

Comparative anatomy and systematics of *Amphissa acuminata* and *Amphissa cancellata* (Gastropoda, Caenogastropoda, Columbellidae) from southeastern Brazilian Coast

Luiz Ricardo

L. Simone¹

José Luiz M. Leme²

ABSTRACT

The columbellids *Amphissa acuminata* (Smith) and *A. cancellata* (Castellanos) are described anatomically, under comparative and systematic aspects. Both species occur sympatricly from Rio de Janeiro to South Argentina, from 32 to 95 m depth. Both species differ anatomically in characters of the gill, hypobranchial gland and penis, and differ from other columbellid species in characters of the odontophore cartilages, pallial oviduct and penis. Beyond the shell and radular characters, the small, socket-like head, rounded lateral margins of the foot and spermoduct running within head integument are suggested additional characters of the family Columbellidae.

KEY WORDS

Amphissa acuminata; *A. cancellata*; Anatomy; Systematics; Columbellidae, Brazil

RESUMO

O columbellídeos *Amphissa acuminata* (Smith) e *A. cancellata* (Castellanos) são descritos anatomicamente, sob aspectos comparativos e sistemáticos. Ambas as espécies ocorrem simpatricamente do Rio de Janeiro ao Sul da Argentina, de 32 a 95 m de profundidade. Ambas as espécies diferem anatomicamente em caracteres da brânquia, glândula hipobranquial e pênis, e diferem de outras espécies de columbellídeos em caracteres das cartilagens do odontóforo, oviduto palial e pênis. Além da concha e caracteres de rádula, a pequena cabeça em forma de soquete, as margens laterais arredondadas do pé e o espermoduto que corre dentro de tegumento da cabeça são sugeridos como caracteres adicionais da família Columbellidae.

UNITERMOS

Amphissa acuminata; *A. cancellata*; Anatomia; Sistemática; Columbellidae, Brasil.

¹Biólogo. Mestre em Ciências e Doutor em Zoologia pela USP. Médico pela USP, Pós-doutorando pelo Museu de Zoologia da USP

²Biólogo. Professor Doutor pela USP. Chefe do Laboratório de Malacologia do Museu de Zoologia da USP

INTRODUCTION

Amphissa acuminata (Smith, 1915) was described in the genus *Glypteuthria* Streb. 1905 (Buccinidae), and afterwards transferred to the genus *Pyrene* Röding, 1798 (Columbellidae) by Fernandez & Castellanos (1973), based on radular characters. Castellanos (1979) transferred this species to the genus *Anachis* H., A. Adams, 1853, based on Radwin (1977a) who restricted the genus *Pyrene* to species from Pacific Ocean, and described *Anachis cancellata* for the Argentina.

In 1983, Leme, Penna-Neme presented a preliminary study on both species in the VIII Brazilian Meeting of Malacology, São Paulo, based on abundant material collected by R. V. "W. Besnard" of Instituto Oceanográfico da Universidade de São Paulo (IOUSP), in that study, based on conchologic characters, on the light of Radwin's (1977a; 1977b; 1978) Columbellidae revision, both species were transferred to the genus *Amphissa* H., A. Adams, 1853 (type species *Buccinum corrugatus* Reeve, 1847, *non* Brocchi, 1814; = *A. columbiana* Dall, 1916), also the first occurrence of *A. cancellata* in Brazilian waters and the first anatomical data of the genus were related. The generic transference was published by Rios (1985).

The knowledge on the anatomy of the Columbellidae, which according to Marcus & Marcus (1962) may bring better elements for a systematic revision of the group, is still scanty. The present paper has the first published anatomical data on the genus *Amphissa*, and justifies formally the generic attribution presented by Leme & Penna-Neme (1983).

MATERIAL AND METHODS

The examined specimens were collected in the dredges of "W. Besnard" of IOUSP, were fixed in 70% ethanol and deposited in the Museu de Zoologia da Universidade de São Paulo (MZUSP) collection.

The specimens were dissected by standard technique, the shells were decalcified in Railliet-Henry fluid. Some of them were dehydrated in ethanol series, stained in carmine, cleared and fixed in creosote. All drawings were made with the aid of a camera lucida. Some shell photos were obtained in SEM in the laboratory of the Universidade Federal de São Carlos, and radulae SEM photos in the "Laboratório de Microscopia Eletrônica do Instituto de Biociências da USP".

Anatomical terminology and comparisons are based on Marcus, Marcus (1962) and systematics on Radwin (1977a; 1977b; 1978). Comparison with *Prosipho mundus* Smith, 1915 is based on photos of the holotype, courtesy of the Natural History Museum, London (BMNH).

