



Two new species of *Thorunna* Bergh 1878 (Mollusca: Nudibranchia: Chromodorididae) from the Indo-Pacific

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KEY WORDS: *Thorunna*, Chromodorididae, Nudibranchia, Mollusca, Indo-Pacific, new species.

ABSTRACT The genus *Thorunna* previously included eleven described species. Two new species from the Indo-Pacific tropics, *Thorunna kabuna* and *Thorunna balourga* are described. *Thorunna kabuna* is the only known species in the genus with both large, visible mantle glands and small glands covering the dorsal surface. It also has a conical penial papilla inside a round penial bulb. This species is sympatric with a similarly colored species in the same genus, *Thorunna daniellae* (KAY & YOUNG 1969). The other new species, *Thorunna balourga* is the only *Thorunna* known to have calcium carbonate spicules visible through the mantle surface.

RIASSUNTO A tutt'oggi il genere *Thorunna* include 11 specie. Due nuove specie dell'indo-pacifico tropicale, *Thorunna kabuna* e *T. balourga*, vengono qui descritte. *T. kabuna* è la sola specie del genere che presenti sia grandi che piccole ghiandole sulla superficie dorsale. Presenta inoltre una papilla peniale conica, all'interno di un bulbo arrotondato. Questa specie è simpatica con *Thorunna daniellae* (Kay & Young, 1969), dalla colorazione simile. L'altra nuova specie, *T. balourga*, è l'unica specie del genere a possedere spicole di carbonato di calcio visibili attraverso la superficie del mantello.

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INTRODUCTION

The genus *Thorunna* (BERGH, 1878) is the most derived group in the family Chromodorididae (GOSLINER & JOHNSON, 1999). All species in the genus are very small, less than 20 mm, have an extremely reduced labial armature and most species have lost the large, visible, defensive mantle glands found in all other chromodorid genera. Due to the loss or reduction of many structures traditionally used for classification of nudibranchs in the family Chromodorididae, some species of *Thorunna* have been separated using biogeography and slight differences in their external coloration (see RUDMAN, 1984). The strength of these distinctions would be substantially increased by the utilization of new characters. A number of previously uninvestigated characters are examined here. They include small, dorsal mantle glands, buccal bulb glands, and two structures found in the male portion of the reproductive system.

SPECIES DESCRIPTIONS

Thorunna kabuna sp.nov.
(Figures 1A, 2-5)

Babaina daniellae BERTSCH & JOHNSON, 1981:109; not (KAY & YOUNG, 1969)

Thorunna sp. HOOVER, 1998:169 lower photograph

Type material

Holotype: CASIZ 087069, dissected, Aino Moana State Park, Mamala Bay, Magic Island, Honolulu, Oahu Island, Hawaii, 6 m depth, 8 February 1986, T.M. Gosliner.

Etymology

The name *Thorunna kabuna* comes from the Hawaiian word for medicine man or healer. Unlike most members of the genus *Thorunna*, *T. kabuna*, has visible mantle glands. These glands contain toxic chemicals and are thought to deter predation. In hopes of finding novel chemicals that may aid in the treatment of disease biochemists have begun to analyze chemicals isolated from the mantle glands of other chromodorid nudibranchs (AVILA, 1995). Eventually, *T. kabuna* and other chromodorids may serve as modern day kahunas.

Distribution

The only known records of *Thorunna kabuna* are from the waters off Magic Island just off the coast of Honolulu on Oahu Island, Hawaii. This single specimen was found, and others have been observed, at up to 6m depth.

External morphology

The living animal was 12 mm in length (Fig. 1A). The body is oval and elongate. The mantle is slightly laterally constricted in the area adjacent to the gills. Posterior to this narrow portion, the mantle again widens and thickens. The mantle is white with a slight pinkish tinge. The body is opaque in the center and becomes more translucent along the mantle edge. The foot is the same color as the mantle, with a thin pink border around the edge of the foot. There is a sub-marginal, dashed, magenta line around the mantle. The magenta areas may be broken up further into small dots. A single row of opaque white mantle glands is visible through the translucent white mantle edge. There are 10-12 glands concentrated in the posterior region of the mantle, and one or two glands are visible on either

