

## Five new species of aeolid nudibranchs (Mollusca, Opisthobranchia) from the tropical eastern Pacific

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**Abstract:** Five new species of aeolid nudibranchs are described based on specimens collected at several localities of the tropical eastern Pacific, from Isla Isabela, Nayarit, Mexico to Parque Nacional de Coiba, Panama. Three of the new species belong to the genus *Cuthona* Alder and Hancock, 1855, one to *Eubbranchus* Forbes, 1838, and one to *Cerberilla* Bergh, 1873. All are distinct from other previously known species of these genera. An additional species, possibly belonging to the genus *Herviella* Baba, 1949 is not named because of the lack of adequate anatomical information.

**Key words:** *Herviella*, *Cuthona*, *Cerberilla*, *Eubbranchus*, Mexico, Panama

The aeolid opisthobranchs of the tropical and temperate eastern Pacific are remarkably diverse (*i.e.*, Marcus and Marcus 1967, Williams and Gosliner 1979, Gosliner 1981, Behrens 1984, 1985a, 1985b, 1987). The aeolid faunal composition of the eastern Pacific is considerably different from that of the tropical Indo-Pacific, which was reviewed in a series of regional monographs on Hawaii (Gosliner 1980), South Africa (Gosliner and Griffiths 1981), and the Indian Ocean and the south-west Pacific (Miller 1971, 1974, 2001, Rudman 1980, Schrödl 2003).

Despite the effort to collect and describe the species of the eastern Pacific, numerous species still remain undescribed, especially those of small, cryptic animals. We describe several new species of aeolid opisthobranchs collected at several localities of Mexico and Panama, contributing new information to the knowledge of this fauna.

### MATERIAL AND METHODS

The material examined was collected from March 2001 to January 2005, primarily by the senior author, in several localities of the tropical eastern Pacific, including Isla Isabela (Nayarit, Mexico), Bahía de Banderas (Jalisco-Nayarit, Mexico), Manzanillo (Colima, Mexico), Ixtapa-Zihuatanejo (Guerrero, Mexico), Punta Roble and Playa Avellanas (Guanacaste, Costa Rica), and Golfo de Chiriquí, Panama, with geographic coordinates ranging from 21.5°N-105.5°W (Bahía de Banderas) to 7°N-80°W (Golfo de Chiriquí). The collecting sites included several habitats of open and pro-

tected coastlines such as coral reefs, sea grass beds, rocky reefs, estuaries, islets, islands, and seamounts.

The specimens were deposited in the Malacology Section of the Natural History Museum of Los Angeles County (LACM), the Department of Invertebrate Zoology and Geology of the California Academy of Sciences, San Francisco (CASIZ), and the invertebrate collections of the Universidad de Costa Rica—ex. Instituto Nacional de Biodiversidad de Costa Rica (INB). The specimens were relaxed in freezing (0°C) seawater and preserved in 90% ethanol. We dissected the specimens by making a dorsal incision from posterior to anterior. The internal features were examined and drawn using a dissecting microscope with a *camera lucida* attachment. The buccal mass was removed and placed in 10% sodium hydroxide until the radula and jaws were isolated from the surrounding tissue. The radula and jaws were then rinsed in water, dried, and mounted for examination with a scanning electron microscope (Hitachi S-3000N). Notes on the external features of the living animals were taken in the field using a dissecting microscope or a 10x magnification loupe. When possible, the specimens were photographed *in situ*; all of them were later photographed in an aquarium using a Nikon Coolpix 995 digital camera with two INON strobes; white balance set up to bright day light. The color plate was composed with Adobe Photoshop® 7.0, colors of the images were not modified.

### SPECIES DESCRIPTIONS

Family Facelinidae Bergh, 1889

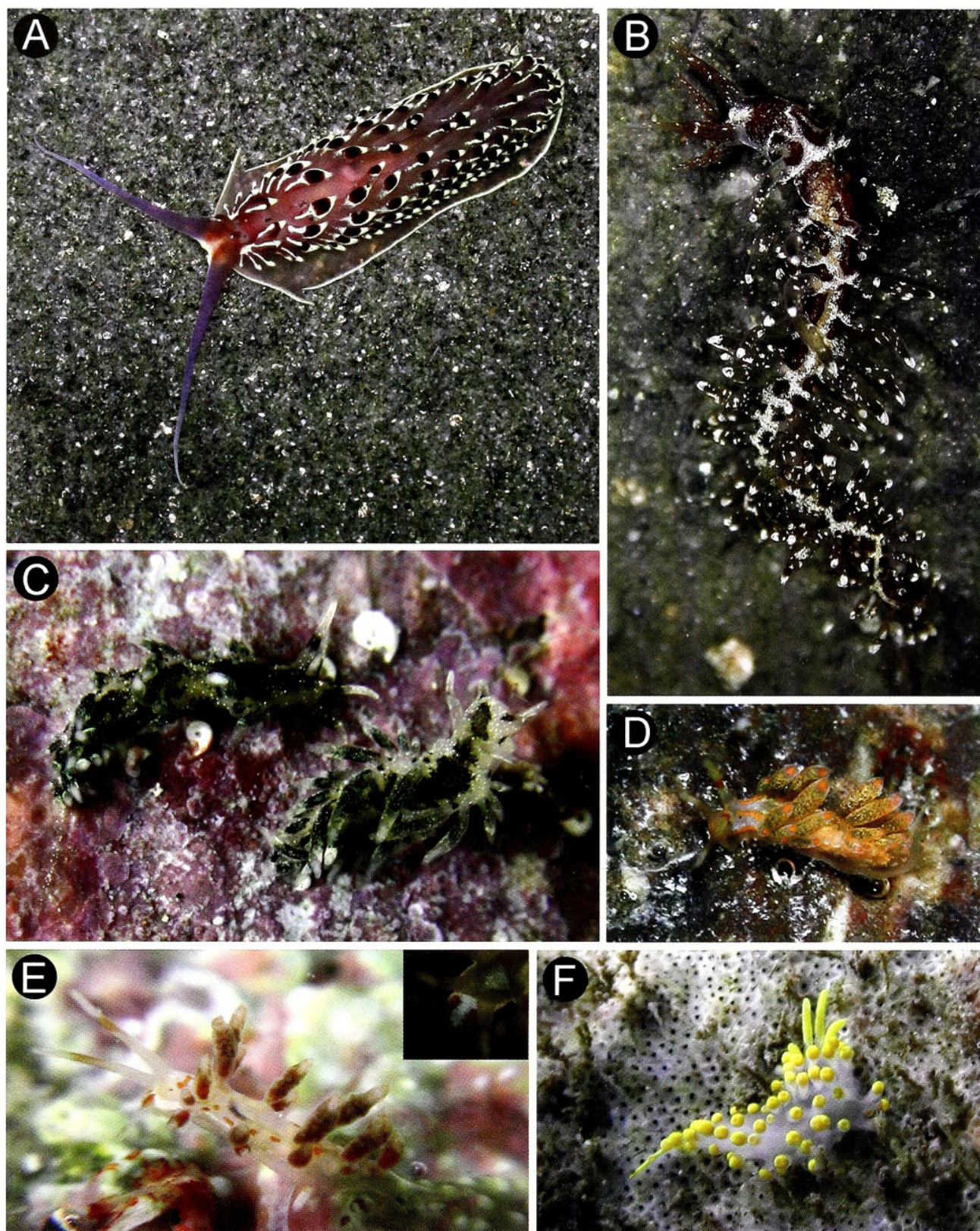
Genus *Herviella* Baba, 1949

*Herviella* sp.

(Figs. 1B, 2-3)

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**Figure 1.** Photographs of eastern Pacific aeolids taken in the field. A, *Cerberilla chavezii* sp. nov., holotype, 19 mm long (LACM 3058). B, *Herviella* sp., 23 mm long (LACM 172799). C, *Cuthona destinyae* sp. nov., holotype and paratype, 6 mm long (LACM 3052, CASIZ). D, *Cuthona millenae* sp. nov., holotype, 5 mm long (LACM 3053). E, *Eubranchius yolandae* sp. nov., holotype, 6 mm long (LACM 3055), inset showing markings on cephalic region. F, *Cuthona behrensi* sp. nov., holotype, 5 mm long (LACM 3059).



### Material examined

Two specimens 11 and 23 mm long, Bahía Damas (7°24.000'N, 81°39.000'W), southeast of Isla de Coiba, Parque Nacional de Coiba, Panama, 11 May 2003, collected on a floating buoy (LACM 172799).

### External morphology

The body is extremely long and narrow (Fig. 1B); the larger specimen examined was 23 mm long and 4 mm wide, and the smaller specimen was 11 mm long and 3 mm wide. The pedal corners are short and rounded. There is a pair of cerata anterior to the pericardium on each side. The rest of the cerata are situated behind the pericardium and arranged in rows of one to two cerata. The larger specimen had 23 rows of cerata and the smaller one had 12. The cerata are short and slender, club-shaped, and slightly curved upwards. The rhinophores are smooth, wider at the base, and taper abruptly to a pointed tip. The oral tentacles are almost as long as the rhinophores. The gonopore is situated on the right side of the body. The position of the anus could not be determined with certainty.

The body is light brown. The dorsum bears a grayish-silver line composed of numerous minute silver specks. The line is wider at the base of the rhinophores and in the cephalic region. Posterior to the rhinophores, the line splits into two branches that surround each of the first ceratal groups and the pericardium. There is a gap in the interhepatic region where the silver line is not visible and the ground color is lighter than in the rest of the body. Posterior to the pericardium the divided silver line merges again at the center of the dorsum, branching out to each ceratal group, forming a zigzag pattern. The cerata are translucent, with the brown, non ramified projections of the digestive gland visible, and opaque white specks on the surface. The tips of the cerata are white; cnidosacs were not seen. The color of the rhinophores is translucent off-white with irregular brown blotches and occasional white specks. The oral tentacles are the same color as the rhinophores.

### Internal anatomy

The radular formula is  $33 \times 0.1.0$  in the 23 mm-long specimen. The radular teeth are two thirds as wide as long (Fig. 2A). The teeth have a smooth central projecting cusp, which is large, wide, and elongated, tapering to a rounded tip. The teeth bear from six to seven smooth denticles on each side of the cusp. The flanking denticles are about half as long as the cusp. The middle denticles on each side are slightly longer than the outermost and innermost ones. The denticles are curved inwards.

The jaws are oval in shape (Fig. 2B). There is a masticatory border consisting of a single row of seven irregular

denticles (Fig. 2C). The denticles are coarse and irregular in shape, size, and position within the masticatory edge.

### Reproductive system

The reproductive system is diaulic (Fig. 3A). The ampulla is an extremely wide and convoluted muscular duct that tapers abruptly distally, where it connects with the female glands. The prostate is long and narrow, coiling several times before connecting with the deferent duct. The bursa copulatrix is rounded and small. The seminal receptacle is about one-sixth of the size of the bursa copulatrix and connects directly with it. The vagina is a long and narrow duct that extends along almost the entire length of the female glands. It lacks a penial spine.

### Natural history and geographic range

The specimens were found on a floating buoy that was covered with hydroids. This species is only known from the type locality in Bahía Damas, Isla de Coiba, Parque Nacional de Coiba, Pacific Coast of Panama (Hermosillo 2004).

