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A New *Polycera* (Opisthobranchia: Mollusca) from Bahía de Banderas, México

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A new species of dorid nudibranch of *Polycera* is described for Bahía de Banderas, along the Pacific coast of Mexico. The coloration of *Polycera kaiserae* sp. nov. is distinct from all other known species of *Polycera*. Distinctive characteristics are a pink body covered with white spots and navy blue with white tips on oral veil processes, pedal corners, branchial plumes, rhinophores, extrabranchial appendages and tail. The notum is smooth, and the radular formula and morphology are consistent with those of other species of *Polycera*. Jaws are strong with smooth masticatory edges. *Polycera kaiserae* is compared with the other six species of *Polycera* known from the eastern Pacific and with other brightly colored *Polycera* from the Indo-Pacific, Mediterranean and Atlantic.

KEYWORDS: Polyceridae, *Polycera*, new species, Bahía de Banderas, tropical eastern-Pacific, nudibranchs.

Resumen

Se describe una nueva especie de *Polycera* para Bahía de Banderas, en la costa Pacífica de México. La coloración de *Polycera kaiserae* sp. nov. es distinta de cualquier otra especie de *Polycera* conocida. Sus caracteristicas difenciales son el cuerpo es rosa, cubierto de manchas blancas y con puntas azul marino y blancas en los procesos del velo oral, esquinas del pie, plumas branquiales, rinóforos, apéndices extrabranquiales y porción distal. El dorso es liso. La morfología radular es consistente con la de otros miembros de *Polycera*. La mandíbula es fuerte con los bordes masticatorios lisos. Se compara *Polycera kaiserae* con las otras seis especies de *Polycera* conocidas del Pacífico Este y con las especies de *Polycera* de coloraciones brillantes conocidas en el Indopacífico, Mediterráneo y Atlántico.

PALABRAS CLAVE: Polyceridae, *Polycera*, especie nueva, Bahía de Banderas, Pacifico Este tropical, nudibranquios.

Altogether, four species of *Polycera* have been found in various habitats within Bahía de Banderas, Jalisco-Nayarit, Mexico (Hermosillo-González 2006). Among these, *Polycera alabe* Colier and Farmer, 1964 is known from California to Panama and displays four distinct color forms (Behrens and Hermosillo 2005); the four have been observed regularly at Bahía de Banderas, but the most common one is the form with thick orange lines, green body processes and branchial plume pink with black tips (variation B in Behrens and Hermosillo 2005); furthermore, all feed on a *Bugula* sp., a branching black bryozoan. *Polycera gnupa* (Marcus and Marcus, 1967) has a

known distribution from the Gulf of California down to the Islas Galápagos, Ecuador. Only two specimens of this species have been observed in Bahía de Banderas. Thirdly, an undescribed species of a small sized *Polycera* (*Polycera* sp. in Camacho-Garcia et al. 2005) is known from Islas Revillagigedo to Islas Galápagos. When observed, it is found in clusters of multiple animals feeding on the bryozoan *Sessibugula translucens* or *Membranipora* sp.

The present paper describes a fourth, hithero undescribed species based on specimens collected eighteen months apart at two different sites in Bahía de Banderas. The first three specimens (January 11, 2006) were found at Mismaloya, a popular tourist beach located south of the town of Puerto Vallarta, at the inlet of the Mismaloya river. The substrate has large boulders, small turnable rubble and a muddy sand bottom, with a steep profile. The second two specimens (June 12, 2007) were found at El Morro, which is an islet located outside the mouth of the bay close to the marine park of Islas Marietas. The most notable characteristic of El Morro is a through-and-through sea cave at a depth of about 30 meters. The opisthobranch fauna observed inside the cave is similar to the one observed at another large cave located on one of the Islas Marietas. The species composition found inside the cave is remarkably different from other sites studied in the bay (Hermosillo-González, 2006). The specimens were found at some 10 meters into this cave.

Materials and Methods

The material examined is deposited at the Department of Invertebrate Zoology and Geology of the California Academy of Sciences, San Francisco (CASIZ) and the Malacology Section of the Natural History Museum of Los Angeles County (LACM). Specimens were dissected and the internal features were examined and drawn using a dissecting microscope with a camera lucida. The penis was dissected and dried with 1,1,1,3,3,3-hexamethyldisilazane for Scanning Electron Microscopy (SEM). The buccal mass was removed and dissolved in 10% sodium hydroxide until the radula was isolated from the surrounding tissue. The radula was then rinsed in water, dried, and mounted for examination with the SEM.