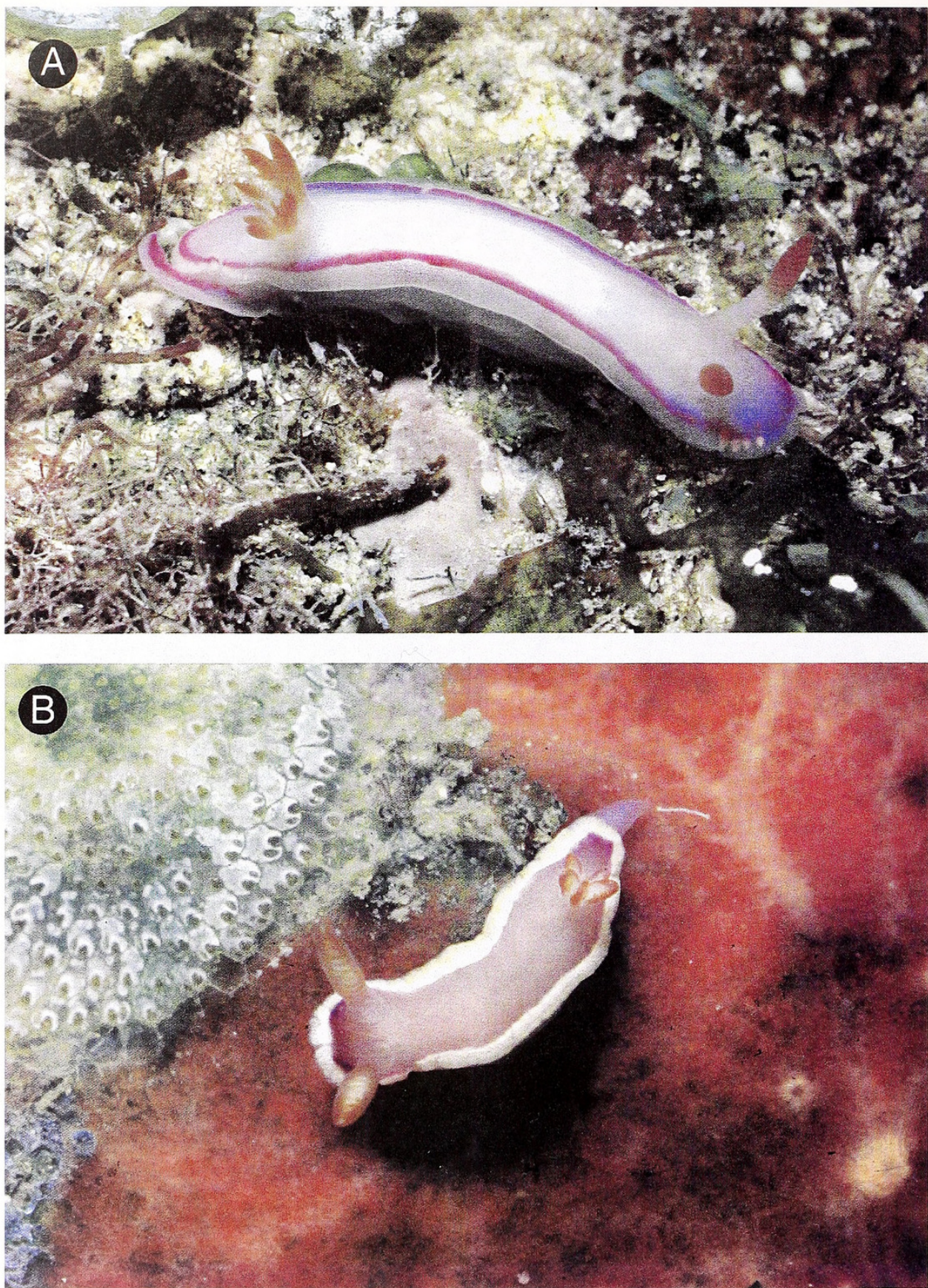


Figure 1. Living animals. A. *Thorinna kabuna* sp. nov. CASIZ 087069, 12 mm in length, Magic Island, Honolulu, Hawaii. B. *Thorinna balourga* sp. nov. CASIZ 086434, 10 mm in length, Rasch Passage, Madang, Papua New Guinea.



side of the head. The mantle overhang is also covered with minute, raised glands. These glands are arranged in concentric rings around the mantle and are barely visible without a dissection microscope (Fig. 2). The simple gills are white at the base and reddish-orange at the tips. The rhinophores are very long and club-like. They are pinkish-white at their bases and reddish-orange at the apices.

Alimentary canal

The oral tube is twice as long as the muscular portion of the buccal mass. There is a wide ring of glandular tissue surrounding the oral tube (Fig. 3). The radular formula is $34 \times 18.0.18$. There is no differentiation between the inner lateral teeth and all of the other teeth. It is difficult to determine whether the teeth have a primary cusp with denticles or many cusps. They will be called denticles for ease of discussion. There are 5-9 denticles on each tooth. One or two denticles are turned toward the center of the radula, whereas the remainder of the denticles are pointed toward the outer edges of the radula (Fig. 4A). On most teeth, the last denticle on the outer edge of the tooth is much more pointed than the rest of the denticles. The bases of the teeth are flattened and greatly elongated (Fig. 4B, C). The jaws are small and delicate. They are composed of bifid or multifid elements. These small thin rodlets join together to form single recurved hooks (Fig. 4D).