### Remarks

This species is provisionally placed in the genus *Herviella* because it possesses the following combination of characters: Elongate shape of the body with rounded pedal corners, smooth rhinophores, long oral tentacles, uniseriate radula with a protruding cusp, and few denticles and arrangement of cerata in single sloping rows. Some species of *Herviella*, including the type species, have penial spines, however, a spine is absent in *Herviella* sp., and some other species such as *Herviella africana* Edmunds, 1970 and *H. cloaca* Rudman, 1980 (Burn 1967).

We were unable to locate the position of the anus and therefore the generic placement is uncertain; for the same reason we are not naming the species until more specimens become available for study.

There are ten members of the genus *Herviella*, nine of them known from the Indo-West Pacific (Burn 1967, Rudman 1980) and one from Tanzania, eastern Atlantic (Edmunds 1970). If the generic placement is confirmed, *Herviella* sp. would be the only species of the genus that has been collected in the eastern Pacific.

Family Tergipedidae Bergh, 1889

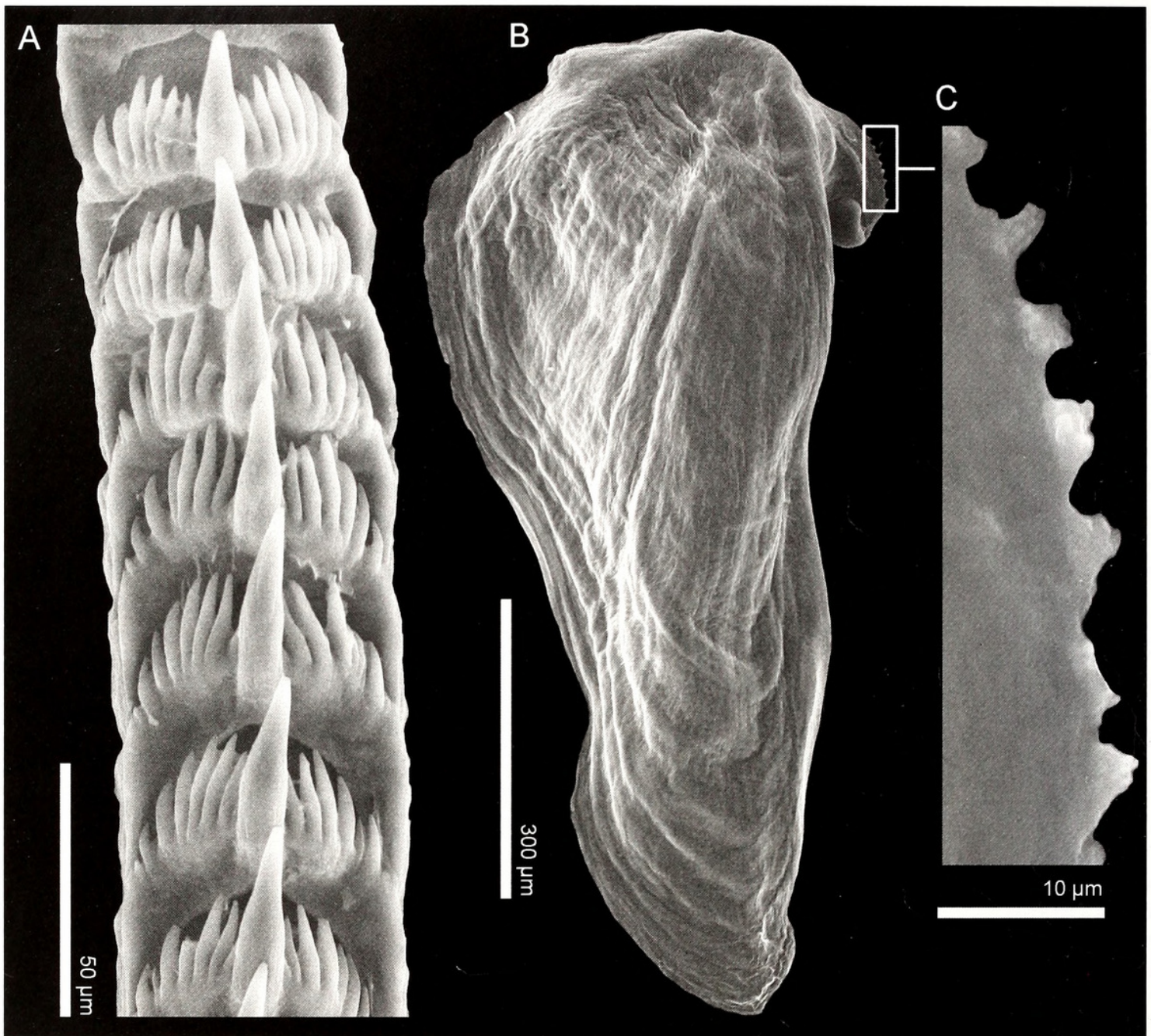
Genus *Cuthona* Alder and Hancock, 1855

*Cuthona destinyae* Hermosillo and Valdés, sp. nov.  
(Figs. 1C, 4-5)

### Material examined

Holotype: 6 mm long, La Godornia (17°37.854'N, 101°33.562'W), Zihuatanejo, Guerrero, Mexico, 19 March 2004, collected from scrapings of the hull of the M/V *Destiny*





**Figure 2.** *Herviella* sp. (LACM 172799), scanning electron micrographs of the radula and jaw. A, Rachidian tooth, scale bar = 50 µm. B, Distal view of the right jaw, scale bar = 300 µm. C, Masticatory edge of the jaw, scale bar = 10 µm.

by A. Hermosillo and D. Behrens (LACM 3052). Paratypes: 7 specimens 6, 3, 2, 5, 4, 3, and 5 mm long, La Godornia (17°37.854'N, 101°33.562'W), Zihuatanejo, Guerrero, Mexico, 19 March 2004, collected from scrapings of the hull of the M/V *Destiny* by A. Hermosillo and D. Behrens (CA-SIZ). Playa Avellanas, Guanacaste, Costa Rica, (10°13.583'N, 85°50.433'W), 15 January 2001, 4 specimens, 1.5-2 mm preserved length, leg. S. Avila (INB 0003118106).

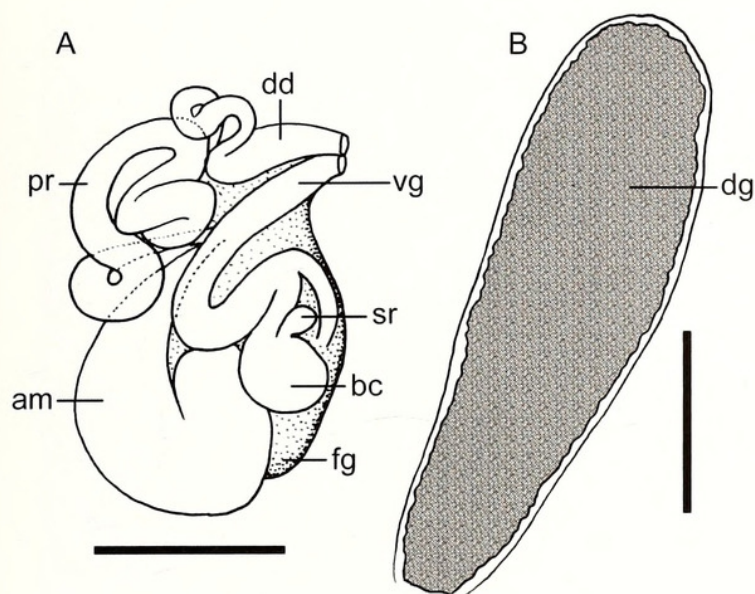
#### External morphology

The body is narrow and elongate. The rhinophores are smooth and long, tapering to blunt apices. The pedal corners

are rounded. The genital opening is located anteriorly, below the first group of cerata. The anal opening is acleioproctic, located between the first and second rows of cerata, posterior to the pericardium at the same level as the lower-most cerata (Fig. 5A). The oral tentacles are half as long as the rhinophores, tapering to blunt tips. The cerata are lanceolate (Fig. 5C), arranged in four to five straight rows. The first row is situated anterior to the pericardium and contains four cerata; the rest of the rows contain five cerata each. The cerata located more ventrally are smaller than those located more dorsally.

The body is translucent white. There are large dark





**Figure 3.** *Herviella* sp. (LACM 172799). A, Reproductive system, scale bar = 1 mm. B, Ceras showing the digestive gland, scale bar = 1 mm. Abbreviations: am, ampulla; bc, bursa copulatrix; dd, deferent duct; dg, digestive gland; fg, female glands; pr, prostate; sr, seminal receptacle; vg, vagina.

patches composed of densely arranged olive-green to black spots along the midline of the notum and on the cephalic area. The sides of the body bear dark brown markings. Minute, opaque white specks are present on the lighter parts of the body. The ramifications of the digestive gland are brown. Basally, the cerata are covered with dark specks. The middle region of each ceras has a lighter band. The tip of each ceras is white, where a cnidosac can be observed. There are occasional white flecks on the surfaces of the cerata. The rhinophores have white specks on their bases, medial bands of black blotches, and white tips. The oral tentacles bear brown blotches on their sides and scattered white specks; their distal portions are lighter, with a less dense pigment present.

#### Internal anatomy

The radular formula is  $19 \times 0.1.0$  in a 6 mm-long specimen. The radular teeth bear elongated, smooth central cusps (Fig. 4A). The base of the central cusp is narrow, it widens slightly distally and gradually tapers to a pointed tip. Each tooth has five to six smooth denticles on each side of the cusp, the denticles are slightly inclined inwards. The innermost denticles are shorter; they increase in length towards the outside of the ribbon. Some teeth have smaller outer denticles distal to the larger ones. The jaw is ovoid in shape (Fig. 4B). The masticatory edge of the jaw is serrated (Fig. 4C), with 31 smooth denticles; some denticles have ramified tips.

#### Reproductive system

The reproductive system is diaulic (Fig. 5B). The am-

pulla is long, convoluted and connects with the female glands. The prostate is also convoluted and long. It narrows slightly into the deferent duct. The deferent duct opens into a common atrium with an accessory penial gland. The vaginal duct is long and connects directly with the bursa copulatrix, which is rounded and small. The penis does not have a cuticular stylet.

#### Geographic range

This species is only known from Ixtapa-Zihuatanejo, Guerrero, Pacific coast of Mexico (Hermosillo and Behrens 2005) as *Cuthona* sp. 1 and from Costa Rica and the Galapagos Islands, Ecuador (Camacho-García *et al.* 2005) as *Cuthona* sp. 2.

**Natural history:** Specimens of this species were found on encrusting hydroids living on a boat hull. Numerous egg masses were collected on the same hydroids and probably belong to this species; they were white and shaped like the letter "c."

#### Etymology

The expedition on board of the M/V *Destiny* allowed us to learn more about the opisthobranchs of the Panamic Pacific. The specific name *destinyae* is given in appreciation to *Destiny's* owner Steve Drogin for all his support.

