Ann. Naturhist. Mus. Wien	101 B	475 - 488	Wien, Dezember 1999

On two alpheids from Araçá (São Paulo, Brazil) with a description of a new species of *Leptalpheus* (Decapoda: Caridea: Alpheidae)

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Abstract

Sampling for infaunal decapods from a tidal flat at Praia do Araçá (São Sebastião, São Paulo) has yielded two members of the family Alpheidae, one representing a new species of the genus *Leptalpheus* WILLIAMS, 1965. *Leptalpheus axianassae* sp.n. is described from sixteen specimens taken from burrows of the thalassinid *Axianassa australis* RODRIGUES & SHIMIZU 1992 with which it is associated. The second species, *Automate evermanni* RATHBUN, 1901 was also collected with a yabby pump at this tidal flat, but never together with the thalassinid.

Key words: *Leptalpheus*, new species, *Automate evermanni*, *Axianassa australis*, Brazil, tidal flat, association.

Zusammenfassung

Beim Aufsammeln grabender Krebse in einem Gezeitenwatt bei Araçá (São Sebastião, São Paulo) wurden mehrere Alpheiden gefangen. Eine erwies sich als neue Art der Gattung *Leptalpheus* WILLIAMS, 1965. *Leptalpheus axianassae* sp.n. wird anhand von 16 Exemplaren beschrieben. Diese Art lebt in den Bauten des Maulwurfskrebses *Axianassa australis* RODRIGUES & SHIMIZU 1992. Die zweite Art, *Automate evermanni* RATHBUN, 1901, wurde ebenfalls mit einer Saugpumpe gefangen, jedoch nie gemeinsam mit dem Maulwurfskrebs.

Introduction

Alpheid shrimp are mainly cryptic and can be found in a variety of habitats. Many species live under stones, between dead or living corals (BANNER & BANNER 1975, 1982) or associated with other invertebrates such as sponges (BANNER & BANNER 1975, DUFFY 1992, 1996), anemones (KNOWLTON 1980), crinoids (VAN DEN SPIEGEL 1998) or sea urchins (BANNER & BANNER 1973, GHERARDI 1991). A few species bore in living corals (KROPP 1987) or even in hard basaltic rock (HOLTHUIS 1980, FISCHER 1981). Other species construct burrows in soft bottoms (BANNER & BANNER 1982, DWORSCHAK & OTT 1993) and gobiid fish are often associated with these shrimps (KARPLUS 1987). Other alpheids have been found living in burrows of echiurids (BERGGREN 1991) or stomatopods (FROGLIA & ATKINSON 1998).

Thalassinidean shrimp are also cryptic crustaceans, the majority living in burrows excavated in soft sediments. Several species of alpheid shrimp were found associated with

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thalassinideans. COUTIÈRE (1899) found *Amphibetaeus jousseaumei* (COUTIÈRE, 1896) in *Callianassa mucronata* STRAHL, 1861 burrows. HART (1964) reported *Betaeus harrimani* RATHBUN, 1904, *B. longidactylus* LOCKINGTON, 1877, and *B. ensenandensis* GLASSELL, 1938, occurring in burrows of the upogebiid *Upogebia pugettensis* (DANA, 1852) or the callianassid *Neotrypaea* (as *Callianassa*) *californiensis* (DANA, 1854) in California. *Leptalpheus forceps* WILLIAMS, 1965 has been described living in association with the upogebiids *Upogebia affinis* (SAY, 1818) (WILLIAMS 1965, SALOMAN 1971) and has also been found in burrows of the callianassids *Lepidophthalmus louisianensis* (SCHMITT, 1935) (DAWSON 1967, FELDER & RODRIGUES 1993), *Neocallichirus grandimana* (GIBBES, 1850) (Dworschak, pers. obs.). In Brazil, it was collected together with *Lepidophthalmus siriboia* FELDER & RODRIGUES, 1993 (as *Callianassa jamaicensis* SCHMITT, 1935; CHRISTOFFERSEN 1980, M. Christoffersen, pers. comm. 1999). The second species, *L. mexicanus* RÍOS & CARVACHO, 1983, was described from the Pacific coast of Mexico and occurs in burrows of *Upogebia dawsoni* WILLIAMS, 1986 (RÍOS & CARVACHO 1983, RÍOS 1992, CAMPOS & al. 1995). The third species, *L. pacificus* BANNER & BANNER, 1974, from Hawaii, lives probably in callianassid burrows (BANNER & BANNER 1974). FELDER & MANNING (1997a) reported an undescribed species of *Leptalpheus* collected together with *Lepidophthalmus richardi* FELDER & MANNING, 1997, in Belize. *Fenneralpheus chacei* MANNING & FELDER, 1986, is probably associated with thalassinids or stomatopods as well (FELDER & MANNING 1986). Recently, *Chelomalpheus koreanus* KIM, 1998 (as *Cavipelta yamashitai* HAYASHI, 1998) was collected from burrows of *Upogebia major* (DE HAAN, 1839) or *Nihonotrypaea* (as *Callianassa*) *japonica* (ORTMANN, 1891) (HAYASHI 1998).

