Micronesica 33(1/2):169-178, 2000

Notes on *Atys multistriatus* Schepmen, 1913 (Opisthobranchia: Cephalaspidea: Haminoeidae)

C. H. CARLSON[1] AND P. J. HOFF[1]

The Marine Laboratory, University of Guam, Mangilao, Guam 96923

Abstract—The original description of *Atys multistriatus* Schepman, 1913 was based upon the shell only. Live specimens of *A. multistriatus* have been found in Chuuk, Palau and Guam in the Micronesian area. A description of the living animal is presented. Male and female genital systems are described and figured. Photographs or SEMs are presented for the radula and gizzard plates.

Introduction

Almost 500 species of opisthobranch mollusks have been found on Guam. This group of animals is probably best known for its shell-less brightly colored nudibranchs, or sea slugs. A lesser known, less studied group is the Cephalaspidea which have generally retained a shell—whether it be external, or vestigial inside the body. The animal discussed in this paper is a Cephalaspidean belonging to the family Haminoeidae. One of the characteristics of this family is a relatively thin shell of about one and a half whorls; the older, inner whorls of which are resorbed by the animal.

Numerous living specimens of an animal with a shell conspecific with *Atys multistriatus* Schepman, 1913 have been found on Guam, Chuuk and Palau in Micronesia. Shells have also been found in the Philippines. As has been true with most shelled opisthobranchs, this species was originally described from the shell alone. Included in this paper are descriptions of the living animal, male and female genital systems, as well as the radula, gizzard plates and jaw elements.

Atys multistriatus Schepman, 1913

Atys multistriatus Schepman, 1913:468, pl. 32, fig. 2.

MATERIAL

11.75 mm shell	Indonesia, Sailus ketjil, Paternoster Islands. [= Pulu Tenga, N. of Sumbawa]. Holotype from the Instituut voor Taxonomische Zoölogie, Amsterdam.
6.0 mm specimen	Guam, Bile Bay, 6 m, 2 December 1972.
9.0 mm specimen	Chuuk, Weno, reef flat, 3 July 1973.
6.0 mm specimen	Guam, Cetti Bay, 14 m, 14 June 1973.