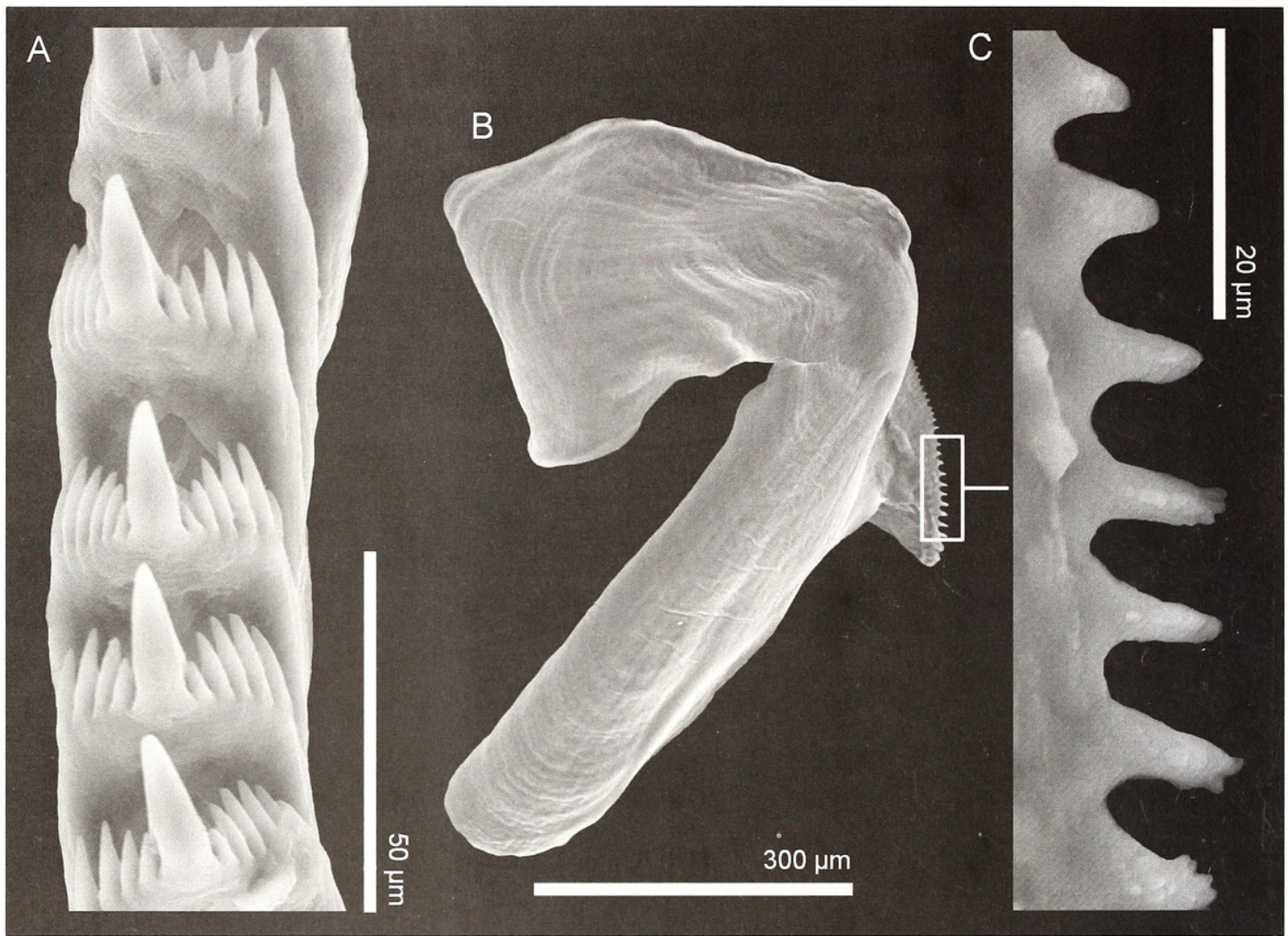
#### Remarks

The placement of this species in *Cuthona* is based upon the presence of several diagnostic features of the genus, as discussed by Gosliner (1981), such as rounded corners of the foot; smooth, tentacular rhinophores; club-shaped cerata; acleioproctus anus; reproductive system with an accessory penial gland; and uniseriate radula.

There are 22 species of *Cuthona* known for the western hemisphere. Gosliner (1981) reported 17 valid species of *Cuthona* for the eastern Pacific and described *Cuthona phoenix* Gosliner, 1981 from La Jolla, California, which has since been reported from Guerrero, Mexico (Hermosillo and Behrens 2005) and Costa Rica (Y. Camacho-García, pers. comm.). Behrens (1985a, 1987) described two additional species: *Cuthona longi* Behrens, 1985 from the Gulf of California and *Cuthona hamanni* Behrens, 1987 from San Diego, California. Millen (1985) described *Cuthona punicea* Millen, 1985 from Vancouver, Canada. More recently, Angulo-Campillo and Valdés (2003) described *Cuthona lizae* Angulo-Campillo and Valdés, 2003 with the type locality in Baja California Sur; this species has been subsequently found in Bahía de Banderas, Jalisco-Nayarit and Isla Isabela, Nayarit, Mexico (Alicia Hermosillo, pers. obs.).

No other eastern Pacific species is similar to *Cuthona destinyae* in external coloration. Only *Cuthona phoenix* Gosliner, 1981 has a known geographic range that overlaps with





**Figure 4.** *Cuthona destinyae* sp. nov., holotype (LACM 3052), scanning electron micrographs of the radula and jaw. A, Radular teeth, scale bar = 50 µm. B, Distal view of the right jaw, scale bar = 300 µm. C, Masticatory edge of the jaw, scale bar = 20 µm.

that of *Cuthona destinyae* because it is known from California (Gosliner 1981) to Costa Rica (Y. Camacho-García, pers. comm.). These two species are easily distinguishable. Individuals of *C. phoenix* have only one ceras per row, whereas those of *C. destinyae* have four to five. The general body color of *C. phoenix* is translucent white with an orange tint and the cerata are orange-brown with small brown flecks (Gosliner 1981). This contrasts with the translucent white with dark blotches, central clear band, and white tip of the cerata of *C. destinyae*. *Cuthona phoenix* has an orange spot on the cephalic area whereas *C. destinyae* has a brownish-black spot.

*Cuthona pinnifera* (Baba, 1949) is known from Japan and Hawaii (Gosliner 1980) but is the only other Pacific species with a similar overall coloration to *Cuthona destinyae*. *Cuthona pinnifera* has a patchy dark brown coloration with some occasional opaque white spots on the dorsum. The oral tentacles are opaque white distally (Baba 1949).

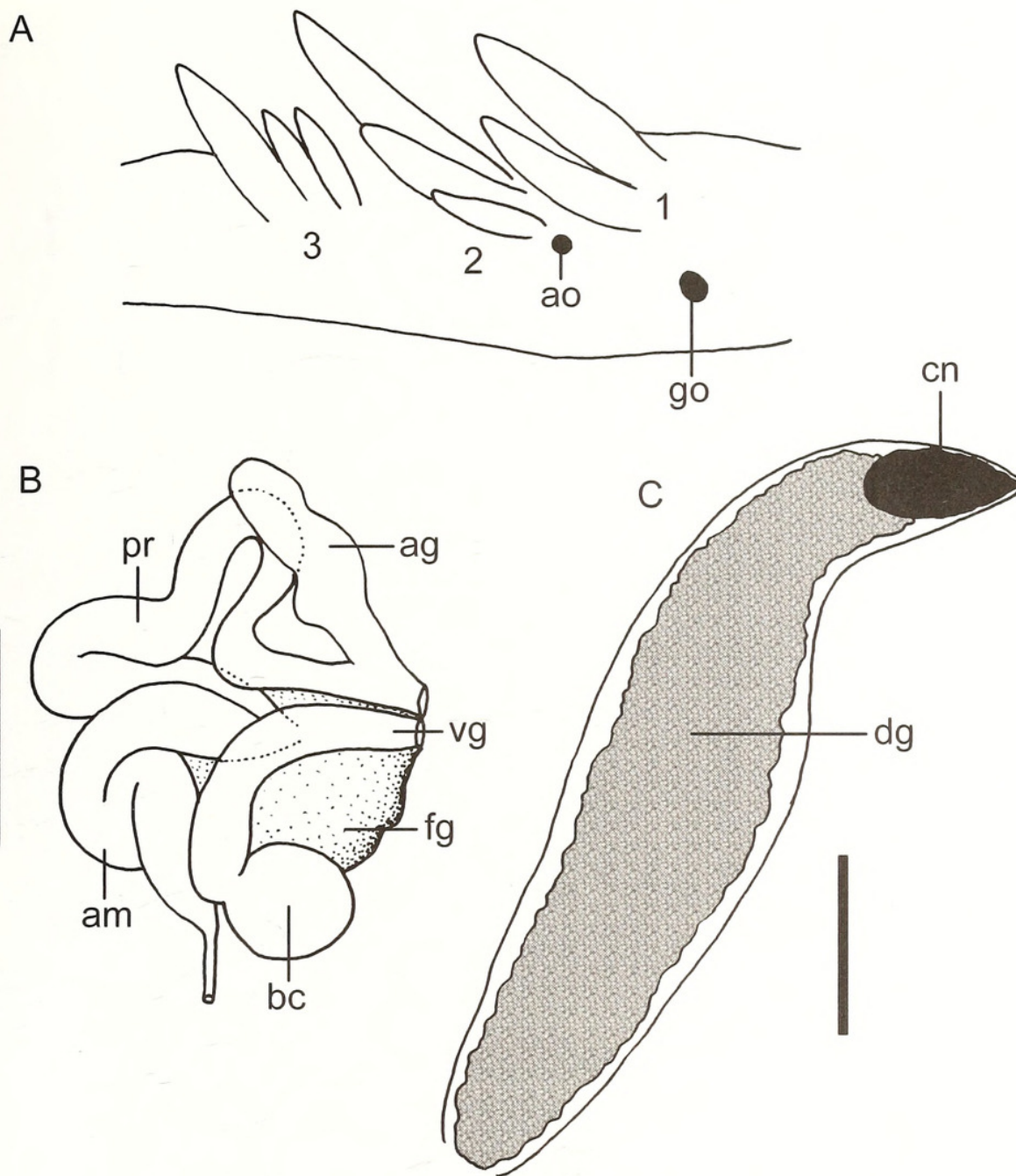
*Cuthona destinyae* also has brown blotches but the background color is translucent white, which gives it the appearance of a much lighter animal. The most distinctive character separating *C. destinyae* from *C. pinnifera* is the form of the rhinophores. The rhinophores of *C. pinnifera* are annulate and the rhinophores of *C. destinyae* are smooth.

*Cuthona millenae* Hermosillo and Valdés, sp. nov.  
(Figs. 1D, 6-7)

#### Material examined

Holotype: 5 mm long, Los Arcos (20°32.855'N, 105°17.340'W), Bahía de Banderas, Jalisco-Nayarit, Mexico, 29 May 2003, collected under a rock at 19 m of depth (LACM 3053). Paratype: 1 specimen 5 mm long, Islas Marietas (20°42.042'N, 105°33.878'W), Bahía de Banderas, Jalisco-Nayarit, Mexico, 11 January 2005 (LACM 3050). Playa Real, NE Punta Roble, Guanacaste, Costa Rica, 20





**Figure 5.** *Cuthona destinyae* sp. nov., holotype (LACM 3052). A, Arrangement of the anal opening and the gonopore; numbers represent the ceratal groups. B, Reproductive system, scale bar = 0.5 mm. C, Ceras, scale bar = 1 mm. Abbreviations: ag, accessory penial gland; am, ampulla; ao, anal opening; bc, bursa copulatrix; cn, cnidosac; dd, deferent duct; dg, digestive gland; fg, female glands; go, gonopore; pr, prostate; sr, seminal receptacle; vg, vagina.