During a study on the biology of the thalassinidean shrimp *Axianassa australis* RODRIGUES & SHIMIZU, 1992 (Laomediidae), at Praia do Araçá we found two species of alpheids, *Automate evermanni* and an undescribed species of *Leptalpheus*, when trying to capture the thalassinid shrimp. The present paper provides a complete description of the new species and notes on the occurrence of both alpheids in that region.

Abbreviations

MZUSP: Museu de Zoologia, Universidade de São Paulo, Brazil

NHMW: Naturhistorisches Museum in Wien, Austria

RMNH: Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands

USNM: National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.

Material and Methods

The study site is a tidal flat at Praia do Araçá, São Sebastião, São Paulo. The sediment surface is characterized by low mounds in densities of up to 8 m^{-2} which represent the burrow openings of the thalassinid shrimp *Axianassa australis* RODRIGUES & SHIMIZU, 1992 (see DWORSCHAK & RODRIGUES 1997). Shrimps were captured using a yabby pump. In April 1994, thalassinds and alpheids were captured haphazardly. In August 1998, over two days, 34 burrows of *Axianassa* were sampled systematically, and the number of thalassinids and alpheid shrimps obtained noted. Animals were fixed in buffered seawater-formaldehyde and later transferred into 70% ethanol.

Measurements are given in mm as carapace length (CL) from the tip of the rostrum to the posterior margin of the carapace.

Results

Leptalpheus axianassae sp.n.
(Figs. 1-30)

Holotype: NHMW 18342, 1 ovigerous female, Praia do Araçá, São Sebastião, São Paulo, Brazil, V.R. Coelho & S.de A. Rodrigues coll. 8 August 1998.

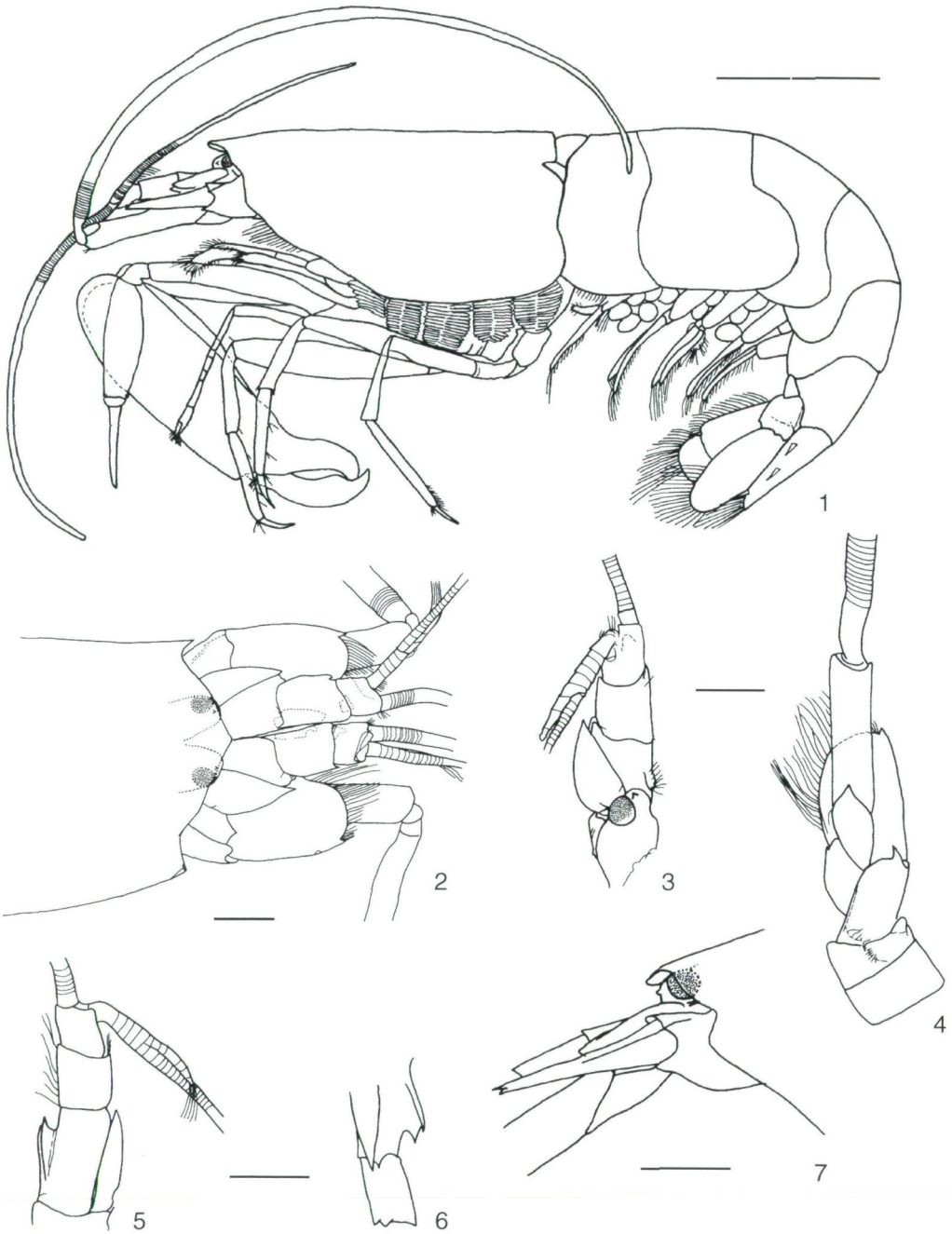
Paratypes: NHMW 18343, 1 male (dissected); NHMW 18344, 1 male 3 females; NHMW 18345, 1 male, 1 female; same data as holotype. – USNM 291170, 1 male; USNM 291169, 1 female; MZUSP 13010, 1 male, 1 female; NHMW 18346, 1 male, 1 female (collected as pair); RMNH D 48028, 1 male; RMNH D 48029, 1 female; Praia do Araçá, São Sebastião, São Paulo, Brazil, V.R. Coelho & S.de A. Rodrigues coll. 9 August 1998.

