

Chromodorid Nudibranchs from the Hawaiian Islands

by

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Abstract. We propose four new specific taxa of Opisthobranchia—*Hypselodoris andersoni*, *Glossodoris poliahu*, *Glossodoris tomsmithi*, and *Ardeadoris scottjohnsoni*—and we redescribe *Chromodoris albopunctata* (Garrett, 1879). We comment on the anatomy, ecology, and zoogeography of these species, and interspecific differences with their Indo-Pacific congeners.

INTRODUCTION

Although the molluscan fauna of the Hawaiian Islands is one of the best known among the western and central Pacific islands, knowledge of the opisthobranch species is far from complete (GOSLINER *et al.*, 1986). These authors recently wrote that they are aware of over 90 undescribed species of opisthobranchs that occur in this island archipelago.

In our previous studies, we have discussed the zoogeography and taxonomy of various cephalaspidean, doridacean (BERTSCH & JOHNSON, 1979, 1982), dendronotaean (GOSLINER, 1987a), and eolidacean (GOSLINER, 1980) species of Hawaiian opisthobranchs. In this paper, we describe four new species of doridacean nudibranchs from the Hawaiian Islands and correct the nomenclature of another species. Two of these have been previously listed as unnamed species ("locust" and "snowflake" of BERTSCH & JOHNSON, 1981), and three were originally misidentified in Hawaiian waters as *Chromodoris imperialis* (non Pease, 1860), *Chromodoris albonotata* (non Bergh, 1875), and *Chromodoris sibogae* (non Bergh, 1905) (by KAY & YOUNG, 1969; KAY, 1979; and BERTSCH & JOHNSON, 1981). All five of these species are illustrated with color photographs in BERTSCH & JOHNSON (1981).

Collecting localities from the Hawaiian island of Oahu are identified in Figure 1; approximate coordinates for sites from other central Pacific islands are given in the text.

Family CHROMODORIDIDAE

Hypselodoris Stimpson, 1855

Hypselodoris andersoni Bertsch & Gosliner, sp. nov.

(Figures 2, 7-12)

References:

- Locusts: BERTSCH & JOHNSON, 1981:66-67, 107 (color photographs).
Chromodorid 1: JOHNSON, 1983:356-364.

Material examined: (1) Holotype, California Academy of Sciences, CASIZ 064807; collected subtidally, 5 m depth, Pupukea, Oahu, 11 September 1987, Terrence M. Gosliner (TMG).

(2) 2 paratypes, California Academy of Sciences, CASIZ 064820; collected subtidally, 10 m, past Makua, Oahu, 15 September 1978, by Scott Johnson (SJ) and Hans Bertsch (HB) (*ex* HB 710).

(3) 1 dissected paratype, CASIZ 066609; collected subtidally, 10 m, past Makua, Oahu, 15 September 1978, SJ and HB.

(4) 11 paratypes, CASIZ 064808; same locality and date as holotype.

(5) 1 dissected paratype, CASIZ 066608; same locality and date as holotype.

(6) 1 paratype, CASIZ 064809; collected subtidally, 10 m, Makua, Oahu, 14 September 1987, TMG.

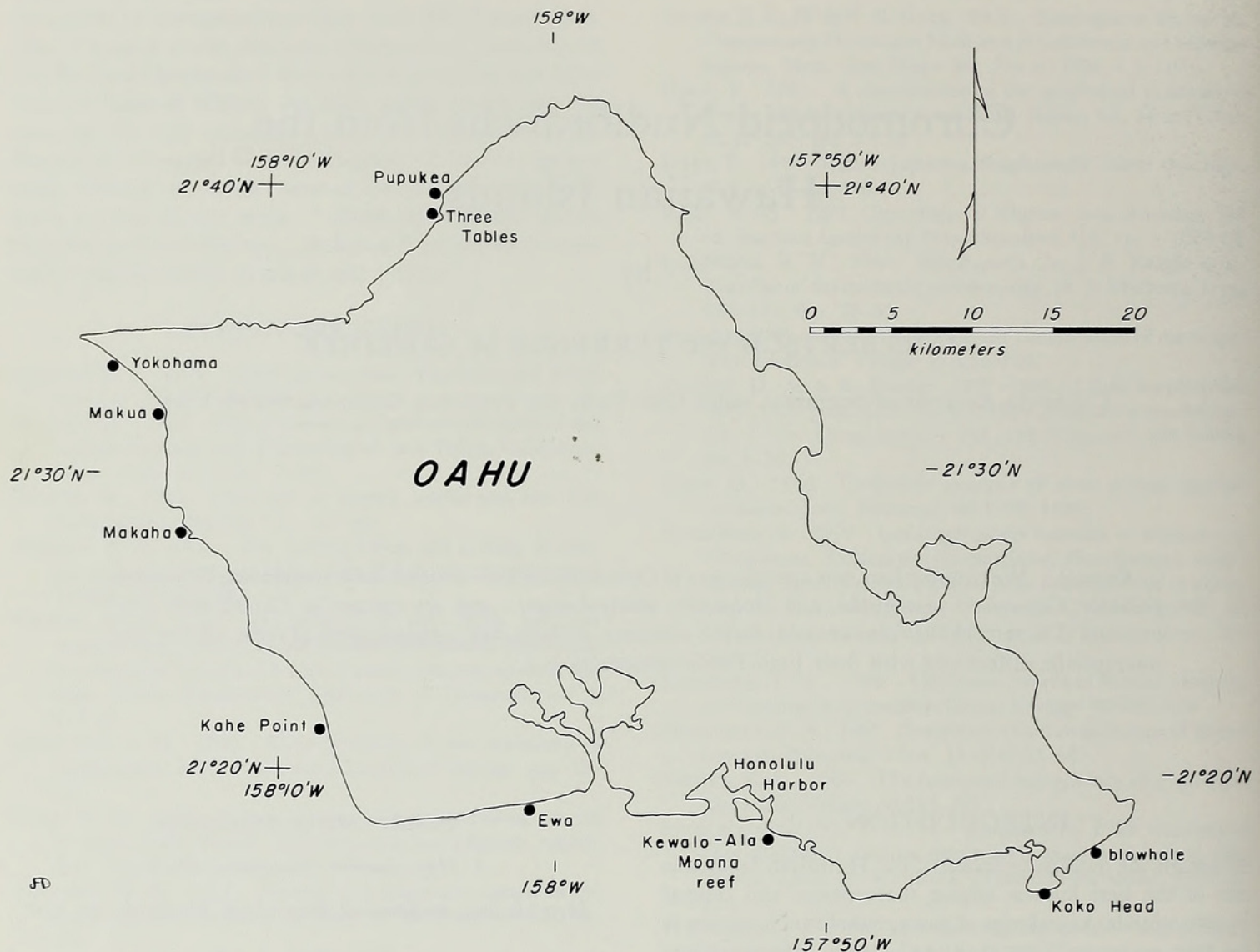


Figure 1

Map of Oahu, showing collecting localities.

(7) 5 paratypes, Los Angeles County Museum of Natural History, LACM 2294; collected subtidally, 15 m, at Pupukea, Oahu, 18 September 1978, SJ (*ex* HB 718).

(8) 1 specimen, collected subtidally, 17 m, off the Lanai Lookout, Oahu, 26 September 1978, SJ (*ex* HB 733).

(9) Additional specimens reported from the western shore of Oahu near Makua by JOHNSON (1983).

Distribution: Specimens of *Hypselodoris andersoni* have been collected from high-energy, rocky subtidal regions on the east, west, and north shores of Oahu, to 18 m deep.

Etymology: This species is named in honor of our good friend and colleague Mr. Roland Anderson of the Seattle Aquarium. We especially salute his untiring efforts and enthusiasm at educating the public regarding the biology and beauty of living mollusks.

External morphology: Preserved specimens measure about 3–7 mm in total length; living animals can reach 15 mm