April 2004 (10°23.200'N, 85°50.733'W), 5 m depth, 1 specimen 2 mm long, leg. T. M. Gosliner (INB 0003836263).

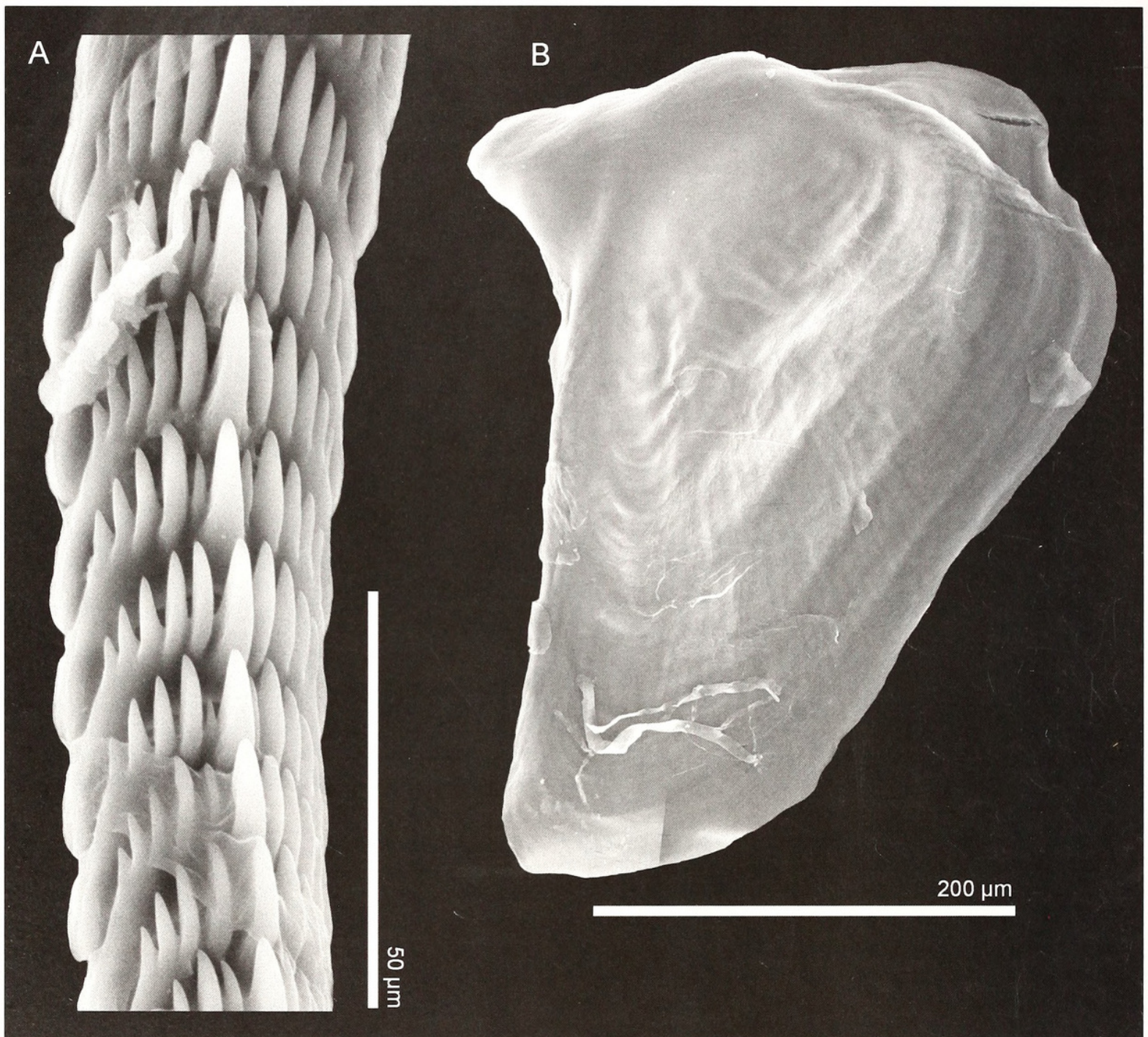
#### External morphology

The living animal was 5 mm in length. The body is elongated and narrow, the posterior end is long and pointed. The pedal corners are wide and rounded. The oral tentacles are about two thirds the size of the rhinophores. The rhinophores are smooth, tapering slightly to rounded tips. The cerata are relatively large compared to the size of the animal. The cerata are club-shaped with pointed apices (Fig. 7B). The cerata are arranged in two groups of straight rows. One group is located anterior to the pericardium. The first row has six cerata; the cerata become smaller ventrally. The num-

ber of cerata in the half rows posterior to the pericardium are 2(4) and 3(4). The gonopore is situated on the right side of the body.

The background color of the body is orange with darker orange and yellow spots. The cephalic portion of the body is pale whitish-blue and bears two well-defined orange lines that extend from the bases of the rhinophores to the first ceratal row. Two other orange lines are visible from the first ceras to the bases of the oral tentacles. Each rhinophore is proximally white and graduates into light yellow towards the apex, with a tan band in the middle. The oral tentacles have tan bases that extend onto the front of the cephalic area and yellow tips. The cerata are blotchy pale orange, with apical pale blue bands and bright orange pointed cnidosacs.





**Figure 6.** *Cuthona millenae* sp. nov., holotype (LACM 3053), scanning electron micrographs of the radula and jaw. A, Radular teeth, scale bar = 50  $\mu$ m. B, Distal view of the left jaw, scale bar = 200  $\mu$ m.

#### Internal anatomy

The radular formula is  $42 \times 0.1.0$  in the holotype. The rachidian tooth bears a smooth central cusp that is just slightly longer and wider than the lateral denticles (Fig. 6A). There are four to five smooth denticles on each side of the central cusp. The outermost denticles are smaller than the ones in the middle of the row. The jaws are irregular in shape, with smooth masticatory edges (Fig. 6B).

#### Reproductive system

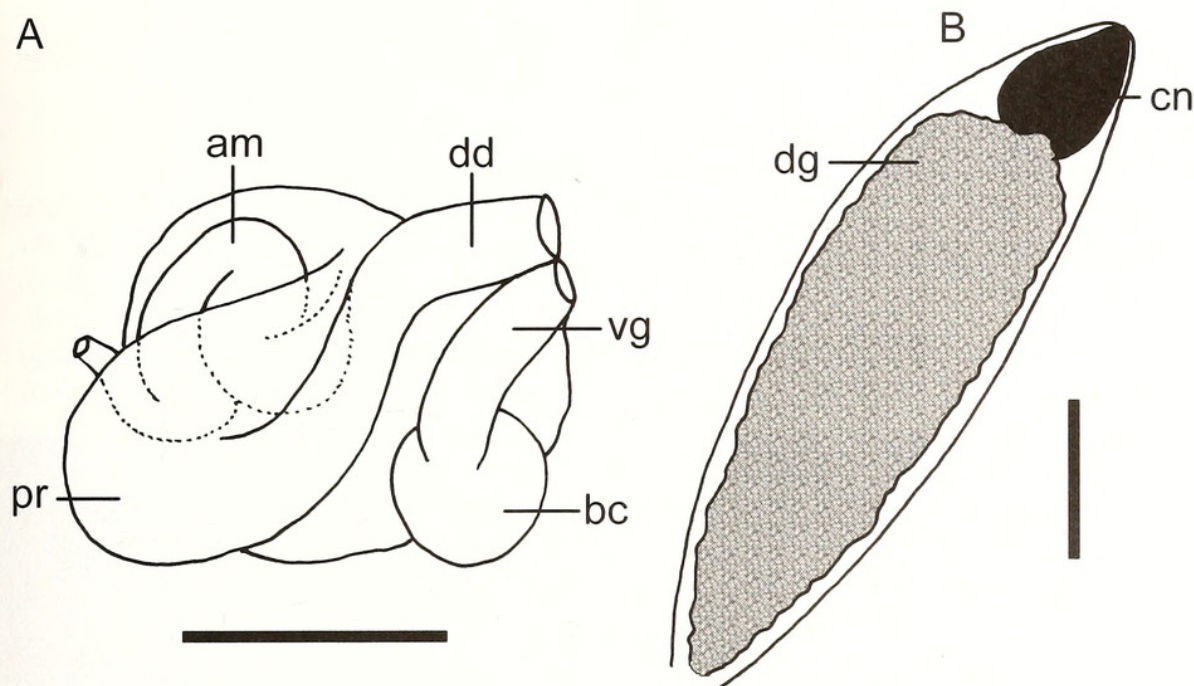
The reproductive system is diaulic (Fig. 7A). The am-

pulla is wide and convoluted with two folds; it narrows and connects with the female glands. The prostate is long and wide, with one fold. The prostate is about half the size of the entire reproductive system. The deferent duct is not distinguishable in dissection from the prostate. The bursa copulatrix is rounded and small and connects directly to the vaginal duct, which is the same size as the deferent duct. An accessory penial gland was not found.

#### Natural history and geographic range

Individuals of this species were found crawling on a





**Figure 7.** *Cuthona millenae* sp. nov., holotype (LACM 3053). A, Reproductive system, scale bar = 0.5 mm. B, Ceras, scale bar = 1 mm. Abbreviations: am, ampulla; bc, bursa copulatrix; cn, cnidosac; dg, digestive gland; pr, prostate; vg, vagina.

rock wall covered by various species of hydroids. This species is only known from Bahía de Banderas, Jalisco-Nayarit, Pacific coast of Mexico (A. Hermosillo, pers. obs.) and from Costa Rica (Camacho-García *et al.* 2005), cited as *Cuthona* sp. 8.

### Etymology

The specific name *millenae* is given in honor of Sandra Millen in appreciation for her contributions to the present paper and to the knowledge of the opisthobranch fauna in the eastern Pacific.

### Remarks

The generic placement of *Cuthona millenae* is based on the shape of the body and the morphologies of the rhinophores and the radular teeth, which are consistent with the characteristics of other species of the genus *Cuthona* discussed by Gosliner (1981). However, an accessory penial gland was not found in *C. millenae*. This is most likely due to the small size of the specimen dissected: it was either immature or the small size of the reproductive system prevented us from observing all the organs. It is also possible that this character may be variable within the genus *Cuthona*.

*Cuthona millenae* is distinguishable from other members of the genus in several regards. The characteristic bright orange pigment on the tips of the cerata, the orange lines running from the bases of the rhinophores to the first ceras, and the pair of lines extending to the bases of the oral tentacles, have not been described for any other species of *Cuthona*. Only two other species of *Cuthona* are found within the geographic range of *C. millenae*: *Cuthona lizae*

Angulo-Campillo and Valdés, 2003, which is known from La Paz, Baja California; Isla Isabela, Nayarit; and Bahía de Banderas, Jalisco-Nayarit; Mexico (A. Hermosillo, personal observation) and *Cuthona phoenix* Gosliner, 1981, which is known from La Jolla, California, to Guerrero, Mexico (Hermosillo and Behrens 2005) and Costa Rica (Camacho-García *et al.* 2005). The three species are readily distinguishable by their external colorations. *Cuthona lizae* has a brown body with a bright pink cephalic area and it has a large and distinctive white spot on the dorsum (Angulo-Campillo and Valdés 2003). *Cuthona phoenix* is translucent white with an orange tint but the cerata are orange-brown with small brown flecks (Gosliner 1981).