Features of living animals were recorded in the field by digital photography, both *in situ* and in aquarium photographs. On the first occasion, an Olympus 770 digital camera was used, with an Olympus housing and an INON slave strobe. The second time, a Nikon Coolpix 995 camera, with a YS-90 Sea and Sea and a slave strobe INON, was used. Neither color correction was used nor were the photographs modified in Photoshop.

Species Description

Family Polyceridae Alder and Hancock, 1845; Bergh, 1891
Genus *Polycera* Cuvier, 1817

Polycera kaiserae **Hermosillo and Valdés, sp. nov**
Figures 1A, B and C.

Synopsis of *Polycera*.— Body limaciform, notum smooth, papillate or tuberculate; veil with digitate or tuberculate papillae, nonretractile rhinophores, perfoliate clavus, one or more extrabranchial papillae on either side of the branchia, pinnate gill in semicircle around the anus. Gill not retractable into gill pocket. Paired jaws with or without a large wing-like extension. Radula with no rachidian tooth, inner laterals hamate, outer laterals simple plates. Large prostrate gland, glans penis armed with spines.

Material examined.— Holotype: El Morro (20º41.253′N 105º39.913′W), Bahía de Banderas, Jalisco-Nayarit, México, 12 June, 2007, 1 specimen preserved length 11 mm, collected inside a sea cave at 30