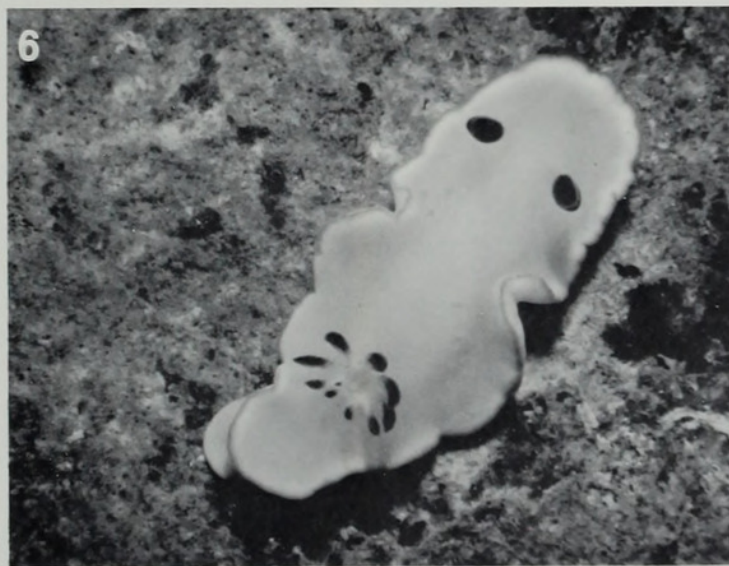
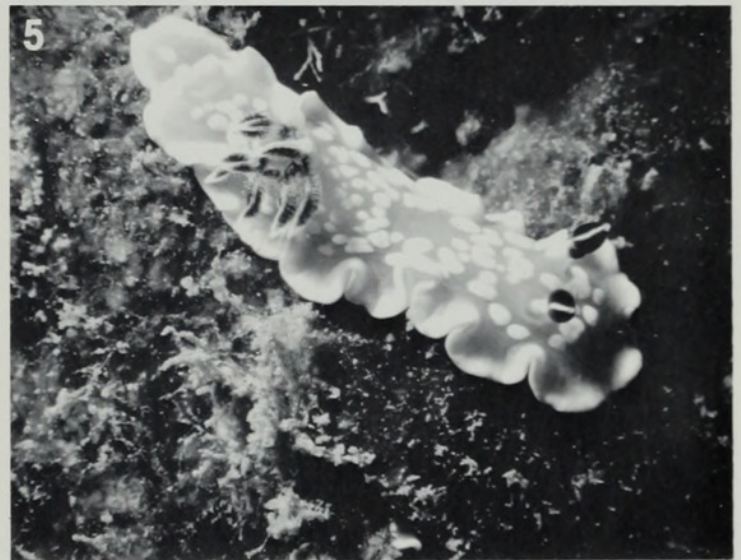
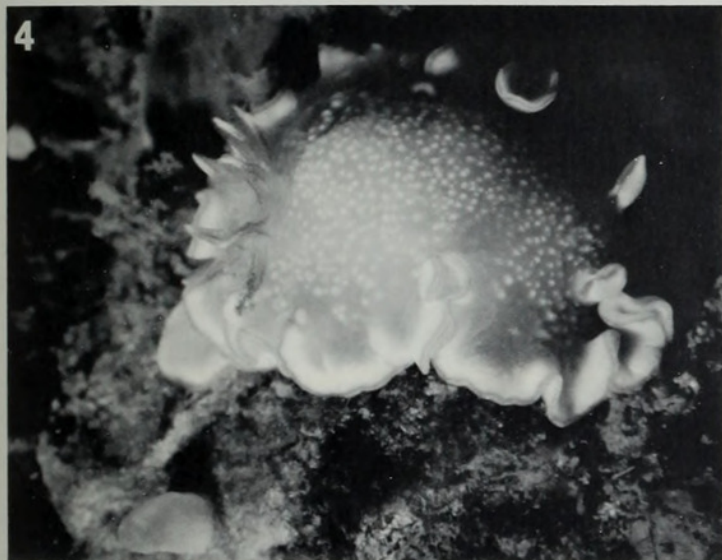
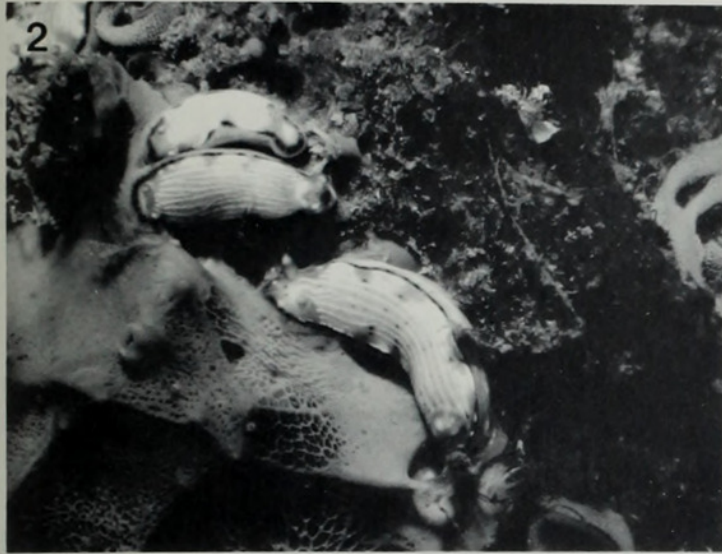
long, but the monthly averages for several hundred animals ranged from about 4 to 7 mm (JOHNSON, 1983:fig. 4).

The animals are elongate, with the posterior portion of the foot protruding slightly behind the dorsum (Figure 2). The mantle margin forms a very small ridge; since there is almost no rim hanging over the side of the foot, the foot sides are completely exposed (characteristic of species of *Hypselodoris*; cf. RUDMAN, 1984:185). The rhinophores and gills are set at the far extremes of the body; rhinophores are cream white to pink with an encircling red-orange band about two-thirds of the distance to the tip. The 6–8

Explanation of Figures 2 to 6

Figure 2. *Hypselodoris andersoni* sp. nov.: *in situ* photograph of 8- and 10-mm-long animals on prey sponge; photo by Scott Johnson, 5 m underwater, Makua, Oahu, December 1977.

Figure 3. Close-up of *Chromodoris albopunctata* (Garrett, 1879):



50-mm-long animal collected at Magic Island, Oahu; photo by Hans Bertsch, 11 May 1978.

Figure 4. *Glossodoris poliahu* sp. nov.: 25-mm-long animal; *in situ* underwater photo by Hans Bertsch, 10 m deep, Three Tables, Oahu, 6 August 1981.

Figure 5. *Glossodoris tomsmithi* sp. nov.: 24-mm-long animal; *in situ* underwater photo by Hans Bertsch; 12 m deep, Makua, Oahu, 15 July 1980.

Figure 6. *Ardeadoris scottjohnsoni* sp. nov.: 21-mm-long animal; underwater photo by Scott Johnson, Puako, Hawaii, May 1978.

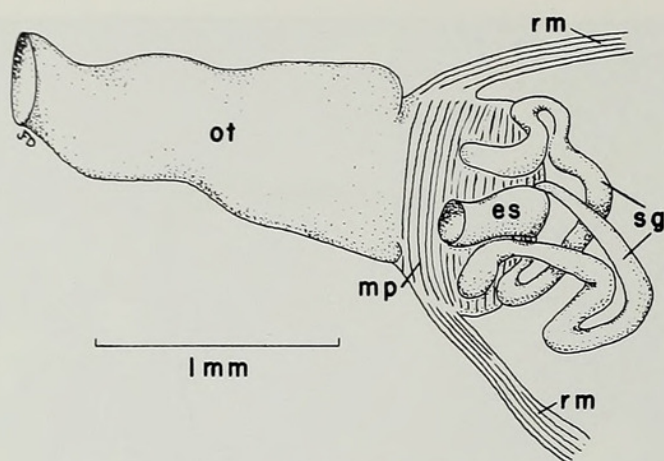


Figure 7

Hypselodoris andersoni sp. nov. Dorsal view of the foregut of specimen CASIZ 066608. Symbols: es, esophagus; mp, muscular portion; ot, oral tube; rm, retractor muscle; sg, salivary gland. Scale = 1 mm.

simply pinnate gills are held erect, closely together, with the distal tips curling in towards the center of the gill circlet. They are basally and distally cream colored, with most of the gill possessing a red-orange coloration, especially on the outer face.

The dorsum and sides of the foot are cream colored to pink; the mantle margin is usually tinged with a continuous deep blue band encircling the whole animal (less frequently there are slight interruptions of this band; even when the band is not continuous the appearance is of a solid line, not a broken one), and another blue band around the rim of the foot (most prominent on the posteriorly protruding part of the foot). The dorsum is streaked with 10–12 thin, opaque white, nearly parallel, close-set longitudinal lines, some of which may be discontinuous.

Buccal mass and radula: The buccal apparatus is well developed (Figure 7). The oral tube is elongate with an apparently glandular epithelium. At the junction of the oral tube and the muscular buccal mass is a pair of long retractor muscles. The muscular portion consists largely of circular bands of muscle, and contains the jaws and radula. The esophagus recurves anteriorly on the dorsal surface of the buccal mass. On each side of the esophagus is the insertion of the duct of an elongate salivary gland.

The radular formula of a specimen collected at the Lanai Lookout was $40 \times 34.0.34$, and a paratype from Pupukea had a formula of $53 \times 38.0.38$ (counted from scanning electron micrographs). The innermost lateral teeth (Figure 8) have a prominent denticle on the inner side of the erect shaft, and 1–3 denticles below the main cusp. Lateral teeth are bicuspid (lacking inner denticles); middle lateral teeth (Figure 9) have 3–5 denticles below the main cusps, and become stubbier in appearance. Jaw armature (Figures 10, 11) consists of simple or bifid hooks.

Reproductive system: The arrangement of the reproductive system is triaulic (Figure 12). The pre-ampullary duct expands into a straight ampulla. The ampulla divides distally into a short oviduct and the prostatic portion of the vas deferens. The vas deferens is highly convoluted throughout most of its length. Distally it widens into a straight ejaculatory segment, prior to entering the penial sac. The oviduct enters the female gland mass. Adjacent to the entrance of the oviduct into the female gland mass is the narrower uterine duct. The uterine duct joins the vagina near the minute receptaculum seminis. The spherical, thin-walled bursa copulatrix is located at the proximal end of the vagina. A large, digitate vestibular gland joins the female gland mass, vagina, and penis at the common genital aperture.

Natural history: The biology of this species was studied by JOHNSON (1983). He described its predation exclusively on the sponge *Luffariella* sp. (also illustrated in BERTSCH & JOHNSON, 1981:66, 107), its density and distribution in relation to its prey sponge, monthly variation in body length, and its year round reproductive cycle and laying of egg masses (illustrated in BERTSCH & JOHNSON, 1981:66).

