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Comparative pleopod morphology of eleven species of parasitic isopods from Brazilian fish

by

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Abstract

The pleopod morphology of eleven species of parasitic isopods from Brazilian fish was compared. Ten species of Cymothoidae were studied, as follows: *Asotana magnifica* THATCHER, 1988; *Artystone minima* THATCHER & CARVALHO, 1988; *Braga cichlae* SCHIÖDTE & MEINERT, 1881; *Braga nasuta* SCHIÖDTE & MEINERT, 1881; *Braga patagonica* SCHIÖDTE & MEINERT, 1884; *Braga* spp. 1 & 2; *Riggia brasiliensis* SZIDAT & SCHUBART, 1960; *Telotha henselii* (VON MARTENS, 1869); and *Nerocila orbignyi* (GUERIN-MENEVILLE, 1832). All of these species are from freshwater in the Brazilian Amazon except for *N. orbignyi* which is marine. The pleopods of *Excorallana berbicensis* BOONE, 1918, a freshwater representative of the family Excorallanidae, were also studied. The pleopods of the cymothoid species are individually characterized. Pleopod morphology is shown to be useful in defining species and genera. The evolution of the "appendix masculinum" from a reproductive structure to an accessory gill is also indicated.

Keywords: **Isopod, cymothoid, fish parasite, Brazil, pleopods.**

Resumo

A morfologia dos pleópodos de onze espécies de isópodos parasitos, procedentes de peixes brasileiros, foi comparada. Dez espécies de Cymothoidae foram estudadas, a saber: *Asotana magnifica* THATCHER, 1988; *Artystone minima* THATCHER & CARVALHO, 1988; *Braga cichlae* SCHIÖDTE & MEINERT, 1881; *Braga nasuta* SCHIÖDTE & MEINERT, 1884; *Braga* spp. 1 & 2; *Riggia brasiliensis* SZIDAT & SCHUBART, 1960; *Telotha henselii* (VON MARTENS, 1869); and *Nerocila orbignyi* (GUERIN-MENEVILLE, 1832). Todas estas espécies são de água doce menos *N. orbignyi* que é marinha. Os pleópodos de *Excorallana berbicensis* BOONE, 1918, uma representante de água doce da família Excorallanidae também foram estudados. Os pleópodos das várias espécies de cymotoídeos são individualmente caracterizados. Está demostrado que a morfologia dos pleópodos poderia ser usada para definir espécies e gêneros. A evolução do apêndice masculino, de uma estrutura reprodutiva, até formar uma brânquia acessória é indicada.

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The pleopods are paired, biramous abdominal appendages found in some of the higher Crustacea. These structures are frequently fringed with setae and serve a natatory function. In cymothoid isopods, the pleopods are greatly flattened and expanded and lack setae. According to BRUSCA (1981), these structures are used mainly for respiration. Additionally, the first two pairs of pleopods in the male may aid in the transfer of spermatophores to the female.

Several recent papers, especially BRUSCA (1981) and BRUCE (1990), have emphasized the importance of pleopod morphology in the systematics of the group. Most of the older publications, however, either did not mention pleopods or figured only the second pleopod of the male since it bears a so called "appendix masculinum" on the medial margin of the endopod. Details on the pleopod morphology of South American cymothoids are almost completely lacking. The present study proposes to help fill this knowledge gap and cast some light on the systematics of the family.

Material and methods

All of the isopod specimens studied came from the Crustacea Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA) of Manaus, Amazonas, Brazil. Specimens studied were: *Asotana magnifica* THATCHER, 1988, from *Serrasalmus* sp.; *Artystone minima* THATCHER & CARVALHO, 1988, from *Nannostomus beckfordi* GUENTHER; *Braga cichlae* SCHIÖDTE & MEINERT, 1881, from *Cichla temensis* HUMBOLDT; *Braga nasuta* SCHIÖDTE & MEINERT, 1881, from *Cichla ocellaris* SCHNEIDER; *Braga patagonica* SCHIÖDTE & MEINERT, 1884, from *Colossoma macropomum* CUVIER; *Braga* spp. 1 & 2 from *Cichla ocellaris*; *Riggia brasiliensis* SZIDAT & SCHUBART, 1960, from *Pseudoplatystoma* sp.; *Telotha henselii* (VON MARTENS, 1869) from *Mylesinus pauscisquamatus* JÉGU & DOS SANTOS; *Nerocila orbignyi* (GUERIN-MENEVILLE, 1832) from a marine fish (*Prionotus* sp.) and *Excorallana berbicensis* BOONE, 1918, (Excorallanidae) from *Ageneiosus brevifilis* VALENCIENNES.

