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A NEW *APLYSIOPSIS* (OPISTHOBRANCHIA: HERMAEIDAE) FROM CENTRAL FLORIDA, WITH A BRIEF SUMMARY OF THE CERATIFORM FAMILIES OF THE ORDER ASCOGLOSSA (=SACOGLOSSA)

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ABSTRACT

A new species of *Aplysiopsis* is described from Fort Pierce, Florida; this is the first report of the genus from the western Atlantic. Unique characteristics of the species include spoon-shaped extensions of the digestive gland diverticula, a foot with indistinct lateral margins, and pigmentation in a series of longitudinal stripes on the body and cerata. A series of veins radiates from the pericardial hump, as in the Elysiidae; this feature has not been previously reported for the genus *Aplysiopsis*. The new species feeds upon the alga *Cladophora prolifera*. Development is planktotrophic.

The genus *Aplysiopsis* is placed in the family Hermaeidae, which is recognized as a family distinct from the Stiligeridae. Characteristics of the families Hermaeidae, Stiligeridae, and Caliphyllidae are summarized. The Hermaeidae exhibit characteristics transitional between the Caliphyllidae and the Stiligeridae.

Species of the genus *Aplysiopsis* Deshayes 1858 (=*Hermaeina* Trinchese, 1874) are known from most the world's coasts, but none has yet been recorded from the western Atlantic Ocean. As such, the genus is one of the few ascoglossan genera unknown from this area. The species described here was collected during a long-term effort to characterize the ascoglossan fauna of Florida; this report extends the range of the genus to include the eastern coast of North America.

MATERIAL EXAMINED

A total of about 50 specimens were collected from the type locality, the north jetty at Fort Pierce Inlet, Florida (Latitude 27°28′23″W, Longitude 80°17′24″N). One specimen was studied from transverse sections. The holotype (USNM 796588) and a lot of three paratypes (USNM 796589) have been deposited with the National Museum of Natural History, Smithsonian Institution.

Aplysiopsis zebra new species

Diagnosis.—Genus with auriculate rhinophores, usually with middle of anterior margin expanded to form ventral lobe extending beyond posterior margin; cerata fusiform, usually somewhat flattened, originating as a single dorsolateral row on each side, but displaced to appear as multiple rows; cerata usually bearing branched vein-like complex on posterodorsal surface; front of head forming flattened lobes on either side of mouth, appearing as short oral tentacles; anus on mid-dorsal papilla. Radular teeth non-deciduous, cestus-like in shape, with denticulate lateral flanges, short thick base, and deep median keel; penis unarmed, genitalia diaulic; albumen gland not entering cerata; esophageal diverticula absent; digestive diverticula usually lobed or sparingly branched within the cerata.

Species with slightly flattened cerata (ventral surface somewhat concave), bearing gill-like veins; digestive diverticula within cerata in form of dorsal duct with dual series of ventrolateral spoon-shaped processes; foot without distinct lateral margins; anal papilla urn-shaped, between anterior cerata; cerata arranged as double row on each side, about 30 per side, the largest dorsal and increasing in

