loam bottom).

Subgenus *Apionsoma* (*Edmondsius*) Gibbs & Cutler, 1987

Apionsoma* (*Edmondsius*) *pectinatum (Keferstein, 1867): 47–48, as *Phascolosoma pectinatum*; type locality: Pacific of Panama. — Fisher, 1952: 386–388, pl. 22, as *Siphonides rickettsi* (Point Lobos, Espíritu Santo Island, Baja California Sur, Mexico). — Brusca 1980: 127, as *Phascolosoma rickettsi* (Gulf of California, Mexico). — Dean 2001: 88 (Herradura Bay, Gulf of Nicoya and Gulf of Papagayo, Costa Rica, in rocks).

Genus *Phascolosoma* Leuckart, 1828
Subgenus ***Phascolosoma* (*Phascolosoma*)** Leuckart, 1828

Phascolosoma* (*Phascolosoma*) *agassizii agassizii Keferstein, 1866: 218–219, as *Phascolosoma agassizii*; type locality: Mendocino, California. — Steinbeck & Ricketts 1941: 345–346 (under boulders, intertidal, Point Lobos, Espíritu Santo Island, Baja California Sur). — Brusca & Thompson 1977: 44, as *P. agassizii* (Cabo Pulmo reef, Baja California Sur, Mexico, in coral). — Brusca 1980: 126, as *P. agassizii* (Gulf of California, Mexico). — Dean *et al.* 2010: 62, as *P. agassizii* (Point Ulloa, Costa Rica, in calcareous rock).

Phascolosoma cf. ***agassizii*** in Steinbeck & Ricketts, 1941: 346, as *Physcosoma* cf. *agassizii* (in debris of *Pocillopora*, Cabo Pulmo reef; Baja California Sur; under boulders, Puerto Escondido, Baja California Sur; in rocks, San Carlos Bay, Baja California Sur; under boulders, Puerto Refugio, Baja California, Mexico).

Phascolosoma* (*Phascolosoma*) *perlucens Baird, 1868: 90–91, pl. 10, fig. 2–2a, as *Phascolosoma perlucens*; type locality: Jamaica (coralline rocks). — Fisher 1952: 432–434, pl. 39, figs 4–7, as *P. dentigerum* (Cabo Pulmo reef, in *Pocillopora*, Baja California Sur; Puerto Escondido, San Carlos

Bay, Baja California Sur; Puerto Refugio, Ángel de la Guarda Island, Gulf of California, Mexico; Panama Bay, Panama). — Brusca 1980: 127, as *P. perlucens* (Gulf of California, Mexico). — Cutler *et al*. 1992: 154, as *P. perlucens* (Murcielagos Islands; Point Morales, Gulf of Nicoya; Wafer Bay, Cocos Island, Costa Rica). — Fonseca *et al*. 2005: 107 (Golfo Dulce, Costa Rica). — Dean 2001: 87 (Murcielagos Islands, Gulf of Papagayo, in sandstone, intertindal; Point Morales, Gulf of Nicoya, in sandstone, intertidal; Pacific Coast, Punta Judas, in hardened clay; Mal País, Cabo Blanco, in limestone; Wafer Bay, Cocos Island, under rocks, intertidal; Rincón de Osa, Golfo Dulce, between rocks, intertidal, Costa Rica). — Schulze *et al*. 2007: 186 (Puerto Peñasco, Sonora, Mexico). — Spongberg 2006: 30, fig. 1c (sandflats, Cocosrocas, Gulf of Nicoya; Culebra Bay; Puerto Jiménez and E of Rincón, Golfo Dulce, Cost Rica). **Questionable records in the TEP.**

Phascolosoma* (*Phascolosoma*)** cf. ***perlucens Baird, 1868 in this paper: Fig. 6A–G (Southern Mexican Pacific, intertidal and subtidal 0–20 m, in dead coral, pier piles, in algae, sabelariid colony, mangrove roots, sand, epibionts of *Pinctada mazatlantica*, *Pocillopora damicornis* and *Porites* sp.). [Different lineage according to Kawauchi & Giribet 2010.]

Phascolosoma* (*Phascolosoma*) *puntarenae Grube & Örsted in Grube, 1858: 13; type locality: Puntarenas, Costa Rica. — Fisher 1952: 430–432, pl. 36, figs 1–2, pl. 37, figs 1–3, pl. 30, fig. 3 (Espíritu Santo Island, Baja California Sur; Miramar Beach, Guaymas, Sonora, Mexico; Panama Bay, Panama). — Brusca 1980: 127, as *P. puntarena* (Gulf of California, Mexico). — Cutler *et al*. 1992: 154–156, as *P. nigrescens* (Conchal Beach, Costa Rica). — Fonseca *et al*. 2005: 107 (Golfo Dulce, Costa Rica). — Dean *et al*. 2010: 63 (Ulloa Point and Chatham Bay, Cocos Island, Costa Rica in calcareous rock). — Dean 2001: 87 (Puntarenas, Gulf of Nicoya; Conchal Beach, Brasilito Bay; Sándalo, Golfo Dulce, Costa Rica, between rocks). [*Phascolosoma* (*P.*) *puntarenae* has been considered a synonym of *P.* (*P.*) *nigrescens* (Keferstein, 1865): 424, pl. 21, fig. 2, pl. 23, figs 14–15; type locality: Fiji.] **Name reestablished in this paper.**

Phascolosoma* (*Phascolosoma*) *scolops Selenka & De Man in Selenka, 1883: 75–76, as *Phascolosoma scolops*; type locality: Philippines. — Dean *et al.* 2010: 63, as *P. scolops* (Silverado, Costa Rica). **Questionable record in the TEP.**

Phascolosoma sp. in Dean *et al*. 2010: 63 (Chatham Bay and Point Ulloa, Cocos Island and Silverado, Costa Rica).

