

A New Species of Dorid Nudibranch (Mollusca) from the Revillagigedo Islands of the Mexican Pacific

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A new species of dorid nudibranch is described from the Revillagigedo islands, in the Mexican Pacific. *Chromodoris socorroensis* was found living under rocks and is unique among all described taxa being translucent white with large salmon red markings outlined in opaque white. Aspects of its radular and reproductive anatomy also distinguish this species from other species found in the eastern Pacific.

Key Words: Tropical Eastern Pacific, Revillagigedo Islands, Chromodorididae, *Chromodoris*

Resumen

Se describe una nueva especie de nudibranchio dórido de las islas Revillagigedo, en el Pacífico mexicano. *Chromodoris socorroensis* se encontró viviendo bajo rocas. Es distinta de otras especies de chromodorididae ya que tiene un característico pigmento rojo salmón sobre un fondo rosa translucido.

Palabras Clave: Pacífico oriental tropical, Islas Revillagigedo, Chromodorididae, *Chromodoris*

Due to an unprecedented acceleration of opisthobranch research within the Panamic Faunal Province from México to the Galápagos Archipelago, numerous papers have documented recently many previously undescribed species from this region (Camacho-García and Valdés 2003; Fahey and Gosliner 2003; Hermosillo-Gonzalez 2003; Camacho-García and Gosliner 2004; Gosliner and Bertsch 2004; Gosliner, Ortea, and Valdés 2004; Hermosillo 2004; Hermosillo and Valdés 2004; Dayrat 2005; Hermosillo and Behrens 2005; Millen and Bertsch 2005; Pola, Cervera, and Gosliner 2005). Additionally, three photographic field guides have been published to assist biologist and divers alike in the identification of the hundreds of species occurring in the region (Behrens and Hermosillo 2005; Camacho-García, Gosliner, and Valdés 2005; and Hermosillo, Behrens, and Rios 2005).

At present, 26 species of Chromodorididae are known from the Panamic Pacific, the most recently described species being *Mexichromis tica* Gosliner, Ortea, and Valdés 2004, from Costa Rica and the Galápagos. Only six species are assigned to the genus *Chromodoris*: *Chromodoris galaxorum* Bertsch, 1978, *C. macfarlandi* Cockerell, 1901, *C. marislae* Bertsch, 1973, *C. norrisi* Farmer, 1963, *C. ruzafai* Ortea, Bacallado and Valdés, 1999, and *C. sphoni* (Marcus, 1971).

This paper describes one species collected by the third author during her research on Panamic opisthobranchs. The paper describes the anatomy of this species and compares it to morpholog-

ically similar species. An extensive paper on the opisthobranch fauna of Islas Revillagigedo was published by Hermosillo and Gosliner (2008), where this new species was reported as *Chromodoris* sp. It is one of the only two possibly endemic species so far found for these oceanic islands. The other is an unidentified species of *Runcina*. The rest of the species found are Panamic in affinity (Hermosillo and Gosliner 2008).

SPECIES DESCRIPTIONS

Family Chromodorididae Bergh, 1891 Genus *Chromodoris* Alder and Hancock, 1855

Chromodoris socorroensis Behrens, Gosliner and Hermosillo sp. nov.

Figures 1A-B, 2A-D, 3A.

Chromodoris sp. 1. Behrens and Hermosillo, 2005: 82

Chromodoris sp. 1. Hermosillo, Behrens and Rios, 2005: 89

TYPE MATERIAL.— HOLOTYPE: CASIZ 174134, 31 January, 2005, Cabo Pierce, Isla Socorro, Archipiélago de Revillagigedo, 18.77784°N, 110.907194°W, 3 mm long, under rocks, 6 m of depth. PARATYPES: CASIZ 174135, 2 specimens, 1 dissected, 9 March, 2005, in front of Naval Base, Isla Socorro, Archipiélago de Revillagigedo, 18.723038°N, 110.948741°W, 8 mm long, under rocks, 12 m of depth. CASIZ 174131, one specimen, Isla San Benedicto, Archipiélago de Revillagigedo, March 28, 2005, Alicia Hermosillo. CASIZ 174132, two specimens, Isla San Benedicto, Archipiélago de Revillagigedo, March 28 2005, Alicia Hermosillo. CASIZ 174133, one specimen, Cañon, Isla San Benedicto, Archipiélago de Revillagigedo, March 8, 2005, Alicia Hermosillo.