Reproductive system

The arrangement of organs is triaulluc (Fig. 5). The ampulla is short and irregularly rounded. It tapers into a thin, muscular tube before it joins with the prostate and enters the female gland mass. The prostate is wide and highly convoluted, but narrows into the ejaculatory portion. The ejaculatory portion is very short and narrow, but muscular. It widens into a very large round, muscular bulb at the top of the penis. A small, conical papilla is visible through the musculature of this bulb. The penis is very long and narrow. The bursa copulatrix is large and rounded. The large, elongate, pyriform receptaculum seminis bends sharply at the point where it enters the bursa copulatrix. The common uterine and vaginal duct enters the bursa copulatrix at this point, as well. This long, thin duct divides into the uterine duct and the vaginal duct close to the female gland mass. The short and narrow uterine duct continues into the female gland mass, whereas the vaginal duct widens slightly and meets the penis to form the common genital opening. A thin, highly ramified vestibular gland surrounds the entire female side of the reproductive system and is attached to the base of the female gland mass.

DISCUSSION

Thorunna kabuna is most similar in external morphology to *T. daniellae*. They are both whitish in color with a purple to pink mantle border. *Thorunna daniellae* has a much more opaque white general body color that becomes translucent on the outside of the maroon mantle margin and has distinct translucent patches behind and around the rhinophores (HOOVER, 1998), whereas *T. kabuna* is a uniform pinkish white

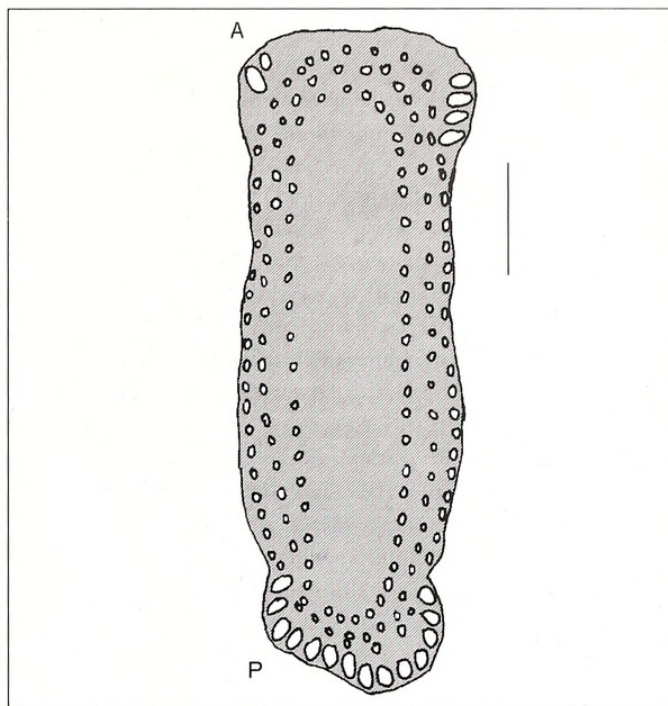


Figure 2. Mantle glands. *Thorunna kabuna* sp. nov. Abbreviations: A- anterior, P- posterior, dorsal side faces up. Scale = 2mm.

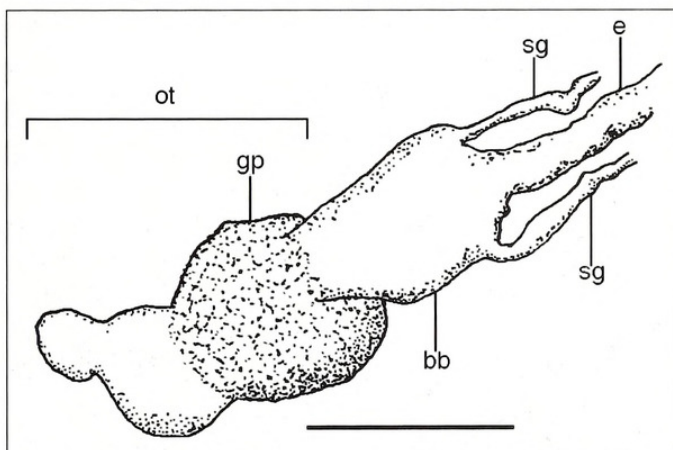


Figure 3. Alimentary canal. *Thorunna kabuna* sp. nov. Abbreviations: bb- buccal bulb, e- esophagus, gp- glandular portion, ot- oral tube, sg- salivary gland. Scale bar = 1 mm.