Abbreviations in the figures: **aa**, anterior aorta; **ae**, anterior esophagus; **ag**, albumen gland; **an**, anus; **au**, auricle; **bc**, bursa copulatrix; **bm**, buccal mass; **cg**, capsule gland; **cm**, columellar muscle; **cv**, ctenidial vein; **dd**, duct to digestive gland; **ep**, posterior esophagus; **es**, esophagus; **fp**, female pore; **fs**, foot sole; **gd**, gonopericardial duct; **gi**, gill; **gl**, gland of Leiblein; **he**, head; **hg**, hypobranchial gland; **in**, intestine; **ki**, kidney; **m2**, retractor muscle of buccal mass; **m4**, dorsal tensor muscle; **m5**, ventral tensor muscle; **m8**, retractor muscle of cartilages; **m11a**, anterior-ventral tensor muscle; **mb**, mantle border; **me**, middle esophagus; **mo**, mouth; **ne**, nephrostome; **nr**, nerve ring; **oc**, odontophore cartilages; **od**, odontophore; **op**, operculum; **os**, osphradium; **pb**, proboscis; **pe**, penis; **pg**, pedal gland anterior furrow; **pp**, penis papilla; **ra**, radula; **rm**, retractor muscle of proboscis; **rn**, radular nucleus; **rs**, radular sac; **rt**, rectum; **rw**, rhynchodeal wall; **sc**, subradular cartilage; **sd**, salivary gland duct; **sg**, salivary gland; **si**, siphon; **st**, stomach; **sv**, seminal vesicle; **te**, cephalic tentacle; **ts**, testis; **vd**, vas deferens; **ve**, ventricle; **vg**, vaginal canal; **vl**, valve of Leiblein, **vo**, visceral oviduct.

SYSTEMATICS

Amphissa acuminata (Smith, 1915) (Figs. 1, 2, 5, 9, 10, 13-23)

Glypteutbria acuminata Smith, 1915: 91, pl. 2, f. 5; Castellanos, 1970: 98, pl. 7, f. 1.

Pyrene acuminata: Fernandez & Castellanos, 1973: 135, f. 3.

Anachis acuminata: Castellanos, 1979: 93.

Amphissa acuminata: Rios, 1985: 98, pl. 34, f. 432; Rios 1994: 124, pl. 40, f.524.

Type. BMNH.

Diagnosis. Shell sculptured by about 25 axial and 6-7 spiral ridges in penultimate whorl, both predominating; inner margin of outer lip smooth. Gill filaments short. Hypobranchial gland small. Odontophore cartilages coalescent at about 80% of they length. Penis of homogeneous width along its length, with a small pointed papilla in mid region of tip. Female with gonopericardial duct, albumen gland and bursa copulatrix.

Description. **Shell** small (to 16 mm), long, fusiform (Figs. 1, 2), color pale-cream to pale-brown. Protoconch of two convex, grassy and smooth whorls. Teleoconch up to 6 convex whorls. Periostracum thin and yellowish. Suture somewhat deep. Sculpture about 25 axial ridges and 6-7 spiral ridges (in penultimate whorl), both predominating; a small node in intersection of spiral and axial ridges (Fig. 5). In inferior region of body whorl axial ridges faint, only spiral ridges present. Aperture oval. Outer lip arched, with small and regular teeth near its inner margin. Inner lip arched, covered by a thin-glossy lamina, a small tooth in superior region. Canal short and broad.

Head-foot. Head small, without snout, only developed as a salient common socket of short, pointed and divergent tentacles (Fig. 13). Eyes dark, in lateral-basal region of tentacles. Proboscis opening inconspicuous, lies beneath ventral base of head. Foot narrow, truncate in front, pointed behind (Fig. 13). Operculum lies obliquely on a pad set close to posterior-dorsal extremity of foot. A conspicuous anterior groove of pedal gland. Sole not clearly of a crawling animal, with rounded borders and limited in sides by a longitudinal furrow (Fig. 13) situates slightly over sole. Color pale-cream, with minute dark spots, mainly in lateral regions of head.

Operculum. Ovate, unguiculate, nucleus terminal, concentrically undulate (Fig. 17), oc-

cupies entire aperture. Inner scar close to inner margin.

Mantle border. Simple, thin (Fig. 14), without pigments. Siphon well-developed, short, border smooth (Fig. 14), color pale-cream. Siphon right base with a flap covering anterior limit of osphradium and gill (Fig. 14).

Pallial organs. Osphradium bipectinate, very-large, situated in siphon roof, left leaflets reduced and less numerous than right ones (Fig. 14). Osphradium anterior region with left leaflets missing. Gill with several triangular and short filaments (Fig. 15), surrounds right border of osphradium (Fig. 14). Hypobranchial gland inconspicuous, flattened and restrict to posterior region of cavity (Fig. 14).

Circulatory-excretory systems. Heart very developed. Auricle elongated and transversal. Ctenidial vein inserting in left side of auricle, junction with ventricle inserting in it mid-posterior side (Fig. 14). Ventricle very-large, rounded outline (Fig. 14); anterior aorta very-larger than posterior aorta. Kidney situated behind posterior limit of mantle cavity, well developed. Nephrostome a slit surrounded by muscular walls (Fig. 14).

Digestive system. Proboscis of moderate size (Fig. 16), several and powerful muscle fibers from its tip into inner and ventral wall around proboscis base. Proboscis' buccal mass long, about same length of proboscis. Odontophore long, in right-ventral side of buccal mass (Fig. 18). Odontophore and anterior esophagus narrow and very-long, lie in proboscis as two tubes (Fig. 18), each surrounded by radial and oblique muscular fibers, which connect with each other and both in inner proboscis wall. No developed oral tube. Odontophore cartilages paired behind and coalescent in front for about 80% of its total length (Figs. 19, 20). Some of odontophore muscles indicated in Fig. 19. Radula very-long, about same length than proboscis (Fig. 19). Rachidian plate-like, posterior border thickened and smooth. Lateral teeth movable, tall, fixed to radular membrane only by this base, which has a triangular expansion (Fig. 10); posterior side of each lateral tooth bears two sub-terminal cusps (Figs. 9, 10). Anterior esophagus narrow, originated in buccal mass in its left-dorsal side (Figs. 16, 18). Valve of Leiblein developed, fusiform, situated close and anterior to nerve ring (Fig. 16). Salivary glands cluster around nerve ring and valve of Leiblein. A pair