[1]Present address: P.O. Box 8019, Merizo, Guam 96916

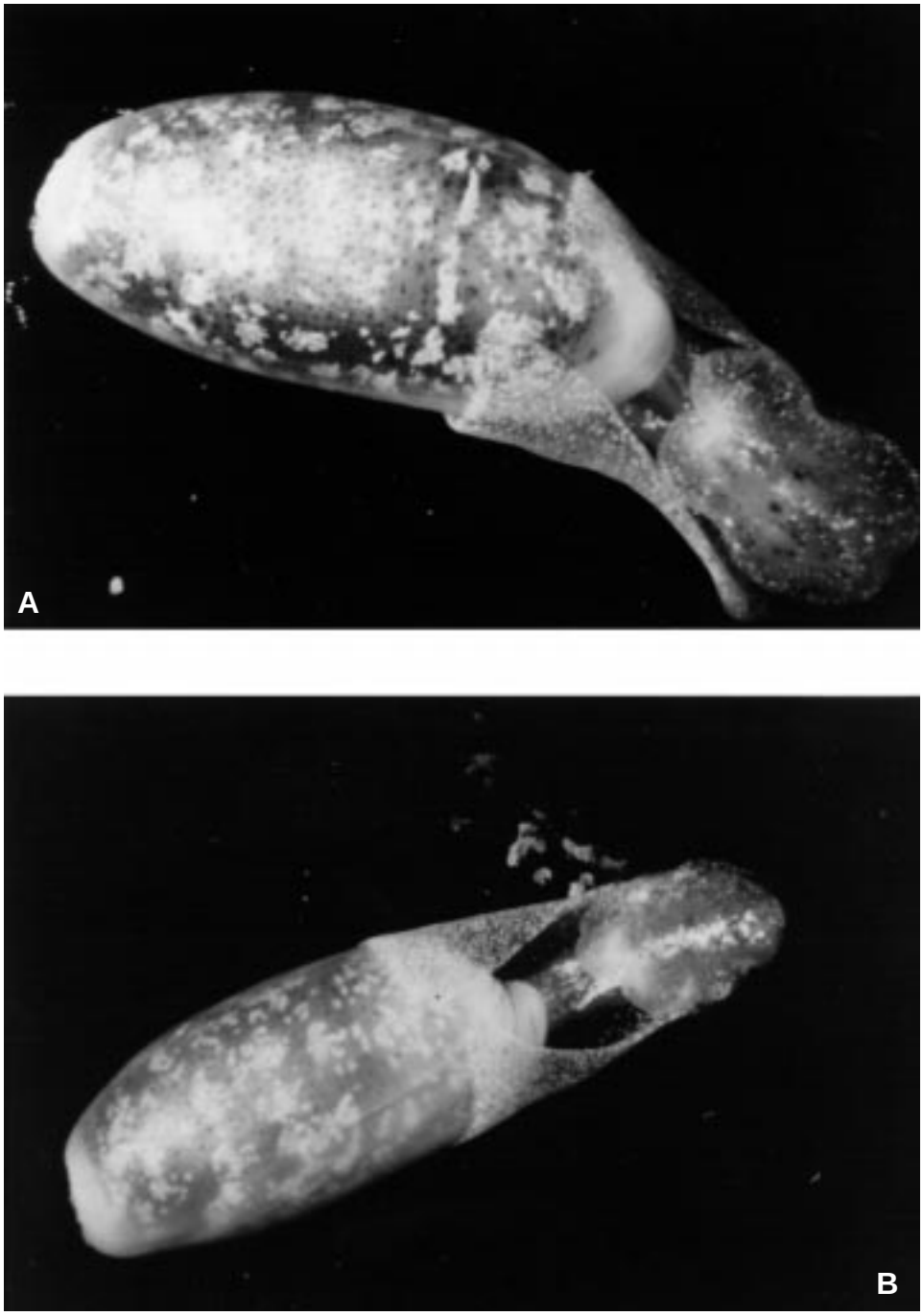

Figure 1. *Atys multistriatus,* A. 6 mm specimen. Guam, Bile Bay, 6 m; 2 December 1972. B. 9 mm specimen. Chuuk, Weno, reef flat; 3 July 1973.

8.5 mm specimen	Guam, Toguon Bay, 2 m, 18 April 1987. dissected
8.0 mm specimen	Guam, Toguon Bay, 8 m, 17 April 1991. dissected
10.5 mm specimen	Guam, Toguon Bay, 8 m, 17 April 1991. SEM
9.0 mm specimen	Guam, Bile Bay, 14 m, 21 April 1994. dissected
8.0 mm specimen	Guam, Bile Bay, 3 m, 1 August 1995. dissected
6.0 mm specimen	Palau, Ngchesar, 11 m, 23 September 1996.
7.0 mm specimen	Palau, Ngchesar, 11 m, 23 September 1996.
3.8 mm shell	Philippines, Luzon, Batangas, Anilao, 21 April 1997
5.0 mm specimen	shell 4.1 x 1.9 mm; Guam, Bile Bay, 11 m, 18 July 1998

Description

In living specimens (Figure 1), the head shield is short, broadened anteriorly and extends well forward of the anterior of the shell when the animal is crawling. The posterior lobes are short. The head and neck, when extended, make up about one third of the total length. The parapodia are broadly triangulate and cover the anterior of the shell. Only the edge of the infrapallial lobe and occasionally a short rounded tail are visible posteriorly from a dorsal view. The lateral margins of the tail lie flat on the substrate. The translucent Hancock's organs appear as a thin low profile ridge. The internal black eyes are visible through clear areas in the headshield.

Figure 2. *Atys multistriatus*, shell, 8 x 3.6 mm; from 10.5 mm living specimen; Guam Toguon Bay, 8 m; 17 April 1991.

Figure 3. *Atys multistriatus*, posterior of shell showing square pattern; original shell 4.1 x 1.9 mm from 5 mm living specimen; Guam, Bile Bay, 11 m; 18 July 1998.