No other species described for the eastern Pacific has the combination of colors nor is as colorful as *Cuthona millenae*. Therefore, comparisons are made with other colorful species from the Indo-West Pacific. *Cuthona ornata* Baba, 1937 from Japan and *Cuthona speciosa* (Macnae, 1954) from South Africa are the species most similar to *C. millenae*. The background color of the three species is orange, but individuals of *C. millenae* are covered with opaque yellow and bright orange spots, whereas those of *C. ornata* and *C. speciosa* are solid orange (Gosliner 1981). Individuals of both *C. ornata* and *C. millenae* have colored markings on the cephalic areas, but the markings on individuals of *C. millenae* are orange and those of *C. ornata* are white. The most distinctive difference is in the color of the cerata: *Cuthona ornata* has electric blue cerata with yellow tips, *C. speciosa* has turquoise blue cerata with yellow tips, and *C. millenae* has pale yellow cerata with bright orange tips.

*Cuthona diversicolor* Baba, 1975 is known from Japan and Hong Kong. The background color of this species is



white with yellow specks. The cerata are dark green with a white band and an orange tip (Baba 1975). The orange tips of the cerata is the only characteristic it has in common with *Cuthona millenae*. The elongated shape of *C. diversicolor* and the large number of cerata (see Baba 1975) clearly distinguish these two species.

*Cuthona behrensi* Hermosillo and Valdés, sp. nov.  
(Figs. 1F, 8-9)

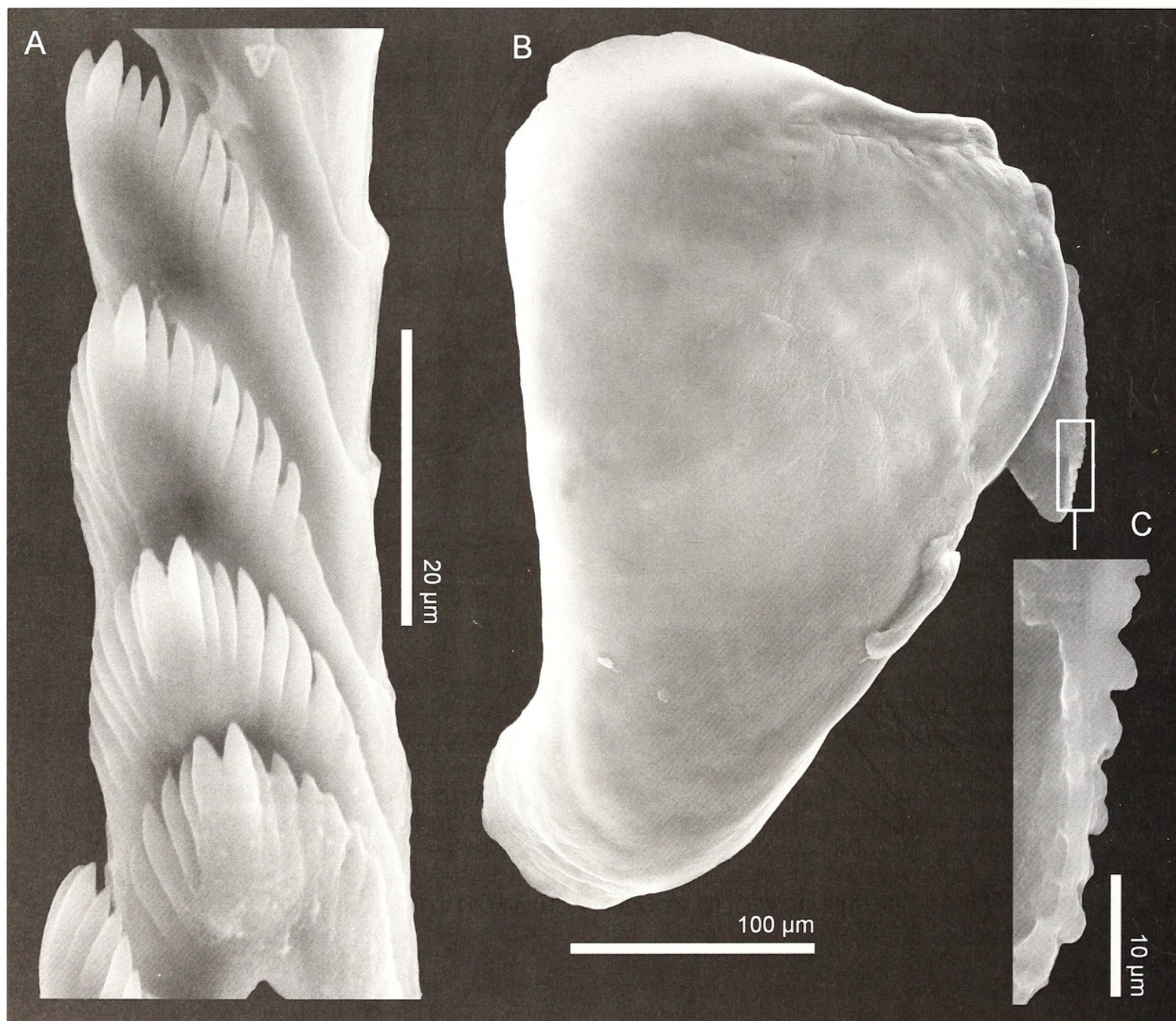
#### Material examined

Holotype: 5 mm long, Los Frailes Norte (7°22.370'N,

80°09.289'W), Los Frailes, Azuero Peninsula, Golfo de Chiriquí, Panama, 2 May 2003, collected under a rock at 13 m deep (LACM 3059).

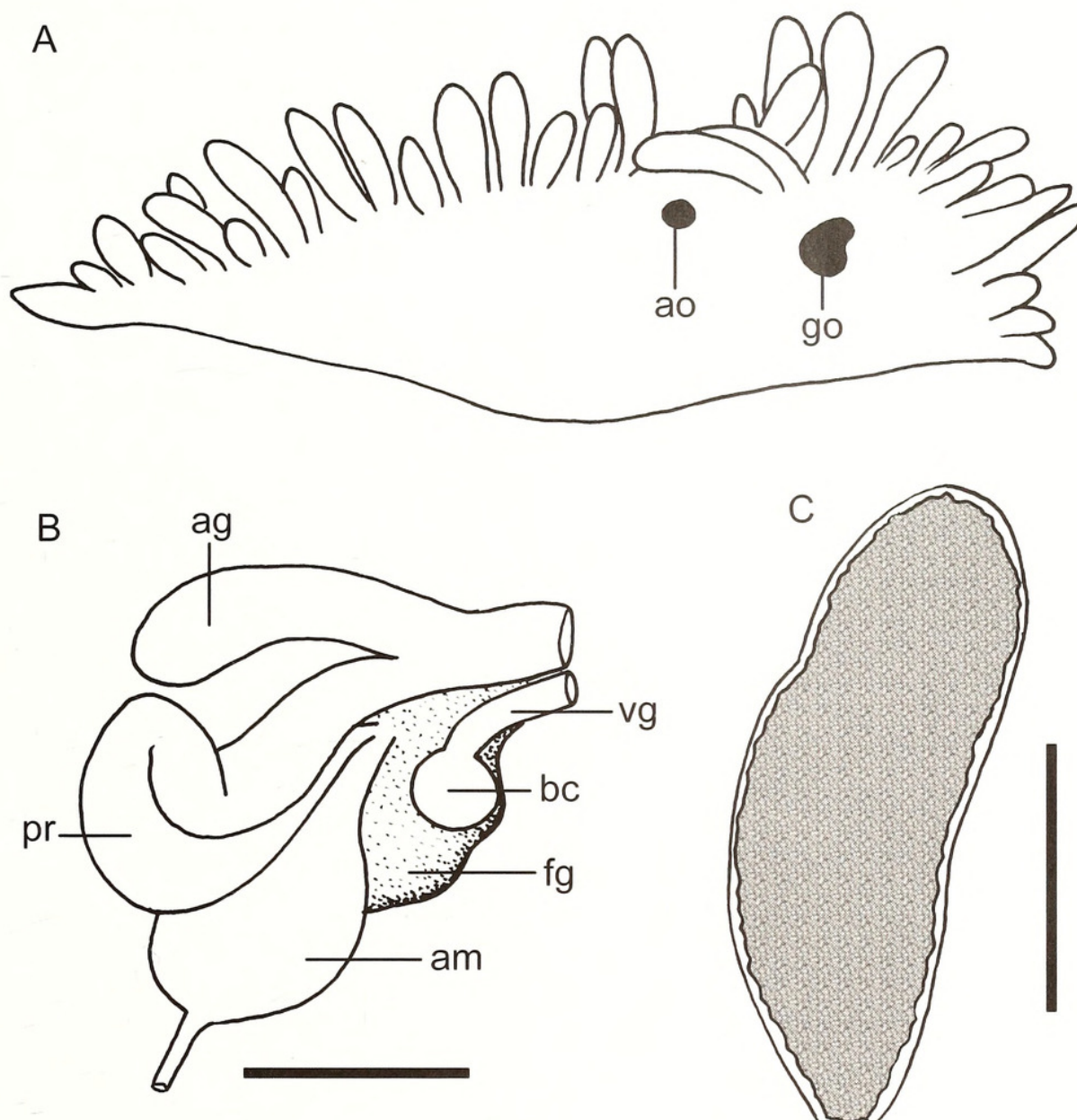
#### External morphology

The body is elongated and narrow (Fig. 9A). The pedal corners are rounded. The foot is wider anteriorly and the posterior portion of the foot is long and thin. The rhinophores are smooth and long, with rounded apices. The diameters of the rhinophores are constant throughout their lengths. The oral tentacles are two-thirds the length of the



**Figure 8.** *Cuthona behrensi* sp. nov., holotype (LACM 3054), scanning electron micrographs of the radula and jaws. A, Radular teeth, scale bar = 20  $\mu$ m. B, Distal view of the right jaw, scale bar = 100  $\mu$ m. C, Masticatory edge of the jaw, scale bar = 10  $\mu$ m.





**Figure 9.** *Cuthona behrensi* sp. nov., holotype (LACM 3054). A, Arrangement of the anal opening and gonopore. B, Reproductive system, scale bar = 0.5 mm. C, Ceras, scale bar = 1 mm. Abbreviations: ag, accessory penial gland; am, ampulla; ao, anal opening; bc, bursa copulatrix; fg, female glands; go, gonopore; pr, prostate; vg, vagina.

rhinophores and taper slightly into rounded tips. The cerata gradually increase in width from slender bases to large, bulbous regions at the distal ends. The tips of the cerata are rounded and no cnidosacs were observed (Fig. 9C). The cerata are arranged in seven rows. The anterior rows have more cerata than do the posterior ones. The cerata closer to the center of the dorsum are larger than the more ventral ones in each row. The number of cerata in each half-row are: 1(6), 2(4), 3(3), 4(3), 5(2), 6(1), and 7 (1). The gonopore is visible on the right side, ventral to the first group of cerata. The anal opening is located anterior to the second group of cerata below the hepatic area.