of ducts of salivary glands easily visible (Fig. 16), not passing through nerve ring, run free by side of valve of Leiblein; afterwards, ducts of salivary glands run attached to anterior esophagus into buccal mass. Mid and posterior esophagus narrow (Figs. 16, 21). Gland of Leiblein small, situated far back from nerve ring (Fig. 16). Posterior region of posterior esophagus with thick-glandular walls (Fig. 21). Stomach poorly developed, with two ducts to digestive glands in its ventral side, close with each other (Fig. 21). Intestine narrow, sinuous, runs ventrally through kidney (Fig. 21) and right side of pallial cavity. Rectum very narrow (Fig. 14).

Male genital system. Seminal vesicle situated behind pallial cavity, coiled and with thick walls (Fig. 22). Pallial connection of sperm duct minute and inconspicuous. Pallial sperm duct lies close to columella along floor of pallial cavity, not visible externally (Fig. 13); walls thick formed by narrow prostate gland. Penis proportionally large, flattened, with uniform width along its length (Figs. 13, 22); a small, sharp-pointed papilla in middle region of penis' tip (Figs. 13, 22), in which vas deferens opens.

Female genital system. Visceral oviduct lies on columella, somewhat sinuous, bearing a small gonopericardial duct in its anterior region. Albumen gland short and rounded. Capsule gland long and cylindrical. Bursa copulatrix short and sacciform (Fig. 23).

Measurements (in mm). MZUSP 20553 (figs. 1-2): 1) 12.3 by 5.4; 2) 12.3 by 5.0.

Habitat. Sandy and muddy bottoms, from 32 to 70 m depth.

Distribution. From Rio de Janeiro to south Argentina and Falkland Islands.

Material Examined. BRAZIL. **Rio de Janeiro**, Ilha Grande Bay, R.V. "Emilia"; MZUSP 24529 (1 specimen), sta. 282, 48.5m, 14/vii/1966. **São Paulo**, R. V. "W. Besnard"; MZUSP 20550 (2 specimens), sta. 1145, 23°00'S 42°25'W, 60m 8/viii/1970; MZUSP 20553 (30 specimens), sta. 1476, 23°06'S 42°54'W, 59m, 9/iii/1971; MZUSP 19495 (2 specimens), sta. 1485, 22°39'S 41°33'W, 52m, 10/iii/1971; MZUSP 20557 (7 specimens), sta. 302, 23°14'S 43°56'W, 49m, 16/ii/1968; MZUSP 20551 (1 specimen), sta. 1469, 23°44'S 44°36'W, 60m, 7/iii/1971; MZUSP 24528 (13 specimens), off Santos Bay, 32m, 14/iv/1969; MZUSP 20552 (2 specimens), sta. 1471, 24°22'S 44°23'W, 156m, 7/iii/1971; MZUSP 19268 (3 specimens), sta. 1911, 31°39'S 50°43'W, 69m, 21/viii/1972;

MZUSP 20558 (3 specimens), sta. 425, 32°08'S 51°10'W, 62m, 4/xi/1968; MZUSP 19266 (2 specimens), sta. 427, 32°34'S 50°30'W, 101m, 4/xi/1968; MZUSP 19264-19265 (4 specimens), sta. 417, 33°00'S, 51°50'W, 58m, 1/xi/1968; MZUSP 19263 (6 specimens), sta. 405, 34°32'S, 52°27'W, 65m, 29/x/1968; MZUSP 28103 (1 specimen) sta. 164, 21°15'S 40°50'W, 19m, 6/ix/1970; MZUSP 24560 (3 specimens), sta. 315, 23°22'S 44°26'W, 50m, 7/ii/1969.

Amphissa cancellata

(Castellanos, 1979)

(Figs: 3, 4, 6-8, 11, 12, 24-30)

Pyrene agnesta: Fernandez & Castellanos, 1973: 135, f.1, 2, 4 (*non* Strebel, 1905).

Anachis cancellata Castellanos, 1979: 91, f.6; Figueiras & Sicaldi, 1980: 210, pl.4, f.29.

Amphissa cancellata: Rios, 1985: 99, pl.34, f. 433; Rios, 1994: 124, pl.40, f. 525.

Types. Museo de La Plata.

Diagnosis. Shell sculptured by about 15 axial and 5-6 spiral ridges in penultimate whorl, axial ridges predominating, inner margin of outer lip smooth. Gill filaments tall. Hypobranchial gland large. Odontophore cartilages coalescent at about 80% of its length. Penis very long narrowing gradually along its distal end, which has a small papilla in right side. Female with gonopericardial duct, albumen gland and bursa copulatrix.

Description. Shell small (to 14 mm), long, fusiform (Figs. 3, 4), color white to pale-brown. Protoconch of two convex, glossy and smooth whorls (Fig. 6). Teleoconch up to five convex whorls; suture deep. Periostracum thin and yellowish, bearing several microscopical scales (Fig. 8). Sculpture about 15 axial ridges and 5-6 spiral ridges (in penultimate whorl), axial ridges predominating (Figs. 6, 7). A small node in intersection of spiral and axial ridges (Figs. 6, 7). In inferior region of body whorl axial ridges faint, only spiral ridges visible. Aperture oval. Outer lip arched and internally smooth. Inner lip covered by a thin and smooth lamina. Canal short and broad.