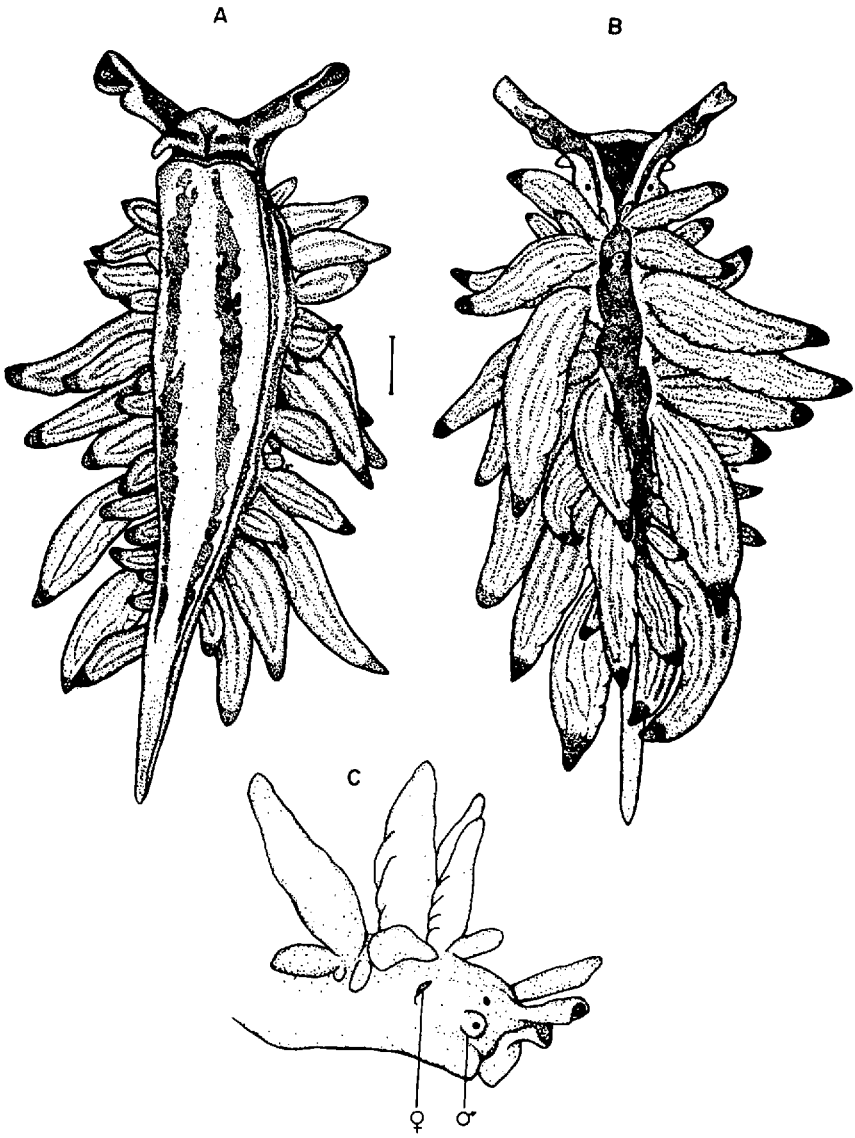

Figure 1. A, Ventral view of *Aplysiopsis zebra*; B, Dorsal view; C, Right lateral view. Scale bar equals 1 mm.

size toward the tail; penis below right eye, bulbous, without tentacle. Pigmentation melanic, forming series of longitudinal stripes on each ceras and along back, sides, head, and foot; ground color pale yellow-green; size to 15 mm.

Description.—Body broadest in region of pericardial hump, gently tapering to long tail (Fig. 1). Lateral margins of the foot do not form distinct edges, but merge with sides of body, so that body is "U"-shaped in cross section. Cerata (as in other members of genus) originate from single duct along dorsolateral edge of body. Cerata large enough that alternate cerata are displaced, giving appearance of two rows, with largest cerata forming upper row; cerata also increase in size

toward tail. Largest animals, about 15 mm, with total of about 60 cerata. Anteriormost cerata supported by faint transverse ridge, nearly meeting at midline of back. Cerata usually reflected over back in living animal, concealing anal papilla and pericardial hump. Pericardial hump elongate, with poorly defined margins. Anus located at tip of dark, urn-shapped papilla, just anterior to pericardial hump and slightly to right of midline. Ladder-like series of about 10 pairs of veins extends from bases of cerata to pericardial hump; these are most easily observed in preserved animals.

Rhinophores large, with shape typical of genus; however, many specimens had somewhat deformed rhinophores, as if they had been bitten and were regenerating. Anterior margin of head laterally extended to form pair of lobes, appearing as short oral tentacles when viewed from above. Penis located directly below right eye, bulbous in shape, with subterminal aperture, located slightly posterior to tip. Female aperture located just anterior to first group of cerata (Fig. 1C).

Cerata highly extensile, but typically fusiform in shape, with somewhat lumpy surfaces when contracted. Vein-like extensions of posterior surface of cerata give a gill-like appearance; these veins are fairly indistinct in living animals, but become sharply defined when fixed (Fig. 2C). Digestive diverticula visible through ceratal wall as series of spoon-shaped processes extending from median duct (Fig. 2D). Larger cerata sometimes bear distinct pore on surface. Optically refractile gland cells visible in ceratal wall (Fig. 2D).