Phascolosoma sp. in Hermoso-Salazar *et al.* 2013: 331 (Wagner and Consag Basins, Gulf of California, Mexico, 113.1 m, sandy loam bottom).

Family Siphonosomatidae Kawauchi, Sharma & Giribet, 2012
Genus ***Siphonosoma*** Spengel, 1912

Siphonosoma cumanense (Keferstein, 1867): 53–55, pl. 6, figs 19–21, as *Phascolosoma cumanense*; type locality: Cumaná, Venezuela. — Dean *et al.* 2010: 61–62 (Chatham Bay, Costa Rica, 29.9 m, sandy bottom). **Questionable record in the TEP.**

Siphonosoma cf. ***cumanense*** in this paper: Fig. 3A–D (Santa Cruz Beach, Huatulco, Oaxaca, in sand, 3 m). **Questionable record in the TEP.**

Siphonosoma vastum (Selenka & Bülow in Selenka, 1883): 103–104, pl. 12, fig. 171, pl. 13, fig. 179, as *Sipunculus vastus*; type locality: Jaluit, Marshall Islands (without details). — Cutler *et al.* 1992: 154 (Isla del Caño, Costa Rica, under boulders and in debris coral). — Dean 2001: 86–87 (same data as preceding). **Questionable records in the TEP.**

Siphonosoma cf. ***vastum*** in this paper: Fig. 4A–H (San Agustín Bay, Huatulco, Oaxaca, Mexico, between rock and sand, 3 m).

Family Sipunculidae Rafinesque, 1814
Genus *Sipunculus* Linnaeus, 1766
Subgenus ***Sipunculus* (*Sipunculus*)** E. Cutler & Cutler, 1985

Sipunculus* (*Sipunculus*)** cf. ***polymyotus in this paper: Figs 1A–E, 2A–D (Boquilla Beach, Puerto Ángel, sandy substrate, 5 m).

Sipunculus* (*Sipunculus*) *natans Fisher 1954: 238–240, figs 1–2, type locality: Santa Inés Bay, Baja California Sur, Mexico.

Sipunculus* (*Sipunculus*) *nudus Linnaeus, 1766: 1078; type locality: European Ocean. — Steinbeck & Ricketts 1941: 346 (in mud, El Mogote, Baja California Sur; in sand, Bahía de los Ángeles, Baja California, Mexico). — Fisher 1952: 376–377, pl. 18 (Guaymas, Sonora, lagoon at Miramar Beach, 6 mi. from Ensenada; El Mogote, near La Paz, Baja California Sur; Estero de Punta Banda, Baja California, Mexico). — Brusca 1980: 125 (Gulf of California). — Cutler *et al.* 1992: 153 (Point Morales, Gulf of Nicoya, Costa Rica, intertidal to 12 m in mud and sand). — Dean 2001: 86 (Puntarenas, Costa Rica, intertidal to 18 m, in mud and sand). — Schulze *et al*. 2007: 186 (Taboguilla Island, off Panama City, Panama). — Spongberg 2006: 30, fig. 1d (sandflats, Gulf of Nicoya, Costa Rica). — Melwani & Kim 2008: 171 (sediments outside hydrothermal vents, Concepción Bay, Baja California Sur, Mexico). — Hermoso-Salazar *et al*. 2013: 328–329 (Wagner and Consag Basins, Gulf of California, 59–162 m, sandy loam bottom). — Berrú & Berrú 2013: 245–252 (North of Peru). **Questionable records in the TEP.**

Sipunculus* (*Sipunculus*) *phalloides phalloides (Pallas, 1774): 12–15, pl. 1, as *Lumbricus phalloides*; type locality: coast of Granada. — Fisher 1947: 358–360, as *Sipunculus galapagensis* (Galapagos Islands, in fish stomach). — Cutler *et al.* 1992: 153–154 (Herradura Bay, Gulf of Nicoya, Costa Rica, 10 m, under debris of coral and in sand). — Dean 2001: 86 (Puntarenas, Gulf of Nicoya; Conchal Beach, Brasilito Bay, Costa Rica, in fine sand). **Questionable records in the TEP.**

Sipunculus sp. in Cantera *et al.* 2003: 212 (in dead and live *Pocillopora damicornis*, Gorgona Island, Colombia).

Sipunculus sp. in Fonseca *et al*. 2005: 106 (Golfo Dulce, Costa Rica).

Sipunculidae sp. in Yupanqui *et al.* 2007: 79 (Ensenada de Sechura, Piura, Peru).

Genus ***Xenosiphon*** Fisher, 1947

Xenosiphon branchiatus (Fischer, 1895): 3, pl. 1, figs 1–1a, 2, as *Sipunculus mundanus* var. *branchiatus*; type locality: Esmeraldas, Ecuador. — Fisher 1947: 360–363, as *Xenosiphon branchiatum* (from La Paz, Baja California Sur to Panama). — Fisher 1952: 377–380, pl. 19, as *X. branchiatum* (La Paz, Baja California Sur; Panama, Hassler Expedition). — Brusca 1980: 125, as *X. branchiatum* (Gulf of California). — Cutler *et al.* 1992: 154 (Curú Beach, Gulf of Nicoya; Tamarindo Beach, Costa Rica, in fine sand). — Dean 2001: 86 (Conchal Beach, Brasilito Bay; Curú Beach, Gulf of Nicoya; Tamarindo Beach, Tamarindo Bay, Costa Rica, in fine sand). — Schulze *et al*. 2007: 186 (Tamarindo Beach, Costa Rica).