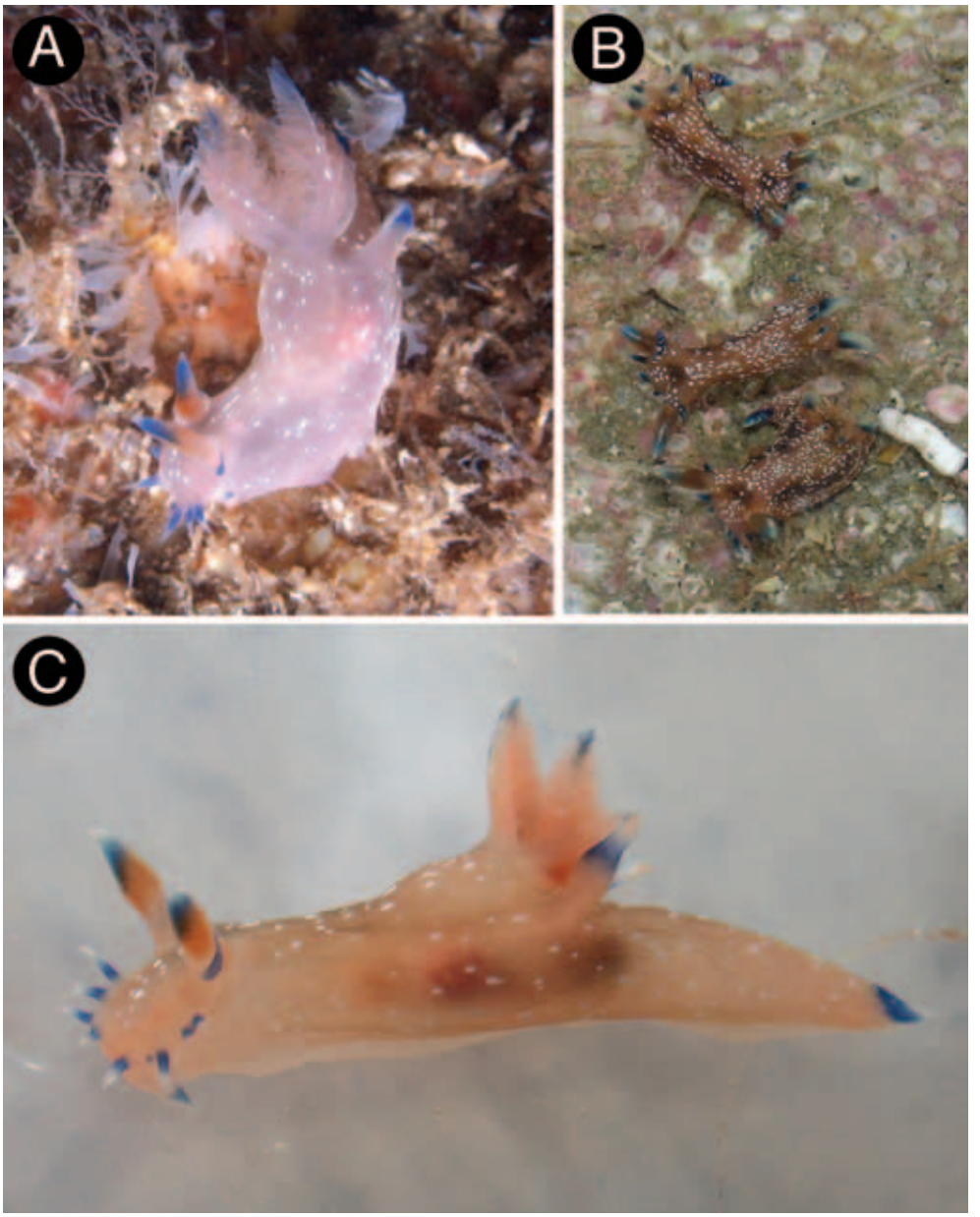

FIGURE 1. Living animals of *Polycera kaiserae* sp. nov. (A) *In situ* photograph. (B) Aquarium photograph of the paratypes (LACM 1850) Photography by Mike Miller. (C) Aquarium photograph of the holotype (CAZIS 175654).

m of depth (CAZIS 175654). PARATYPES (3): Mismaloya (20°31.937′N, 105°17.700′W) Bahía de Banderas, Jalisco-Nayarit, México, 11 January, 2006, 3 specimens collected on rocks and rubble at 11 m of depth, preserved length is 5 mm (LACM 1850).

EXTERNAL MORPHOLOGY.— The maximum length of the living animals was 24 mm (holotype). The preserved holotype measures 11 mm long and 3 mm wide, the length of the three paratypes is 5 mm. The morphology of the body is typical of *Polycera*. The body is elongated and

spindle shaped when fully extended. The widest and highest part of the body is located at the level of the branchial plume and extra branchial processes. It is compressed laterally and highly arched in the branchial region. Posterior to the gill, the body tapers rapidly to a sharply pointed posterior end of the foot. There is a distinctive mid-dorsal cardiac prominence just anterior to the gill. The foot is simple, with pointed pedal corners (Fig. 2C). There is no marked caudal ridge.

The velar processes or papillae are conical in shape with a point tip, numbering six to eight in the five specimens examined (Fig 2C). The velar processes are held straight out and horizontal and are of unequal lengths. On each side of the veil the papillae are about equally spaced, with a larger gap between the frontal-most papillae, which are shorter than the lateral ones.

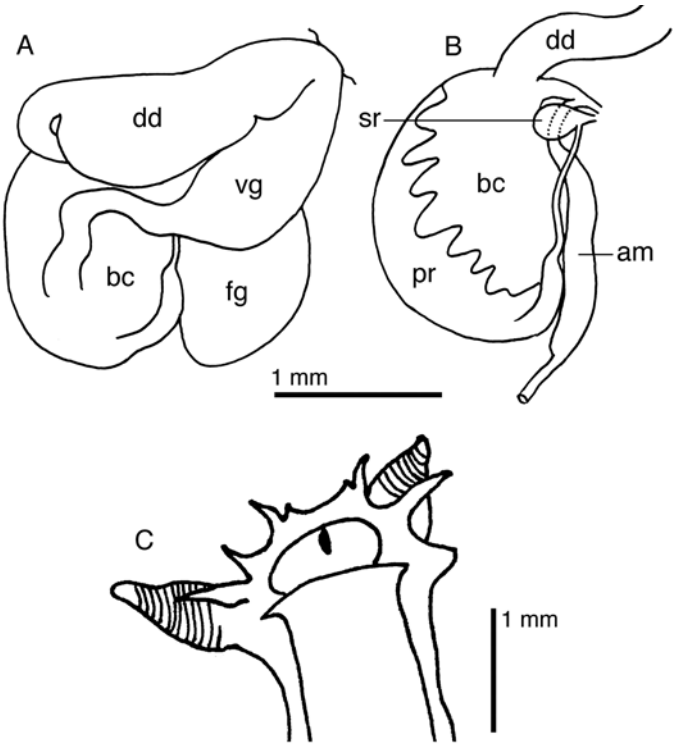

FIGURE 2. *Polycera kaiserae* sp. nov., anatomy. (A) and (B) Reproductive system and detail of reproductive organs of the paratype (LACM 1850). (C) Ventral view of cephalic region of the holotype (CAZIS 175654). Abbreviations: am, ampulla; bc, bursa copulatrix; dd, deferent duct; fg, female glands; pr, prostate; sr, seminal receptacle; vg, vagina.

