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## Taxonomy and distribution of *Talitroides alluaudi* (Chevreux, 1896) and *T. topitotum* (Burt, 1934) (Amphipoda, Talitridae) in Atlantic rain forests of southeastern Brazil

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### ABSTRACT

The family Talitridae Rafinesque, 1815 is the only group, among the amphipods, that colonized the terrestrial environment, and more than half of its species live in tropical and subtropical forests. Nowadays, the family has approximately 270 species described in 64 genera. Leaf litter samples from Atlantic forests and urban areas of the states of Rio de Janeiro, São Paulo, Minas Gerais, Paraná, Santa Catarina, and Rio Grande do Sul, provided material to redescribe the two terrestrial species known to Brazil, *Talitroides alluaudi* (Chevreux, 1896) and *Talitroides topitotum* (Burt, 1934), and enlarge their known distribution. These species have a worldwide distribution, as they are commonly dispersed in a synanthropic way. *Talitroides topitotum* seems to be well established in Brazilian Atlantic forests: 96% of the 1787 individuals examined (51 samples) corresponded to this species. Also, females dominated the samples and only six males were found: four from *T. alluaudi* and two from *T. topitotum*. A detailed comparison of these two species, as well as their geographical distribution, is given.

### KEY WORDS

Taxonomy, Talitridae, Atlantic forest, introduced species, Brazil.

### INTRODUCTION

The family Talitridae Rafinesque, 1815 is the only group among the amphipods that colonized the terrestrial environment, including supralittoral beaches, estuarine areas, caves and forests. During the past 10 years many species and genera have been erected for the family Talitridae and nowadays there are approximately 270 species described in 64 genera (Horton and De Broyer, 2015), with more than half of these species found in forests, indicating a strong adaptive radiation of the group in the terrestrial habitat (Bousfield, 1984). The classical ecological groups proposed by Bousfield (1984) for the Talitridae are: palustral talitrids; beach-hoppers (non-substrate modifying); sand-hoppers (substrate modifying) and land-

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hoppers. More recently, Wildish et al. (2012) proposed another ecological classification for the group: terrestrial talitrids; wrack generalists; and substratum specialists. Among the last group three subgroups were recognized: sand burrowers, troglobionts (from caves) and driftwood talitrids. They play important roles in the dynamics of their habitat functioning as decomposers since they are essentially detritivorous animals (Friend and Richardson, 1986; Friend, 1987).

Terrestrial talitrids are commonly called land-hoppers and are primarily distributed in New Zealand, Australia, the Pacific and Subantarctic Islands, South Africa, Indo-Pacific region and Central America (Hurley, 1968; Bousfield, 1984; Friend and Richardson, 1986). Some species have been introduced in many regions, including South and North America, western Eurasia, and the United Kingdom (Bousfield, 1984; Duncan, 1994). When dealing with truly terrestrial habitats there are no records of native talitrids in Brazil. On the other hand, the introduced species *Talitroides topitotum* (Burt, 1934) was first registered in Brazil from São Paulo by Lemos de Castro (1972). After that, Lemos de Castro and Pereira (1978) reported *T. topitotum* again from Rio de Janeiro (RJ) and recorded for the first time a large population of *Talitroides alluaudi* (Chevreux, 1896) from Madureira (RJ). However, the latter species is not so common and until the present study it has no further records in Brazil after its first record. Whereas *T. topitotum* seems to be very widespread and abundant in some areas, as shown by studies on reproductive biology and distribution at Serra do Mar, Guaratuba, Paraná (Lopes and Masunari, 2004a; 2004b) and at Serra do Mar State Park, São Paulo (Matavelli et al., 2009). More recently, Eutrópico and Krohling (2013) recorded *T. topitotum* from coffee and *Eucalyptus* plantations in the state of Espírito Santo. *Talitroides topitotum* seems to be introduced in Brazil by imported plants from the United States that received *Eucalyptus* trees from Australia for commercial purposes (Lopes and Masunari, 2004a) and probably have been spread by human gardening and landscaping activities.

After Chevreux's early descriptions (Chevreux, 1896; 1901; Chevreux and Fage, 1925), a recent study redescribed the type material of *T. alluaudi* deposited in the Paris Museum, which clarified the identity of this species (Morino and Ortal, 1993). Burt (1934) originally described *T. topitotum* from

Ceylon (now Sri Lanka), India (as *Talitrus*), and later Stephensen (1935) and Shoemaker (1936) redescribed this species wrongly identified as *Talitrus sylvaticus* Haswell, 1879 and mentioned its introduction in North America. Hurley (1955) described *Talitrus (Talitroides) pacificus* from New Zealand, which was subsequently synonymized to *T. topitotum* by Bousfield (1982). More recently, Morino (2013) redescribed *T. topitotum* based on material from tropical East Asia. Both *T. alluaudi* and *T. topitotum* have a wide distribution in the tropics, subtropics and warm temperate forests of the world. At the same time, they occur in greenhouses, urban parks and silviculture areas as they are known to present a synanthropic dispersal (Vader, 1972; Bousfield, 1984; Friend and Richardson, 1986). Sampling in the Atlantic forest litter and urban areas of the states of Rio de Janeiro, São Paulo, Minas Gerais, Paraná, Santa Catarina and Rio Grande do Sul provided material to redescribe and enlarge the distribution of the two terrestrial species previously known in Brazil: *T. alluaudi* and *T. topitotum*. Detailed comparison between these two species with comments on its distribution is given.