Pleopods were removed with needles and forceps while working under a dissecting microscope. Permanent slides were made of these structures by means of the phenol-balsam method explained in THATCHER & CARVALHO (1988). Drawings were made with the aid of a compound microscope equipped with a drawing tube, or by microprojection. All figures represent the anterior (= ventral) faces of right pleopods. Scale bars indicate sizes of either 1, 2 or 5 millimeters (mm).

Results and discussion

The cymothoid pleopod consists of a base (or peduncle) upon which are mounted the plate-like exopod and endopod. These structures overlap each other with the exopod being the more anterior (or ventral). The pleopods of these parasitic isopods function as gills and in many species, the lamellae bear expanded lobes or accessory lamellae. BRUSCA (1981) pointed out that some cymothoids have accessory lamellae as large as or larger than the exopod or endopod. As an example, he mentions the trilaminate pleopods of *Cymothoa exigua* SCHIÖDTE & MEINERT, 1884.

Pleopod 1 (Figs. 1-9, 41 & 43)

In all species studied, the first pleopods consisted of large lamellar exopods covering smaller lamellar endopods. Some species showed from 1-5 medial spines on the base. Most had lateral peduncular lobes and endopods with proximomedial lobes (Fig. 9).

Pleopod 2 (Figs. 10-18, 39, 42 & 44)

Second pleopods in many male isopods bear elongate medial structures used to transfer spermatophores to the female (Fig. 39). The endopod of either side bears one of these digitiform processes and each is termed "an appendix masculinum." According to BRUSCA (1981) the appendix masculinum is reduced in cymothoids and may have lost its reproductive function.

A fully functional appendix masculinum can be seen on the second pleopod of the male of *Excorallana berbicensis* (Fig. 39). This structure may still have a reproductive function in the male of *Nerocila orbignyi* (Fig. 10). In males of *Artystone minima* (Fig. 11) and *Braga nasuta* (Fig. 15), however, the appendix masculinum is reduced, flattened and gill-like.

The appendix masculinum persists as a modified accessory gill on the pleopods of many cymothoid females. In *Asotana magnifica* (Fig. 12), *Telotha henselii* (Fig. 13) and *Riggia brasiliensis* (Fig. 14) these accessory gills evolved from the male appendix masculinum are nearly as large as the endopods.

Second pleopods of *Braga* spp. were found to be different from those of other genera (Figs. 15-18, 42 & 44). In this genus, there is a large lamellar accessory gill anterior (or ventral) to the exopod. Since the endopodal accessory gill (apparently derived from the appendix masculinum) is also large, these pleopods are effectively quadrilaminate.

Pleopods 3-5 (Figs. 19-37)

Pleopods 3, 4 & 5 were found to be relatively simple structures in most of the species studied. All gradually decreased in size from 3 to 5, except for the male of *Artystone minima* in which the reverse was true.

In the species examined, the endopod was found to be smaller than the exopod, except for pleopods 1 & 5 of *Nerocila orbignyi* (Figs. 1 & 21). In this species, pleopod 1 has an endopod that is slightly larger and more elongate than the exopod. Also, pleopod 5 has an endopod with an extensive folded accessory gill area.

The species of *Braga* were found to differ from the other genera in that pleopods 3-5 all had lamellar accessory gills anterior to the eopods. Species of this genus, therefore, have bilaminate pleopods 1, quadrilaminate pleopods 2 (at least in females) and trilaminate pleopods 3-5.

The pleopods studied may be described and characterized as follows:

***Nerocila orbignyi* (GUERIN-MENEVILLE, 1832), (♀)**

This marine species is world-wide in distribution. It was redescribed by BRUCE (1987) who stated, as follows: "Pleopod 2 appendix masculinum about 0.5 length of endopod; pleopod 5 with 2 large folds." The present study verified this definition.