Head-foot (Fig. 24); **operculum** and **mantle border** (Fig. 25) with similar characters to those described for *A. acuminata*.

Pallial organs. Osphradium bipectinate (Fig. 26) and very-large, left leaflets reduced and less numerous than right ones; anterior region

of osphradium with left leaflets missing (Fig. 25). Gill with several triangular and slightly long filaments (Fig. 26, 25). Hypobranchial gland somewhat developed, situated at some distance from gill in right margin of cavity, length more than a half of total pallial cavity length (Fig. 25).

Circulatory-excretory systems. Similar to those of *A. acuminata* (Fig. 25).

Digestive system. Very similar to that of *A. acuminata*, proboscis long, proboscis' buccal mass with about same length of proboscis (Fig. 28). Radula similar to that of *A. acuminata* (Figs. 11, 12), except by broader base of lateral teeth. Posterior esophagus, near to stomach, with thick glandular walls (Fig. 27). Stomach as in *A. acuminata*. Intestine sinuous (Fig. 27), rectum very narrow (Fig. 25).

Male genital system. Seminal vesicle coiled behind pallial cavity with a inconspicuous pallial connection, similar to that of preceding species. Pallial sperm duct lies immerse in floor of pallial cavity near columella (Fig. 24), not visible externally. Prostate gland narrow. Penis narrow and long, flattened, gradually narrowing up to tip (Figs. 24, 29). Terminal papilla small, situated in right side of penis' tip, in which penis duct opens (Figs. 24, 29).

Female genital system. As described for *A. acuminata*. Gonopericardial duct present. Albumen gland short and rounded. Capsule gland long and cylindrical. Bursa copulatrix short and sacciform (Fig. 30).

Measurements (in mm). MZUSP 19476 (figs. 3-4): 1) 9.3 by 3.9; 2) 9.4 by 4.1.

Habitat. Sandy and muddy bottoms, from 49 to 95 m depth.

Development. A female presented posture in pallial cavity, capsules containing several embryos in stages from egg into veliger larva.

Distribution. From Rio de Janeiro to south Argentina and Falkland Islands.

Material examined. R. V. "W. Besnard"; MZUSP 19553, sta. VII, 22°27'S 40°39'W, 95m, 1 specimen, 11/ii/1969; MZUSP 19484, sta. 1495, 22°39'S 41°33'W, 52m, 7 specimens, 10/iii/1971; MZUSP 19452, sta. 1476, 23°06'S 42°54'W, 59m, 8 specimens, 9/iii/1971; MZUSP 19476, sta. 1483, 23°00'S 42°10'W, 64m, 52 specimens, 10/vii/1971; MZUSP 24530, sta. 1471, 24°22'S, 44°23'W, 156m, 2 specimens, 7/iii/1971; MZUSP 20555, sta. 302, 23°14'S 43°56'W, 49m, 6 specimens, 16/ii/1968; MZUSP 20531, sta. 1469, 23°44'S 44°36'W, 60m, 1 specimen, 7/iii/1971; MZUSP 20554, sta. 1873, 35°10'S 52°46'W, 94m, 1 specimen, 13/viii/1972.

DISCUSSION

The affinities of the both studied species with the columbellids, as also noted by Fernandez, Castellanos (1973), is suggested analyzing the radular characters (Figs. 9-12), very similar to those of other columbellid species, rather than Buccinidae. Within Columbellidae, the conchologic character of both species show close similarity with *Amphissa* (sense Radwin, 1978), such as well-developed sculpture, periostracum present and rounded whorl's profile (Figs. 1-8), rather than *Anachis*.

Amphissa cancellata differs from sympatric *A. acuminata* in having shell with fewer axial ridges, the axial ridges predominating, gill leaflets taller, hypobranchial gland more developed, the penis longer, narrowing gradually along its length, and with papilla in lateral region of the penis tip. In contrast, the penis of *A. acuminata* is shorter, with a uniform width along its length and the papilla is in middle region of the tip.

A. cancellata has some shell similarity with the buccinid *Prosipho mundus* Smith, 1915. Differs in having shallower suture, whorl's profile less rounded and axial sculpture well developed. *P. mundus* has well-developed spiral threads and poor axial threads, which characterize it as a good species. The generic attribution of this species is still focus of study.

Both species differ anatomically from the species of Columbellidae studied by Marcus, Marcus (1962) in having the odontophore cartilages coalescent in a larger degree; gonopericardial duct, albumen gland and bursa copulatrix occurring simultaneously in the female, and by the papilla in the penis tip of the males.

Beyond shell and radular features, which characterize Columbellidae, some soft-parts data may be analyzed as additional characters of the family, such as the small, socket-like head; the rounded lateral border of the foot, without a clear crawling sole; and the sperm duct running immerse, and not on the floor of the pallial cavity as usual neogastropod.