all over the mantle except for the pinkish maroon mantle border. *Thorunna kabuna* has white rhinophoral stalks and orangish- red rhinophore clubs. *Thorunna daniellae* has translucent rhinophoral stalks and its rhinophore clubs are reddish on the anterior side and opaque white on the posterior facing side. The gills are similar, but *T. kabuna* has uniformly orangish-red gills with translucent white bases and *T. daniellae* has opaque white gills with orangish-red rachises. The most distinct external difference between these species is the presence of large, visible mantle glands on the sides of the head anterior to the rhinophores and posterior to the gills in *T. kabuna* (Fig. 2, BERTSCH & JOHNSON, 1981:109). Visible mantle glands are not

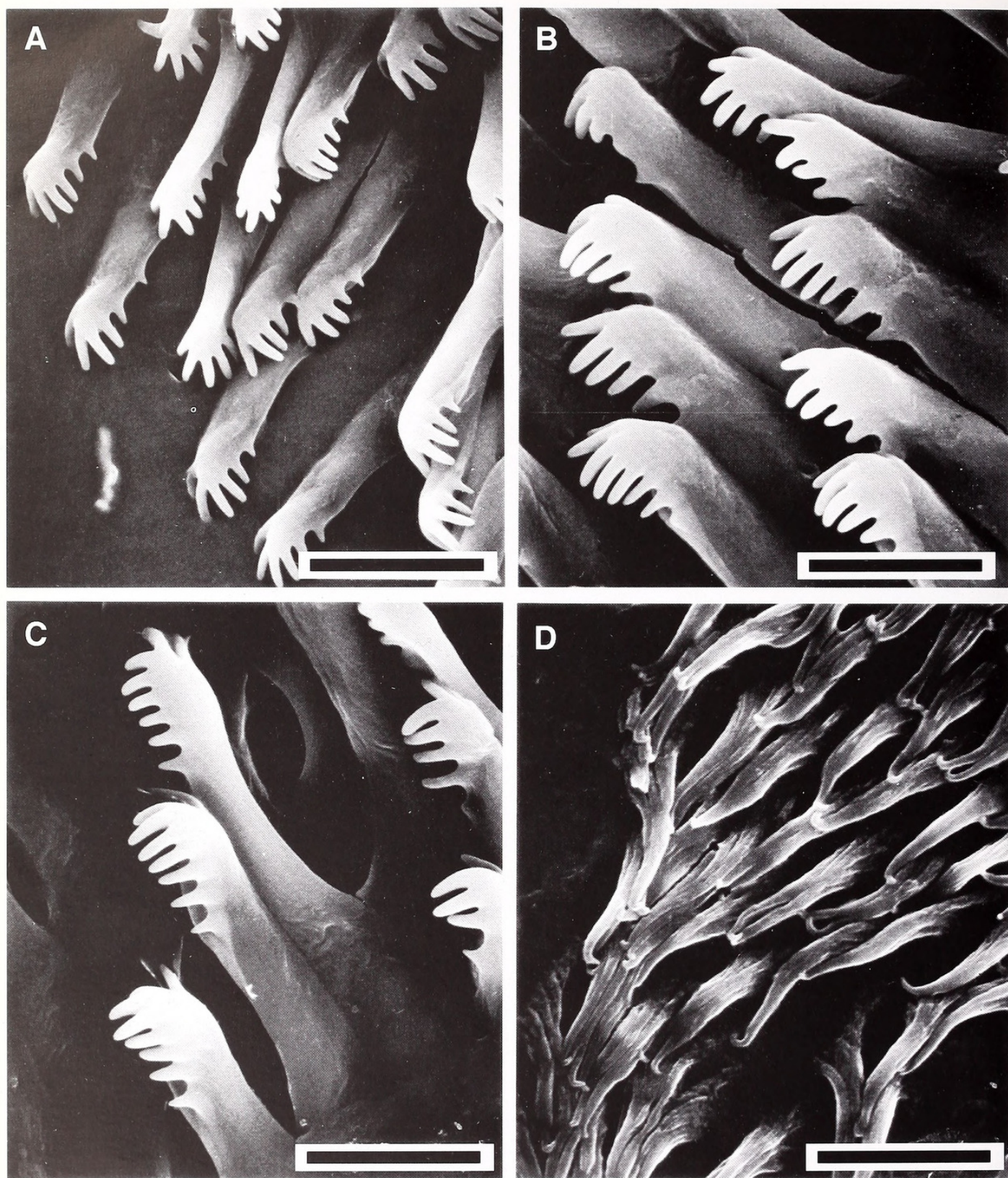


Figure 4. Scanning electron micrographs. *Thorunna kabuna* sp. nov. CASIZ 087069. A. Inner lateral teeth. Scale = 15 μ m. B. Middle lateral teeth. Scale = 10 μ m. C. Outer lateral teeth. Scale = 10 μ m. D. Jaw rodlets. Scale = 15 μ m.



present in *T. daniellae* (KAY & YOUNG, 1969; RUDMAN, 1984), although, a row of tiny glands visible only with a scanning electron microscope has been found on the notum of *T. daniellae*. These glands may be similar to the minute dorsal glands found in *T. kabuna*, except that *T. kabuna* has multiple, concentric rings of glands on the dorsal surface, and *T. daniellae* only has one sub-marginal row. This type of dorsal gland has never been reported for any member of the family Chromodorididae. Further investigation is needed to determine if this type of dorsal gland arrangement is present in other chromodorids.