Discussion: This new species is most similar to the Hawaiian specimens attributed to *Hypselodoris lineata* (Eydoux & Souleyet, 1852) by OSTERGAARD (1955), KAY & YOUNG (1969), and BERTSCH & JOHNSON (1981). However, EYDOUX & SOULEYET's (1852) species has purple rather than white longitudinal lines. That species is probably synonymous with *H. maridadilus* (Rudman, personal communication). However, *Doris lineata* Eydoux & Souleyet, 1852, is a primary homonym of *Doris lineata* Brocchi, 1819. Therefore, *H. maridadilus* remains the valid name for the species. The Hawaiian specimens represent an undescribed species that we distinguish from *H. andersoni*. The living animals are immediately separable. *Hypselodoris andersoni* tends to be smaller (<15 mm) than *H. sp.*; the white lines on the dorsum are more numerous and often extend the full length of the animal's dorsum; the gills and rhinophores have a lighter golden yellowish hue; the blue band around the mantle is complete and a light-toned bluish color; and there are no prominent navy blue streaks or splashes of color on the central region of the dorsum. *Hypselodoris* sp. (see color photo in BERTSCH & JOHNSON, 1981:65) is larger (20–30 mm) and has about 5–8 frosty

Explanation of Figures 8 to 11

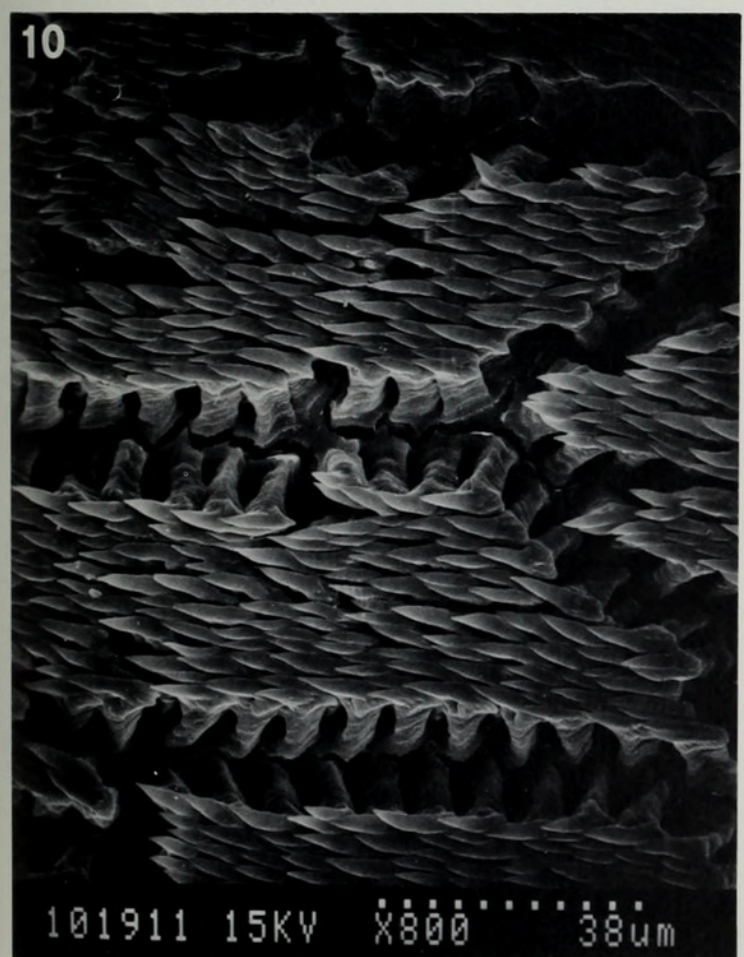
Figures 8–11. Scanning electron micrographs of the radula and jaws of *Hypselodoris andersoni* sp. nov. Illustrated specimen is CASIZ 066608.

Figure 8. Innermost teeth of radula.

Figure 9. Teeth near middle of half-row of radula.

Figure 10. Jaw elements.

Figure 11. Close-up of jaw armature.



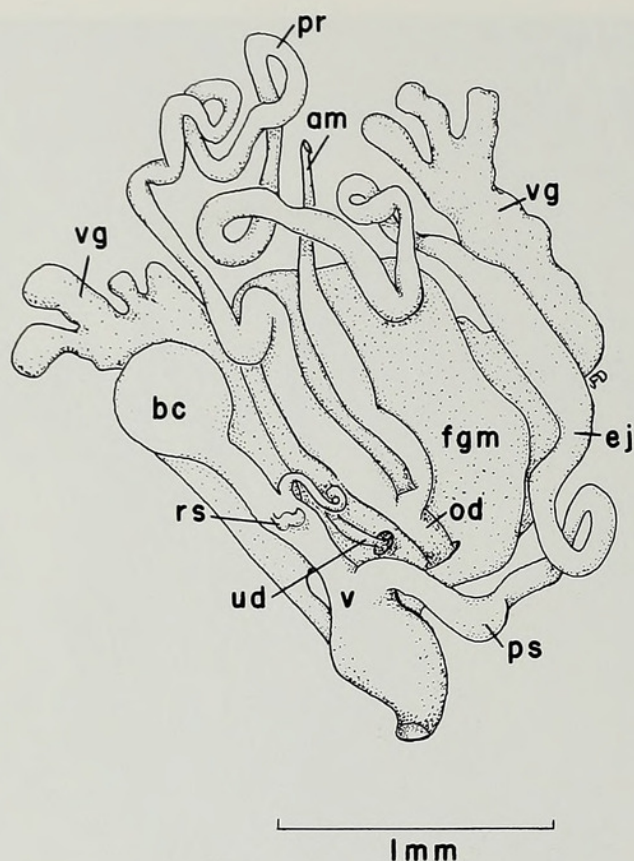


Figure 12

Reproductive system of *Hypselodoris andersoni* sp. nov. Illustrated specimen is CASIZ 066609. Symbols: am, ampulla; bc, bursa copulatrix; ej, ejaculatory portion of the vas deferens; fgm, female gland mass; od, oviduct; pr, prostatic portion of vas deferens; ps, penial sac; rs, receptaculum seminis; ud, uterine duct; v, vagina; vg, vestibular gland. Scale = 1 mm.

white lines on the dorsum that merge, anastomose, and are interrupted at various places on the back; there is a dark yellow-orange coloring on the rhinophores and gills; the mantle is margined with a thin, opaque white line, inside of which is a broken (interrupted) band of navy blue; there are also numerous dark navy blue streaks and splashes of color extending lengthwise in irregular rows down the animal's back. *Hypselodoris andersoni* has 6 gills, and *H. sp.* has 10–12 gills.

Internal morphological differences are seen in the radula and reproductive system. The innermost lateral teeth of *Hypselodoris sp.* lack denticles other than the bifid cusp (KAY & YOUNG, 1969:209). The reproductive system of *H. sp.* (as shown by KAY & YOUNG, 1969) differs from that of *H. andersoni* in that the vas deferens is thicker and less convoluted.

There are also ecological differences. *Hypselodoris sp.* tends to be a solitary, intertidal species, whereas *H. andersoni* often feeds in aggregations of more than two or three individuals (JOHNSON, 1983:363) and is subtidal in occurrence.

At least four other species of *Hypselodoris* have opaque white longitudinal lines on the notum. *Hypselodoris mac-*

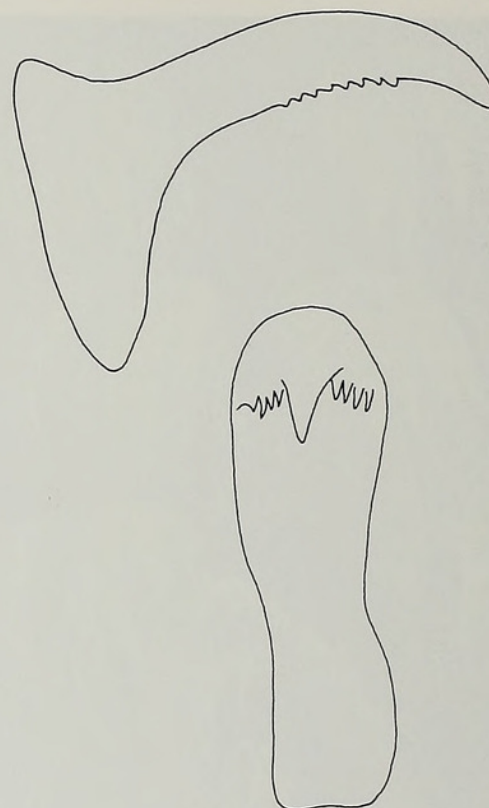


Figure 13

Drawing of radular teeth of *Chromodoris albopunctata*.

ulosa (Pease, 1871) has a more complex color pattern with submarginal red-orange pigment and scattered purple spots on the notum. Its radular teeth bear more denticles than do those of *H. andersoni*. The vaginal duct is much shorter in *H. maculosa* (Rudman, 1986b) than in *H. andersoni*. *Hypselodoris capensis* (Barnard, 1927) and *H. carnea* (Bergh, 1889) both have black or dark brown spots on the notum (GOSLINER, 1987b). *Hypselodoris capensis* has denticles only on the outer 5 or 6 radular teeth while all of the teeth are denticulate in *H. andersoni*. *Hypselodoris carnea* has a rachidian tooth, which is absent in *H. andersoni*. GOSLINER (1987b) reported an additional species with white lines (*H. sp. 1*). It also has red longitudinal lines paralleling the white lines, and yellow and purple marginal rings. This species has denticles on only the outer 10–12 radular teeth.