The body is a translucent bright white. The rhinophores

are white basally and bright yellow on the upper two thirds. The oral tentacles have the same coloration as the rhinophores. The cerata are translucent white. The ramifications of the digestive gland are opaque white with orange areas below the bright yellow rounded apices. The dorsal surface of the posterior end of the foot has a bright yellow line.

#### Internal anatomy

The radular formula is  $17 \times 0.1.0$  in the holotype (Fig. 8A). The radular teeth have bifid central cusps. On each side of the cusp there are five to seven smooth, shorter denticles. The outermost denticles are smaller than the ones closer to the central cusp. The denticles are slightly curved inwards.



The jaws are oval in shape (Fig. 8B); each one has a single row of rounded, irregular denticles on the masticatory edge.

### Reproductive system

The reproductive system is diaulic (Fig. 9A). The ampulla is large and pyriform. The vaginal duct is tubular, short, and connects directly with the small, round bursa copulatrix. The prostate is long and convoluted, opening into a common atrium with the accessory penial gland. Penial papillae and penial spines were not present.

### Natural history and geographic range

The single specimen was found on an islet in an environment exposed to considerable wave action, under a rock covered with numerous hydroids. This species is only known only for the type locality, Los Frailes, Azuero Peninsula, Golfo de Chiriquí, Panama (Hermosillo 2004).

### Etymology

The specific name is given in honor of our dear friend and colleague Dave Behrens, for his contributions to the knowledge of the opisthobranch fauna of the eastern Pacific and for his unconditional support.

### Remarks

The generic placement of *Cuthona behrensi* is based on the external morphology and anatomy of this species, which fit within the diagnosis of the genus by Gosliner (1981).

Externally, *Cuthona behrensi* is very different from other known species of *Cuthona*. There is no other species in this genus with only two colors that has a geographic range that overlaps the known occurrence of *C. behrensi*. Moreover, no other species of *Cuthona* is currently known from Panama.

Among the species of *Cuthona* described for the eastern Pacific, *Cuthona cocoachroma* Williams and Gosliner, 1979 also has two colors, but it has a brown-tinted white background with brown cerata; the cerata bear bright white tips (Williams and Gosliner 1979). The shape of the body is also different from that of *Cuthona behrensi*, being more slender with narrower cerata, as opposed to the stouter *C. behrensi* with inflated cerata.

*Cuthona concinna* (Alder and Hancock, 1843) is found in the eastern Pacific (Vancouver, Canada) and in the North Atlantic (see Behrens 1991). This species has a white background color similar to that of *Cuthona behrensi*, but it is easily distinguishable by the presence of its brown color and the more slender shape of the cerata. Moreover, the rhinophores of *C. concinna* are thick at the bases and taper abruptly into pointed apices (Behrens 1991), whereas the rhinophores of *C. behrensi* do not taper and the apices are rounded.

*Cuthona divae* (Er. Marcus, 1961) is known for the

northern Pacific coast of the United States (see Behrens 1991). The body is white as are the rhinophores and the oral tentacles. The dark pink digestive gland can be seen through the translucent white cerata (Marcus 1961).

Family Eubranchidae Odhner, 1934

Genus *Eubranchus* Forbes, 1838

*Eubranchus yolandae* Hermosillo and Valdés, sp. nov.  
(Figs. 1E, 10-11)

### Material examined

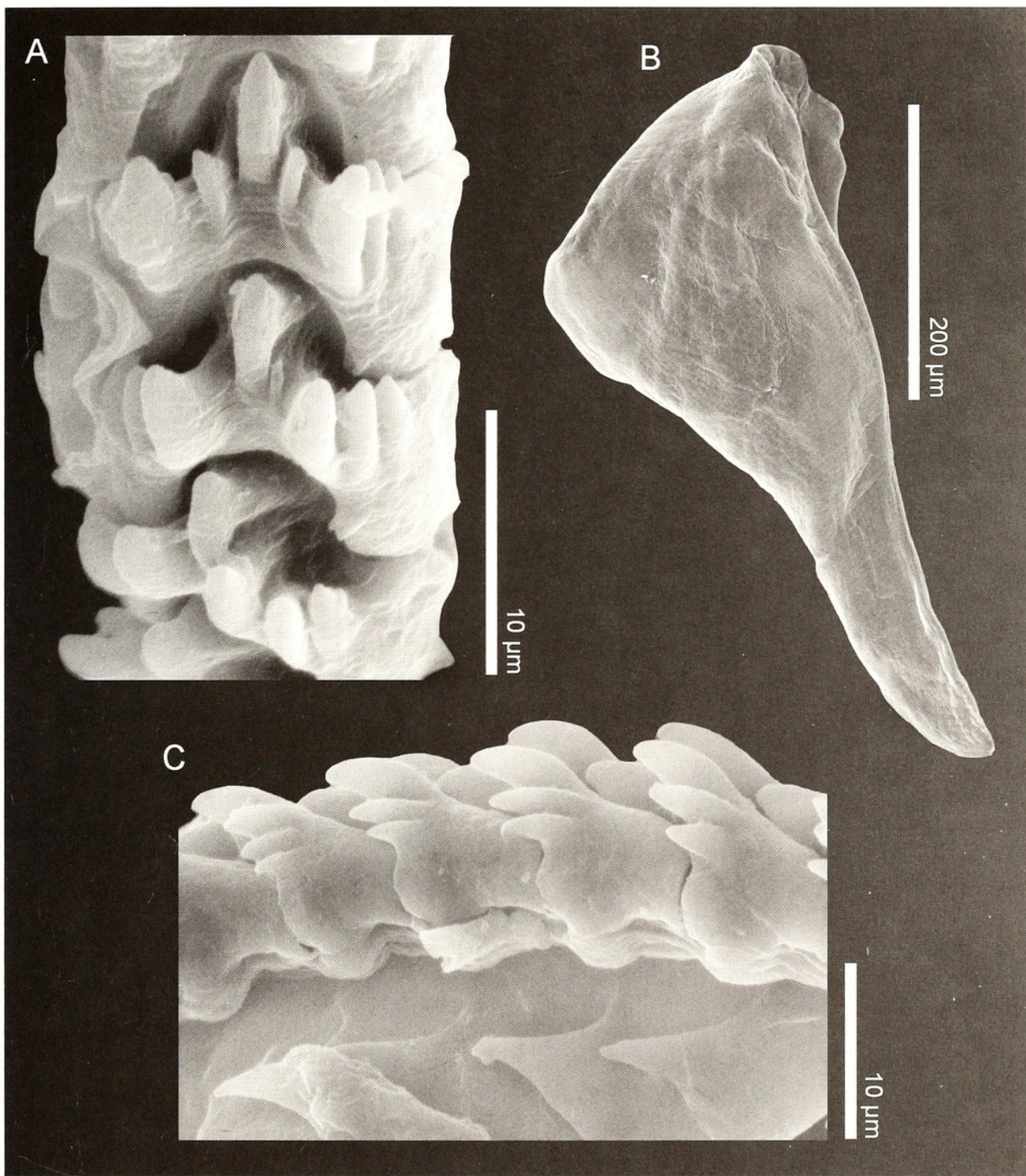
Holotype: 6 mm long, Los Arcos (20°32.855'N, 105°17.340'W), Bahía de Banderas, Jalisco-Nayarit, Mexico, 26 May 2004, collected on a rock wall at 17 m of depth (LACM 3055). Paratypes: 2 specimens, 2-3 mm long, Los Arcos (20°32.855'N, 105°17.340'W), Bahía de Banderas, Jalisco-Nayarit, Mexico, 26 May 2004 (LACM 3056); 1 specimen, 4 mm long, Mismaloya (20°31.937'N, 105°17.700'W), Bahía de Banderas, Jalisco-Nayarit, Mexico, 21 May 2004, collected on a wall at 17 m of depth (LACM 3057).

### External morphology

The shape of the body is narrow and elongated (Fig. 1E), up to 6 mm long in life. The rhinophores are smooth and very long, tapering into blunt apices. The pedal corners are rounded. The posterior portion of the foot is long and slender. The genital opening is located anterior to and below the first group of cerata. The anal opening is acleioproctic, located between the first and second rows of cerata, posterior to the pericardium and at the same level of the lower cerata. The oral tentacles are short relative to the rhinophores. The cerata located more dorsally are larger than the more ventral ones. A few cerata are much larger than the rest and are located randomly along the dorsum. The cerata are club-shaped and elongated (Fig. 11A), arranged in 7 rows of 1(3), 2(3), 3-6(2), and 7(1) cerata per half-row. There are 6 rows of cerata in the 4 mm specimen and 5 rows in the 2 and 3 mm long specimens. The first row is anterior to the pericardium. Smaller specimens readily shed the cerata when they were being collected.

The background color is translucent white. Fine opaque yellow lines can be observed along the dorsum, arranged in a random manner that varies among individuals. The sides of the body have opaque clear blue markings composed of minute specks; these marks are situated ventral to the ceratal level. The cephalic area is clear blue with two orange triangular streaks that begin anterior to the bases of the rhinophores and end at the bases of the oral tentacles. The oral tentacles are basally white, with three fourths of the length orange, and a white tip. The surface of each cerata is wine red with a distal orange band and a white cnidosac. In some





**Figure 10.** *Eubranchius yolandae* sp. nov., holotype (LACM 3055), scanning electron micrographs of the radula and jaw. A, Radular teeth, scale bar = 10 µm. B, Distal view of the right jaw, scale bar = 200 µm. C, Lateral view of the radular teeth, scale bar = 10 µm.

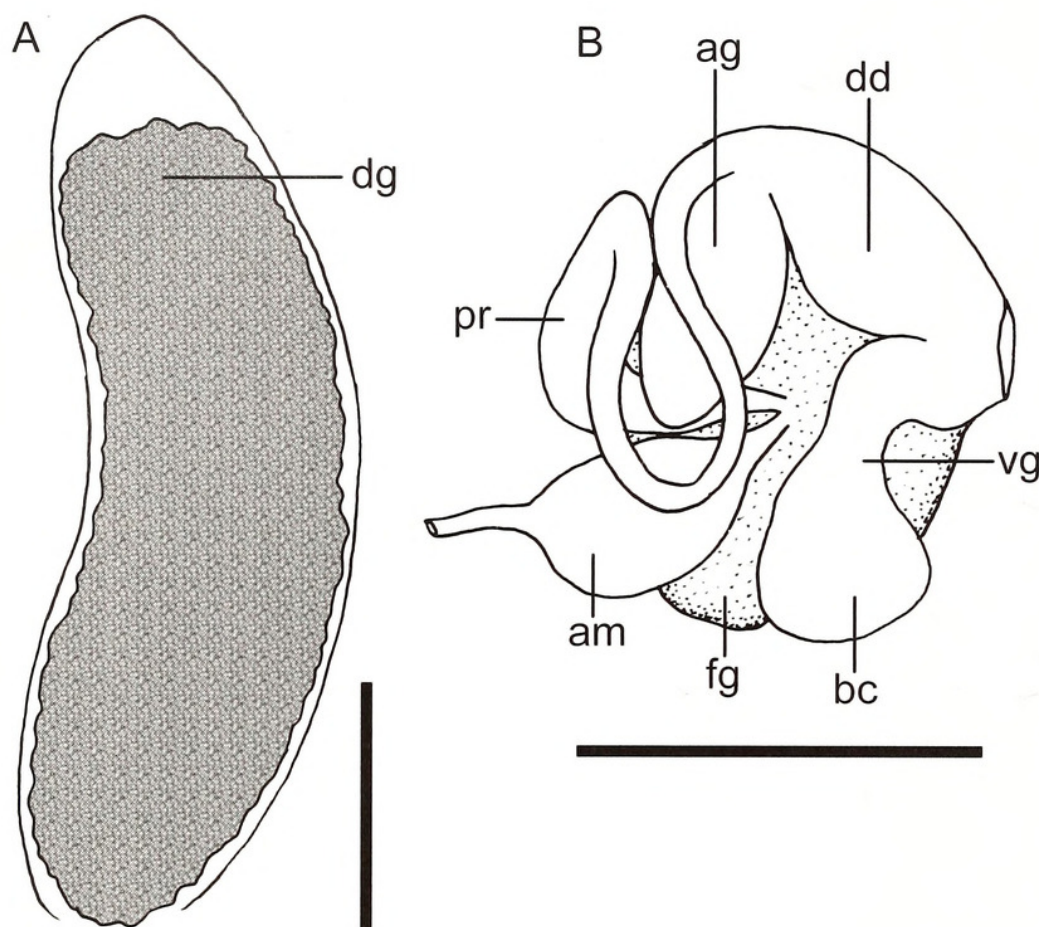
specimens the cerata are dark brown. Each rhinophore is white with a distal orange band and a lighter tip.