The radular morphology of these two species is very different. *Thorunna kabuna* has multiple cusps (5-7) on each tooth and all of the teeth are the same general shape, there is no differentiation between the inner and outer lateral teeth. *Thorunna daniellae* has bifid middle and outer laterals and short multifid inner lateral teeth (RUDMAN, 1984). The jaw morphology is very similar in the two species. *Thorunna daniellae* lacks the large penial bulb and conical papillae found in *T. kabuna*. The vaginal duct and the uterine duct in *T. daniellae* branch at a point that is closer to the bursa copulatrix than the branching point in *T. kabuna*. *Thorunna kabuna* also has a wider penis than *T. daniellae*.

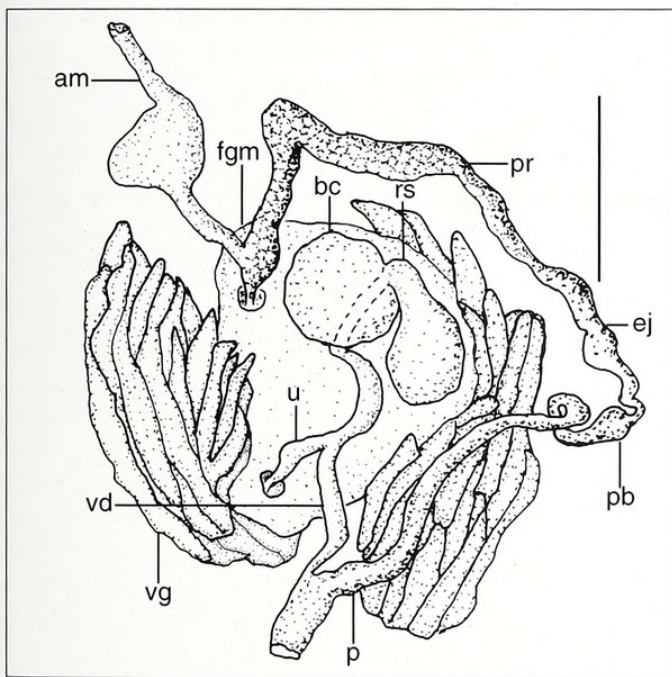


Figure 5. Reproductive system. *Thorunna kabuna* sp. nov. CASIZ 087069. Abbreviations: am- ampulla, bc- bursa copulatrix, ej- ejaculatory portion of the vas deferens, fgm- female gland mass, p- penis, pb- penial bulb, pr- prostate, rs- receptaculum seminis, u- uterine duct, vd- vaginal duct, vg- vestibular gland. Scale = 1 mm.

Thorunna balourga sp. nov.

(Figures 1B, 6-8)

Type material

Holotype: CASIZ 075089, Rasch Passage, Madang, Papua New Guinea, 9 m depth, 17 November 1990, T.M. Gosliner and G. Williams.

Paratypes:

CASIZ 1103605, one specimen, dissected, Basilisk Point, Milne Bay Province, Papua New Guinea, 3 m depth, 28 May 1988, T.M. Gosliner.

CASIZ 075265, three specimens, Planet Rock, south of Madang, Papua New Guinea, 44 m depth, 21 November 1990 T.M. Gosliner, G. Williams and M. Jebb.

CASIZ 086434, one specimen, Rasch Passage, Madang, Papua New Guinea, 50 m depth, 9 June 1992, T.M. Gosliner.

CASIZ 086321, two specimens, south side of Rasch Passage, Madang, Papua New Guinea, 5 m depth, 16 June 1992, T.M. Gosliner.

CASIZ 110452, two specimens, Bethlehem, Maricaban Island, Batangas Province, Luzon Island, Philippines, 24 April 1997, T.M. Gosliner.

Etymology

The name *Thorunna balourga* comes from the Greek word halourgus, which means sea-purple. The body color of this tiny animal is a brilliant purple.

Distribution

This animal has been found only in Papua New Guinea and the Batangas region of the Philippines. *Thorunna balourga* has been observed at depths from 3 to 50 meters.