We are aware of the similarities of our new species with *Doris prismatica* var. *lineata* Pease, 1860, and two unde-

Explanation of Figures 14 to 17

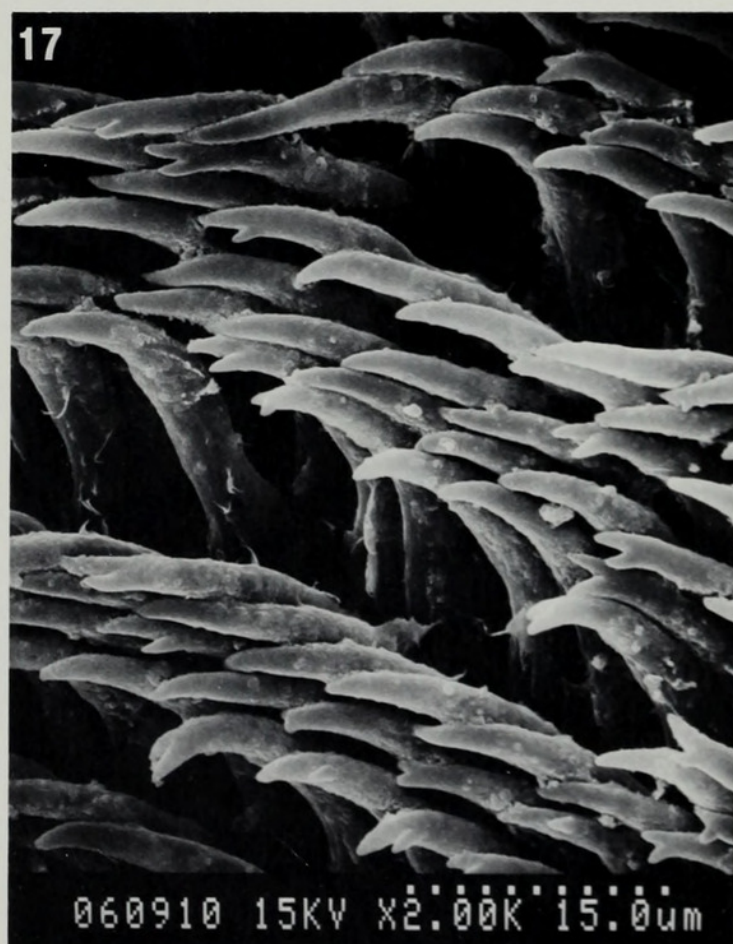
Figures 14–17. Scanning electron micrographs of the radula and jaws of *Chromodoris albopunctata*. Illustrated specimen is CASIZ 066610.

Figure 14. Rachidian and inner lateral teeth.

Figure 15. Radular teeth from middle of half-row.

Figure 16. Outer lateral teeth.

Figure 17. Jaw elements.



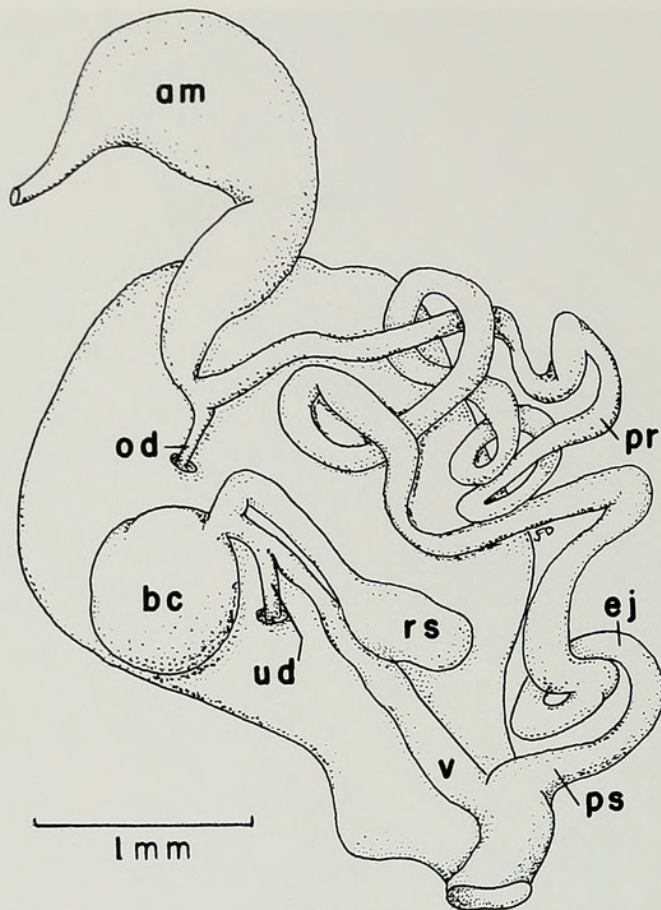


Figure 18

Reproductive system of *Chromodoris albopunctata*. Illustrated specimen is CASIZ 066610. Lettering symbols as in Figure 12. Scale = 1 mm.

scribed species of *Hypselodoris* (including "white dot," illustrated in BERTSCH & JOHNSON, 1981:66) from the Hawaiian Islands. It is difficult to identify Pease's species, because his description is vague and lacks information on the internal anatomy of the animal. Nevertheless, Pease's species is a junior homonym of both Brocchi's and Eydoux & Souleyet's *lineata* species, so it would require a new name.

Chromodoris Alder & Hancock, 1855

Chromodoris albopunctata (Garrett, 1879)

(Figures 3, 13–18)

References and synonymy:

- Goniadoris albopunctatus* GARRETT, 1879:31.
Chromodoris albopunctatus [sic]: JOHNSON & BOUCHER, 1984:263–264.
Chromodoris imperialis (non Pease, 1860): KAY & YOUNG, 1969:202, figs. 41, 59; KAY, 1979:467, 469; BERTSCH & JOHNSON, 1980; BERTSCH & JOHNSON, 1981:48–49, 58–59 (color photographs). *Chromodoris imperialis* (Pease, 1860) is actually *Risbecia imperialis* (Pease), and *Chromodoris godeffroyana* Bergh, 1877a, appears to be a junior synonym, based on specimens collected in Tahiti, the type locality of the latter species (cf. Bertsch, in prep., and personal observation).

It is unclear whether specimens identified as *R. godeffroyana* by RUDMAN (1984) and WILLAN & COLEMAN (1984) are also conspecific, or whether they represent an undescribed species.

Material examined: (1) 3 specimens, CASIZ 064821; collected subtidally, 3 m, at Ewa, Oahu, 29 June 1978; Stan Jazwinski (ex HB 756).

(2) 1 dissected specimen, CASIZ 066610; from the Ewa site, 29 June 1978.

(3) LACM 78-183; 2 specimens, collected subtidally, 5 m, Honolulu Harbor, Oahu, 2 July 1978; Stan Jazwinski (ex HB 776).

(4) Additional specimens from Kewalo (straight off Ala Moana Reef), Oahu, August 1977; SJ (illustrated in BERTSCH & JOHNSON, 1981:48, upper right).

(5) 1 specimen, collected at night, subtidally, 12 m, at west side of Savo Island, Solomon Islands (9°8'S, 159°47'E; approximately 5400 km SW of Oahu), 20 August 1977; Jeanette Johnson (personal communication, Scott Johnson).

Distribution: The infrequent Hawaiian records of this foudroyant, colorful species are all from Oahu. However, this species was originally described from Huahine, Society Islands (approx. 16°45'S, 151°00'W), over 4000 km S of Oahu. It has also been reported from Enewetak Atoll (approximately 11°20'N, 162°20'E), more than 3500 km SSW of Oahu (JOHNSON & BOUCHER, 1984:263–264). These records (including our new report from the Solomon Islands) indicate a wide range through the central tropical Pacific.

External morphology: Preserved specimens measure 15–20 mm in total length; living animals longer, usually from 20 to 45 mm long, although KAY (1979) reported a specimen 65 mm long.

General body shape oval (Figure 3), low in profile (flattened dorsoventrally). Mantle completely overhangs the sides of the body, covering the foot. Mantle margin smooth, may be temporarily ruffled as it is lifted or moved by the animal.

Rhinophores darkish red-brown, with interrupted white streaks, dots, or dashes on the edges of the 21–35 lamellae, and a vertical white line down the center. The 8–10 gills are often retracted; expanded they are elongate, and encircle the anal opening. They are the same color as the rhinophores (KAY, 1979:469, fig. 150H).

Central portion of the dorsum light red, on which are numerous opaque white rings. Around the perimeter is an inner golden yellow-orange band, surrounded by an outer blue band (this blue band tends to be darker on the inside and lighter on the outside). Between the red and white ringed central dorsal region and the yellow band, the white coloration coalesces into splashes and patches, forming an interrupted boundary region.

The foot is a uniform golden orange (same as the band between the blue and red-white portions of the dorsum), with no other colors forming a margin to the foot.

Some color variation was observed in the animals we studied. A 14-mm-long specimen found in 15 m depth at Makua, Oahu, had a dorsum totally of golden yellow, with white rings. Instead of the reddish central dorsal coloration, the color of the circumferential golden yellow band continued throughout the entire dorsum. The specimen found at Enewetak was similar in all coloration shades and tones to the more typical animals collected at Hawaii. However, the blue and gold bands around the perimeter were a bit narrower than usual for the Hawaiian specimens. A light blue, dark blue, and an inner yellow band form a characteristic marginal color pattern for this species.

Buccal mass and radula: The buccal apparatus is muscular throughout most of its length. There is no distinct, elongate oral tube. KAY & YOUNG (1969) reported a radular count of 63 (65.0-65). Contrary to their description, a small rachidian tooth is present (Figure 14). The specimen illustrated with SEMs (Figures 14-17) has a count of $49 \times 41.1 \times 41$. Another specimen we dissected had 49 rows and 53 teeth per half-row. The minute rachis was visible even with light microscopy. The innermost lateral tooth has 3 or 4 inner lateral denticles and 4-6 outer lateral denticles (Figures 13, 14). Lateral teeth from the middle of each half-row (Figure 15) have 8-12 posterolateral denticles on the erect cusp. The outermost lateral teeth (Figure 16) become shorter and wider (along the antero-posterior plane). Jaw structure elements are simple, or with a small accessory tip below the main tip, making most elements bifid (Figure 17). Line drawings of the radular teeth and elements of the jaw armature are presented in KAY & YOUNG (1969:201, fig. 41B, C).