ETYMOLOGY.— *Chromodoris socorroensis* is named for Isla Socorro, 430 kilometers southwest of Cabo San Lucas, Baja California Sur, México, the largest island in the Revillagigedo Archipelago, the location of the collection of the type material.

DISTRIBUTION.— Known only from San Benedicto and Socorro Islands, Islas Revillagigedo, México.

EXTERNAL MORPHOLOGY.— The living animals (Fig. 1A) are relatively small, reaching a maximum length of about 10 mm. The body is a translucent pinkish white, encrusted with large salmon-red patches and opaque white markings. These red patches vary greatly between specimens in their size and distribution (Fig. 1B), but all specimens have four distinct red markings of different sizes and shades: one covers most of the center of the dorsum; another one demarks the lateral edges of the mantle; a small one is present on the frontal portion of the notum, which is a darker red with varying orange spots and the last one is a thin line that connects the large spot in the center of the dorsum with the one in the frontal portion. The mantle is delineated by a blotchy opaque white line, with 5–6 red spots on each side. There are two distinct translucent pink clearings outlined in white behind the rhinophores, divided by a red line. A similar clearing, also outlined in white, occurs just posterior-laterally to the gill. There is a white line delineating the edge of the rhinophoral and gill cavity. The translucent pink rhinophores are perfoliate, with 7–10 lamellae. The gill plume is clear pink, with 5–7 unipinnate branches. In some specimens, the gill is slightly tipped with orange. The posterior end of the foot is clear with an orange medial line. The foot is anteriorly thickened and there are a pair of short rounded tentacles on either side of the mouth.

MANTLE GLANDS.— The subcutaneous mantle glands are simple in morphology. They are few and evenly distributed along the edge of the mantle.

BUCCAL ARMATURE.— The muscular portion of the buccal mass is approximately equal in length to the oral tube. At the anterior end of the muscular portion of the buccal mass is a chitinous

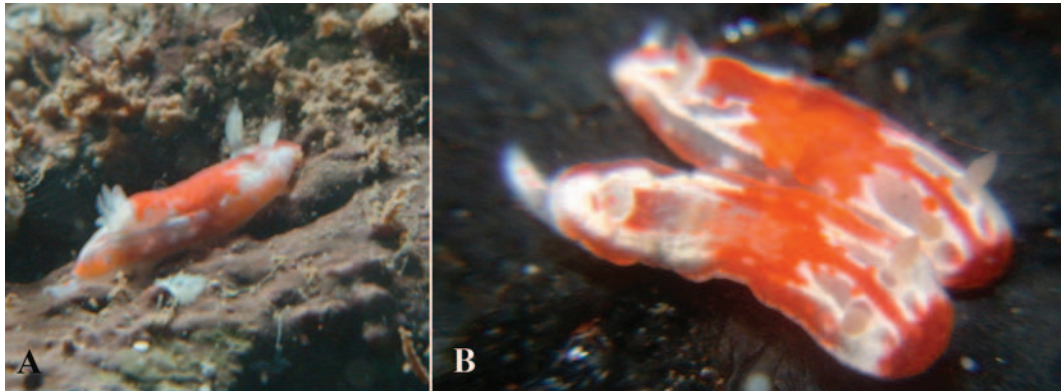


FIGURE 1. Living animals. A-B. *Chromodoris socorroensis* sp. nov. Socorro Islands, Islas Revillagigedos, Mexico, photographs by Alicia Hermosillo.