The gill is composed of five unipinnate branchial plumes, the three anterior ones are longer than the two posterior ones (4–1.9 mm long), they form a semi-closed circle, with an open angle of approximately 120°. The anus is located in the middle of the branchial plume. There is one extra branchial appendage on each side of the gill; positioned posterior to the forward most plume and parallel to the middle pair. These processes are digitiform, wide at the base and tapering abruptly to a blunt tip.

The rhinophores of the holotype have 22 lamellae, with a short terminal knob. The total length of the rhinphore is 3.7 mm. The rhinophoral sheath is cylindrical, taller in the back than in the front (1.7 and 0.9 mm respectively). The rhinophores are located relatively far apart in the cephalic region.

The color of the body varies from a light pink in the larger specimens (Fig. 1A and C) to a darker pink in the smaller ones (Fig. 1B). It is sprinkled with numerous opaque white irregularly shaped spots on the dorsum, cephalic region, rhinophoral sheats and gill plumes. These spots are denser on the smaller specimens, giving them a frosted appearance. The most distinctive external feature of this species is the coloration scheme on gill plumes, extra branchial processes, foot, rhinophores, pedal corners, rim of rhinophoral sheath and velar processes. Proximally, all these processes are the same color as the body; the distal half is navy blue with a white or off-white tip.

INTERNAL ANATOMY.— The buccal mass is muscular with a small radular sac and two salivary glands attached at the sides of the esophageal connection.

The radular formula is 11 x 2.1.1.0.1.1.2 for one of the paratypes (12 mm long specimen LACM 1850). There are no rachidian teeth. The innermost lateral teeth are hamate with a strong, triangular cusp and a smaller, secondary cusp about mid-length (Fig 3A). The second lateral teeth are also hamate and have a wing-like extension near the base. The outer teeth are two small, simple plates per row, lacking denticles.

The labial cuticle has a pair of jaws with smooth masticatory edges (Fig. 3B). The shape of the jaw is almost rectangular with a pointy lateral expansion.

Reproductive system.— The description of the reproductive system is based on sexually mature animals (Figs. 2A–B, 3C–D).