***Artystone minima* THATCHER & CARVALHO, 1988, (♂)**

Pleopods simple, lamellar; bluntly rounded distally; pleopods 1 & 2 elongate, 3-5

ovoid; 1 & 2 larger, 3-5 smaller, with 5 larger than 3; all endopods smaller than exopods (about 0.5 to 0.7 times as long). Appendix masculinum flattened, gill-like.

***Asotana magnifica* THATCHER, 1988, (♀)**

Pleopods lamellar, progressively smaller from 1 to 5; all provided with small lateral peduncular lobes and proximomedial endopodal lobes; appendix masculinum of pleopod 2 modified to form accessory gill, nearly as large as endopod. All pleopods bluntly rounded distally; 1-3 elongate, 4-5 subspherical in outline.

***Telotha henselii* (VON MARTENS, 1869), (♀)**

Pleopods lamellar, elongate, tapering; appendix masculinum modified to form accessory gill which is nearly as large as endopod: lateral peduncular lobes and proximomedial lobes present; pleopod 3 with proximolateral lobe on exopod.

***Riggia brasiliensis* SZIDAT & SCHUBART, 1960, (♀)**

Pleopods lamellar, elongate, tapering; appendix masculinum modified to form accessory gill which is nearly as large as endopod; lateral peduncular lobes and proximomedial lobes present.

***Braga nasuta* SCHIÖDTE & MEINERT, 1881**

(♂): Pleopods short, rounded; appendix masculinum flattened, tapering; small lateral peduncular and proximomedial lobes present on all pleopods; anterior accessory gill lamellae present on pleopods 2-5 (pleopod 1 bilaminate, 2-5 trilaminate).

(♀): Pleopods similar to those of male but appendix masculinum modified to form accessory gill (pleopod 1 bilaminate, 2 quadrilaminate and 3-5 trilaminate).

***Braga patagonica* SCHIÖDTE & MEINERT, 1884, (♀)**

Pleopods lamellar, short, subcircular in outline; appendix masculinum elongate, large, gill-like; pleopods 2-5 provided with accessory gills; (pleopod 1 bilaminate, 2 quadrilaminate and 3-5 trilaminate); all pleopods with small, lateral peduncular and proximomedial lobes.

***Braga cichlae* SCHIÖDTE & MEINERT, 1881, (♀)**

Pleopods similar to those of *B. patagonica* but oval in outline (wider than long); appendix masculinum rounded.

***Braga* spp. (♀), (Figs. 41-44)**

Two apparently undescribed species of *Braga* were studied. Pleopods similar to those of *B. cichlae* but with greatly expanded exopods. One of these species also has a large and complex proximomedial lobe.

***Excorallana berbicensis* BOONE, 1918, (♂), (Excorallanidae; Figs. 38-40)**

Pleopods lamellar, elongate to subcircular in outline, trimmed with setae; appendix masculinum elongate, longer than endopod and exopod, slender, cylindrical.

Conclusion

We may conclude from this study that the pleopods are indeed useful for taxonomic purposes, as BRUSCA (1981) affirmed. Differences such as overall shape and the presence or form of lateral peduncular and proximomedial lobes may be good species characters. Major differences in shape and the presence or absence of accessory gill lamellae may be useful in defining genera.

Pleopod morphology may also be indicative of either phylogenetic or ecologic relationships. It would appear that *Telotha henselii* (Figs. 4 & 13), which inhabits the gill chamber of its host, may be phylogenetically related to *Riggia brasiliensis* (Figs. 5 & 14), which penetrates into the host's body cavity.

It may also be concluded that BRUSCA (1981) was correct in stating that the appendix maxulinum in cymothoids has lost its reproductive function and evolved into a respiratory structure. Figures 10-16 clearly show some of the stages in this process.