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LEGENDS

Figs. 1-10, *Amphissa* spp hard parts: **1-2**, *Amphissa acuminata* shell, frontal and dorsal views, scale = 2 mm; **3-4**, *A. cancellata* shell, frontal and dorsal views, scale = 2 mm; **5**, *A. acuminata*, SEM, detail of shell sculpture, scale = 0.5 mm; **6**, *A. cancellata*, SEM, detail of spire, scale = 1 mm; **7**, same, detail of shell sculpture, scale = 0.5 mm; **8**, same, scale = 0.2 mm; **9**, *A. acuminata* radula, SEM, scale = 20 µm; **10**, same, detail of lateral teeth, scale = 5 µm.

Figs. 11-12, *Amphissa cancellata* radula, SEM: **11**, scale = 20 µm; **12**, detail of lateral teeth, scale = 5 µm.

Figs. 13-17, *Amphissa acuminata* anatomy: **13**, head-foot, male, frontal view; **14**, pallial cavity hoof and anterior portion of visceral mass, ventral view; **15**, detail of a gill filament; **16**, foregut, ventral view, esophagus extended; **17**, operculum. Scales = 1 mm, except fig. 15 = 0.5 mm.

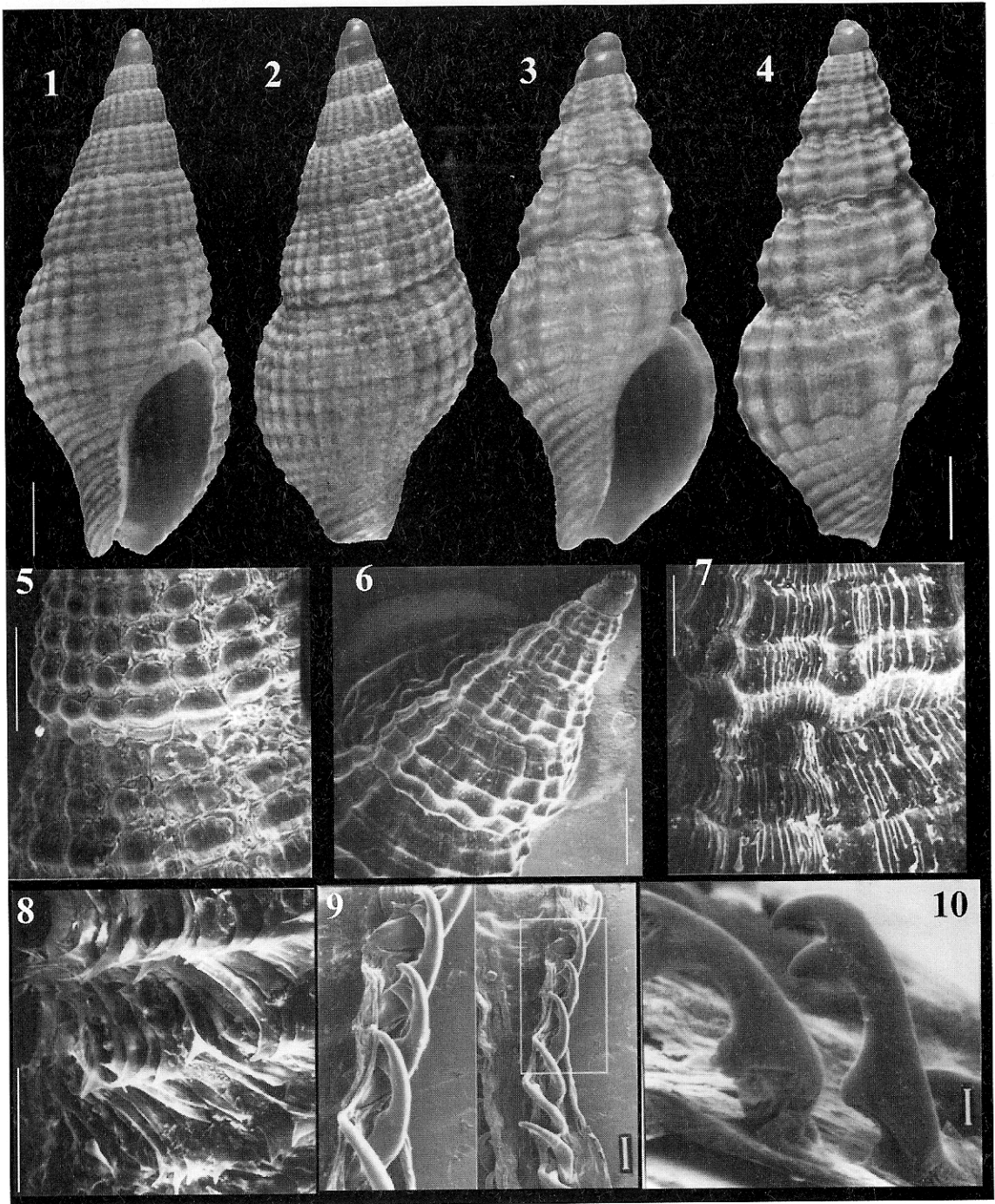
Figs. 18-23, *Amphissa acuminata* anatomy: **18**, proboscis opened longitudinally, lateral-left view; **19**, odontophore, lateral-left view, outer surface of membrane and muscles removed, most structures deflected; **20**, odontophore cartilages, lateral-left view, some muscle insertion also shown; **21**, midgut, ventral view as in situ, renal portion also shown; **22**, male genital system, whole ventral view; **23**, pallial oviduct of female, detail of its anterior portion. Scales = 1 mm.