Description: Carapace with smooth front, lacking rostrum, obtusely triangular, produced into hood projecting over eyes reaching approximately to middle of first segment of antennular peduncle. Pterygostomial angle rounded; a well developed cardiac notch present on posterior border. Eyes almost completely covered by carapace in dorsal view, but visible from anterior and in lateral view; eyestalks with thickened basis, as broad as antennal peduncle near basis, well-developed cornea on anterolateral margin, small tubercle mesially to cornea.

Antennular peduncles stout, somewhat broader proximally than distally; first article longest, second article half length of first, third article as long as second; basal and second article each with prominent but appressed tooth at anterolateral corner. Stylocerite acute distally, slightly overreaching basal article, mesially with prominent, thin mesioventral keel terminating anteriorly in a small tooth. Outer flagellum shorter than inner one, thickened for 5 segments proximal to bifurcation.

Antennal peduncle longer than antennular peduncle. Basicerite with acute tooth on inferior margin. Scaphocerite 1.5 times as long as broad, reaching to middle of carpocerite; latter with outer margin almost straight; mesial and distal margin broadly rounded; lateral spine slightly overreaching lamella; flagellum more than twice as long as carapace.

Mouthparts as illustrated. Mandible with incisor process armed with 6 teeth; molar process well developed, palp 2-segmented. First maxilla with upper endite broad, bearing spinules on distolateral margin; endopod bilobed, subterminal lobe bearing long seta, terminal lobe bearing short seta. Second maxilla with upper endite broad, bilobed, and edged with setae; lower endite small, with setae only on upper margin; scaphognathite well developed; endopod (palp) small. All maxillipeds with well-developed exopod. First maxilliped with bilobed endite, bearing row of setae on marginal region; exopod with well developed caridean lobe; endopod slender, with one long seta on distal edge and shorter setae on mesial margin; epipod broad. Second maxilliped of typical caridean shape with elongated epipod. Third maxilliped reaching to proximal third of carpocerite; ultimate segment of endopod with transverse rows of plumose setae becoming progressively longer distally; strap-like epipod and well developed arthrobranch present; lateral plate enlarged and acute.



Figs 1-7: *Leptalpheus axianassae* sp.n. 1: Holotype NHMW 18342, ovigerous female, CL = 8.4 mm; 2-6: Paratype, NHMW 18343, dissected male, CL = 8.0 mm. 2: dorsal aspect of front; 3: dorsal aspect of left antennular peduncle and eye; 4: ventral aspect of left antennal peduncle; 5: ventral aspect of left antennular peduncle; 6: lateral aspect of left antennular peduncle. 7: Paratype NHMW 18345 female, CL = 9.0, lateral aspect of front. Scales are 5 mm in 1 and 1 mm in 2-7.

First pereiopods strongly unequal, carried beneath cephalothorax with chelae flexed against meri; right pereiopod larger in female holotype, for other paratypes see Table 1.

Major cheliped with propodus longer than merus, round, deeply excavated ventrally to accomodate merus; palm more than twice as long as broad; fingers slightly curved in direction of chela flexure, slightly gaping. Fixed finger with proximal margins laterally produced into crests, forming sharp tooth proximally on inner margin; distally strongly curved towards dactylus, tip flat with a weak incision. Dactylus slightly curved; distal inner margin convex accomodating fixed finger tip; distal part overreaching distal edge of fixed finger. Kidney-shaped adhesive plaques on opposing faces of the superior surface of the dactylus and distal border of palm. Carpus very small, cup-shaped, less than half as long as fingers. Merus shorter than palm, slender, smooth, elliptical in cross-section with flattened face to accomodate chela, distal section slightly thicker than proximal. Carpus reaching to end of antennular peduncle, fixed finger reaching to coxa of fourth pereiopod in flexed posture.