Reproductive system: The ampulla (Figure 18) is large and saccate, consisting of several convolutions. Distally, it narrows and divides into the short oviduct and elongate, convoluted vas deferens. The proximal portion of the vas deferens is prostatic and distally it forms a muscular, ejaculatory segment. The penial sac is slightly expanded and contains minute penial rodlets. The uterine duct is short and straight, and enters the vagina immediately distal to the junction of the spherical bursa copulatrix and the recurved, pyriform receptaculum seminis. The vagina is long and straight.

Our diagram (Figure 18) compares well with that of KAY & YOUNG (1969:201, fig. 41A), with the exception that theirs is an "exploded" illustration, with the various sections of the system pulled apart.

Discussion: Most features of GARRETT's (1879) terse external description closely match the characters of our Hawaiian specimens: "The upper surface is bright orange-yellow, with crowded opaque white dots, and minute annulae; the mantle with a band of small irregular lemon-yellow spots near the margin, which latter is edged with violaceous. . . . The dorsal tentacles . . . [rhinophores] purple-brown, profusely dotted with opaque white, and marked with two vertical lines of the latter color. The branchial

plumes . . . are colored and dotted similar to the tentacles, and each ornamented with two longitudinal white lines. The under surface of the mantle and foot are pale lemon-yellow, the former margined the same as above." The only discrepancy is that our specimens had a solid yellow band inside the violet marginal band, not a band of irregular lemon-yellow spots. Connected spots versus a solid band is certainly just an example of intraspecific variation in dorid coloration patterns. Moreover, KAY & YOUNG's (1969: 212, fig. 59) illustration (reprinted in KAY, 1979:469, fig. 150H) shows a nearly continuous yellow marginal band, with several interrupting gaps.

External features immediately distinguish *Chromodoris albopunctata* from *Risbecia imperialis* (Pease, 1860). Pease's species has a white body with golden yellow dorsal spots, and a single dark navy blue marginal band, with a varying number of medially pointed navy blue flanges in which are 0-4 yellow dots (cf. illustrations in BERTSCH & JOHNSON, 1981:50-51).

Several other species have a similar reddish and white maculation to the dorsum, but they do not have the distinctive yellow and blue marginal bands. In the cases of all the other species with red and white reticulation, the ground color is white overlain with red. However, in *Chromodoris albopunctata* the ground color is reddish with opaque white pigment deposited on top of the red. *Chromodoris petechialis* (Gould, 1852) has a faint yellow margin and light yellow orange rhinophores; *Chromodoris tinctoria* (Rüppell & Leuckart, 1828) has red reticulations on the mantle, but the rhinophores are gray and the gills are translucent (WILLAN & COLEMAN, 1984:22-23), there is no marginal banding of yellow and blue, and the body shape is different from *Chromodoris albopunctata*. *Glossodoris gregorius* Rudman, 1986a, has white spots, but they are less pronounced than in *C. albopunctata*, and do not form rings; the dorsum of *G. gregorius* is a darker reddish brown, rather than bright orange red. This species has two marginal bands: an outer black and an inner yellow. The radula and other internal characteristics also distinguish the two species (hence their placement in two different genera).

Two species of *Chromodoris* have blue or violet outer marginal bands. JOHNSON & BOUCHER (1984) considered *Chromodoris sykesi* Eliot, 1904, to be a synonym of *C. albopunctata*, but we consider it premature to synonymize these species until *C. sykesi* from the type locality can be re-examined. Although very similar in coloration, there are several intriguing differences: the branchial pocket of *C. sykesi* was described as a "capacious and very strong bag," the rhinophore perfoliations were indistinct, the white dorsal markings form only rings and not dots, and *C. sykesi* lacks rachidian teeth (ELIOT, 1904:388).

Chromodoris briqua Marcus & Burch, 1965, is also similar in color, but has no white markings on the dorsum. Most significantly, it has a strongly developed rachidian tooth with a pronounced cusp (MARCUS & BURCH, 1965: 246-247, fig. 22).

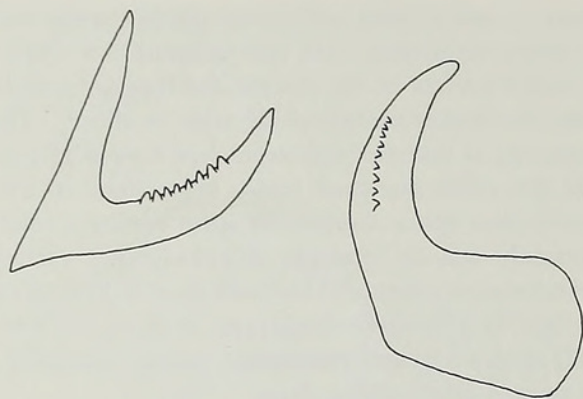


Figure 19

Line drawings of radular teeth of *Glossodoris poliahu* sp. nov.

Glossodoris Ehrenberg, 1831

Glossodoris poliahu Bertsch & Gosliner, sp. nov.

(Figures 4, 19–25)

References:

Snowflake: BERTSCH & JOHNSON, 1980:73–77; BERTSCH & JOHNSON, 1981:59 (color photograph).

Material examined: (1) Holotype, CASIZ 064810; collected subtidally, 17 m, off the Lanai Lookout, Oahu, 26 September 1978; HB (ex HB 730).

(2) 3 paratypes, CASIZ 064811; collected subtidally at Pupukea, Oahu, 26 May 1978; SJ (ex HB 607).

(3) 1 dissected paratype, CASIZ 066611; collected subtidally at Pupukea, Oahu, 26 May 1978; SJ.

(4) Paratype, CASIZ 064812; collected subtidally, 10 m, off Makua, Oahu, 14 September 1987; TMG.

(5) 4 paratypes, LACM 2295; collected at night, subtidally, 15 m, Pupukea, Oahu, 12 June 1978; SJ (ex HB 617).

(6) 4 paratypes, LACM 2296; collected subtidally, 15 m, Three Tables, Oahu, 10 June 1978; SJ (ex HB 622).

Distribution: Specimens are known from sites on the island of Oahu (also including Yokohama, Ewa, and Koko Head), and from Puako on the island of Hawaii (approximately 19°49'N, 155°47'W). Most animals occurred in water 9–15 m deep.

Etymology: While collecting this unnamed animal, we provisionally called it “snowflake,” calling attention to the white frosting specks on its dorsum. Hence it is appropriate to name the species *poliahu*, after the Hawaiian goddess of the snow-covered mountain. According to legend, the snow goddess Poliahu lives on the snowy summit of Mauna Kea. While the goddess Pele pours fiery lava over the land from the volcano Mauna Loa on the south side of Hawaii, at the other end of the island Poliahu spreads her cooling mantle of snow (BECKWITH, 1970).

(For euphony, we treat the species-group name as a noun in apposition. Although we are aware of ICZN rec-

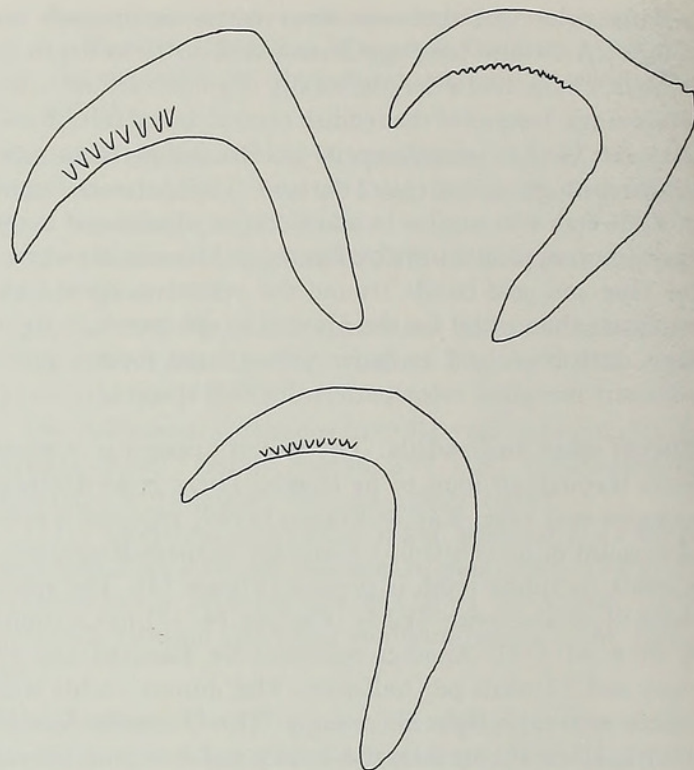


Figure 20

Line drawings of radular teeth of *Glossodoris poliahu* sp. nov.

ommendation 31A, against such use, our adding adjectival or genitival suffixes would have resulted in an unnecessarily complicated word to pronounce; four syllables is enough.)

External morphology: Preserved specimens measured between 15 and 25 mm total length; living animals are usually between 25 and 35 mm long.

The animals are an elongate ovoid, low in profile, with the foot protruding slightly beyond the posterior portion of the mantle (Figure 4). The mantle overhangs the sides of the body, and is usually convoluted; however, the animal is not as “elevated” as is typical for species of *Glossodoris*, and the mantle margin is much broader with a greater overhang (cf. RUDMAN, 1984). The rhinophores are about evenly spaced from the edges of the body and from each other. They are dusty cream colored, with a light rust-brown vertical streak on both the anterior and posterior surfaces, which bifurcates basally on the posterior side.

Explanation of Figures 21 to 24

Figures 21–24. Scanning electron micrographs of radula and jaws of *Glossodoris poliahu* sp. nov. Illustrated specimen is CASIZ 066611.