Under a dissecting microscope, the living animal appears translucent white with numerous scattered fine rust-brown flecks and irregular clusters of opaque white dots. The head shield and parapodia are translucent with some of the same rust-brown flecks as seen on the mantle through the shell. There are numerous white dots which tend to remain discrete rather than form clusters. The dots are more numerous on the margins of the parapodia and often on the midline of the headshield. On some specimens (see, for example Figure 1B) white dots are concentrated so that they form a white band on either side of the dorsal surface of the neck. White dots can be seen on the edge of the visible parts of the propodia. The tail is translucent with scattered white dots.

The shell (Figure 2) is translucent with a small portion of the anterior and posterior appearing opaque white. It is thin, elongate and ovoid, with the posterior obliquely truncated, the anterior rounded. The aperture is broad anteriorly, narrow medially and broadens slightly posteriorly. The inner margin of the lip rises a little above the vertex and has a short curve before slanting obliquely to the outer edge. The columella is slightly curved with a broad fold reflected over the body whorl. A deep umbilicus is present behind the fold. The vertex is narrowly concave and perforate. Regular spiral striations cover the entire shell, but are weaker medially. Axial striations (longitudinal growth striae) are variable; irregular on some specimens, somewhat regular on others. The axial striations are prominent and more regular at the posterior. On some specimens, the intersection of spiral and axial striae creates a prominent square pattern (Figure 3). The holotype, 6 and 10.5 mm specimens from Guam and a 9 mm specimen from Chuuk all had a width/length shell ratio of 0.45.

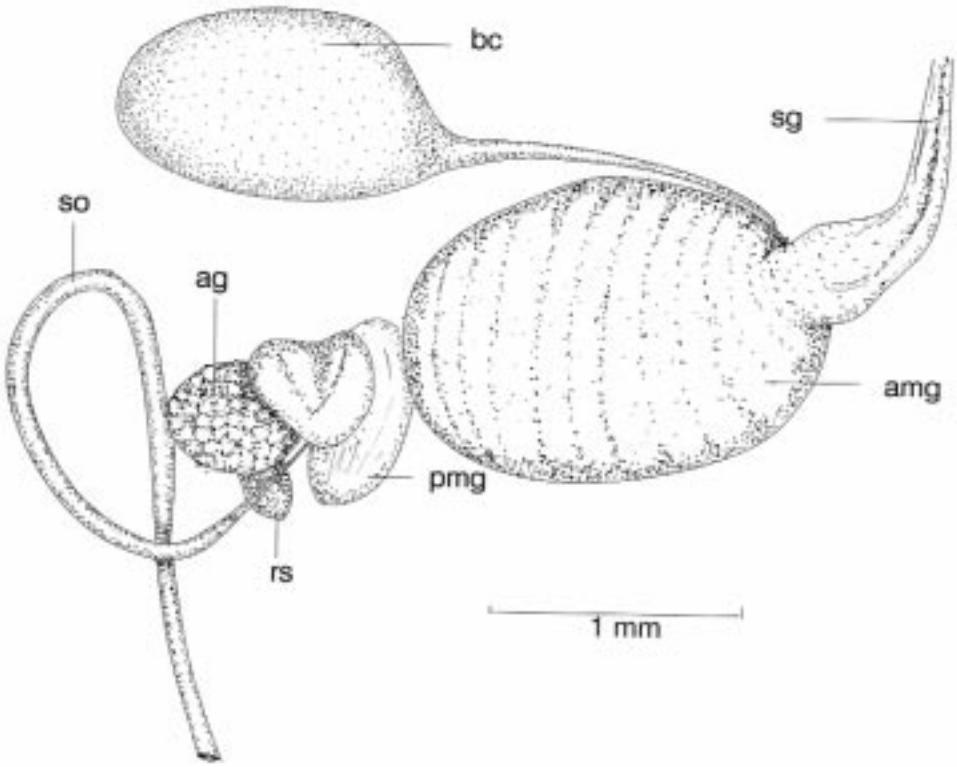

Figure 4. *Atys multistriatus*, Female genital system: ag, albumen gland; amg, anterior mucous gland; bc, bursa copulatrix; pmg, posterior mucous gland; rs, receptaculum seminis; sg, seminal groove; so, sperm oviduct.