Figs. 24-30, *Amphissa cancellata* anatomy: **24**, head-foot, male, frontal view; **25**, pallial cavity hoof and anterior portion of visceral mass, ventral view; **26**, pallial cavity roof, transversal section in middle level of osphradium; **27**, midgut, ventral view as in situ, renal portion also shown; **28**, foregut, ventral view, esophagus extended; **29** penis, extracted, ventral view; **30**, pallial oviduct, female, ventral view. Scales = 1 mm, except fig. 26 = 0.5 mm.

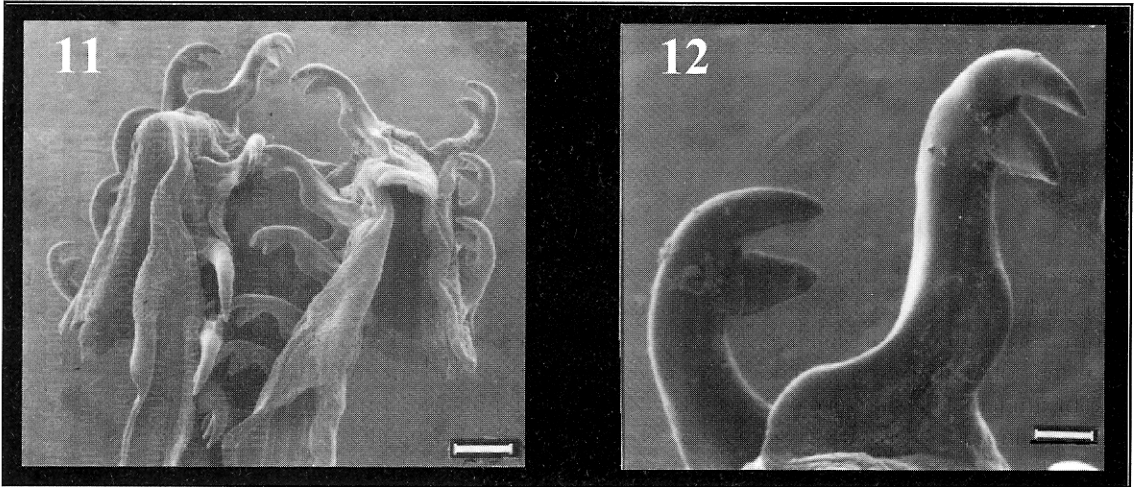
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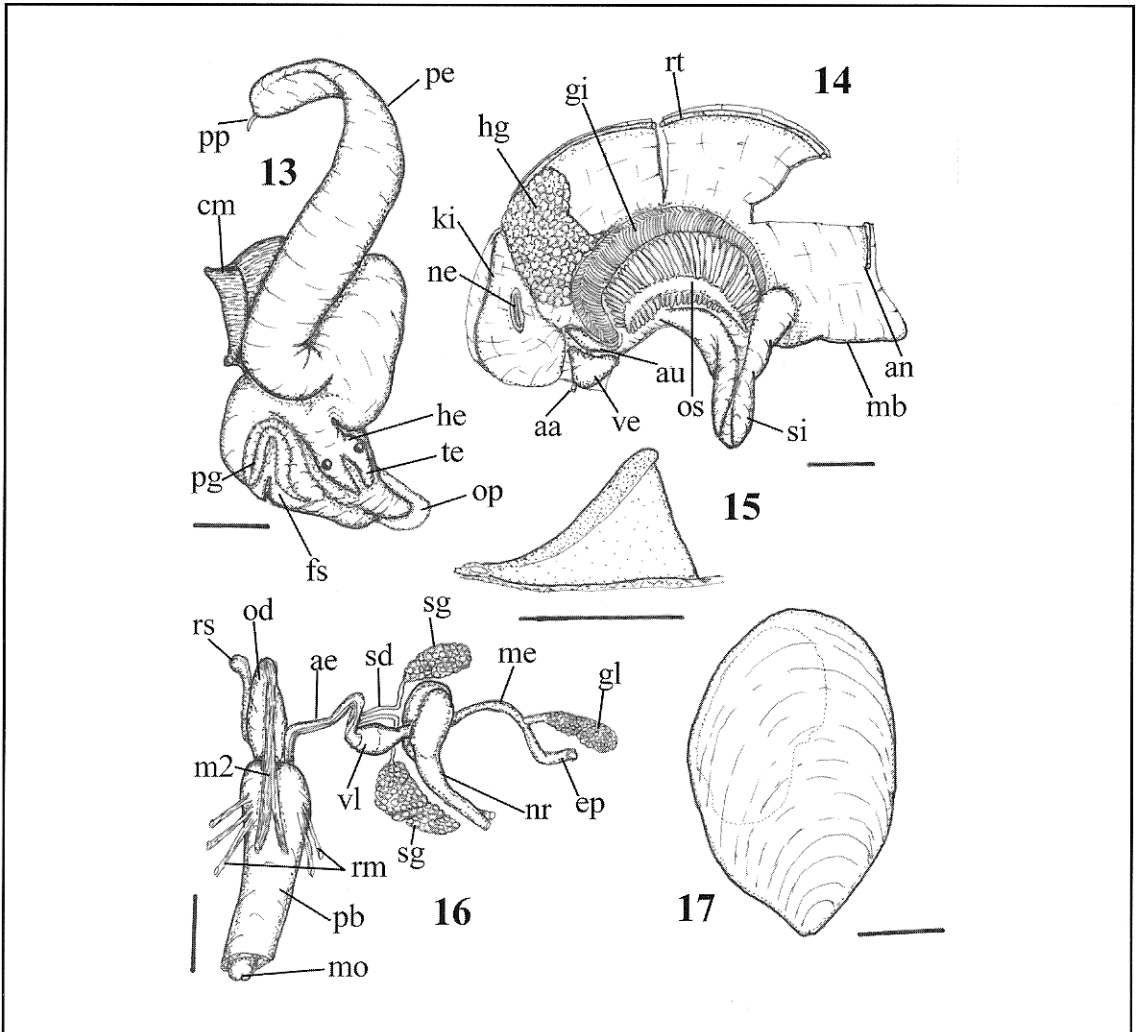
ANEXO - FIGURAS (1-30)