Ground color of animals pale yellow-green, persisting in starved animals. Digestive diverticula dark green in freshly fed animals. Two types of melanic pigment occur: a brownish stripe encircles each rhinophore and extends onto head to a point slightly posterior to eye; remaining pigment patterns of dark grey, granular pigment. Median dorsal stripe extends from point midway between pericardial hump and tail, over pericardium and anal papilla, and onto head, narrowing as it passes between anterior cerata. Digestive diverticula, along lateral margins of back, give impression of two additional dorsal stripes. Three lateral stripes extend from head to tail along each side, coalescing to two stripes at about midlength. Two additional irregular stripes occur on sole of foot, extending only partway to tail. Anterior borders of foot and oral lobes with transverse bars. Each ceras bears about 6 longitudinal bands, with 1 or 2 pairs of bands joining near ceratal tip. Faint band of pigment outlines ceratal veins, forming rosette pattern.

Remarks.—The radula of a 12-mm specimen contained 23 functional teeth, 4 ascending and 19 descending, plus four preradular teeth (Fig. 2A). The teeth were strongly bound to the radular membrane by a system of tough fibrils (Fig. 2B), which were resistant to alkali treatment. The largest teeth were about 205–210 μm in length. The denticles of the laminae vary in number with age of the tooth, from 11 on the oldest (smallest) tooth to 45 on the youngest. The denticles are fairly constant in length, however, ranging from about 1 μm on the oldest teeth to about 1.5 μm on the youngest.

Habitat and Biology.—*Aplysiopsis zebra* feeds on *Cladophora prolifera* (Roth) Kützing, a coarse, wiry-textured alga. The animal occurs in the lower intertidal zone in an area exposed to strong wave action. Animals were most abundant in August and September, and the highest densities occurred in algae which were partially submerged in wet beach sand at low tide.

When handled, the cerata gave off a very strong, viscous mucus strand, tough enough to support the animal in air. The mucus strand took the form of a string of 30 μm beads. Possibly this strand was excreted from the ceratal pore described above, but this was not observed. The cerata are very strongly attached in healthy