Minor cheliped much different in shape and size from larger opposite member. Propodus slightly longer than merus, 2.5 times as long as broad, rounded in cross-section. Fingers 0.75 times length of propodus, straight in direction of chela flexure, slightly curved in lateral aspect, not gaping. Cutting edge of fixed finger with row of small teeth (12) which become larger distally, largest tooth marking distal toothless third. Opposable margin of dactylus with 6 teeth in the middle third, largest tooth distally, distal third toothless, tips crossed when closed. Carpus short, being about one third length of fingers. Merus slightly curved, elliptical in cross-section, flexor surface flattened, proximally excavate.

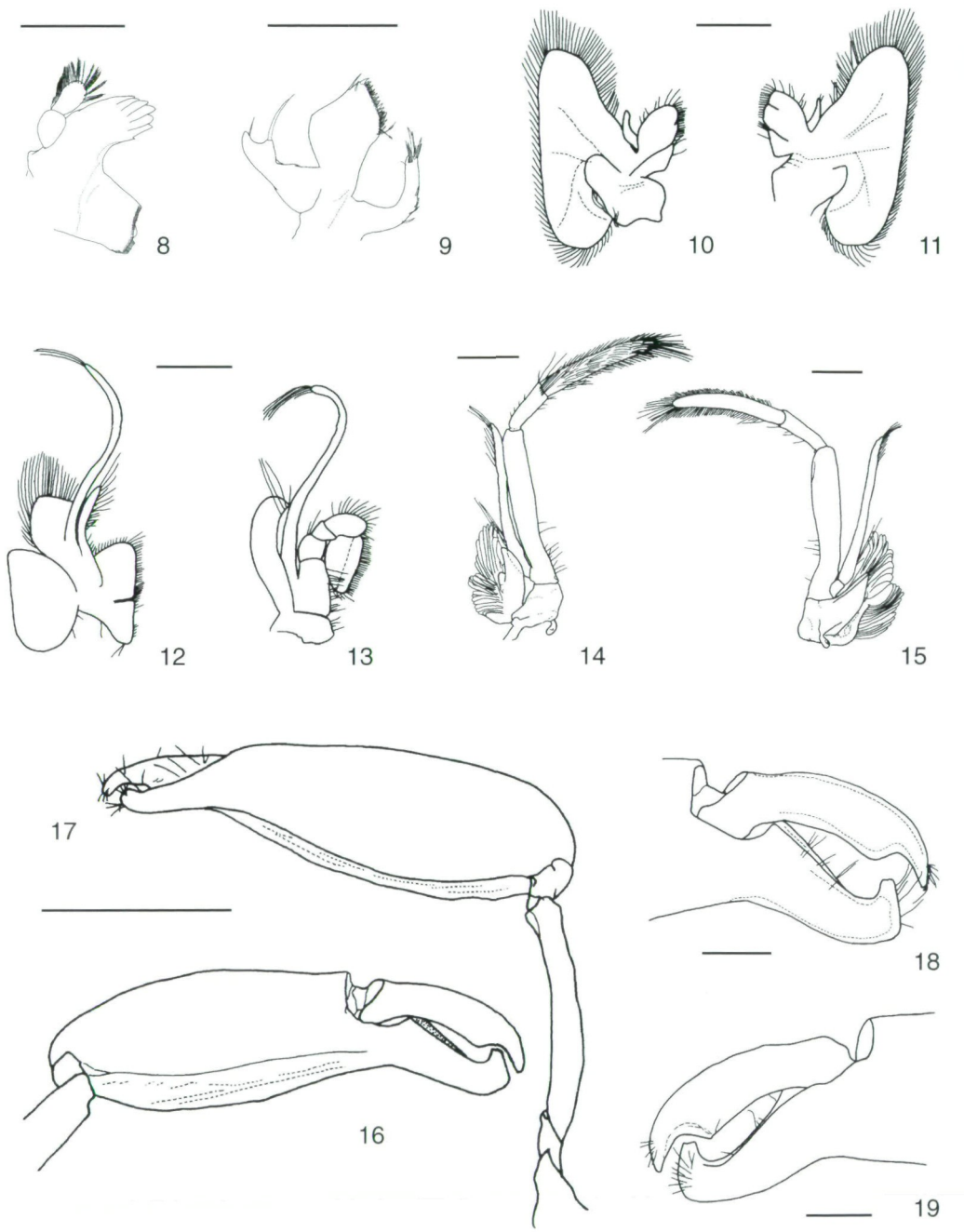
Second pereiopods equal, each distinctly smaller than third and fourth, slightly smaller than fifth. Chela with fingers shorter than palm, fixed and movable fingers with loose brushes of setae on distal half. Carpus 2.5 times as long as chela, subdivided into 5 articles, middle 3 shortest, proximal longest, longer than middle three articles combined, and almost twice length of distal article; extensor margin of proximal article with sharp bend. Merus almost as long as entire carpus and distincly longer than ischium.