Figure 21. Rachidian and inner lateral teeth.

Figure 22. Radular teeth from middle of half-row.

Figure 23. Outer lateral teeth.

Figure 24. Jaw armature of bifid rods.



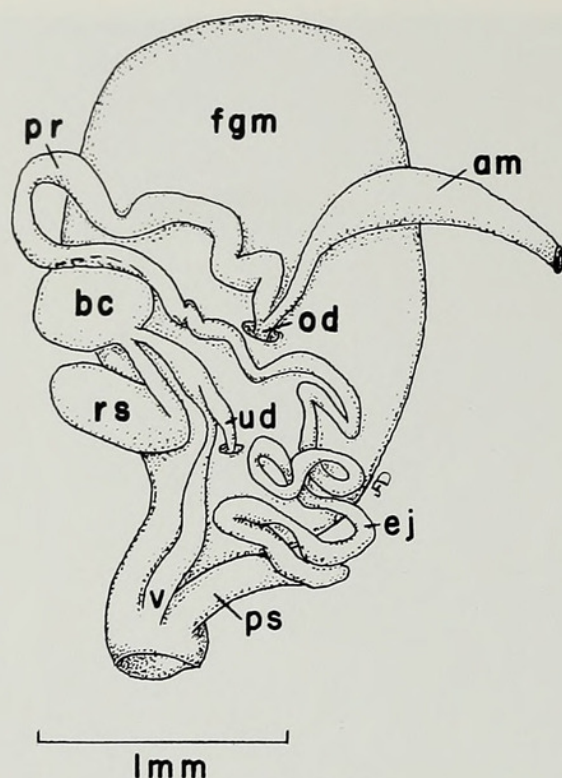


Figure 25

Reproductive system of *Glossodoris poliahu* sp. nov. Illustrated specimen is CASIZ 066611. Lettering symbols as in Figure 12. Scale = 1 mm.

The 10–14 gills are spread out widely, with 5 or 6 pinnae coming off each side of a lateral, central axis. They are arranged in the characteristic double spiral of *Glossodoris*. The gills are dusky cream, lined along the longitudinal axis (from which extend the pinnae) with a light rust brown coloration.

The dorsum is a light brown color, with white dots sprinkled densely throughout the entire brownish area. The mantle margin has a white band. The extreme edge has a narrow light golden brown line totally encircling it. Another line of the same color occurs in the same location on the ventral side of the mantle margin. Between these two colored lines (on the very edge of the frilly mantle margin) is a thin white line. The upper surface of the foot is encircled marginally by a similar broad white band and narrow light golden brown line.

Buccal mass and radula: The buccal apparatus consists of a large muscular buccal mass and an elongate, glandular oral tube.

The radular formula of the specimen collected 26 September 1978 is $64 \times 49 \cdot 1 \cdot 49$. The rachidian is a small, narrow, elongate plate. The innermost lateral teeth have 3 or 4 denticles on both the inner and outer surfaces of the erect cusp (Figure 21) (for terminology of radular teeth, cf. BERTSCH, 1977). The next few inner laterals have denticles on the outer side, which become posteriorly placed as the erect cusp elongates at about the fourth or fifth lateral tooth. Each tooth from the center of a half-row has

a long recurving cusp with 6–9 posterolateral denticles (Figures 19, 20, 22). Outermost lateral teeth become shorter, losing pronounced denticulation (Figure 23). The jaw elements are bifid (Figure 24).

Reproductive system: The reproductive system is triauleic (Figure 25). The ampulla is short, widest in the middle. It bifurcates into a short oviduct and a highly convoluted vas deferens. The proximal portion of the vas deferens is prostatic, while the more distal portion is thin, more highly convoluted and muscular, forming an ejaculatory segment. The distal end of the vas deferens enters the simple penial sac. The uterine duct is elongate and straight. It enters the vagina immediately distal to the junction of the thin-walled, spherical bursa copulatrix and the recurved receptaculum seminis.

Natural history: BERTSCH & JOHNSON (1980) report this subtidal species as most abundant between 9 and 16 m depth at the Lookouts, Pupukea, and Makua (on the island of Oahu).

Discussion: We had difficulty placing this species within a genus. Externally, it appears to be a species of *Glossodoris*, with a convoluted mantle margin and gills arranged in a double spiral. The relatively broad radula bears few radular rows (64) making it similar to the radulae of members of the genus *Chromodoris*. The shape of the radular teeth is somewhat intermediate between *Glossodoris* and *Chromodoris*. The morphology of the reproductive system more closely approaches that of a *Glossodoris*, with an elongate vaginal duct and long, cylindrical prostate (RUDMAN, 1984). *Glossodoris poliahu* most closely resembles *G. carlsoni* Rudman, 1986a. In *G. carlsoni* there are relatively few radular rows (55) (RUDMAN, 1986a). The two species are similar in their coloration, with pink or orange ground color with white spots, a golden marginal band, and a red vertical stripe on the rhinophores. However, there are consistent external and internal morphological differences between the two species. In *G. poliahu* the white spots are smaller and more numerous. The red vertical posterior line on the rhinophores bifurcates basally and there are actually two golden marginal bands, one on the dorsal surface of the margin and one ventrally. The jaw elements have more regular, bifurcate apices in *G. poliahu* than in *G. carlsoni*. In *G. poliahu* there is a distinct rachidian tooth that is absent in *G. carlsoni*. The innermost lateral teeth of *G. poliahu* bear denticles on both the inner and outer sides of the central cusp, whereas in *G. carlsoni* denticles are present only on the outer side of the central cusp.

A similar appearing sympatric species is *Glossodoris rufo-marginata* (Bergh, 1890), immediately distinguishable by its typical *Glossodoris* radula (RUDMAN, 1986a:144–148), golden brown edge of mantle (without the thin white edge between the golden brown mantle margin line that is characteristic of *G. poliahu*), and whitish dorsum covered with bright golden brown speckles (opposite to the golden brown with minute white spotting of *G. poliahu*); contrast the

color photographs of *G. rufomarginata*, identified as *Chromolaichma youngbleuthi* (Kay & Young, 1969), in BERTSCH & JOHNSON, 1981:59, 68–71.

The seemingly nondescript coloration of *Glossodoris poliahu* is actually quite distinctive and unique among known species of chromodorids.

Glossodoris tomsmithi Bertsch & Gosliner, sp. nov.

(Figures 5, 26–30)

References and synonymy:

Chromodoris albonotata (non Bergh, 1875): BERTSCH & JOHNSON, 1981:52–53 (color photographs).

Material examined: (1) Holotype, CASIZ 066612; collected subtidally, 13.7 m, Makua, Oahu, 14 September 1978, HB and SJ (*ex* HB 699).

(2) 2 dissected paratypes, CASIZ 064817; collected subtidally, 10 m, Pupukea, Oahu, 11 September 1987; TG.

(3) 1 paratype, CASIZ 064818; collected subtidally, 5 m, Makua, Oahu, 14 September 1987; TG.

(4) 3 paratypes, LACM 2297; collected subtidally, 21 m, off Makaha, Oahu, 17 September 1978; HB and Judith Young (*ex* HB 712).

(5) 1 paratype, LACM 2326; collected subtidally, 15 m, off Blowhole (near Lanai Lookout), Oahu, 26 September 1978; HB and SJ (*ex* HB 729).

Distribution: Specimens are known from subtidal locations in the Hawaiian Islands, on Oahu (from 4.5 to 21 m depth, also including Three Tables, just west of Pupukea) and on Hawaii (along the Kona coast, from 3 to 30 m); and in the Marshall Islands, from Enewetak (Cement Ship Pinnacle and R-Buoy Pinnacle, 6–10 m; approximately 11°20'N, 162°20'E) and Kwajalein (oceanside of Enubuj-Ennylabagan reef, 20 m; approximately 8°46'N, 167°38'E).

Etymology: This species is named for Mr. Tom Smith, of San Diego, California, who has accompanied the senior author on numerous nudibranch research expeditions to Hawaii, Mexico, and California. His skills at spotting nudibranchs are matched by his diving abilities and his generosity in supplying equipment when items are not brought to the dive site.

External morphology: The elongate animal has a convoluted overhanging notal margin, with the posterior portion of the foot protruding beyond (Figure 5). The rhinophores and gills are set at approximately one-fifth and four-fifths, respectively, the distance between the anterior and posterior edges of the notum. The rhinophores (17 or 18 perfoliations) are white basally; the distal two-thirds are dark brown (some a dark golden-brown or brass color, others nearly a dark steel color), with a prominent vertical opaque white line on the anterior and posterior faces. The 8–11 branchial plumes are arranged in a double spiral

(the attachment points of the posterior smaller plumes curl slightly inward, scroll-like); the central stalks are whitish, fading to a dark steel or blue black along the pinnae. Some animals had this dark blue coloration tinting the basal portions of the interior of the gill circlet.

The dorsum and sides of the foot are a dirty cream white, with a yellow marginal band on the foot. The dorsum is spotted with circular, 1–2-mm-diameter white dots that vary in number, size, and placement. The body is also rimmed by a white marginal band; the extreme edge of the overhanging margin has a very thin bright yellow tint.