#### Internal anatomy

The radular formula is  $55 \times 1.1.1$  in the holotype (LACM 3055). The rachidian teeth are short and wide, and have elongated, smooth central cusps (Fig. 10A). The base of

the central cusp is narrower; it widens distally and gradually tapers slightly to a pointed tip. Each tooth has two to four smooth denticles on each side. There is a lateral tooth on each side of the rachidian teeth (Fig. 10C). The lateral teeth are flat, smooth, triangular plates. The jaw is composed of two elongate plates (Fig. 10B) with smooth masticatory edges.





**Figure 11.** *Eubranchus yolandae* sp. nov., holotype (LACM 3055). A, Ceras, scale bar = 1 mm. B, Reproductive system, scale bar = 0.5 mm. Abbreviations: ag, accessory penile gland; am, ampulla; bc, bursa copulatrix; dd, deferent duct; dg, digestive gland; fg, female glands; pr, prostate; vg, vagina.

### Reproductive system

The reproductive system is diaulic (Fig. 11). The ampulla is short, wide, and connects directly to the female gland. The prostate is slender, convoluted, and long, folding three times. The deferent duct is a short wide muscular duct that opens into a common atrium with the vagina. There is a large, oval accessory penial gland that opens into the proximal end of the deferent duct. The vaginal duct is short and connects directly to the bursa copulatrix, which is large and oval.

### Natural history and geographic range

*Eubranchus yolandae* is found on rocks or macroalgae with dense hydroid coverage. Yellow, "c"-shaped egg masses were attached to the plumarid hydroids on which the nudibranchs were found; these are probably the spawn of this species. This species has been found in several localities in Bahía de Banderas, Jalisco-Nayarit, Mexico.

### Etymology

The specific name is given in recognition of our col-

league and friend Yolanda Camacho-García because of her contributions to the knowledge of the Panamic opisthobranch fauna.

### Remarks

The generic placement of *Eubranchus yolandae* is based on the presence of a combination of features including rounded pedal corners, triseriate radula, rachidian tooth with a single cusp, lateral teeth triangular and elongated, smooth rhinophores, and club-shaped cerata (see Edmunds and Kress 1969). No other species of *Eubranchus* has a color pattern similar to *E. yolandae*. Unique to this species are the blue cephalic region with two orange bands and opaque blue markings on the sides of the body.

There are 7 species of *Eubranchus* described or reported from the eastern Pacific. Only two of those species, *Eubranchus cucullus* Behrens, 1985 and *Eubranchus madapanamensis* (Rao, 1969) are known from areas that overlap the geographic range of *Eubranchus yolandae*. Specimens of *E. cucullus* are very variable in color (Millen *et al.* 2003), therefore color cannot be used to distinguish this species. However, *E. cucullus* is clearly different

from *E. yolandae* in several other regards: the former has a cowl-like cephalic region and triangular, short, oral tentacles (see Behrens 1985b), and the masticatory borders of the jaws of *E. cucullus* have over 20 denticles, whereas those of *E. yolandae* are smooth. *E. madapanamensis* is clearly distinguishable by having annulate rhinophores and highly nodular cerata, as well as the body covered with brown-red spots and the presence of bright orange apices on the cerata.

All of the other five species of *Eubranchus* from the eastern Pacific are externally very different from *Eubranchus yolandae*. *Eubranchus misakiensis* Baba, 1960 is known from Japan and introduced in San Francisco Bay (California); it has an off-white background color, some brown spots, brown markings, light cerata, and tentacular pedal corners. *Eubranchus olivaceus* (O'Donoghue, 1922), a possible synonym of *Eubranchus rupium* (Möller, 1842), found from Alaska to Bahía de los Angeles, Gulf of California, has a translucent white background color with irregular opaque white specks, some brown spots, and an olive green digestive gland that can be seen through the translucent cerata. *Eu-*



*branchus rustyus* (Er. Marcus, 1961), known from Alaska to Punta Abreojos in Baja California, has a white background with small yellow-white dots and green cerata. *Eubbranchus sanjuanensis* Roller, 1872, known from Alaska to Washington, has a translucent white body, rhinophores, and oral tentacles; the cerata are bulbous, translucent with a visible bright red digestive gland, and opaque white apices. *Eubbranchus steinbecki* Behrens, 1984, known from California to La Paz, Baja California Sur, has irregular and nodular cerata, and the background color is tan with dark green spots. The same coloration is present on the cephalic area, rhinophores, and oral tentacles. All these species are illustrated by Behrens (1991).

*Eubbranchus echizenicus* Baba, 1975 from Japan is another species of *Eubbranchus* that has some blue spots on the body. However, the rhinophores are red and the background color is white with red spots; the cerata are small and an opaque yellow (see Baba 1975).

Family Aeolidiidae Gray, 1827

Genus *Cerberilla* Bergh, 1873

*Cerberilla chavezii* Hermosillo and Valdés, sp. nov.  
(Fig. 1-A, 12-13)

### Material examined

Holotype: 19 mm long, La Boquita (19°06.303'N, 104°23.915'W), Bahía de Santiago, Colima, Mexico, 21 February 2004, collected at 6 m depth on a sandy bottom (LACM 3058). Paratypes: 1 specimen 11 mm long, La Cruz de Huanacastle (20°44.44'N, 105°23.16'W), Bahía de Banderas, Nayarit, Mexico, 14 January 2004, collected at 10 m depth at night from a sandy bottom (LACM 3059); 1 specimen 14 mm long, La Boquita (19°06.303'N, 104°23.915'W), Bahía de Santiago, Colima, Mexico, 26 March 2004, collected at 6 m depth at night on a sandy bottom (LACM 3060).

### External morphology

The body is wide and elongate (Fig. 1A), up to 19 mm long in life. The anterior end of the body is broader and tapers slightly into the rounded posterior end. The foot is wider than the dorsum and has distinct tentaculiform anterior corners. The rhinophores are small, cylindrical, and smooth, and are situated near the posterior end of the cephalic region. The oral tentacles are extremely long. The cerata are arranged in ten rows, the anterior ones are more distantly separated from each other than the posterior ones. The anterior rows have fewer cerata. The cerata are club-shaped and terminate in cnidosacs at two-thirds of the length of each ceras (Fig. 13D). The cerata of the posterior rows are longer than those of the anterior ones. The center of the dorsum is devoid of cerata and is visible in the area

between the anterior four rows. The longer cerata of the posterior rows cover the center of the dorsum. The number of cerata per half row are 1(5), 2(5), 3(6), and 4(7), and there are about seven cerata in rows 5-10. The gonopore is located on the right side of the body, below the cerata, between the first and second rows. The anal opening is located near the bases of the cerata, behind the pericardium, just below the fourth row of cerata. The renal opening is located anteriorly and more dorsally but close to the anal opening (Fig. 13A).

The background color is red on the center of the dorsum and translucent pinkish violet with an opaque yellow margin along the edges of the foot and pedal corners. The oral tentacles are purple. The rhinophores are red with white tips. The eyespots are visible at the bases of the rhinophores. The cerata are the same color as the body. Each has an opaque yellow line extending vertically and around the reddish-brown ramifications of the digestive gland.

### Internal anatomy

The esophagus opens dorsally into the ovoid buccal mass (Fig. 13C). There is a large glandular structure (oral gland) situated near the anterior opening of the buccal mass from which two large salivary glands emerge.

The radular formula is  $11 \times 0.1.0$  in a 14 mm long specimen (LACM 3060). The radular teeth are several times as wide as long (Fig. 12A). Each tooth has an alternating series of small and large hamate curved denticles on each side and no distinct central cusp. The center of each tooth has two small smooth denticles. The outermost denticles are slightly longer than the others and are also smooth. The jaws are composed of two wide plates with smooth masticatory edges (Fig. 12B).