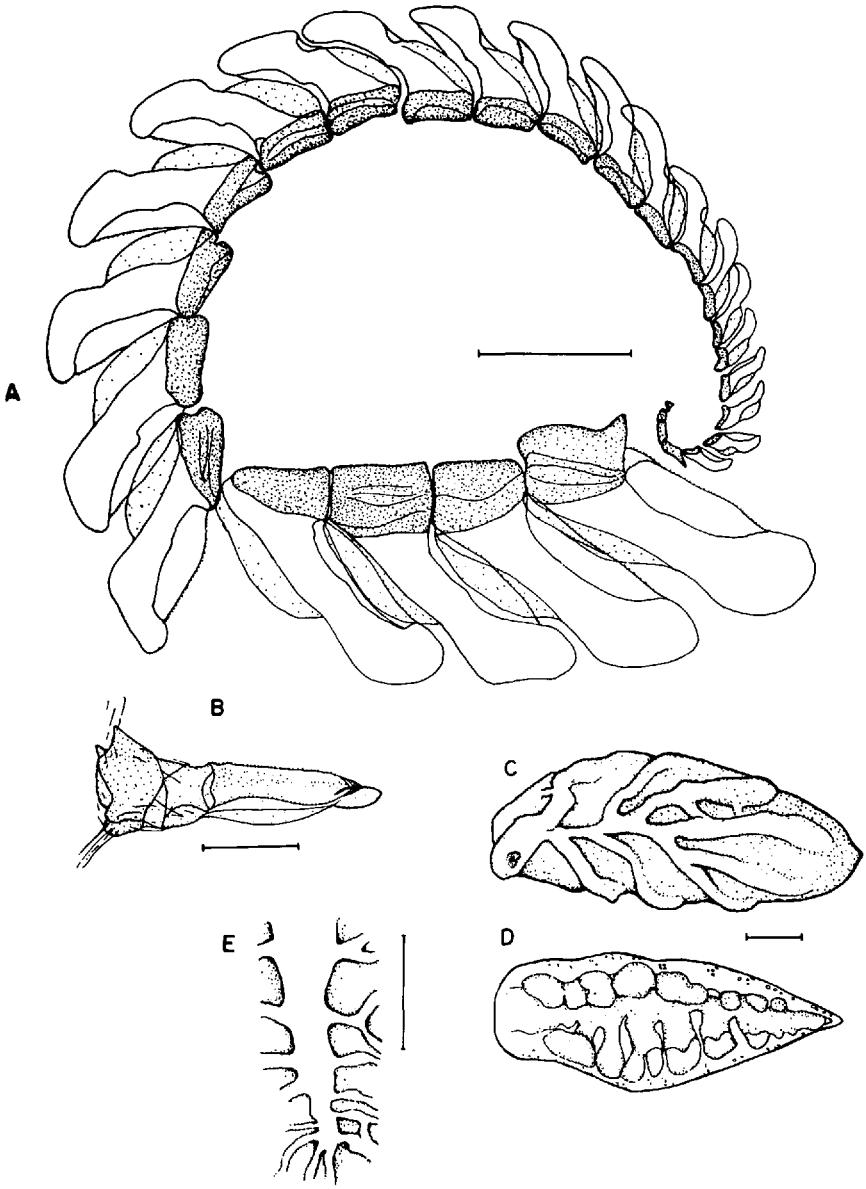

Figure 2. A, Radula of *A. zebra*; B, Single tooth, viewed nearly parallel to radular axis; C, Fixed ceras, external (posterior) view; D, Ceras viewed by transmitted light; E, Pericardial vein complex. Scale bars: A, B, 100 μm; C, D, E, 1 mm.

animals. Tasting of a single ceras produced an initially acidic flavor, followed by a numbing, burning sensation and a strong "clammy" flavor.

The egg mass is in the form of a non-adhesive string wound around the alga. A large egg mass contained 4,500 eggs, and measured 15.5 mm by 1.4 mm. The capsules, each containing a single egg, were oblong, measuring 138 by 92 μm (mean). The eggs were spherical, measuring 71 $\pm$ 14 μm (mean, SD). A fine granular albumen was present; development was planktotrophic.

Etymology.—The specific name *zebra* (appositive noun) refers to the striped pattern of body pigmentation.

Discussion

Keen (1973) has stated that *Aplysiopsis* has seniority over *Hermaeina,* based on the priority of *A. elegans* Deshayes, 1858 over *Hermaeina maculosa* Trinchese, 1874. *Phyllobranchopsis,* based on *P. enteromorphae* Cockerell and Eliot, 1905, is also a junior synonym of *Aplysiopsis*. Cockerell and Eliot's figure of the radula (1905) unquestionably indicates that the species is an *Aplysiopsis*. These authors noted that their specimens were "so badly preserved that many important characters remain uncertain." However, characters clearly consistent with the diagnosis of *Aplysiopsis* include apparent absence of an esophageal diverticulum (crop); cerata arranged in a single row, possibly appearing as two rows; lack of a penial stylet; and the crude figures (20, 21) indicate a general body shape (elongate, with gently tapering tail) quite different from that of the *Polybranchia-Phyllobranchus* type, which has a broad foot, but very much like that of other *Aplysiopsis*. Cockerell and Eliot's notation of "flattened, leaf-like cerata" must be attributed, at least partially, to decompositional changes, but there is also a tendency for the cerata to be somewhat flattened in living *Aplysiopsis* (Baba, 1949; Marcus, 1959; MacFarland, 1966). In any case, their figures and text certainly do not indicate the large, leaf-like cerata found in the Caliphyllidae, and cannot exclude their species from *Aplysiopsis*. Later descriptions (MacFarland, 1966), including those given as *Hermaeina smithi* (Marcus, 1961; Gonor, 1961), confirm the placement in *Aplysiopsis*.

Gonor (1961) noted that several species of the genus were poorly described, hindering interspecific comparisons. Unfortunately, there has been no improvement since Gonor's summary; redescription of these species would greatly improve knowledge of the genus *Aplysiopsis*. Several characteristics appear to be useful and valid for separation of *Aplysiopsis* species. The shape of the penis is useful (Gonor, 1961), but has been described only for *A. enteromorphae, A. brattstroemi,* and *A. zebra*. The number of ascending teeth may be useful, because new teeth are added as older teeth are displaced; however, the number of descending teeth increases steadily with age, so this feature is of little use. The size of the tooth's terminal disc is also of little use, because this also changes with age. The pattern of branching of the digestive gland diverticula within the cerata is also useful, though Gonor (1961) advises caution because the degree of branching in *A. enteromorphae* varies with age and starvation. Pigmentation patterns are quite useful, especially if the range of variation for the species is noted.

Unique characteristics of *A. zebra* include the pattern of pigmentation and the shape of the digestive diverticula. The shape of the penis differs from that of *A. brattstroemi* and *A. enteromorphae*. The radular tooth of *A. zebra* also lacks a pair of small lateral keels near the terminal disc, shown for *A. brattstroemi* by Marcus (1959) and for *A. enteromorphae* by Gonor (1961).