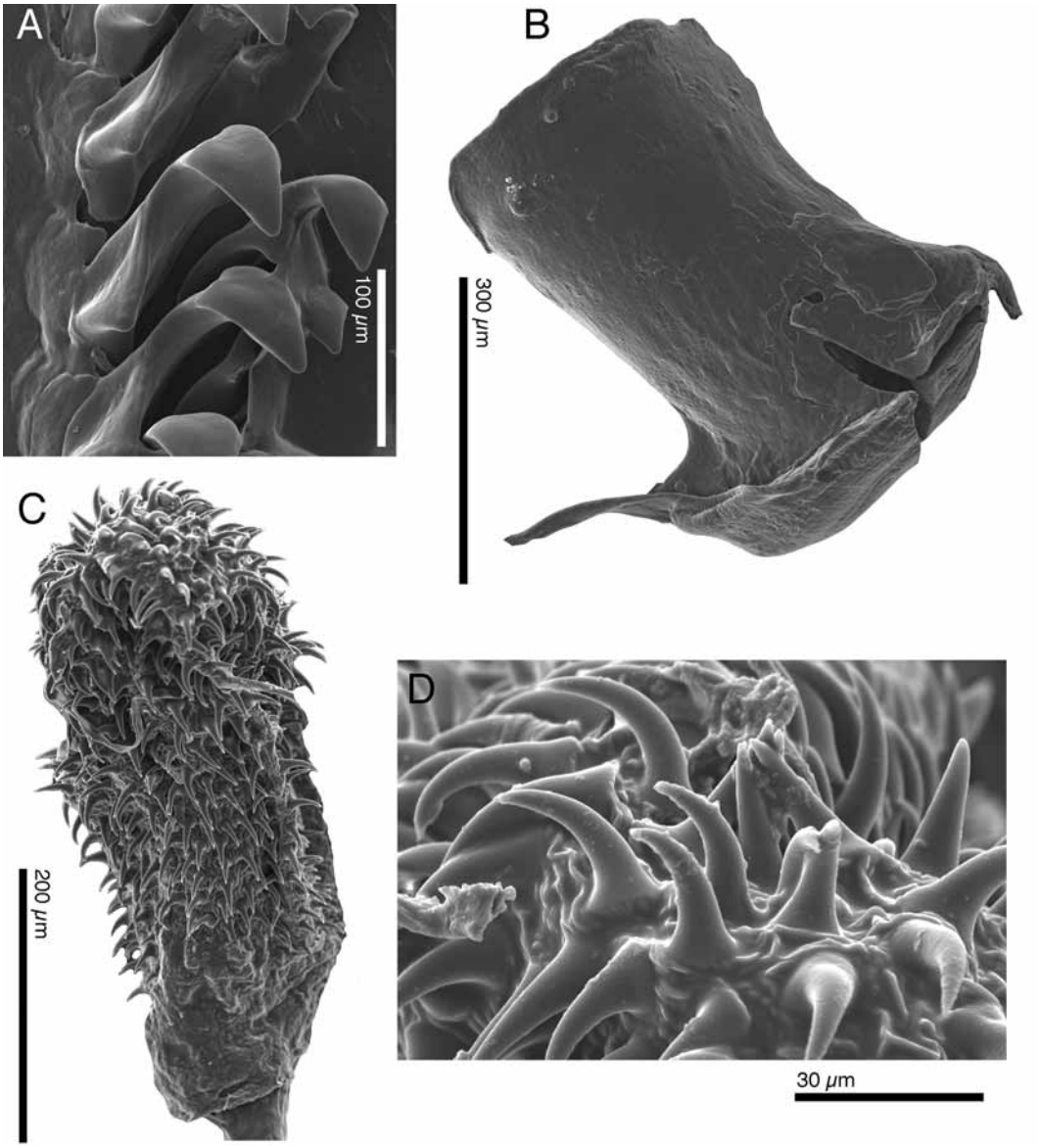

Figure 3. *Polycera kaiserae* sp. nov., paratype (LACM 1850), Scanning Electron Micrographs of radula, jaws and penis. (A) Lateral and marginal teeth. (B) Jaw. (C) Everted penis. (D) Detail of the spines on penis.

The genital opening is located in the right side of the body, posterior to the rhinophores; in the living animals it is observed as a dark spot. Within the genital opening a vestibule is observed where distal portions of the vagina and deferent duct are located. Both are tubular enlarged structures of about the same size. The vagina then tapers and empties into the bursa copulatrix through an irregular duct (Fig. 2A). The bursa copulatrix is oval and large. The deferent duct folds back on itself, tapers and connects into the prostate, which partially envelops the bursa copulatrix and is about half its size (Fig. 2B). The ampulla leads forward and inserts through a branched narrow duct into the deferent duct and prostate connection. The ampulla is long and regularly shaped, tapering at both ends. The pyriform seminal receptaculum is connected to the bursa copulatrix through a long and narrow duct. The penis is armed, the complete surface covered with densely set hamate spines. These spines are equal in size and directed back toward the base of the penis when the penis is everted (Figs. 3C and D).

Geographic range.— This species has only been collected in Bahía de Banderas, Jalisco-Nayarit.

Natural history.— *Polycera kaiserae* has been observed three times, once at 11 m of depth on a coastal rocky shore near a river inlet; there were three specimens close together. The second time, on a far-from-shore islet, two specimens were observed inside a sea cave at a depth of 30 m. The third time, it was seen on a coastal rocky shore area at a depth of 7 m. On all occasions, animals were observed feeding on a clear-colored, branching bryozoan. One egg mass was observed with the three specimens, a typical dorid ruffled spiral, rose pink, laid on the bryozoan (Fig. 1A).

Etymology.— The specific name *kaiserae* is given in recognition of our dear friend Kirstie Kaiser. Her dedication has contributed greatly to our knowledge of the molluscan fauna of the eastern Pacific and her upbeat outlook has made our field work more fun and productive.

Remarks.— *Polycera kaiserae* has all the features characteristic of the genus *Polycera* as follows: body limaciform, notum smooth; veil with digitate pointed, non-retractile rhinophores, perfoliate clavus, extrabranchial appendages on either side of the gill plume; pinnate branchia in semi-closed circle around the anus with five leafs (although some other species of *Polycera* have different numbers). Gill non-retractable. Paired jaws with or without a large wing-like extension. Radula without a rachidian tooth, similarly-sized inner laterals hamate, outer laterals simple plates. Large prostrate gland, glans penis armed with spines.