Third pereiopods strong, slightly longer than fourth. Ischium without spine, about half as long as merus. Merus unarmed, 5.6 times as long as broad; carpus about half length of merus, with two movable spines distally on flexor margin near propodus. Propodus slightly longer than carpus, with two movable spines at distal end proximal to dactylus and 2 to 4 movable spines along flexor margin. Dactylus 0.4 times as long as propodus, simple, slightly curved.

Fourth pereiopods similar to third, slightly shorter. Except for shorter merus, proportions of articles and armature as in third pereiopod.

Fifth pereiopods slightly smaller than third or fourth and sligthtly heavier than second. Dactylus simple, curved, propodus longer than carpus, flexor margin with transverse or oblique rows of setae distally, distal rows longest. Carpus shorter than propodus, merus longer than carpus.

Abdomen smooth. Pleura of 6th abdominal somite with triangular articulated plate. Both sexes with endopod of first pleopod less than half as long as exopod, lacking appendix. Both sexes with appendix interna on endopodites of pleopods 2-5. Males with



Figs 8-19: *Leptalpheus axianassae* sp.n., paratype NHMW 18343, dissected male. (8): left mandible inner face; (9): left first maxilla inner face; left second maxilla (10) inner face and (11) outer face; 12: left first maxilliped; 13: left second maxilliped; third maxilliped (14) outer face and (15) inner face; right major cheliped in (16) lateroventral and (17) lateral view; fingers of major cheliped (18) lateral and (19) mesial aspects. Scale is 5 mm in 16-17 and 1 mm in 8-15 and 18-19.

appendix masculina on endopod of second pleopod, extending well beyond appendix interna.

Uropods with exopod more or less truncated distally, lateral edge broken by an overlapping rectangular cleft armed with strong subterminal spine originating ventrally; inner margin with overlapping pointed lamina; no well-defined suture present. Endopod as long as outer branch, ovate, two times as long as broad.

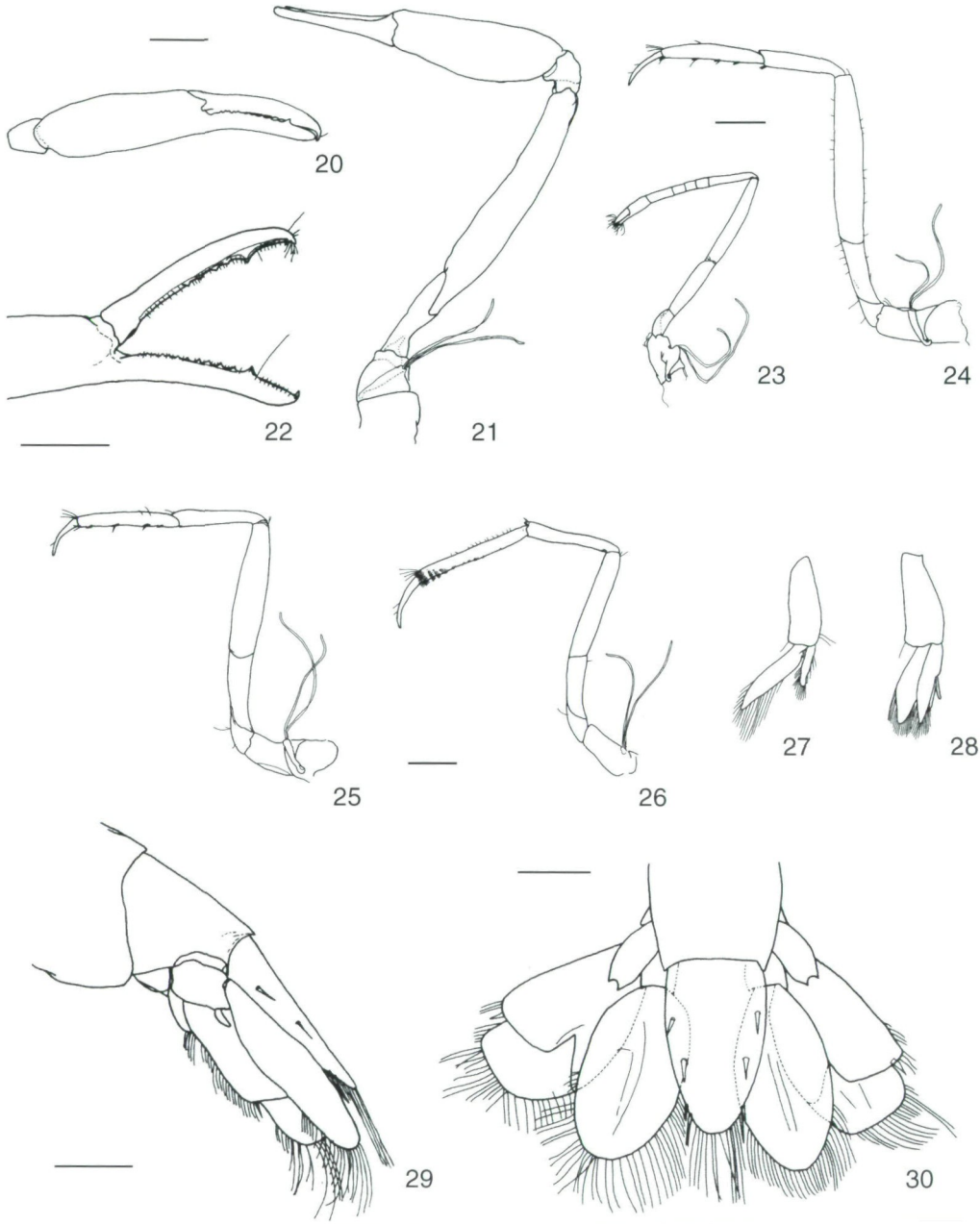
Telson shorter than uropods, rounded distally, armed with two pairs of movable dorsal spines at one-third and two-thirds length, and with movable outer short and adjacent inner long spines at each posterolateral corner.