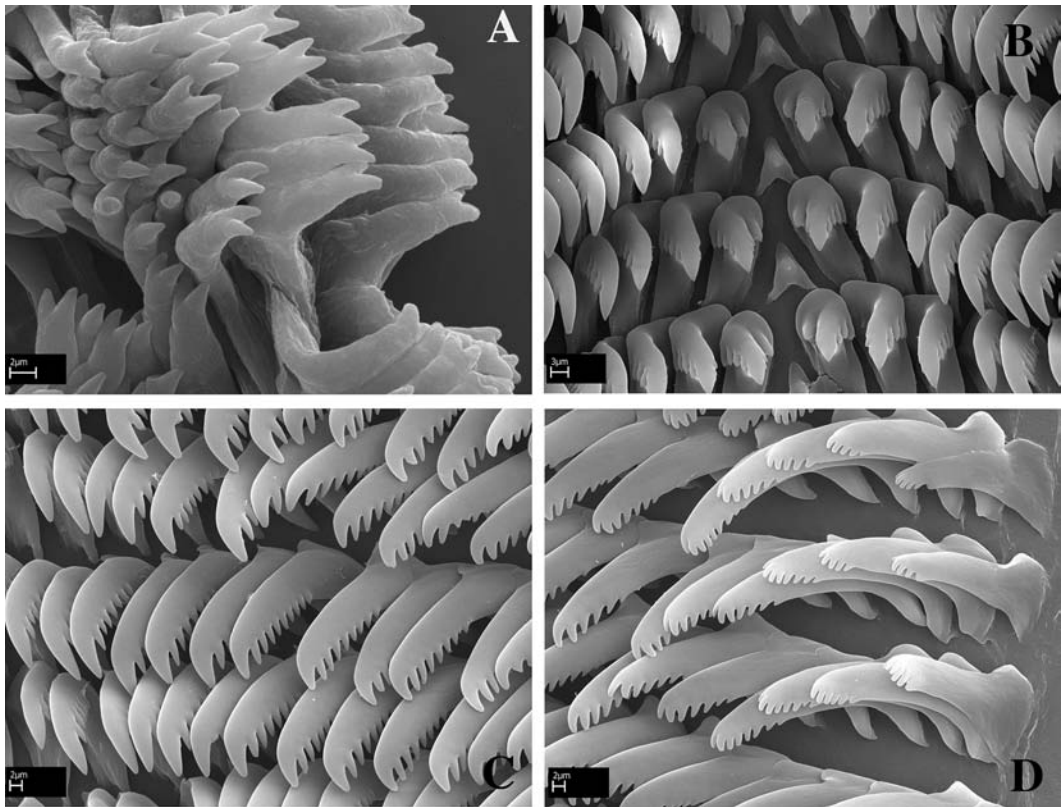


FIGURE 2. *Chromodoris socorroensis* sp. nov. Scanning electron micrographs. A. Bifid apices of jaw rodlets. B. Central portion of radula. C. Midlateral teeth. D. Outermost lateral teeth.

labial cutical, which bears numerous jaw rodlets (Fig. 2A). These rodlets are elongate with spreading bifid apices. The radular formula is 43 x 24.1.24. Triangular rachidian teeth are present in the center of each radular row (Fig. 2B). Each rachidian has a broad base and a single rounded denticle just below its apex. The innermost lateral teeth have a single large triangular denticle on the inner side of the primary cusp (Fig. 2B). The primary cusp is large and triangular with 2-4 smaller denticles on the inner edge and 3-5 denticles along the outer edge. The second and third laterals lack the inner triangular cusp, but have 2-3 small denticles on the inner side of the primary cusp with 4-5 denticles on the outer side. The midlateral teeth (Fig. 2C) are elongate with a small triangular primary cusp with a rounded apex and 7-9 small pointed denticles below the primary cusp. The outermost teeth are elongate with a broad base (Fig. 2D). The primary cusp is small with 4-5 rounded denticles below the cusp.

REPRODUCTIVE SYSTEM (Fig. 3).— The ampulla is thick and tubular, narrowing somewhat before bifurcating into the oviduct and vas deferens. The short oviduct enters the female gland mass near the albumen gland. The prostatic proximal portion of the vas deferens is folded over itself once before it narrows markedly into the muscular, ejaculatory portion. The ejaculatory portion to a curved segment then enters the short penial bulb, which is adjacent to the slender vaginal duct at the common gonopore. The distal end of the vas deferens is devoid of any penial hooks. The female gland mass consists of the large mucous gland and small membrane and albumen glands. Near the exit of the mucous gland there is a small, ovoid vestibular gland. A long vagina leads to a spherical bursa copulatrix. Adjacent to the vagina, a small duct emerges and connects the pyriform receptaculum seminis. The uterine duct emerges about half of the length along the duct to the receptaculum seminis. The uterine duct is relatively short and enters the female gland mass near the albumen gland.