External morphology

The living animal is 10 mm in length (Fig. 1B). The body color ranges from a light purplish-pink to a deep purple. This purplish color is darker at the posterior and anterior ends of the animal, where a thick white mantle margin begins. The mantle margin is slightly undulate and opaque, but may become more translucent at the edges. The foot is darker in color than the rest of the body. The rhinophores and gills range from a light almost white to orange or dark red. In the darker animals, the rhinophores and gills are darker as well. The rhinophores are translucent at the bases and dark reddish at the tips. The color pattern of the area in between the translucent and reddish portion is highly variable. On the rhinophores of some specimens there is a purple band present and in others a white band, and some have both bands. There is no evidence of mantle glands anywhere on the animal, but miniscule glands may be present around the mantle margin. Arranged in a chevron-like pattern, on the dorsum, there are spaces where calcium carbonate spicules were present (Fig. 6). Calcium carbonate structures are often lost after the fixation of the specimens in Bouin's solution. The spicules are visible in the living animals (Fig. 1).

Alimentary canal

The oral tube is twice as long as the muscular portion of the buccal mass. There are no glandular structures present on the oral tube or buccal bulb. The radular formula is 38 x 27-29.0.27-29. The inner lateral radular teeth have very wide bases, but narrow into thin, curved cusps (Fig. 7A). The inner 2-3 teeth are bifid, but the second cusp is much smaller and

more pointed than the first. The rest of the middle and outer lateral teeth are long, have wide bases and have cusps that are equal in length (Fig 7B, C). The jaws are extremely small and delicate (Fig. 7D). They are long and thin. Most rodlets share a common base with other rodlets, but then separate into individual, pointed, re-curved hooks.

Reproductive system

The arrangement of organs is triaulytic (Fig. 8). The ampulla is short and rounded. It tapers into a thin, muscular tube before it joins with the prostate and enters the female gland mass. The ampulla narrows and lengthens toward its distal end. The glandular portion of the prostate forms a simple loop that narrows into the ejaculatory portion. The ejaculatory portion is short and thin, but muscular. It widens into a round, muscular bulb at the top of the penis. The penis is very long and narrow. The bursa copulatrix is large and rounded. The large, elongate, pyriform, receptaculum curves slightly at the point where it enters the bursa copulatrix. The common uterine and vaginal duct enters the bursa copulatrix at this point, as well. This long, thin duct divides into the uterine duct and the vaginal duct close to the female gland mass. The short and narrow uterine duct continues into the female gland mass, whereas the long vaginal duct widens slightly and meets the penis to form the common genital opening. A thin, highly ramified vestibular gland surrounds the entire female side of the reproductive system and is attached at the base of the female gland mass.

DISCUSSION

Thorunna halourga is the only member of the genus *Thorunna* with a purple mantle and a wide, white mantle border. It is most similar to *Thorunna punicea* (RUDMAN, 1995), but *T. punicea* is lighter in color, has a fairly narrow mantle border and purple tipped rhinophores and gills. *Thorunna halourga* and *T. punicea* have similar color patterns and reproductive systems and both lack mantle glands, but their radulae are quite different. *Thorunna halourga* has a relatively narrow radula, 38x 27-29.0.27-29, while *T. punicea* has a wider radula, 38x 36.0.36.

The teeth of *T. punicea* are much larger and more developed than those of *T. halourga*. The inner tooth in *T. punicea* has a small denticle on the inside of the bifid cusp, while *T. halourga* lacks an inner denticle and has one greatly reduced cusp. The teeth of *T. halourga* are also much thinner and longer than those of *T. punicea*. The outermost teeth of *T. punicea* have a number of outer denticles, whereas *T. halourga* lacks any outer denticles on any teeth. The jaw rodlets of *T. punicea* are wide, flat and much more developed than the thin long rodlets of *T. halourga*. In the description of *T. punicea* there is no mention of calcium carbonate spicules in the mantle, but these spicules could have easily been overlooked and may have dissolved due to preservation, as mentioned above.

Thorunna halourga is similar in color pattern to all of the animals included in Rudman's (1986) "*Noumea purpurea* colour group". These include *Noumea purpurea*, *Noumea varians*, *Pectenodoris trilineata*, *Durvilledoris similis* and *Durvilledoris pusilla*. All of these species have a pinkish purple background color and a white or yellowish mantle border. Unlike all of these species, which all have other white or yellow lines on their mantle surfaces, *T. halourga* does not have any markings on its mantle surface other than the mantle border. *Thorunna halourga* is similar to all of the aforementioned species in external coloration only, their internal anatomies are very different. All five of the species in this color group have visible mantle glands, whereas *T. halourga* does not have any mantle glands. The radula of *T. halourga* is almost as wide as it is long, is greatly reduced and very thin and delicate. Its radular formula is 38x 27-29.0.27-29, as mentioned above. *Noumea purpurea*, *N. varians*, *Durvilledoris similis* and *D. pusilla* all have extremely narrow radulae with greatly enlarged inner-most teeth and multiple denticles on the other lateral teeth. Their radular formulas are 28x 14.0.14, 39x 18.0.18, 23x 11.0.11 and 44x 19.0.19 respectively. *Pectenodoris trilineata* (JOHNSON & GOSLINER, 1998) has very distinct, extremely short radular teeth. These teeth differ greatly from the long narrow teeth of *T. halourga*. All of the species in the *Noumea purpurea* color group have similar reproductive systems. In all of these species the receptaculum seminis enters directly into the bursa copulatrix. The arrangement of the reproductive system of *T. halourga* is very similar to that of the members of this color group, except the ampulla in *T. halourga* is more rounded than in the other species.