Size: Carapace length between 6.3 and 9.6 mm, total length approximately between 19 and 30 mm. Eggs measuring 730 × 480 µm. Further measurements are presented in Table 1.

Variations: The shape of the major cheliped is nearly the same in all specimens, beside appendix masculina there is no obvious difference between sexes. The number of spines on the propodus of pereiopods 3 and 4 is variable, but there are always two spines present near the articulation with the dactylus. The number of spines along inferior margin ranges from two to four, it can differ in the same specimen between left and right side. In one specimen, a double spine instead of a single one has been observed at the cleft of the outer uropod of one side.

Table 1: Measurements of *Leptalpheus axianassae* sp.n. specimens. Sex: f: female, fo: ovigerous female, m: male; TL: total length, CL: carapace length; si: side of major cheliped, r: right, l: left; maPL: palm length of major cheliped, maPW; palm width of major cheliped; miPL: palm length of minor cheliped, miPW: palm width of minor cheliped; P3: number of spines on propodus of pereiopod 3; P4: number of spines on propodus of pereiopod 4; na: not available. * = holotype.

Inv. No.	sex	TL	CL	si	maPL	maPW	miPL	miPW	P3	P4
USNM 291169	f	23.8	8.4	r	6.0	2.3	3.0	1.0	2	2
RMNH D 48029	f	29.4	9.6	r	6.8	2.8	3.0	1.1	2-3	2
USNM 291170	m	24.2	8.0	r	6.5	2.5	3.0	1.0	2	2
RMNH D 48028	m	19.0	6.3	r	5.2	1.8	2.3	0.7	2-3	na
MZUSP 13010	f	27.2	9.6	r	7.2	2.9	3.0	1.1	2	2
MZUSP 13010	m	25.2	8.6	r	6.8	2.7	3.4	1.2	2	2
NHMW 18344	m	24.2	9.2	l	7.4	3.3	3.2	1.1	2	2
NHMW 18344	f	22.8	7.6	l	na	na	2.7	0.8	2	2
NHMW 18344	f	20.4	6.6	l	5.5	1.9	2.6	0.9	2	3
NHMW 18342*	fo	26.0	8.4	r	6.0	2.5	2.8	1.0	3	2
NHMW 18344	f	21.6	7.2	l	na	na	2.4	0.7	2-3	2
NHMW 18346	m	25.4	8.4	r	7.0	2.8	3.0	1.0	2	2
NHMW 18346	f	25.4	8.7	r	6.6	2.8	2.5	1.0	2-3	2-3
NHMW 18345	f	26.4	9.0	r	6.0	2.5	2.5	1.0	2	2
NHMW 18343	m	23.2	8.0	r	6.3	2.9	2.8	1.0	2-4	2-4
NHMW 18345	m	20.3	6.3	r	5.0	2.0	2.3	0.8	2	2-3



Figs 20-30: *Leptalpheus axianassae* sp.n., paratype NHMW 18343, dissected male. 20-22: right minor cheliped, 20: palm in ventral view, 21: left first pereiopod lateral aspect, 22: opened fingers in ventral view; left (23) second, (24) third, (25) fourth, and (26) fifth pereiopods; left first (27) and second (28) pleopods; tailfan lateral (29) and dorsal (30) aspect. Scale is 1 mm.

Branchial formula as follows:

	maxillipeds			pereiopods				
	1	2	3	1	2	3	4	5
pleurobranchs				1	1	1	1	1
arthrobranchs			1					
epipods								
setobranchs				2	2	2	2	2
mastigobranchs				1	1	1	1	1
exopods	1	1	1					

Type-locality: Tidal flat at Praia do Araçá, São Sebastião, São Paulo, Brazil

Etymology: The name is derived from the thalassinid shrimp with which it is associated, *Axianassa australis* described by RODRIGUES & SHIMIZU (1992).