NATURAL HISTORY.— *Chromodoris socorroensis* was observed to be abundant in two of the islands of the Revillagigedo Archipelago: Socorro and San Benedicto. Specimens were found under rocks with encrusting sponges in the subtidal (depths of 5 to 25 meters).

DISCUSSION.— The family Chromodorididae Bergh, 1892, is well represented with over 350 species known throughout the world; more than 120 of those are currently placed under the genus *Chromodoris*. The generic placement of *Chromodoris socorroensis* is based largely on the possession of several key characters. The jaw rodlets have bifid apices. A triangular rachidian tooth and lateral teeth with a strong primary cusp and smaller denticles is characteristic of many other species of *Chromodoris*, although the presence of a rachidian tooth is variable between species of *Chromodoris*. The reproductive system has a small, simple vestibular gland. The gill does not vibrate and consists of simply pinnate branches arranged in a complete circle.

The color pattern of *Chromodoris socorroensis* clearly differentiates it from the other six known species from the eastern Pacific. No other eastern Pacific chromodorid has a translucent body, encrusted with red patches outlined in white. Only five other Panamic chromodorids have red pigment and thus *C. socorroensis* should be compared closely with them. *Chromodoris galax-*

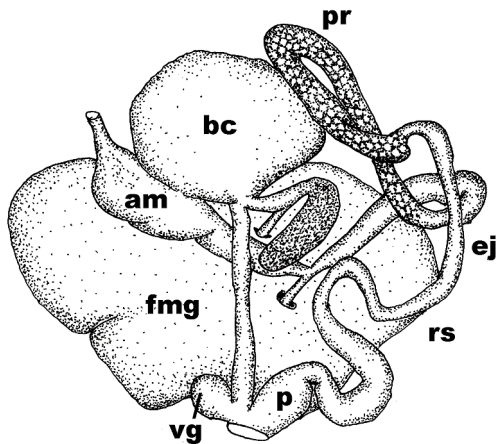


FIGURE 3. *Chromodoris socorroensis* sp. nov. Reproductive system, am=ampulla, bc=bursa copulatrix, ej=ejaculatory duct, fgm=female gland mass, p=penis, pr=prostate, rs=receptaculum seminis, vg=vestibular gland, scale = 1.0mm.

TABLE 1: Comparative data from Panamic chromodorids

Species	Body Color	Red Pigment	Rhinophores	Gill	Known distribution	Radular formula
<i>Chromodoris galaxorum</i> Bertsch 1978	Opaque white	Big random round spots, delineated with yellow	Clear with dark red clavus	Purple red	Outer coast of Baja California and Gulf of California	56-59 x 47-57.1.47-57
<i>Chromodoris ruzafai</i> Ortea, Bacallado & Valdés, 1999	Clear blue	Irregular shaped, bit sized, yellow spots	Dark with white tips	Opaque white	Islas Galápagos	38 x 22.1.22
<i>Chromodoris sphoni</i> (Ev. Marcus, 1971)	Red	Dominating color, thick cross shape, yellow spots, mint blue	Clear pink with dark spots	Pink with red tips	Gulf of California to Panama and Islas Galápagos	40-59 x 26-60.1.26-60
<i>Chromodoris macfarlandi</i> Cockerell, 1901	violet with yellow lines	absent	violet	violet	California to Baja California	36-76 x 16-50.1.16-50
<i>Chromodoris marislae</i> Bertsch in Bertsch et al. 1973	White with orange rings	absent	Light brown with opaque white	Light brown with opaque white	Gulf of California	59-82 x 53-70.1.53-70
<i>Chromodoris norrisi</i> Farmer, 1963	White and red spots	Spots only	Orange with white tips	Orange with white tips	Gulf of California	36-111 x 25-72.1.25-72
<i>Glossodoris baumanni</i> (Bertsch, 1970)	White	Blotchy dense or sparse spots with yellow tint	White with red tips	Yellow with red outline and purple-red tips	Gulf of California to Panama and Islas Galápagos	33-84 x 21-68.1.21-68
<i>Mexichromis tica</i> Gosliner, Ortea & Valdés, 2004	Clear white	Thin line, delineating clear and opaque white dorsum	Clear white with red tips	Clear white	Costa Rica and Islas Galápagos	?
<i>Chromodoris socorroensis</i> sp. nov.	Clear pink	Covering most of the dorsum, thick irregular patches	Clear pink	Clear pink with or whitout orange tips.	Islas Revillagigedo, Mexico	43 x 24.1.24