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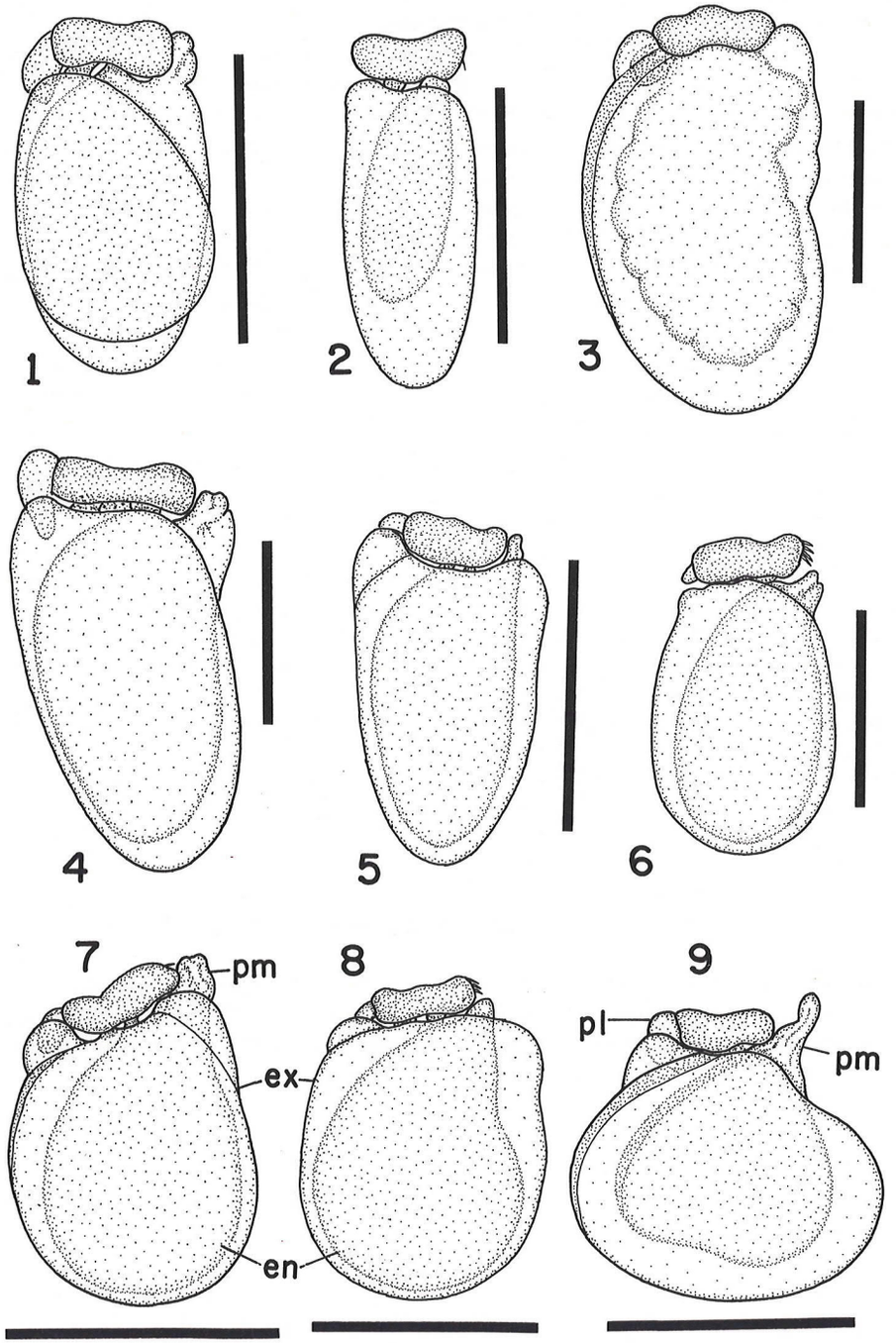
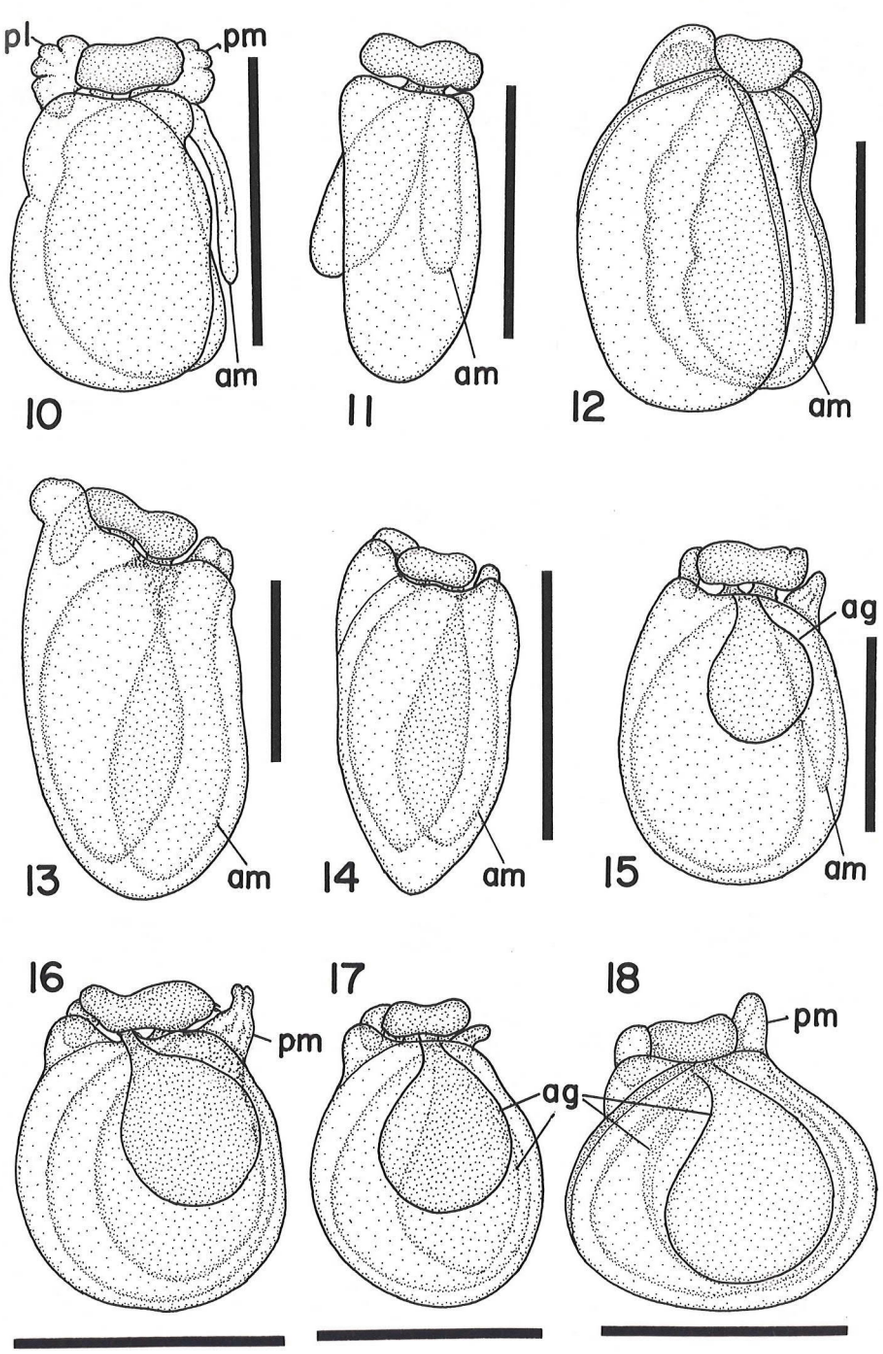
Explanations to figures 1-44