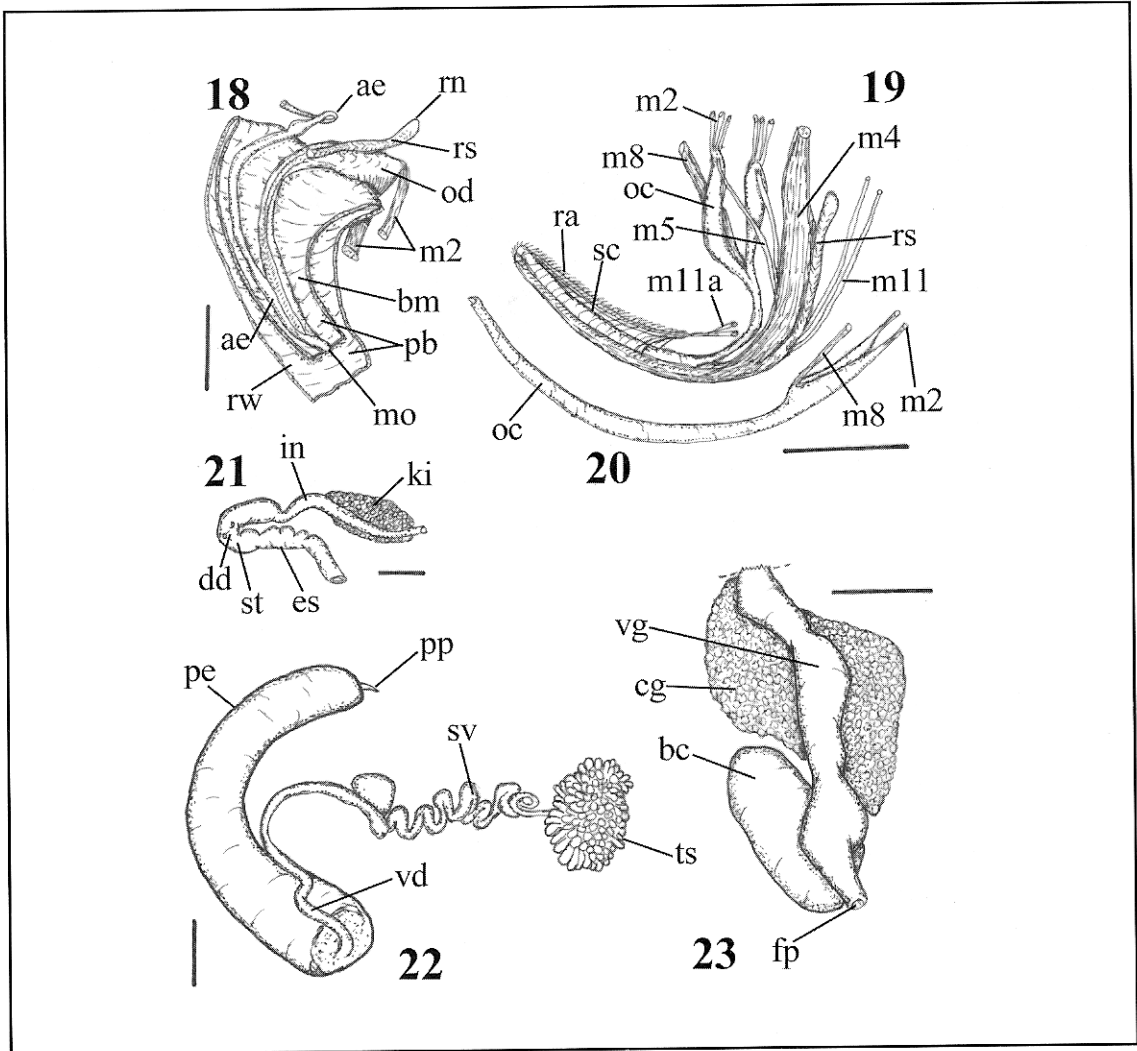
FIGS. 1-10, *Amphissa* spp *hard parts*: 1-2, *Amphissa acuminata* shell, frontal and dorsal views, scale = 2 mm; 3-4, *A. cancellata* shell, frontal and dorsal views, scale = 2 mm; 5, *A. acuminata*, SEM, detail of shell sculpture, scale = 0.5 mm; 6, *A. cancellata*, SEM, detail of spire, scale = 1 mm; 7, same, detail of shell sculpture, scale = 0.5 mm; 8, same, scale = 0.2 mm; 9, *A. acuminata* radula, SEM, scale = 20 μ m; 10, same, detail of lateral teeth, scale = 5 μ m.