In the female genital system (Figure 4), the thin hermaphroditic duct from the ampulla is attached to the female gland mass anterior to the albumin-capsule gland; it then circles around the mass to the posterior where it passes under the gland. It narrows and enters the mass near the anterior mucous gland. A small ovoid receptaculum seminis is located under the gland mass and joins it in approximately the same area as the tube from the ampulla. In the drawing the sperm oviduct is separated from the gland mass and the receptaculum seminis has been moved from under the mass in order to allow the structures to be viewed. The posterior mucous gland is relatively small. The large anterior mucous gland is located posterior to the gizzard plates and extends from the genital opening across to the left side of the body. The large, ovoid bursa copulatrix is on the left slightly forward of the anterior mucous gland. Its duct crosses directly to the female genital opening on the right side.

In the male system (Figure 5), the penial sheath extends alongside the buccal bulb from the opening on the right side of the head. The penial organ is at the beginning of a triple fold which terminates in the relatively simple, ovoid prostate.

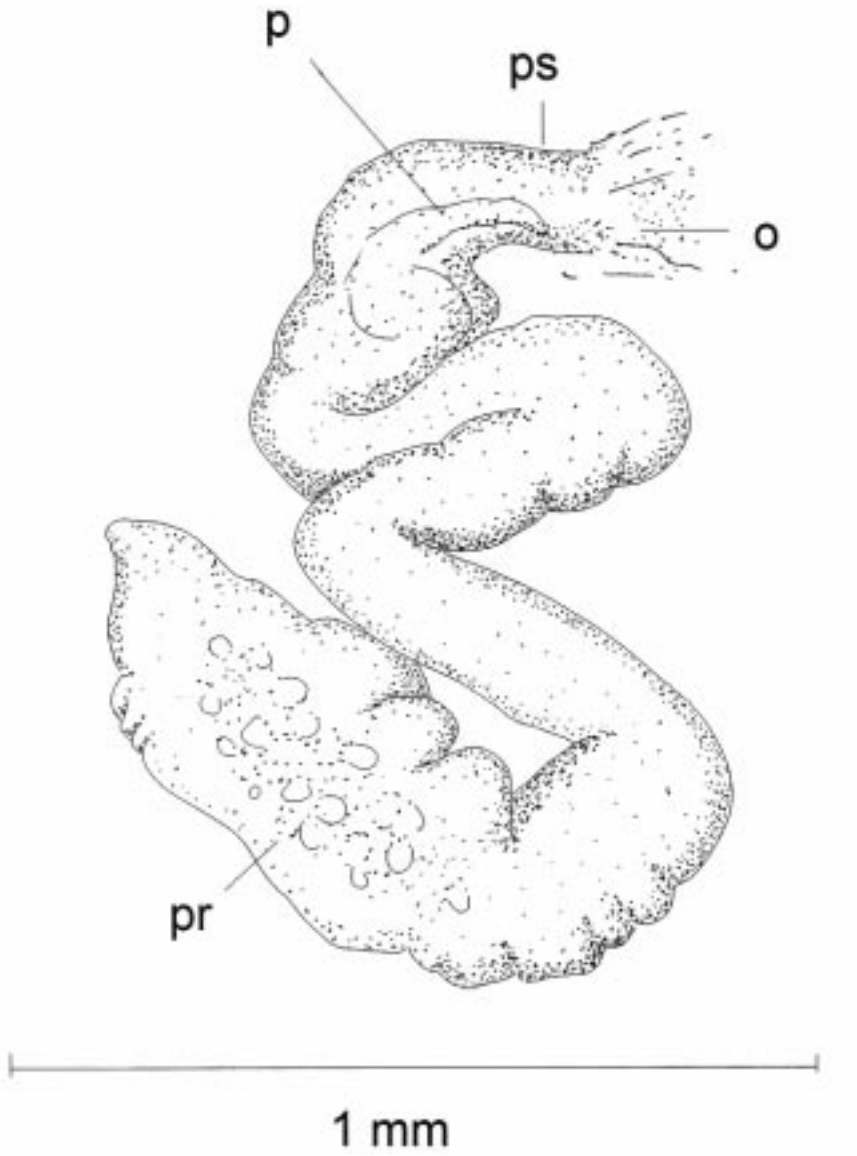

Figure 5. *Atys multistriatus* Male genital system: o, penial opening; p, penis; pr, prostate; ps, penial sheath.