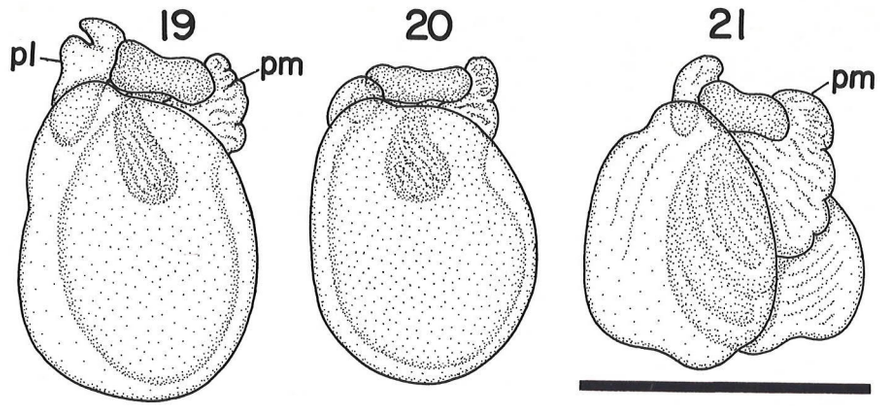
Right pleopods (ventral aspect) of parasitic isopods from Brazil. Abreviations used: **ag** = accessory gill lamella; **am** = appendix masculinum; **en** = endopod; **ex** = exopod; **pl** = lateral peduncular lobe; **pm** = proximomedial lobe of endopod. Scale bars = 1 mm on figures 2, 11, 22-24 & 38-40; = 2 mm on figures 4, 6, 13, 15, 28-30 & 37; = 5 mm on all other figures.