Remarks: This Brazilian species is similar to *L. pacificus* BANNER & BANNER in a number of characters such as the rounded frontal margin of the carapace, the rounded pterygostomial angle and the massive major cheliped. It shares also with *L. pacificus* the presence of adhesive plaques at the dactylus/propodus articulation (A. Anker, pers. comm.). However, it can be clearly separated by the lack of the large teeth on the fixed fingers and the length of the antennular peduncle; in *Leptalpheus axianassae* sp.n. A1 peduncle is shorter than A2 peduncle. In *L. forceps* WILLIAMS the A1 peduncles are longer than the A2 peduncles, in *L. pacificus* BANNER & BANNER and *L. mexicanus* RÍOS & CARVACHO, both peduncles are of almost the same length.

Automate evermanni RATHBUN, 1901
Fig. 31

Material: Praia do Araçá, São Sebastião, São Paulo, Brazil: NHMW 18341, 2 specimens (CL 4.6, 4.0), S. de A. Rodrigues & V.R. Coelho coll. 26 April 1994; NHMW 18340, 3 specimens (CL 5.0, 5.2, 4.6), S. de A. Rodrigues coll. 29 April 1994; USNM 291171, 1 specimen (CL 6.0); USNM 291172, 1 specimen (CL 5.2), V.R. Coelho & S.de A. Rodrigues coll. 9 August 1998; NHMW 18342, 2 specimens (CL 5.6, 5.6), V.R. Coelho & S.de A. Rodrigues coll. 8 August 1998.

Additional Material: USNM 23786, 2M, 1F (CL 3.8, 4.4, 4.6), Syntypes, off Aguadilla, Porto Rico, Fish Hawk Sta. 129 (6055), 137 fms, M.J. Rathbun det., Acc.No. 34984; USNM 97609, 1 ovigerous FFF (CL 4.8), 8 mi. or so S offshore of Galveston, Texas, 35 ft of water, R.Z. Allister #54-14, III 52, F.A. Chace, Jr. det. 1955, Acc. No. 204375; USNM 78465, 1 specimen (CL 3.8) and USNM 78466, 3 specimens (CL 2.4, 2.5, 2.6) 1/4 Mi. S.W. Red buoy, E. of Bush Key, Tortugas, Florida, July 8, 1932, W.L. Schmitt (coll. et don. #40), 13 fms, orange-peel bucket, W.L. Schmitt det., Acc. No. 119885.

Remarks: Not mentioned in the original description of RATHBUN (1901) and subsequent accounts (e.g. HOLTHUIS, 1951, CHACE, 1972, WILLIAMS, 1984) are the presence of movable spines on the ischium of pereiopods 3-5. This has already been noticed in the single specimen studied by CHRISTOFFERSEN (1980, pers. comm. 1997). The syntypes of *A. evermanni* are in a rather poor condition, the series consists of 3 bodies, 3 detached major chelipeds, 3 detached legs (probably pereiopods 3 and 4 and another leg which obviously does not belong to this species), tailfan, antennular peduncle and pleopod. The remaining legs are missing. Pereiopods 3 and 4 of the syntypes both have ischial

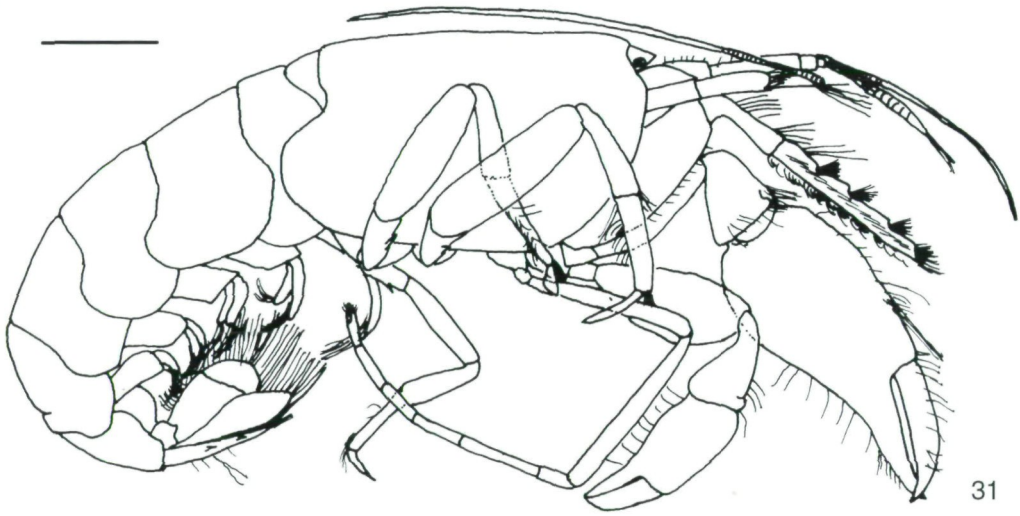


Fig. 31: *Automate evermanni*, NHMW 18340, CL = 5.0. Scale is 2 mm.

spines. As far as legs are present, all the other material from the Gulf of Mexico as well as our specimens from Brazil always show these spines on the ischium of pereiopods 3-5.