Thorunna halourga is also similar in color to *Durvilledoris albofimbria* (RUDMAN, 1995). *Durvilledoris albofimbria* is purplish-pink in color with a thin white mantle margin, unlike the wide white mantle margin found in *T. halourga*. *Durvilledoris albofimbria* differs from both *T. halourga* and *T. punicea* in that it has large visible mantle glands around the entire mantle edge. Visible mantle glands are not found in either of these species of *Thorunna*. *Durvilledoris albofimbria* also differs from *T. halourga* in its internal morphology. The radular formula of *D. albofimbria* is 35x18.0.18, similar, but more narrow than that of *T. halourga* (see above). The biggest radular difference is that *D. albofimbria* has a tricuspid inner tooth, whereas *T. halourga* has a simply bifid inner lateral tooth. *D. albofimbria* may also have slightly larger jaw rodlets than *T. halourga*. The biggest inter-

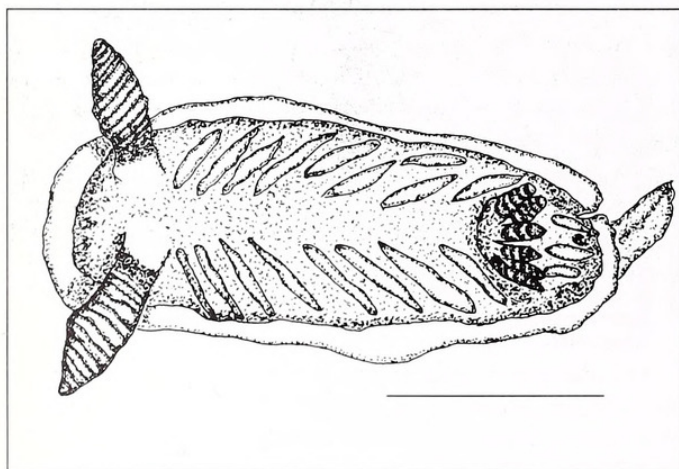


Figure 6. Mantle spicules. *Thorunna halourga* sp. nov. CASIZ 075265. Abbreviation: s- spicules. Scale = 2mm.