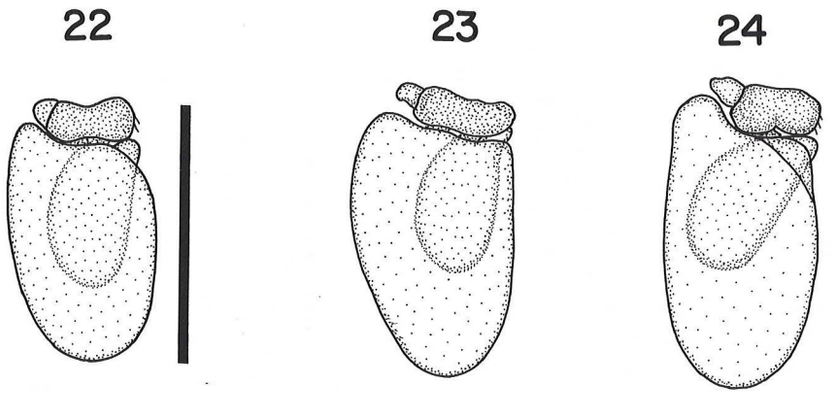


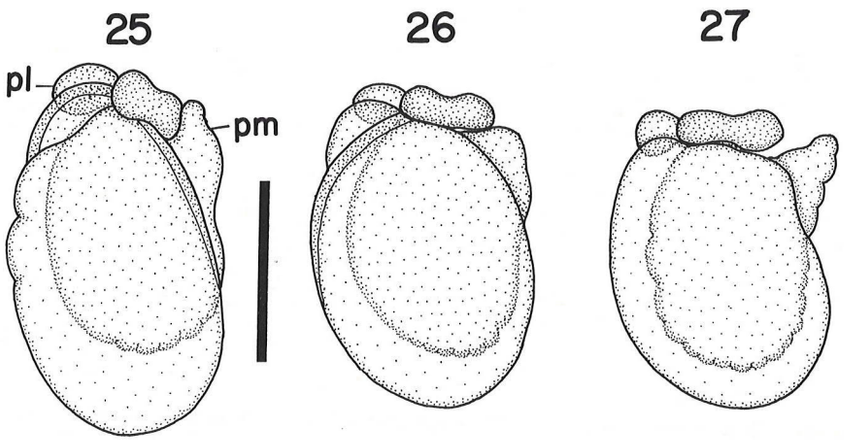
Figs. 1-9:
Pleopods 1 of: **1**: *Nerocila orbignyi* (♀); **2**: *Artystone minima* (♂); **3**: *Asotana magnifica* (♀); **4**: *Telotha henselii* (♀); **5**: *Riggia brasiliensis* (♀); **6**: *Braga nasuta* (♂); **7**: *Braga nasuta* (♀); **8**: *Braga patagonica* (♀); **9**: *Braga cichlae* (♀).



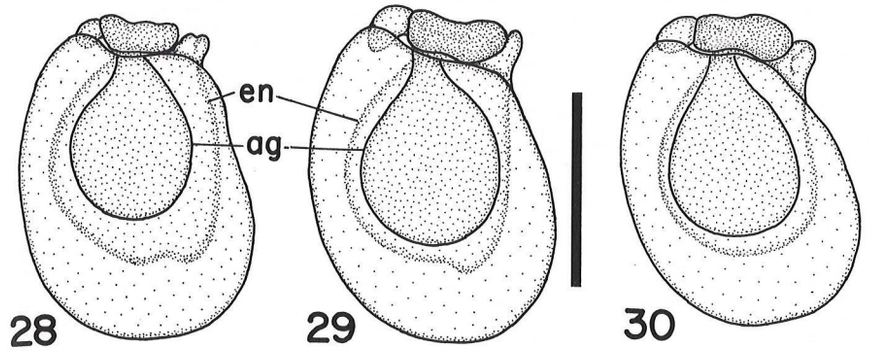
Figs. 10-18:
Pleopods 2 of: **10**: *Nerocila orbignyi* (♀); **11**: *Artystone minima* (♂); **12**: *Asotana magnifica* (♀); **13**: *Telotha henselii* (♀); **14**: *Riggia brasiliensis* (♀); **15**: *Braga nasuta* (♂); **16** *Braga cichlae* (♀); **17**: *Braga patagonica* (♀); **18**: *Braga cichlae* (♀).