It was impossible to determine the sex of the specimens. According to BANNER & BANNER (1973) sex in the members of the genus *Automate* cannot be distinguished by external characters, unless they are ovigerous. RATHBUN (1901), however, described a difference in shape of the major cheliped between male and female. She probably assigned the more massive chelipeds to males and the slender form to females. Contrary to this, the only ovigerous female investigated by us (USNM 97609), has a cheliped which corresponds to Rathbun's male type. All the other specimens from the Gulf of Mexico studied by us have a similar male shaped cheliped. The specimens from Brazil all have a female shaped major cheliped with no gap between dactylus and fixed finger and no granulation along the lower side of the propodus.

Association with thalassinids

For April 1994, no detailed notes are available on how many burrows of *Axianassa* were sampled. On 25 April, 6 specimens of *Axianassa* were obtained. On 26 April, we caught 2 specimens of *Automate* and 3 specimens of *Axianassa*. On 29 April, 3 specimens of *Automate* and no *Axianassa* were captured [but one *Callichirus major* (SAY, 1818) and one *Upogebia paraffinis* WILLIAMS, 1993]. The results of the systematic collection on August 8-9, 1998 are presented in Table 2. *Leptalpheus* was collected in 38 % of the burrows as a single specimen together with a single *Axianassa*. In one case, a male-female pair of Leptalpheus was collected with one specimen of *Axianassa*. If there was no *Axianassa*, we caught either *Leptalpheus* or *Automate* alone. No *Automate* was collected together with *Axianassa*.

Table 2: Number of burrows sampled and number of thalassinids and alpheids obtained per burrow on August 8-9, 1998 at Praia do Araçá.

burrows	*Axianassa*	*Leptalpheus*	*Automate*
13	13×1	0	0
8	8×1	8×1	0
6	0	6×1	0
4	0	0	4×1
2	2×2	0	0
1	1×1	1×2	0

Discussion

Automate evermanni is a widely distributed species. It was first described from Puerto Rico where it was collected from sand, mud and shell bottoms between 26 and 250 m (RATHBUN 1901). Chace (1972) and WILLIAMS (1984) gave the distribution on the east Atlantic coast of North America from North Carolina to Texas. Recently, BLANCO-RAMBLA & LIÑERO-ARANA (1994) reported it from Venezuela to occur on clay bottom in 70 m among *Cheramus marginatus* (RATHBUN, 1901) and *Alpheus heterochaelis* SAY, 1818. POSEY & al. (1998) list *Automate evermanni* RATHBUN, *A. dolichognatha* DE MAN, 1888 (as *A. gardineri* COUTIÈRE, 1902) and *Leptalpheus forceps* as infauna of sublittoral coarse sediments dominated by fine sands and reef outcrops in 13 m off Florida in the Gulf of Mexico.

In the eastern Atlantic this species was reported from the Cape Verde Islands and from Liberia to Nigeria, living in soft sediments in depths between 12 and 85 m (HOLTHUIS 1951, CROSNIER & FOREST 1966). For Brazil, there is a record of one specimen collected off Rio Grande from a depth of 92 m (CHRISTOFFERSEN 1980, 1998). Our findings are the first record of this species from the intertidal.

FELDER & MANNING (1997b) reported briefly on several species of the genus *Leptalpheus* associated with mud shrimps, particularly with those of the genus *Axianassa* from the western Atlantic. Our results clearly indicate that *Leptalpheus axianassae* sp.n. is associated with *Axianassa australis*, as it was mainly collected as a single specimen together with a single *Axianassa*. It seems that both, the host and the associate, live in male-female pairs as in one case, two specimens of *Leptalpheus* were collected with one specimen of *Axianassa* and sometimes *Axianassa* were captured in pairs (DWORSCHAK & RODRIGUES 1997).

No association with *Axianassa* can be concluded for *A. evermanni* as this species was always collected without the thalassinid. Burrows of *Axianassa australis* have a unique shape, consisting of short vertical shafts, wide horizontal tunnels from which several evenly proportioned corkscrew-shaped spirals branch off, leading to further horizontal galleries at sediment depths of up to 130 cm (DWORSCHAK & RODRIGUES 1997). It is almost impossible to collect the inhabitants of such a large burrow system (total length up to 8 m) quantitatively with a suction pump. On the other hand, *Automate* probably digs its own burrows - as obviously do other members of this genus - and their burrow openings are very similar to those of *Axianassa*.

Further investigations on the burrowing abilities of *A. evermanni* would be important to elucidate if this species is able to excavate its own burrow or if it could be living commensally with *Axianassa* as well.

Acknowledgements

Financial support was given to PCD within the frame of the Convenio between the University of Vienna and the University of São Paulo. We are grateful to the entire staff of CEBIMar for their hospitality during our stay in São Sebastião. Our thanks are due to Sérgio de A. Rodrigues for his assistance collecting specimens, to Martin L. Christoffersen for providing us with unpublished information, and to Austin B. Williams and Arthur Anker for critically reading the manuscript.

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