The egg masses are transparent, globular and contain numerous pale brown 70 µm eggs that occur singly in ovoid capsules about 130 µm long. The two masses measured were 8 mm in diameter. Veligers started hatching in the laboratory 3 1/2 days after laying. The water temperature was about 24º C.

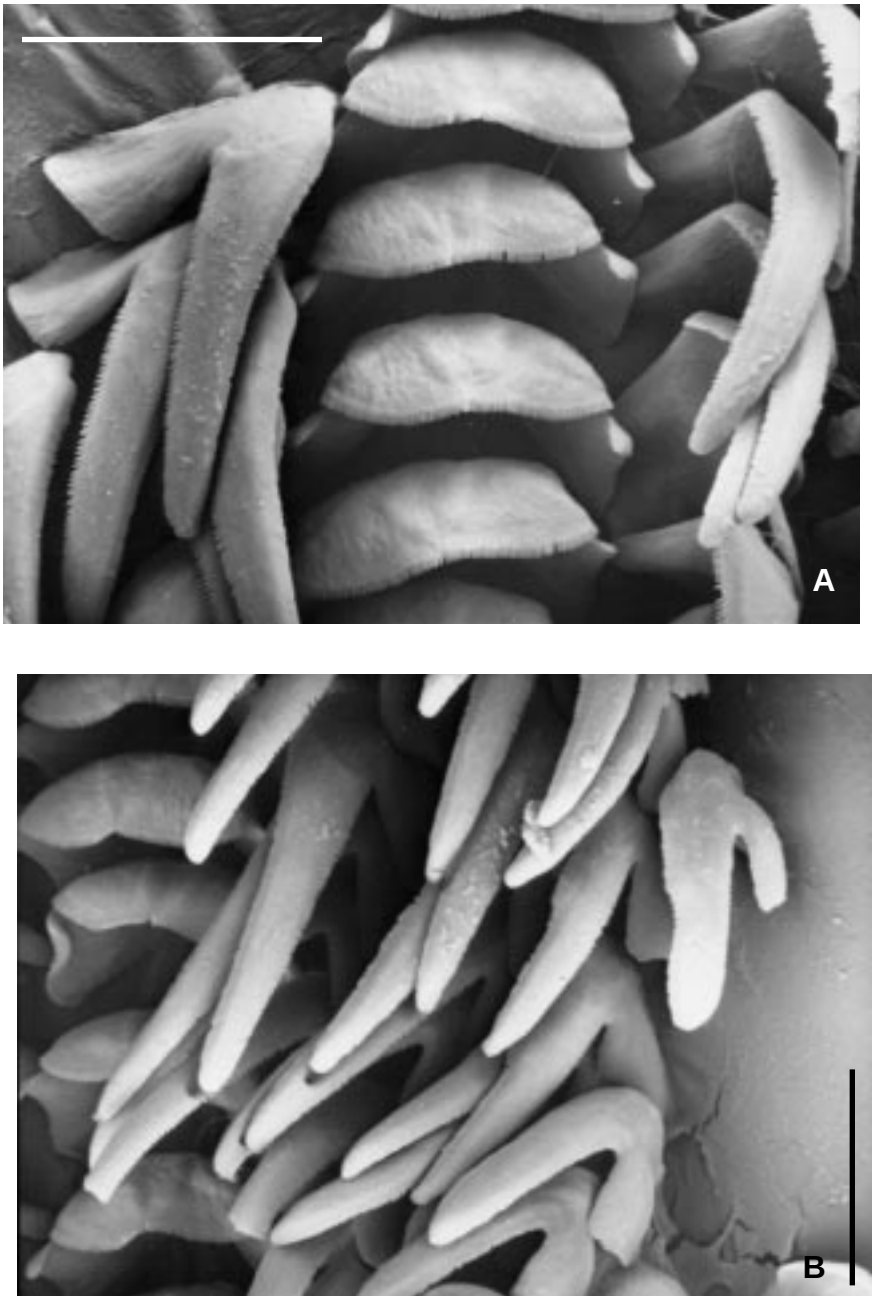

Figure 6. *Atys multistriatus* Scanning Electron Micrographs of radula. A. rachidian and first laterals; B. right side laterals. 8 mm specimen; Guam, Toguon Bay, 8 m; 17 April 1991. Scale bars 20 μm.