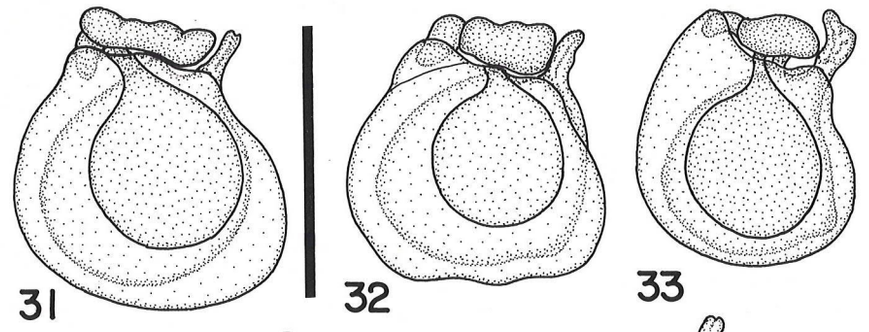


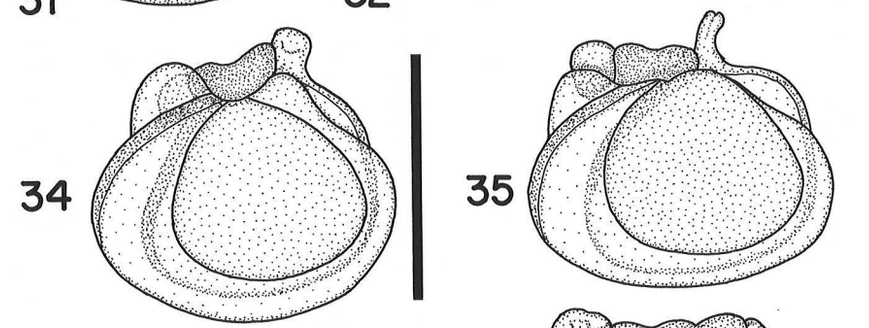


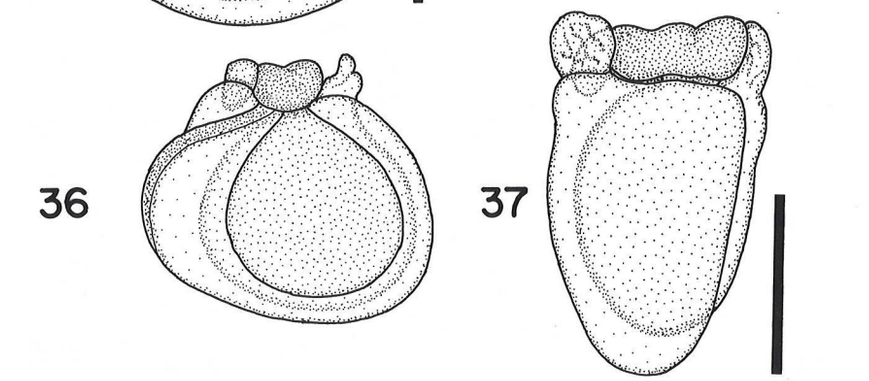


Figs. 19-27:
Pleopods 3-5 of: **19-21**: *Nerocila orbignyi* (♀); **22-24**: *Artystone minima* (♂); **25-27**: *Asotana magnifica* (♀).