A summary of diagnostic characteristics of other species was given by Gonor (1961); only additional possibly significant features will be given below.

Aplysiopsis enteromorphae (Cockerell and Eliot, 1905), from California, includes *A. smithi* (Marcus, 1961) as a junior synonym. *A. brattstroemi* (Marcus, 1959) from Chile is very similar to *A. enteromorphae* in details of teeth and coloration, but apparently has a different penis (only one specimen was described).

Aplysiopsis sinusmensalis (Macnae, 1954) from South Africa is the most poorly described species; the only subgeneric character given is the color, fawn and brown.

Table 1. Comparison of selected characteristics of ascoglossan families Stiligeridae, Hermaeidae, and Caliphyllidae

	Caliphyllidae	Hermaeidae	Stiligeridae
Genera	*Caliphylla, Polybranchia, Cyerce, Mourgona*	*Hermaea, Aplysiopsis, Costasiella*	*Stiliger, Limapontia, Placida, Olea, Calliopea, Ercolania*
Rhinophore	bifid, auriculate	unifid (tips may be bifid), auriculate	unifid, digitiform (sometimes weakly grooved)
Eyes	admedian	admedian (*Costasiella*) or adlateral	adlateral
Genitalia	diaulic*,†	diaulic*, † (tetraulic in *Costasiella*)	pseudodiaulic or triaulic
Ganglia in visceral loop‡	3	3 or 2	2
Cerata	flattened, leaf-shaped, with "petiole"	slightly flattened or fusiform	fusiform or club-shaped, rarely flattened
Digestive-gland diverticula	planodendritic (not penetrating cerata in *Cyerce*)	branched or knobbed	usually simple, sometimes branched
Foot	broadly triangular	narrowly triangular	narrowly triangular
Radular teeth	denticulate	denticulate	usually smooth
Esophageal diverticula	present	absent	often absent
Diet	Siphonales	some Siphonales; usually Cladophorales or Rhodophyta	some Siphonales; usually Cladophorales; some Rhodophyta, some eggs
Distribution	holotropical	subtropical, temperate (*Costasiella* is tropical)	temperate, subtropical, and tropical

* Gascoigne, 1976.
† Gascoigne, 1979a.
‡ Gascoigne, 1979b.

Aplysiopsis elegans Deshayes, 1858, the type of the genus, has priority over *A. maculata* (Trinchese, 1873) (Keen, 1973). Other species of *Aplysiopsis* include *A. orientalis* (Baba, 1949); *A. nigra* (Baba, 1949); *A. toyomana* (Baba, 1949); and *A. formosa* (Pruvot-Fol, 1953) (Gonor, 1961).

Aplysiopsis formosa is fairly similar to *A. zebra*. *A. formosa* has similar stripes on the cerata, but has reddish ceratial tips, lacks the stripe extending from the rhinophoral base admedial to the eye, the ceratal are proportionately smaller, the lateral and pedal stripes are apparently absent, and the dorsal pigmentation forms a reticulate pattern extending to the tip of the tail. The edge of the keel of the radular tooth is almost parallel to the lamina in *A. formosa,* but forms an arc in *A. zebra*.

The genera *Hermaea, Aplysiopsis,* and *Costasiella* share many characteristics, justifying union at the family level as the Hermaeidae. This family is transitional between the Caliphyllidae and the Stiligeridae in many respects, but of course adaptive radiation within the family provides some non-transitional characteristics, justifying separation of the three families. A summary of the three families

is given in Table 1. The genus *Costasiella* is poorly known at present; it differs from *Aplysiopsis* and *Hermaea* in genitalia, position of eyes, diet, and other features (Table 1), and perhaps should be placed in a separate subfamily. *Costasiella* species apparently all feed on *Avrainvillea,* a siphonalean chlorophyte, but neither *Aplysiopsis* nor *Hermaea* uses siphonalean algae as food.

Confusion of the generic definitions of *Hermaea, Placida,* and *Stiliger* has led to confusion over the proper family names in the past, but with recent separation and clarification of the status of these genera (Gascoigne, 1976), the Stiligeridae and Hermaeidae should stand as valid and distinct families. The genus *Alderia* exhibits many stiligerid characteristics, but also has many very specialized features. Thus, I agree with Gascoigne (1976) that *Alderia* should be placed in a separate family.

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