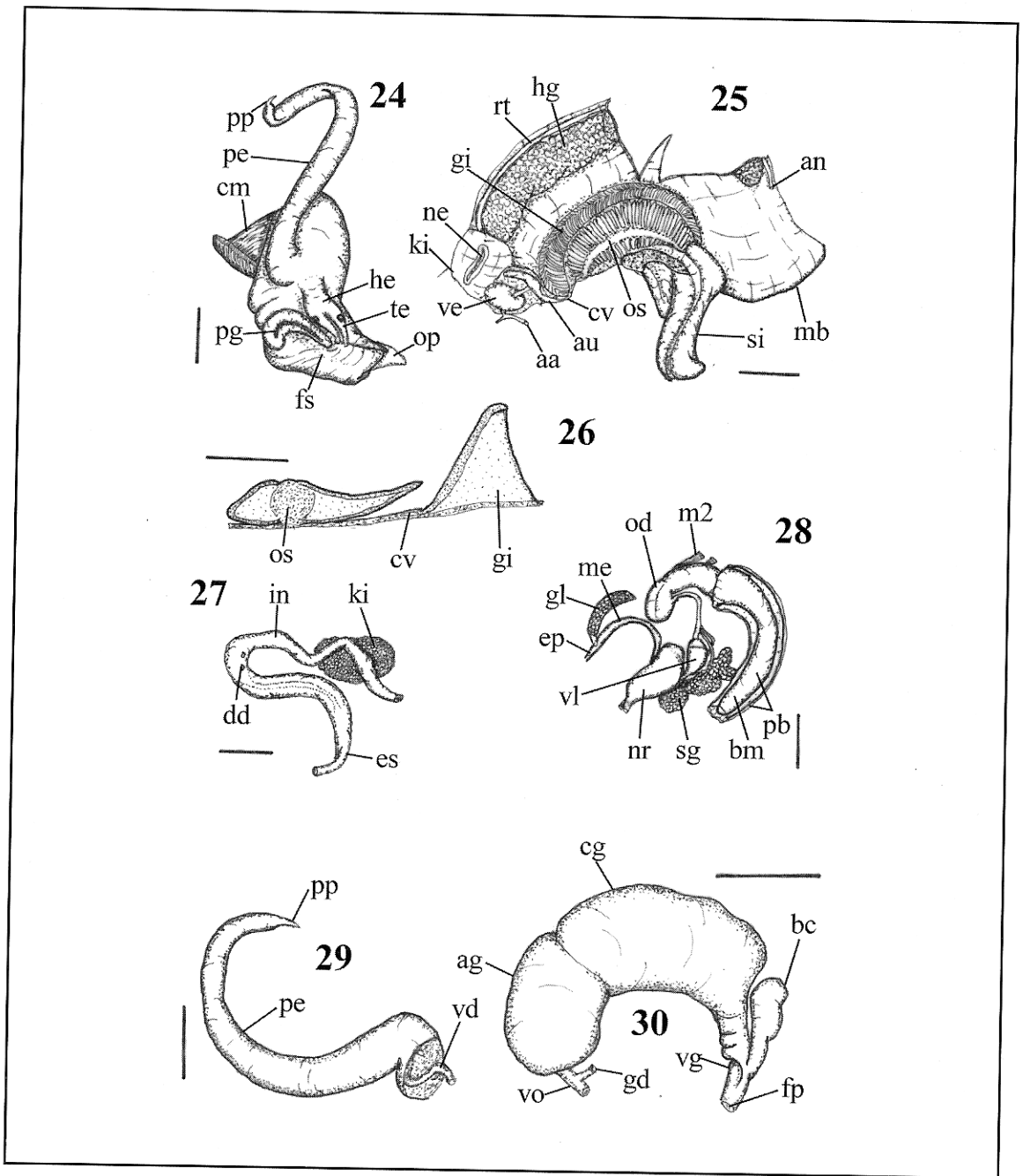
FIGS. 11-12, *Amphissa cancellata radula*, SEM: 11, scale = 20 μ m; 12, detail of lateral teeth, scale = 5 μ m.



FIGS. 13-17, *Amphissa acuminata* anatomy: 13, bead-foot, male, frontal view; 14, pallial cavity hoof and anterior portion of visceral mass, ventral view; 15, detail of a gill filament; 16, foregut, ventral view, esophagus extended; 17, operculum. Scales = 1 mm, except fig. 15 = 0.5 mm.



FIGS. 18-23, *Amphissa acuminata* anatomy: 18, proboscis opened longitudinally, lateral-left view; 19, odontophore, lateral-left view, outer surface of membrane and muscles removed, most structures deflected; 20, odontophore cartilages, lateral-left view, some muscle insertion also shown; 21, midgut, ventral view as in situ, renal portion also shown; 22, male genital system, whole ventral view; 23, pallial oviduct of female, detail of its anterior portion. Scales = 1 mm.



FIGS. 24-30, *Amphissa cancellata* anatomy: 24, head-foot, male, frontal view; 25, pallial cavity roof and anterior portion of visceral mass, ventral view; 26, pallial cavity roof, transversal section in middle level of ospbradium; 27, midgut, ventral view as in situ, renal portion also shown; 28, foregut, ventral view, esophagus extended; 29 penis, extracted, ventral view; 30, pallial oviduct, female, ventral view. Scales = 1 mm, except fig. 26 = 0.5 mm.