## MATERIAL AND METHODS

Material examined was collected since 1970 among urban areas and litter of a vast area of the Brazilian Atlantic forest including the states of Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul. These specimens were deposited in the Crustacea Collection of the Museu Nacional (MNRJ), Universidade Federal do Rio de Janeiro and in the Collection of the Universidade Federal do Rio Grande do Sul (UFRGS). Part of the collection of the UFRGS was legged to the MNRJ, which received a MNRJ number, although the corresponding UFRGS catalog numbers are given in parenthesis. Both *Talitroides alluaudi* and *Talitroides topitotum* are herein redescribed based on the Brazilian material which will complement recent redescriptions made by Morino and Ortal (1993) and Morino (2013). Pooters and pitfall traps were used for collecting specimens. The material was examined under a Zeiss Stemi SV6 stereomicroscope and ZEISS Axioscope coupled with a camera lucida. The individuals were identified, counted and separated by sex, with females being also separated into ovigerous and not ovigerous. The mouthparts were dissected

and mounted in semi-permanent slides made with glycerin jelly. Illustrations were prepared using Corel Draw X4 graphics program with the aid of a Wacom pen tablet 4 adapted from the methodology proposed by Coleman (2006). Photomicrographs were made in a scanning electron microscope (SEM) JEOL model 6390 series set in the Electron Microscopy Center of the Museu Nacional. The methodology used to prepare the material for SEM photos was adapted from Felgenhauer (1987). Setae nomenclature follows Zimmer *et al.* (2009).

*Abbreviations in the figures:* D, dactyl; G, gills; LL, lower lip; LMd, left mandible; Mx, maxilla; Mxp, maxilliped; O, oostegite; PR, pereopod; PL, pleopod; RMd, right mandible; UL, upper lip.

## SYSTEMATICS

### Order Amphipoda Latreille, 1816

### Suborder Senticaudata Lowry and Myers, 2013

### Family Talitridae Rafinesque, 1815

### Genus *Talitroides* Bonnier, 1898

*Talitroides* Bonnier, 1898: 208.

*Talitrus* (*Talitropsis*) Burt, 1934: 184.

*Talitrus* (*Talitroides*) Hurley, 1955: 147.

*Type species.* *Talitroides bonnieri* Stebbing, 1906, by monotypy (= *Talitroides alluaudi* (Chevreux, 1896)).

*Species included.* *Talitroides alluaudi* (Chevreux, 1896) and *Talitroides topitotum* (Burt, 1934).

*Diagnosis.* Antenna 1 subequal to antenna 2 peduncle. Maxilliped palp article 4 reduced. Gnathopod 1 simple in both sexes. Gnathopod 2 mitten shaped in both sexes, no sexual dimorphism. Pereopod 3 longer than 4; pereopods 3–7 cuspidactylate. Pleopods 1 and 2 reduced but functional with 2 setose rami, inner ramus shorter than outer; pleopod 3 reduced, with 0–1 ramus. Uropod 1 with distolateral robust seta; uropods 1 and 2 rami subequal, outer ramus without marginal setae; uropod 3 short and uniramous. Gill on pereopod 6 “L” shaped and facing anteriorly. Telson

entire (modified from Bousfield, 1984).

### *Talitroides alluaudi* (Chevreux, 1896)

(Figs. 1–3)

*Talitrus Alluaudi* Chevreux, 1896: 112, figs. 1–4; –

Chevreux, 1901: 389, figs. 1–6. – Stephensen, 1924:

197. – Chevreux and Fage, 1925: 270, figs. 280–281.

*Talitroides bonnieri* Stebbing, 1906: 527.

*Orchestia senni* Menzel, 1911: 438, figs. 4–9.

*Talitrus alluaudi* – Shoemaker, 1936: 60. – Hurley, 1955: 147 (key).

*Talitroides alluaudi* – Stephensen, 1943: 295. – Palmén,

1947: 61, figs 1–12. – Andersson, 1962: 211, figs.