The Hawaiian and Marshall Islands specimens differ slightly in coloration. Mr. Scott Johnson has generously provided us with the following description of specimens from Enewetak and Kwajalein:

"The mantle is soft, elongate oval, rounded anteriorly, and slightly more pointed posteriorly. The margin is relatively thick and wide, and is highly undulate. The base mantle color is gray brown, more brown over the gut, and minutely speckled with dark brown or dark gray black. The mantle is margined by a wide yellowish white band. The brownish dorsum is spotted with slightly pustulose yellowish white spots measuring one to two millimeters in diameter (in a 22-mm specimen). The spots tend to be most crowded around the rhinophores and gills, often leaving a blank spot in the middle of the dorsum. The sides of the body are light brownish, minutely speckled with black and crowded with slightly raised yellowish white spots similar to those on the dorsum. The foot is margined by a yellowish white band, and the oral tentacles are creamy yellowish and relatively long. The tail is fairly short and rounded at the end. The rhinophores are relatively tall and pointed, and extend from slightly elevated sheaths. Peduncles are transparent anteriorly and white posteriorly. Rhinophore clubs are brown, finely speckled with black, giving them a gray brown appearance. The clubs each have white anterior and posterior vertical lines and 18–20 lamellae. Branchiae consist of about eight vibratile, quadrangular stalks bearing lamellate pinnae and arranged in an incomplete circle around the anus. The stalks are bluish white, becoming more bluish toward the tips, and the pinnae are edged with black."

The differences can be summarized as follows: the Hawaiian specimens have an overall lighter colored mantle, whiter dorsal spots, darker rhinophore clubs and gill stalks, and a thin yellow marginal edge to the overhanging notum with a wide submarginal white band.

Buccal mass and radula: The buccal apparatus consists of a large muscular buccal mass and an equally elongate, glandular oral tube.

The jaws are densely covered with numerous rodlets. Each rodlet has a simple or, more commonly, bifid cusp (Figure 26). The radular formula in one specimen was 53 × 36·1·36. The rachidian tooth (Figure 27) is a vestigial linear ridge. The innermost lateral teeth have 3 or 4 denticles inside the triangular central cusp and 4 or 5 denticles



on the outer side. Lateral teeth from the middle of the radular half-row are curved and elongate with 6–8 denticles below the central cusp (Figure 28). The outermost laterals bear 6–12 denticles below the central cusp (Figure 29). The radular formulae of two specimens from Enewetak were 62–73 rows, with 42–56 teeth per half-row.

Reproductive system: The reproductive system (Figure 30) is triaulic. The preampullary duct is narrow and expands into the saccate ampulla. At its distal end, the ampulla narrows and divides into the short oviduct and elongate vas deferens. The proximal portion of the vas deferens is narrow, highly convoluted, and prostatic. More distally, it becomes more muscular and widens in the ejaculatory portion. The penis is simple. The uterine duct is short and straight. The bursa copulatrix is thin walled and spherical. The receptaculum seminis is pyriform and recurved. The vagina is thin and elongate. The uterine duct branches from the distal third of the vagina and enters the female gland mass after a short distance.

Discussion: Like the preceding species, *Glossodoris tomsmithi* has features somewhat intermediate between *Glossodoris* and *Chromodoris*. Its convoluted mantle margin, vibratile gills arranged in a double spiral, elongate vaginal duct, and long, cylindrical prostate are characteristic of *Glossodoris*. However, the shape of the radula and relatively low number of radular rows (53–73) are similar to *Chromodoris*.

Glossodoris tomsmithi is similar to *G. carlsoni* and *G. poliahu* in its body shape and radular morphology. It differs markedly in its coloration from both other species. *Glossodoris tomsmithi* has a vestigial rachidian tooth, whereas *G. poliahu* has a prominent rachidian and *G. carlsoni* entirely lacks a rachidian.

This Hawaiian species had been considered conspecific with the Tahitian *Chromodoris albonotata* Bergh, 1875. However, there are a number of critical differences in the body shape, gills, coloration (noted by RUDMAN, 1986a: 166), and radular morphology that distinguish this new species from Bergh's. In specimens of approximately equal size, *C. albonotata* was reported to have six branchial plumes arranged in a simple circle (BERGH's [1875] illustration shows them thin, elongate, and sparse) and 30 rhinophoral perfoliations (BERGH, 1879:5–6). By contrast, *G. tomsmithi* has 8–11 branchial plumes arranged in a double spiral, and 17 or 18 perfoliations on the rhinophore. The

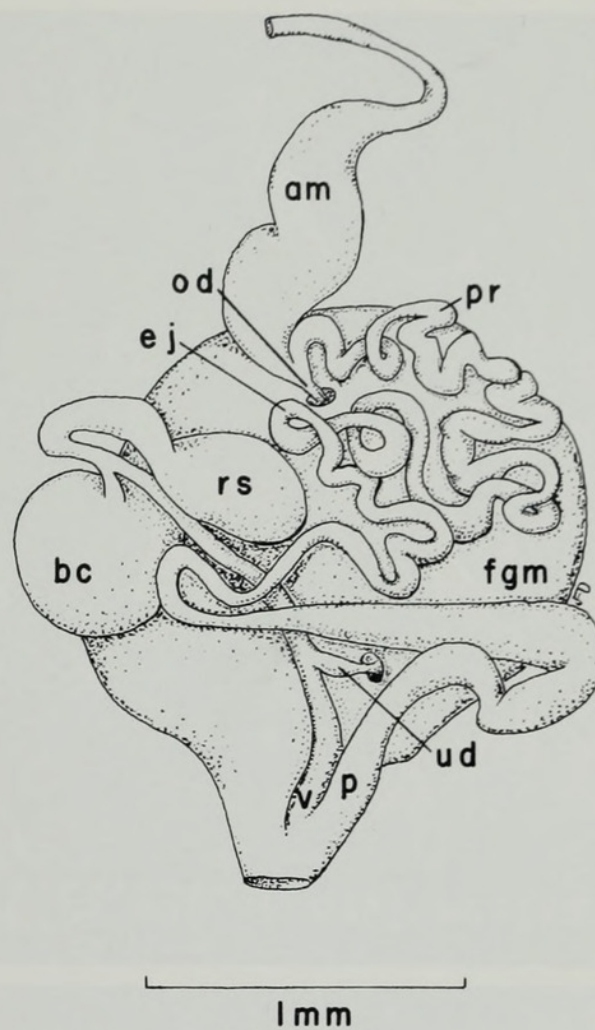


Figure 30

Reproductive system of *Glossodoris tomsmithi* sp. nov. Illustrated specimen is CASIZ 064817. Lettering symbols as in Figure 12. Scale = 1 mm.

mantle margin of *C. albonotata* is smooth, whereas that of *G. tomsmithi* is convoluted. The basic dorsal color of *C. albonotata* is yellowish (BERGH, 1875:pl. VII), but that of *G. tomsmithi* is dirty white. *Chromodoris albonotata* lacks dark pigment on the gills and rhinophores. The radula is especially different: *C. albonotata* has a smaller number of rows of teeth (38) than teeth per half-row (45). This relation is reversed in *G. tomsmithi*: 53 rows, 36 teeth; 62 rows, 42 teeth; and 73 rows, 56 teeth (see BERTSCH, 1976, for a discussion of statistical analyses of radular variation).

Ardeadoris Rudman, 1984

Ardeadoris scottjohnsoni Bertsch & Gosliner, sp. nov.

(Figures 6, 31–35)

References and synonymy:

Chromodoris sibogae (non Bergh, 1905): BERTSCH & JOHNSON, 1981:49 (color photographs).

Material examined: (1) Holotype (dissected), CASIZ 064813; collected subtidally, 5 m, Kahe Point, Oahu, July 1973; TG.

Explanation of Figures 26 to 29

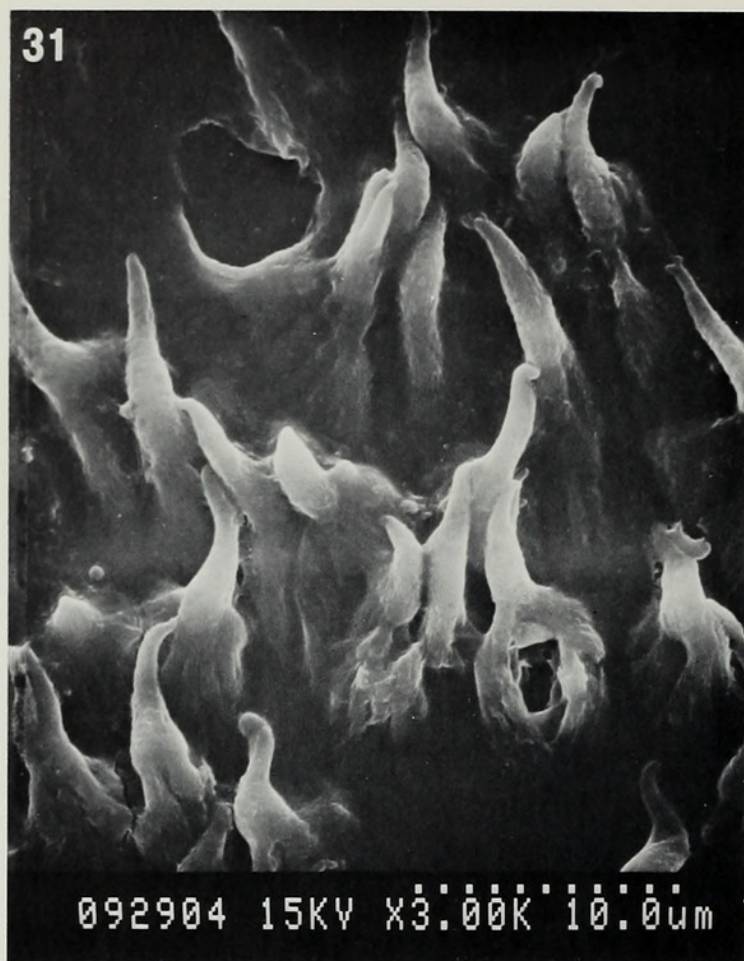
Figures 26–29. Scanning electron micrographs of radula and jaws of *Glossodoris tomsmithi* sp. nov. Illustrated specimen is CASIZ 064817.