orum Bertsch, 1978, bears big red random round spots outlined with yellow on a white background; *Chromodoris ruzafai* Ortea, Bacallado and Valdés, 1999, has irregular shaped blotches on a clear blue background, with yellow spots; in *Chromodoris sphoni* (Ev. Marcus, 1971) red is the dominating color, in a wide cross shape, with yellow small spots and notum marked with mint blue and yellow. *Glossodoris baumanni* (Bertsch, 1970) exhibits color variation where the usually evenly dispersed small spots are so dense that the overall color of the body appears blotchy red; and *Mexichromis tica* Gosliner, Ortea and Valdés, 2004, has a thin red line outlining a clear body. Only *C. sphoni* has red pigment in dominating portions comparable to *C. socorroensis*. Nonetheless, both species are quite distinct from each other. *Chromodoris sphoni* has a red dorsum, with yellow spots scattered all over it, and mint blue and yellow lines; *Chromodoris socorroensis* has a clear background with smaller red markings compared to *C. sphoni*. *C. socorroensis* does not have yellow spots.

The radula of the various Panamic species of *Chromodoris* has been shown to be variable (Bertsch 1977, 1978a, 1978b, 1978c), but there are distinctive patterns for each species. Of the six species of eastern Pacific *Chromodoris* only *C. ruzafai*, *C. sphoni*, *C. macfarlandi* and *C. norrisi* have some specimens with a radular formula that is similar to that of *C. socorroensis*. In all but *C. ruzafai*, the radular for-

mula similar to that of *C. socorroensis* is found only in juvenile specimens. In *C. marislae*, the rachidian tooth is elongate and bifid while in the other six species, it is short and triangular in shape. In *C. marislae*, there are only 3–7 denticles on the middle lateral teeth while in *C. socorroensis* there are 7–9 denticles, while in *C. ruzafai* there are a maximum of 8 denticles. In the other species the middle lateral teeth have more denticles than in *C. socorroensis* and *C. ruzafai*: *C. galexorum* (15–18 denticles), *C. macfarlandi* (10–16 denticles), *C. norrisi* (7–14 denticles) and *C. sphoni* (17–19 denticles). The outer lateral teeth of *C. socorroensis* are straighter and more elongate than those of *C. ruzafai*.

The reproductive system has not been described for most of the eastern Pacific species of *Chromodoris* and is only known for *C. macfarlandi* (MacFarland, 1966: pl. 34, fig. 8), *C. sphoni* (Ortea et al., 1999: fig. 13b), *C. ruzafai* (Ortea et al., 1999: fig. 15b) and *C. socorroensis* (present study, Fig. 3). In *C. macfarlandi* and *C. sphoni* the prostatic portion of the vas deferens is highly convoluted and elongate, while in *C. ruzafai* and *C. socorroensis* it is shorter and consists of only a single loop. In *C. ruzafai*, the distal portion of the ejaculatory segment has an elongate portion that is greatly narrower in diameter than the rest of the ejaculatory duct, while in *C. socorroensis* the ejaculatory segment does not narrow distally. In *C. ruzafai* and *C. sphoni*, the receptaculum seminis joins directly with the base of the bursa copulatrix, while in *C. macfarlandi* and *C. socorroensis* the receptaculum joins the vagina more proximally. Ortea et al. did not describe a vestibular gland for either *C. sphoni* or *C. ruzafai*, but this probably represents an oversight rather than an absence of these structures, as they are generally present in most species of *Chromodoris*.

Detailed phylogenetic studies are needed to determine monophyletic groups within the Chromodorididae. The hypotheses of relationships within the Chromodorididae proposed by Rudman (1984) and Gosliner and Johnson (1999) require additional detailed study and phylogenetic analysis to further define monophyletic groups within the highly diverse chromodorid nudibranchs.

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