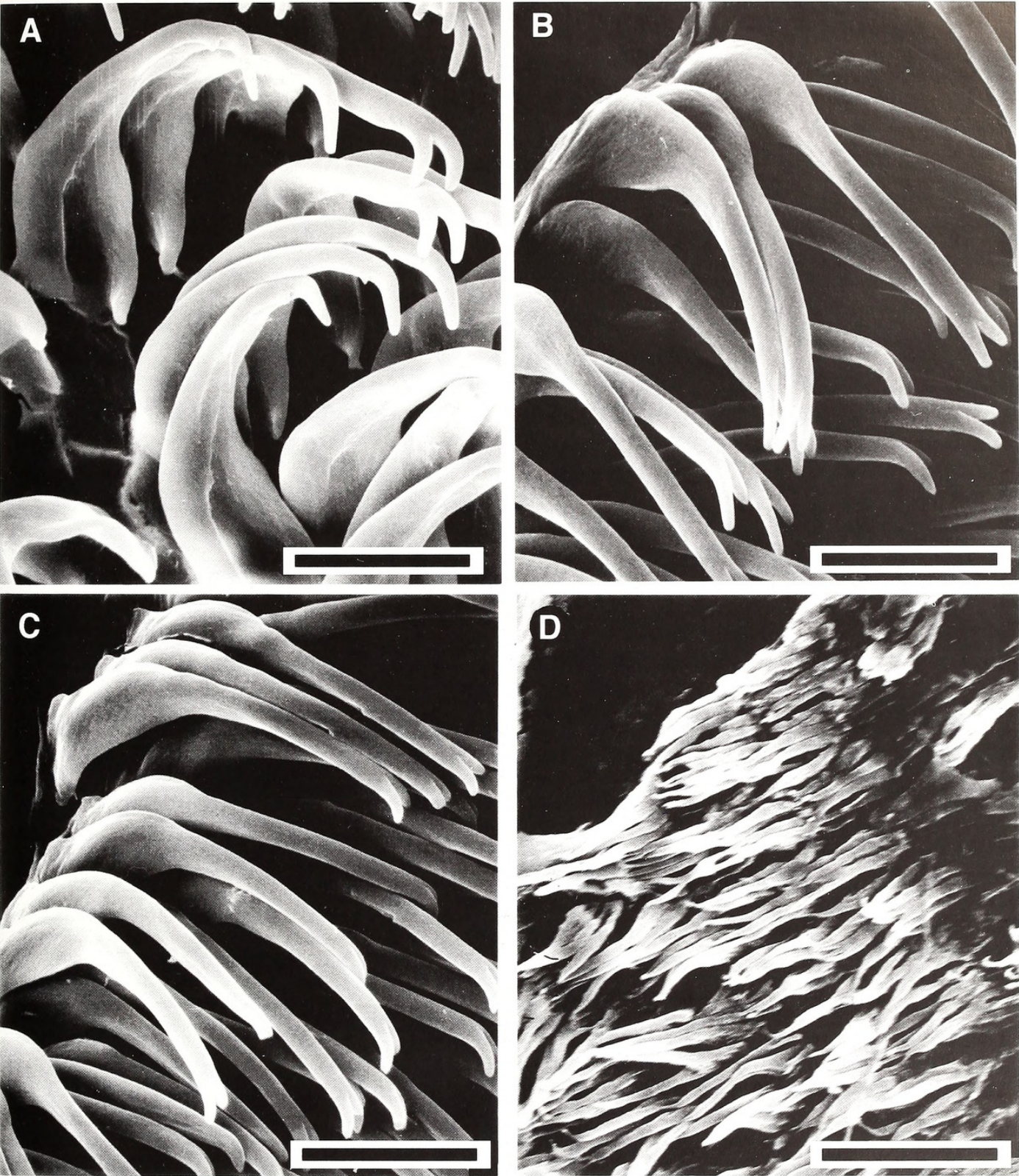


Figure 7. Scanning electron micrographs. *Thorunna balourga* sp. nov. CASIZ 113605. A. Inner lateral teeth. Scale = 15 μ m. B. Middle lateral teeth. Scale = 15 μ m. C. Outer lateral teeth. Scale = 20 μ m. D. Jaw rodlets. Scale = 15 μ m.

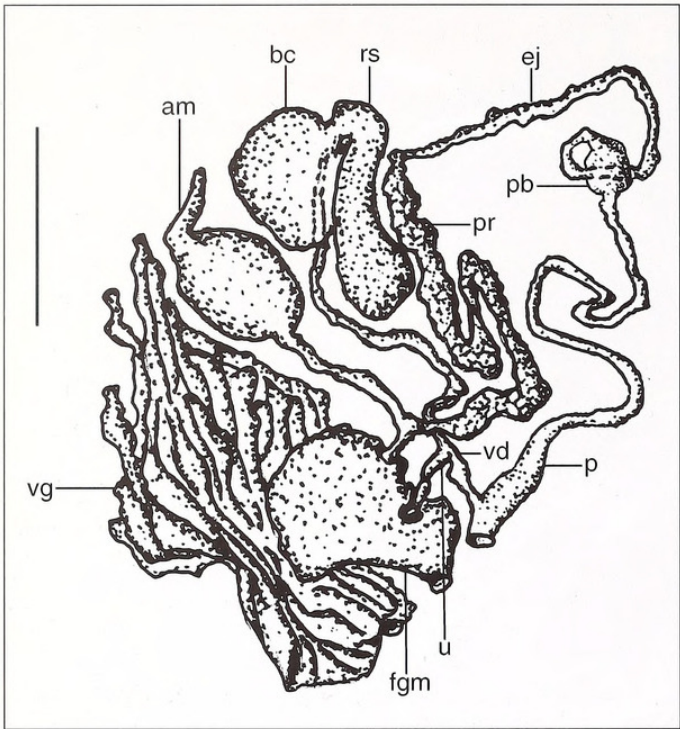


Figure 8. Reproductive system. *Thorunna balourga* sp. nov. CASIZ 113605. Abbreviations: am- ampulla, bc- bursa copulatrix, ej- ejaculatory portion of the vas deferens, fgm- female gland mass, p- penis, pb- penial bulb, pr- prostate, rs- receptaculum seminis, u- uterine duct, vd- vaginal duct, vg- vestibular gland. Scale = 1mm.

nal difference between these two species is the receptaculum seminis. *Durvilledoris albofimbria* has a minute receptaculum seminis, as described for all Indo-Pacific *Hypselodoris* (GOSLINER & JOHNSON, 1999), attached to the vaginal duct at the base of the bursa copulatrix, and *T. balourga* has a large receptaculum seminis, connected directly to the bursa copulatrix. *Durvilledoris albofimbria* also has a much shorter more muscular penis and a long, narrow ampulla.

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