Figure 26. Bifid jaw rodlets.

Figure 27. Rachis area of radula.

Figure 28. Lateral teeth from middle of half-row.

Figure 29. Outer lateral teeth.



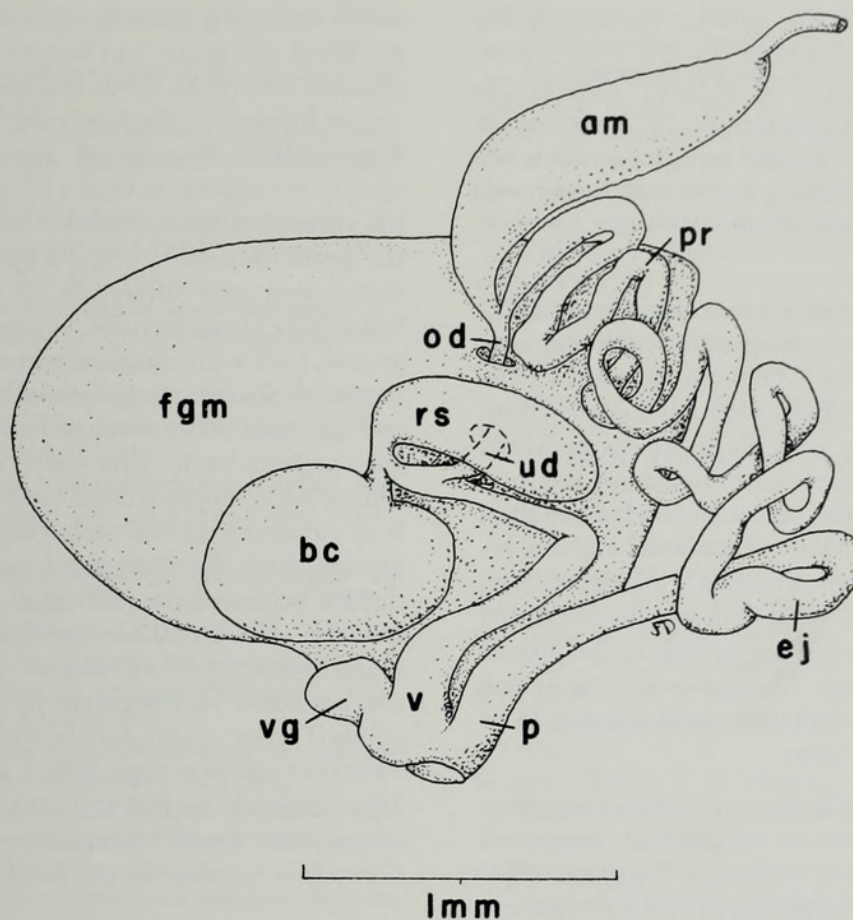


Figure 35

Reproductive system of *Ardeadoris scottjohnsoni* sp. nov. Illustrated specimen is CASIZ 064813. Lettering symbols as in Figure 12. Scale = 1 mm.

(2) 1 dissected paratype, CASIZ 064814; collected subtidally, 15 m, Pupukea, Oahu, 15 August 1978; SJ.

Distribution: We have records of *Ardeadoris scottjohnsoni* also occurring at Yokohama on Oahu, and at Puako on Hawaii. It is presently known from subtidal locations on two of the Hawaiian Islands (Oahu and Hawaii).

Etymology: This species is named in honor of our good friend and colleague Mr. Scott Johnson, in recognition of his many contributions to our understanding of the tax-

onomy and biology of Indo-Pacific nudibranchs. We especially thank him for a generous scientific attitude and his willingness to share specimens he has collected, his field knowledge, and his superb photographs of the living organisms.

External morphology: Living animals are about 15–25 mm long. The body shape is elongate, with the posterior portion of the foot protruding slightly past the hind margin of the animal's notum (Figure 6). The overhanging notal margin has slight notchlike crenulations, with a more prominent wavy crenulation about midway down the length of the body. The 10 simply pinnate gills are white basally, with the distal two-thirds black. The animal vibrates the gills (which are usually held partly upright, slightly spread). The rhinophores are black with a thin vertical white line on the anterior face.

The dorsum and sides of the foot are pure white; both regions are encircled by an even whiter marginal band. Surrounding the white notal band is a thin yellow orange stripe at the edge of the overhanging margin.

Buccal mass and radula: The buccal apparatus consists of an elongate, muscular buccal mass and a large, glandular oral tube.

The jaws are thin and covered with simple or bifid

Explanation of Figures 31 to 34

Figures 31–34. Scanning electron micrographs of the jaw and radula of *Ardeadoris scottjohnsoni* sp. nov.

Figure 31. Jaw with simple rodlets. Illustrated specimen is CASIZ 064814.

Figure 32. Rachidian and central region of radula, showing innermost lateral teeth in the half-row. Illustrated specimen is CASIZ 064813.

Figure 33. Inner- and mid-lateral teeth. Illustrated specimen is CASIZ 064813.

Figure 34. Lateral teeth from central portion of half-row. Illustrated specimen is CASIZ 064814.

conical rodlets (Figure 31). The radular formula of the single specimen examined was $42 \times 15 \cdot 1 \cdot 1 \cdot 15$. There is a faint trace of a rachidian row of teeth (Figures 32, 33). The inner lateral teeth (Figures 32, 33) are elongate and sickle-shaped, with 5–8 rounded denticles on the inner margin of the teeth. The succeeding lateral teeth are curved, elongate, with 3–6 palmately divided denticles on their distal tip (Figure 34).

Reproductive system: The arrangement of organs (Figure 35) is triaulic. The narrow preampullary duct expands into a short, saccate ampulla. The ampulla narrows distally, and bifurcates into the short oviduct and vas deferens. The vas deferens is highly convoluted. In its proximal portion it is prostatic and becomes muscular in the most distal ejaculatory segment. The penial sac is relatively short and bulbous. The spherical bursa copulatrix and the recurved, pyriform receptaculum seminis are adjacent to each other. Immediately distal to the insertion of the bursa and receptaculum onto the vagina is the branch of the uterine duct to the female gland mass. The vagina is elongate and curved. A small spherical vestibular gland appears to be present at the base of the vagina.

Discussion: This species is difficult to place definitely within a genus. It bears similarities to members of the genera *Thorunna* Bergh, 1877b, and *Ardeadoris* Rudman, 1984. RUDMAN (1984) discussed the similarity of the two genera and distinguished *Ardeadoris* (based solely on the single species *A. egretta* Rudman, 1984) by its convoluted, overhanging mantle edge, rather than a slightly undulating edge in *Thorunna*. In *A. scottjohnsoni* the mantle is less convoluted than in *A. egretta*, but more pronounced than in most species of *Thorunna*. In *Ardeadoris egretta* the radula is fairly broad, whereas in *A. scottjohnsoni* and species of *Thorunna* it is much narrower, with fewer teeth per row. *Ardeadoris* has multifid outer lateral teeth as in *A. scottjohnsoni*, whereas species of *Thorunna* have bifid outer laterals. The inner lateral teeth of *A. scottjohnsoni* are similar in shape to both *A. egretta* and *Thorunna furtiva* Bergh, 1878 (RUDMAN, 1984:figs. 33c, 76a). In both species of *Ardeadoris* the reproductive system contains a simple vestibular gland and the uterine duct branches at the bases of the receptaculum seminis and bursa copulatrix. In all species of *Thorunna* that have been studied the vestibular gland is more complex and usually highly ramified and the uterine duct branches from near the middle of the vagina. In the future, it is likely that the systematic status of the genus *Ardeadoris*, or *A. scottjohnsoni* in particular, may need to be re-evaluated. For the present, we believe that *A. scottjohnsoni* is better placed in *Ardeadoris* rather than *Thorunna*.

Ardeadoris scottjohnsoni is the only species of *Ardeadoris* or *Thorunna* with black pigment on the gills and rhinophores.

This species superficially resembles the description of *Chromodoris sibogae*: "Die Farbe war durchgehends weisslich, vorne und hinten am Rücken so wie an den Körper-

seiten schmutzig gelblich; oben am Rückengebräme, dessen Rand eine graue sehr ausgeprägte Linie zeigte, kamen sparsam zerstreute, runde und mehr unregelmässige, kalkweisse Flecke . . . ; die Keule der Rhinophorien so wie die Kiemenblätter braungrau" (BERGH, 1905:157). Bergh's description appears to be of a preserved specimen; however, the recent rediscovery of this species (and transferral to the genus *Glossodoris*) by RUDMAN (1986a:112–116) indicates that color differences are not preservation artifacts but specific characteristics. *Glossodoris sibogae* is brownish-yellow, with a submarginal white band and an outer black border. *Ardeadoris scottjohnsoni* has a distinctly white body and an outer yellow-orange band surrounding the white submarginal band. Moreover, the elongate glossodorid radula with simply cusped teeth (the inner teeth usually bear accessory lateral denticles) is immediately distinguished from the ardeadorid radula with the palmately divided apices of the individual teeth. RUDMAN (1986a) has also shown that *G. undulata* Pruvot-Fol, 1954, is a junior synonym of *G. sibogae*; and he has detailed the characteristics that separate *G. sibogae* from *G. atromarginata* (Cuvier, 1804), both of which have a marginal black band (not yellow orange as in *A. scottjohnsoni*). The specimens reported by ELIOT (1913) and BABA (1949) as *G. sibogae*, from Japan, represent the recently described species *Glossodoris misakinosisibogae* Baba, 1988.

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