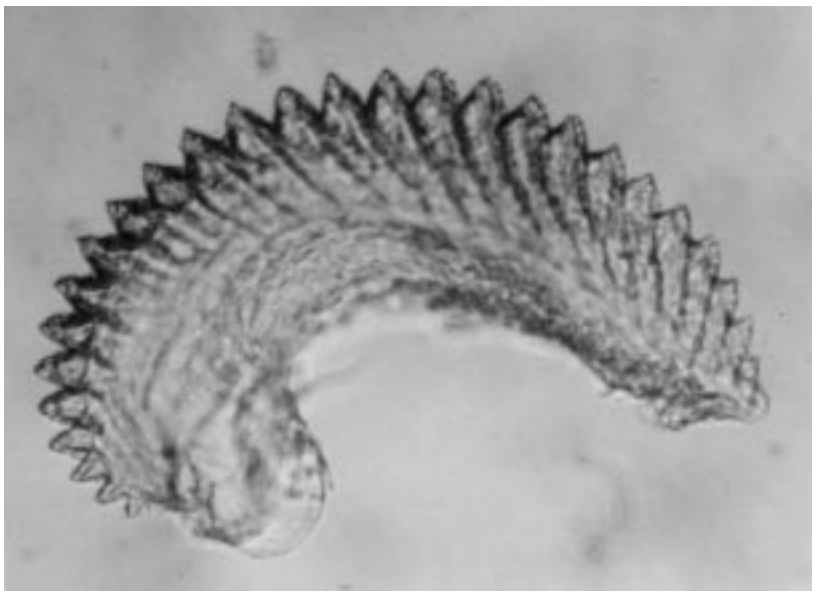

Figure 7. *Atys multistriatus* gizzard plate. 460 µm in length.

In the specimens studied, the radular formula was 21–23 x 4–5.1.4–5. The rachidian (Fig. 6A) is broad, slightly bilobed, finely denticulate and flanked by a small lateral cusp. The basal plate of the rachidian is approximately the same width as the upper part of the tooth. All the lateral teeth (Fig. 6B) are finely denticulate on both sides. The fine denticulations on both the rachidian and laterals were visible with the SEM but could not be seen with the light microscope. The jaw elements are elongate with multiple denticles.

The gizzard plates from a 6 mm specimen (Figure 7) had 21 ridges, and those of a 8.5 mm specimen had 22 ridges, each with a single row of rods. Rods are rounded, mammary-like with a pointed tip. The muscular base is thin. The preserved color is slightly tan, almost transparent.

Atys multistriatus has been found from the reef flat to 21 meters depth usually in or under algae growing on a fine silt covered substrate. The alga is generally *Lyngbya majuscula* (Dillwyn) Harvey but we have no evidence that *A. multistriatus* actually feeds on it.

Discussion

Robert Burns (pers. comm.) first suggested that the specimens described here might be conspecific with Schepman's *Atys multistriatus.* This view was confirmed by our comparison of the Micronesian material with the holotype. A finely denticulate bilobed rachidian, as found in *A. multistriatus,* has not been reported for any other haminoeid species. Gosliner (1994:Fig. 25B) does picture a broadly

rounded, finely denticulate rachidian for an undescribed species collected on Guam. A coarsely denticulate, bilobed rachidian was recently reported for *Atys macandrewii* E. A. Smith, 1872 (Martínez & Ortea 1998).