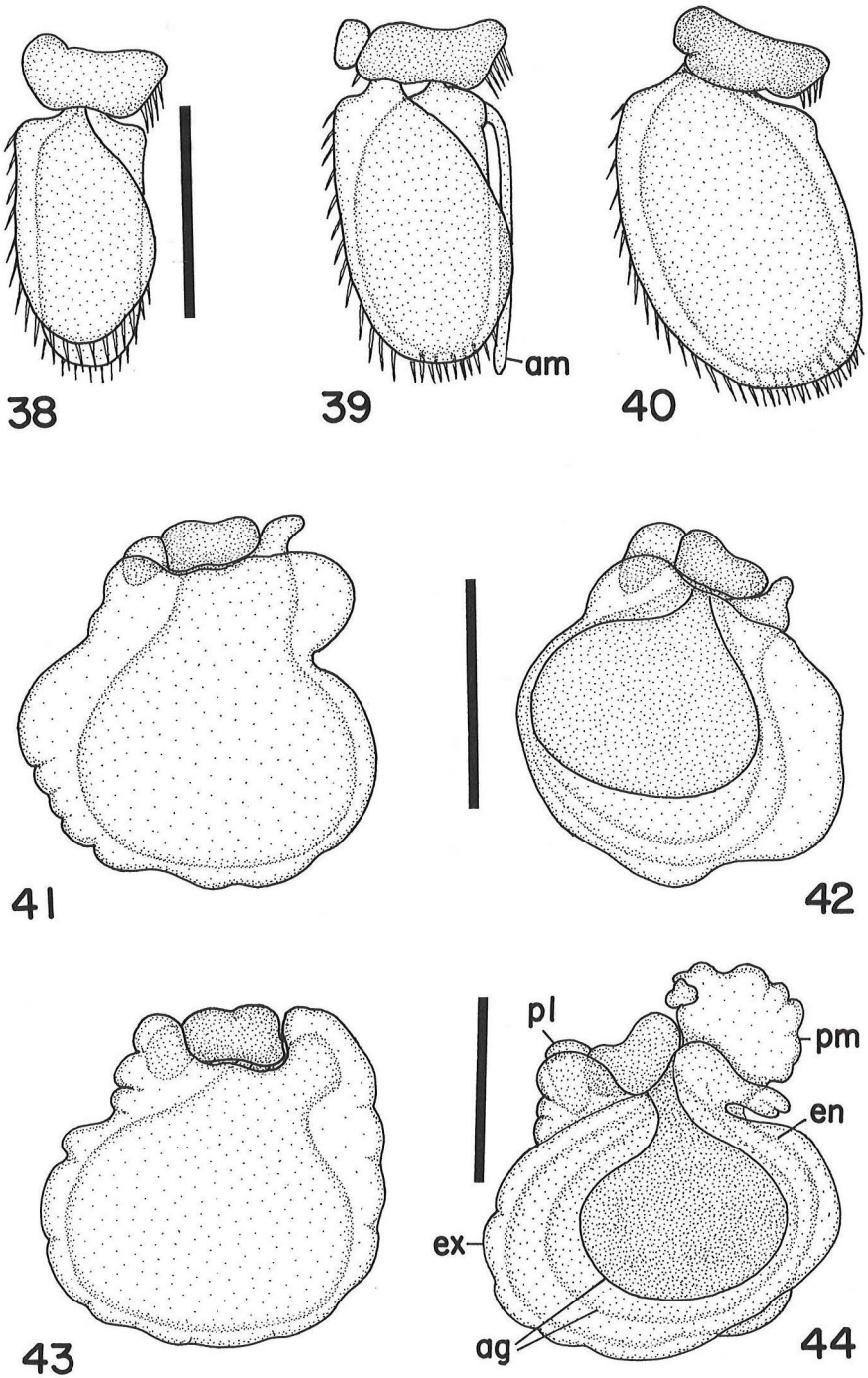








Figs. 28-37:
28-36: Pleopods 3-5 of: **28-30**: *Braga nasuta* (♂); **31-33**: *Braga nasuta* (♀); **34-36**: *Braga cichlae* (♀); **37**: Pleopod 3 of: *Telotha henselii* (♀).



Figs. 38-44:
38-40: Pleopods 1-3 of: *Excorallana berbicensis* (♂); **41-42**: Pleopods 1 & 2 of: *Braga* sp. 1 (♀); **43-44**: Pleopods 1 & 2 of: *Braga* sp. 2 (♀).