No species of *Polycera* resembles the striking external coloration of *Polycera kaiserae*: pink body covered by white spots and navy blue with white tips on oral veil processes, pedal corners, branchial plumes, rhinophores, extrabranchial appendages and tail. Nevertheless, it should be compared with the other six species of *Polycera* known for the eastern Pacific: *Polycera alabe* Colier and Farmer, 1964, *Polycera atra* MacFarland, 1905, *Polycera gnupa* (Marcus and Marcus, 1967), *Polycera hedgpethi* Marcus, 1964, *Polycera tricolor* Robilliard, 1971, and *Polycera* sp. Only three of these, *Polycera alabe*, *P. gnupa*, and *Polycera* sp. overlap the known distribution of *Polycera kaiserae*.

Polycera alabe exhibits a wide variation in its coloration, but it consistenly has green or dark processes, as well as yellow lines and spots on a dark brown or black body (Behrens and Hermosillo 2005); *Polycera atra* has black longitudinal stripes on a white or gray body, with yellow spots all over the body (Robilliard 1971); *Polycera gnupa* has a gray-brown mottled body, with a yellow and blue or green ring on the distal portion of the oral veil processes and extrabranchial appendages (Marcus and Marcus 1967); *Polycera hedgpethi* has a brownish coloration that varies in shade with two white longitudinal lines, the oral veil processes, extrabranchial appendages and tail are white colored with yellow on the distal third; the branchial plume is dark brown (Miller 2001). *Polycera tricolor* has a barely translucent white body, tips of rhinophores, veil papillae, and extrabranchial

processes, a yellow line around the edge of the foot, and the gill plumes, extrabranchial processes, rhinophores and veil processes are proximally black and distally yellow (Robilliard 1971). In an undescribed species from the tropical Eastern Pacific (*Polycera* sp. Camacho-Garcia et al. 2005), the body color is black, with bronze colored papillae and orange lines or dots along the body. The rhinophores, oral veil processes, foot, and extrabranchial appendages are light green (Camacho-Garcia et al. 2005).

The notum of *Polycera kaiserae* is smooth; this is also true for *Polycera tricolor*, whereas the other five eastern Pacific species present varying degrees of papillae and tubercles. Five species have more than one pair of extrabranchial processes, whereas *Polycera kaiserae* has one pair and *Polycera alabe* lacks these altogether (Robilliard 1971).

There are other colorful species of *Polycera*, but none of them resembles the external coloration of *Polycera kaiserae*. Examples include *Polycera chilluna* Er. Marcus, 1961, from the eastern Atlantic and Caribbean, which has a grayish body with longitudinal yellow lines and appendages (Valdés et al. 2006), and *Polycera incognita* (Ortea, Espinosa, and Caballer, 2004), also from the Caribbean, which is reddish brown, with black spots and white appendages, and the body is tuberculate (Valdés et al. 2006). Indo-Pacific examples include *Polycera abei* Baba, 1960, that is bright orange with black spots and appendages (Baba 1960); *Polycera maddoxi* Miller, 2005, is dark maroon with yellow spots (Miller 2005); *Polycera janjukia* Burn, 1962, is purple with yellow spots and appendages (Miller 2005); *Polycera parvula* (Burn, 1958), known from Australia, is reddish orange with yellow spots (Miller 2005); and *Polycera capensis* Quoy and Gaimard, 1824, known from South Africa and Australia, has bright white with black longitudinal lines with yellow appendages and velar processes (Gosliner 1987). Brightly colored species from the Eastern Atlantic include *Polycera faeroensis* Lemche, 1929, from the north-eastern Atlantic, has a white body with yellow appendages (Picton and Morrow 1994), and *Polycera quadrilineata* (Muller, 1776), which is white with speckled with orange or red, is known in Europe, from Greenland to the Mediterranean, and South Africa (Gosliner 1987). *Polycera elegans* (Bergh, 1894), known from the Atlantic and Mediterranean, has a bright orange body with scattered iridescent blue oval spots and gill branches with white longitudinal lines (as *Grielada elegans* in Picton and Morrow 1994).

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