Two other shells that have been described with both axial as well as spiral striae are *Atys dactylus* Hedley, 1899 from the Pacific and *Bulla (Cylichna) jeffreysi* Weinkauff, 1866 from the Mediterranean. There is no information on the internal anatomy of *A. dactylus. B. jeffreysi* is the type for the genus *Roxaniella* Monterosato, 1884. Later authors (Nordsieck 1972, Thompson et al. 1985) have used the more conservative *Atys*. Thompson et al. (1985) described gizzard plates with numerous ridges, each with single rows of rods for *A. jeffreysi*. Similar gizzard plates as those found in *A. multistriatus* and *A. jeffreysi* are described by Vayssière (1893) for *Weinkauffia diaphana* (Aradas & Maggiore, 1840) and by Martínez & Ortea (1998) for *Atys macandrewii* E. A. Smith, 1872. Thompson et al. (1985) also described a smooth rachidian tooth for *A. jeffreysi*. It should be noted that the rachidian of *A. multistriatus* appeared smooth when viewed with a light microscope. SEMs of the rachidian showed it to be finely denticulate.

A number of genera have been proposed for the Haminoeidae generally based upon shell alone. The status of most of these genera will have to wait until more information is available relative to their internal anatomy. As Pilsbry (1892: 262) said: "No really intelligent systematic work can be done in this group by the shells alone."

A shell and unmounted radula and gizzard plates have been deposited as a voucher in the Zoölogisch Museum, Amsterdam, The Natural History Museum, London (BMNH 1994095), and the Bishop Museum, Honolulu (BPBM 249297). Three complete specimens have been deposited in the Australian Museum, Sydney (C303283). A color slide of a living specimen has also been furnished to these four museums and may be seen on the *Micronesica* web site: www.uog.edu/up/micronesica/abstracts_33/carlson_&_hoff.htm.

Acknowledgements

We would like to thank Robert G. Moolenbeek of the Instituut voor Taxonomische Zoölogie, Universiteit van Amsterdam for furnishing the holotype of *Atys multistriatus;* Robert Burn of Geelong, Australia, who first suggested the name *multistriata;* Dr. David Reid of the British Museum (Natural History) for syntypes of *Atys jeffreysi;* Geoff Avern of the Australian Museum for doing the SEM plates; and Dr. Richard Willan of the Northern Territory Museum, Darwin for his careful review of the manuscript.

This paper is contribution number 441 from the University of Guam Marine Laboratory.

References

Gosliner, T. M. 1994. Gastropoda: Opisthobranchia. *In* F. W. Harrison & A. J. Kohn (eds) Microscopic Anatomy of Invertebrates, V. 5: Mollusca I, pp. 253–395. Wiley Liss, Inc., New York.

Hedley, C. A. 1899. The Mollusca of Funafuti. Memoirs of the Australian Museum 3: 397–499.

Martínez, E. & J. Ortea. 1998. Redescription of *Atys macandrewii* E. A. Smith, 1872, an amphiatlantic cephalaspidean. American Malacological Bulletin 14(2): 133–138.

Monterosato, A. 1884. Nomenclatura Generica e Spezifica di Alcune Conchiglie Mediterranee. Palermo. 152 pp.

Nordsieck, F. 1972. Die europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacea). Stuttgart. Gustav Fischer Verlag. 327 pp.

Pilsbry, H. 1893–5. Manual of Conchology 15. 436 pp., 53 pl.

Schepman, M. M. 1913. Pulmonata and Opisthobranchia Tectibranchiata. Part VI of The Prosobranchia, Pulmonata and Opisthobranchia Tectibranchiata of the Siboga Expedition. Monograph 49, pp. 443–494., pls. 31–32.

Thompson, T. E., G. M. Jarman & A. Zenetos. 1985. Infralittoral macrobenthos of the Patras Gulf and Ionian Sea: Opisthobranch Molluscs. Journal of Conchology 32: 71–95.

Vayssière, A. 1893. Etude zoologique du *Weinkauffia diaphana*. Journal de Conchyliologie 41: 90–97.

Weinkauff, H. C. 1866. Nouveau supplément au catalogue des coquilles marines recueillies sur les côtes de l'Algérie. Journal de Conchyliologie 14: 227–248.

Received 24 Feb. 2000, revised 6 Aug.