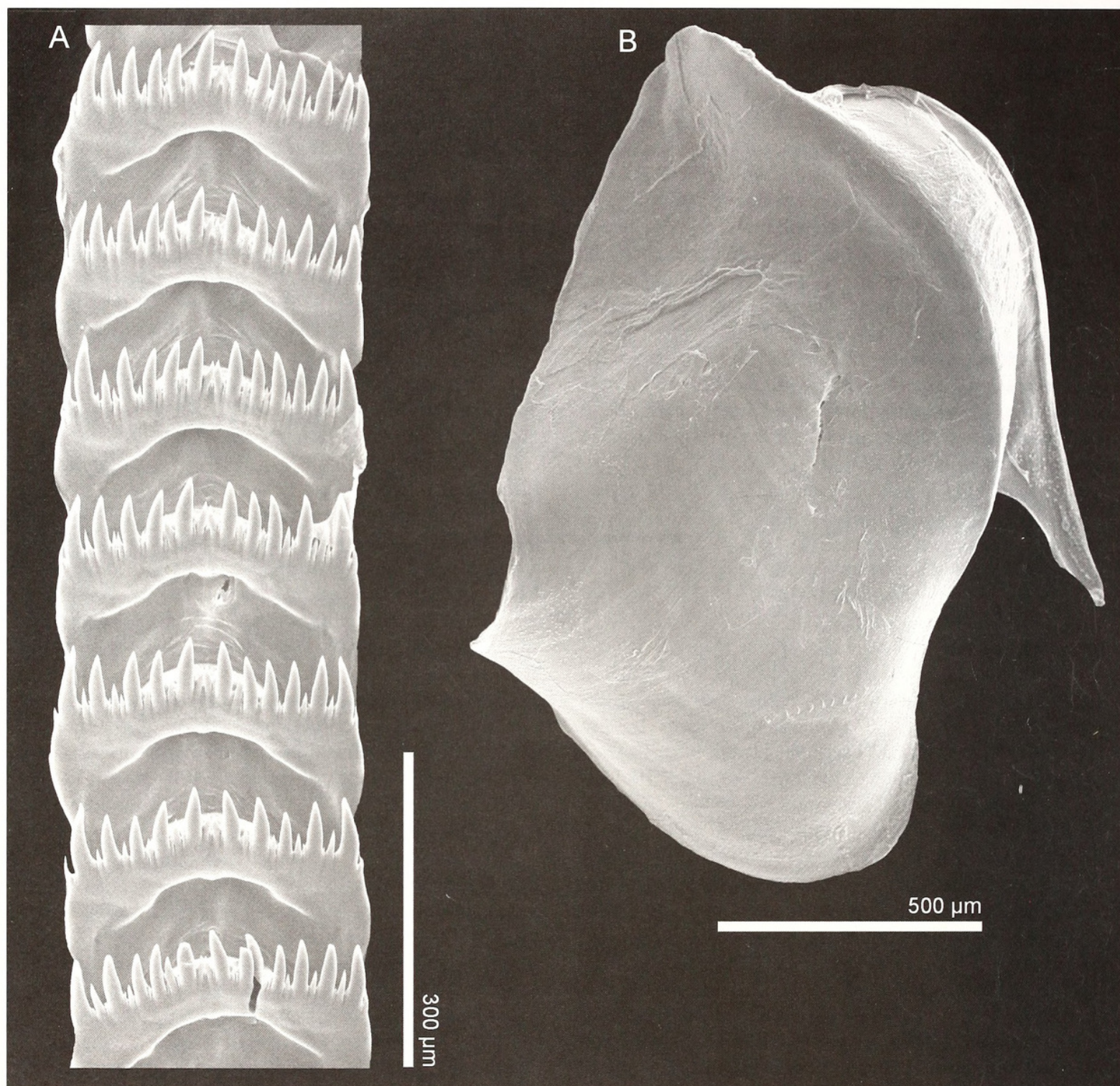
### Reproductive system

The reproductive system is diallic (Fig. 13B). The hermaphroditic gland is divided into several clusters and is connected to the long and convoluted ampulla by a ramified and narrow hermaphroditic duct. The ampulla narrows and then opens into a common atrium with the vaginal duct at the point where the bursa copulatrix also connects. The prostate is long, slender, and convoluted. The prostate connects with the wide ejaculatory portion of the deferent duct that contains an oval and unarmed penis.

### Natural history and geographic range

As in other members of the genus *Cerberilla*, *Cerberilla chavezii* is a burrowing species found only at night crawling on shallow sandy-muddy bottoms. When disturbed by light, the animal burrows back into the sediment, cephalic area first, positioning the oral tentacles parallel to the length of the body. The animal raises the cerata when it is physically disturbed. *C. chavezii* is known from Bahía de Banderas,





**Figure 12.** *Cerberilla chavezi* sp. nov., holotype (LACM 3058), scanning electron micrographs of radula and jaws. A, Radular teeth, scale bar = 300 µm. B, Distal view of the left jaw, scale bar = 500 µm.

Jalisco-Nayarit and in Bahía Santiago, Colima, Mexico (Hermosillo and Behrens 2005).

#### Etymology

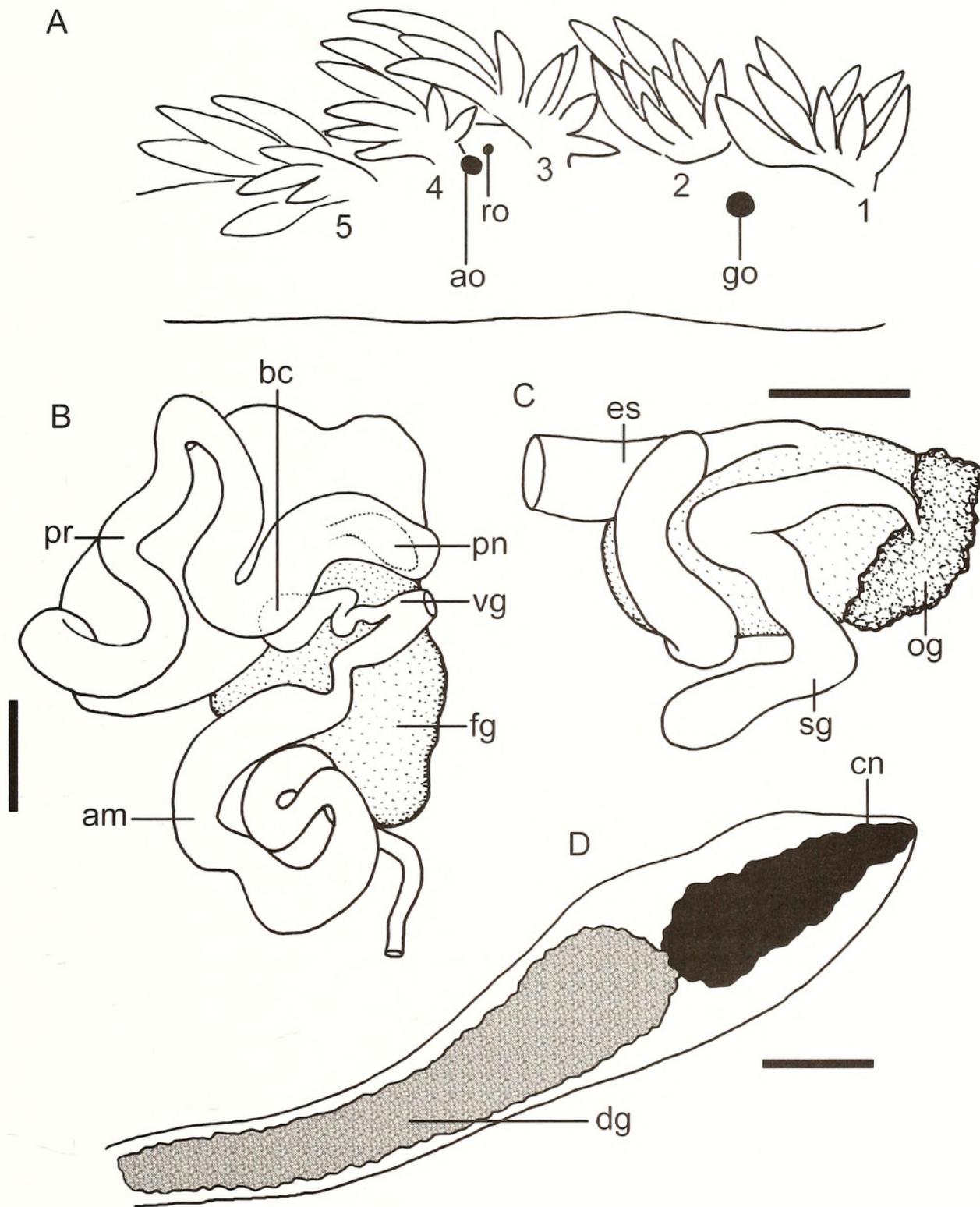
The specific name *chavezi* is given in honor of Roberto Chavez for his invaluable assistance during the field work that produced the material examined and for his sug-

gestion of the dive sites where *Cerberilla chavezi* was collected.

#### Remarks

The generic placement of *Cerberilla chavezi* is based upon the external morphology and anatomy of this species: the foot of *C. chavezi* is wider than the dorsum, with distinct,





**Figure 13.** *Cerberilla chavezi* sp. nov., holotype (LACM 3058). A, Arrangement of the anal opening, renal opening, and gonopore; numbers represent the ceratal groups. B, Reproductive system, scale bar = 0.5 mm. C, Buccal mass, scale bar = 10  $\mu$ m. D, Ceras, scale bar = 10 mm. Abbreviations: am, ampulla; ao, anal opening; bc, bursa copulatrix; cn, cnidosac; dg, digestive gland; es, esophagus; fg, female glands; go, gonopores; og, oral gland; pn, penis; pr, prostate; ro, renal opening; sg, salivary glands; vg, vagina.

very elongate pedal corners; the rhinophores are small and the oral tentacles long, the radular teeth are wide, lacking a distinct cusp and having a series of denticles all similar in size, the outermost being slightly longer. All these are diag-

nostic characteristics of the genus *Cerberilla* (see McDonald and Nybakken 1975).

The morphology of the radular teeth has provided the bases for identifications at the species level within *Cerberilla*



(see McDonald and Nybakken 1975). However, five species of *Cerberilla* (*Cerberilla longicirra* Bergh, 1873; *Cerberilla annulata* Quoy and Gaimard, 1832; *Cerberilla affinis* Bergh, 1888; *Cerberilla africana* Eliot, 1903; and *Cerberilla moebi* Bergh, 1888) have almost identical teeth and so are difficult to distinguish using radular characteristics alone. Therefore, other characters such as color, shape of the cerata, and anatomical features have been used instead following McDonald and Nybakken (1975). Five additional species: *Cerberilla ambonensis* Bergh, 1905; *Cerberilla tanna* Ev. Marcus and Er. Marcus, 1960; *Cerberilla asamusiensis* Baba, 1940; *Cerberilla pungoarena* Collier and Farmer, 1964; and *Cerberilla berna-dettae* Tardy, 1965, have distinctive radulae, especially in the number and arrangement of the denticles (McDonald and Nybakken 1975). *Cerberilla chavez*i is another species with distinctive radular teeth with smooth, alternating, long and short denticles.

None of the previously described species of *Cerberilla* has a color pattern similar to *Cerberilla chavez*i except for *Cerberilla tanna*, described for the Gulf of Mexico. However, *C. tanna* is clearly distinguishable because the color pattern is not as bright as in *C. chavez*i, and the tips of the cerata are white, as opposed to yellow in *C. chavez*i. *C. tanna* has distinctive dark anterior markings that are absent in *C. chavez*i and the oral tentacles are whitish-orange (Marcus and Marcus 1960), whereas they are purple in *C. chavez*i. The radula of *C. tanna* is also different from that of *C. chavez*i; the outermost denticles on the teeth of *C. tanna* are at least twice as long as the rest of the denticles, which show alternation of a large denticle with two or more smaller denticles in between. In contrast, in *C. chavez*i, the radular teeth have an alternating series of a small and a large denticle on each side of the teeth and the outermost large denticles are only slightly longer than the rest of the denticles.

There are two other species of *Cerberilla* described for the eastern Pacific: *Cerberilla pungoarena* Collier and Farmer, 1964, known from the Baja Peninsula and the Gulf of California, and *Cerberilla mosslandica* McDonald and Nybakken, 1975, reported from Monterey Bay to La Jolla, California. Both species are clearly different externally from *Cerberilla chavez*i. *C. mosslandica* is white with terracotta-colored cerata; the rhinophores are white and the oral tentacles have brown and white blotches. *C. pungoarena* has a white foot and the cerata are brown with white tips; the rhinophores are also white and the oral tentacles have a pale bluish tint (Collier and Farmer 1964). There is an opaque white line on the base of each oral tentacle, and the cephalic region is markedly notched (McDonald and Nybakken 1975). The radulae of *C. mosslandica* and *C. pungoarena* are also distinct. The radula of *C. mosslandica* has 11-16 larger denticles and 17-27 smaller outermost denticles alternating with the larger ones (McDonald and Nybakken 1975). The

center of the tooth has five to seven small denticles. Even the larger denticles are small compared to the size of the tooth. The outermost denticles are the same size as the rest of the large denticles. *C. pungoarena* has two long marginal denticles, the largest one is the outermost; each tooth has 10-12 small denticles, which do not alternate with larger denticles (Collier and Farmer 1964).

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