1–3. – Vader, 1972: 32. – Bousfield and Howarth,

1976: 149. – Biernbaum, 1980: 108. – Morino and

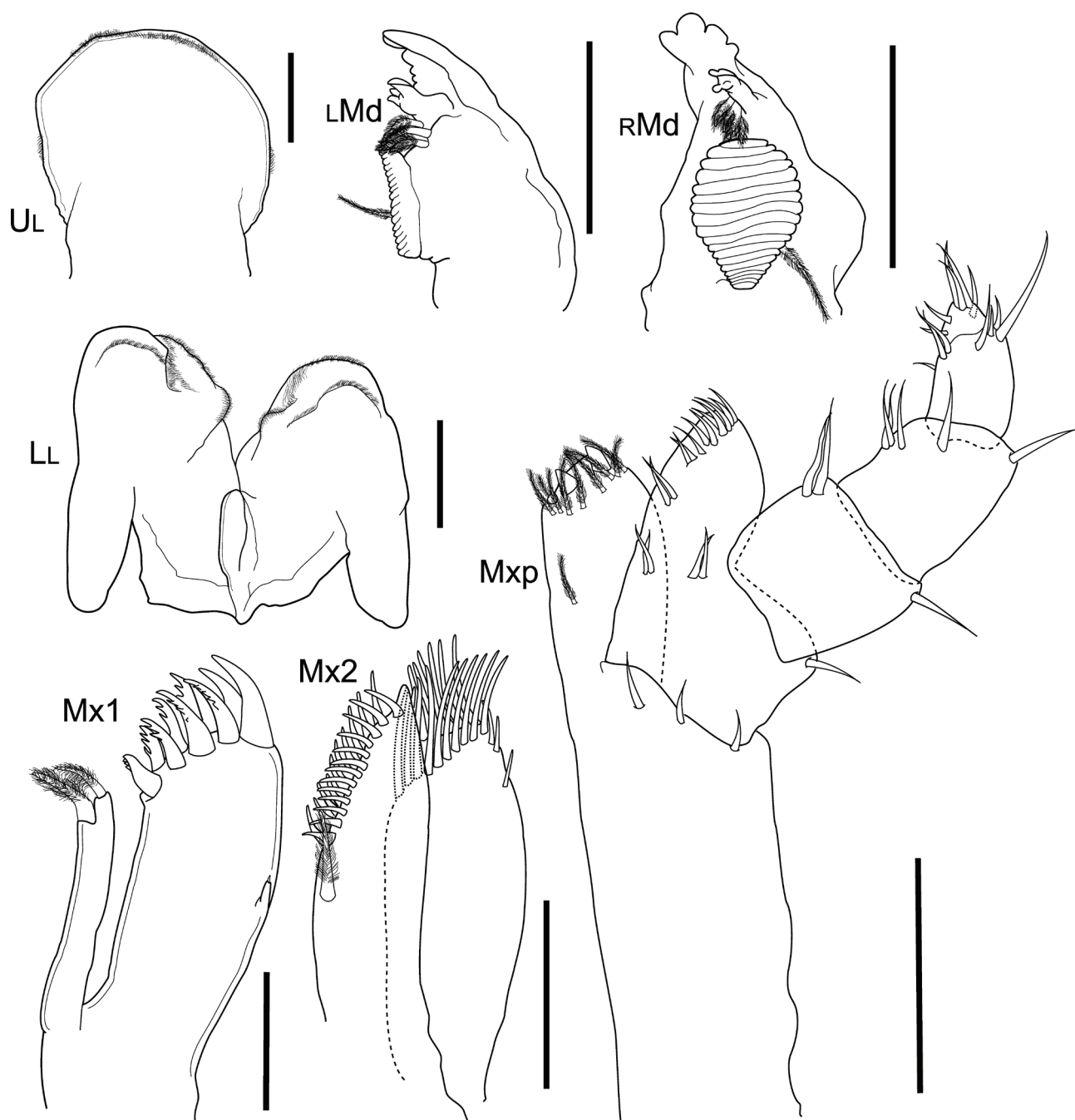
Ortal, 1993: 333, figs. 1–2.

*Talitrus* (*Talitroides*) *alluaudi* – Hurley, 1975: 162. –

Lemos de Castro and Pereira, 1978: 47, figs. 1–12.

*Material examined.* State of Rio de Janeiro – 3 males, 41 females (12 ovigerous), 40 juveniles, Rio de Janeiro, Madureira, 1976, MNRJ 9717. State of São Paulo – 1 male, 4 females (1 ovigerous), 1 juvenile, São Paulo, Universidade de São Paulo (USP), Depósito de Fisiologia, 1972, MNRJ 9752. State of Rio Grande do Sul – 8 females, 1 juvenile, Porto Alegre, Campus of Universidade Federal do Rio Grande do Sul (UFRGS), Instituto de Pesquisas Hidráulicas (IPH), 16/02/1989, MNRJ 24800 (UFRGS 2133).

*Redescription.* Female, 6.2 mm, MNRJ 9717. Eyes oval. Antenna 1 reaching end of peduncular article 5 of antenna 2; flagellum with 5 articles. Antenna 2 reaching about 1/5 body length; flagellum with 8 articles. Upper lip rounded. Mandibles incisor 5-toothed; left *lacinia mobilis* 4-toothed and right *lacinia* 3-toothed; spine row of broad plumose bristles; molar strong and tritulative. Lower lip without internal lobe; external lobe well developed, with two rows of simple setae, marginal and sub-marginal; mandibular lobe rounded. Maxilla 1 inner plate narrow with 2 papposerrate setae distally; outer plate with 9 serrated setae distally; palp vestigial, 2-articulated. Maxilla 2 inner plate distal margin oblique, distolaterally pointed, with many robust distal setae and 1 papposerrate seta; outer plate with long robust setae distally. Maxilliped inner plate



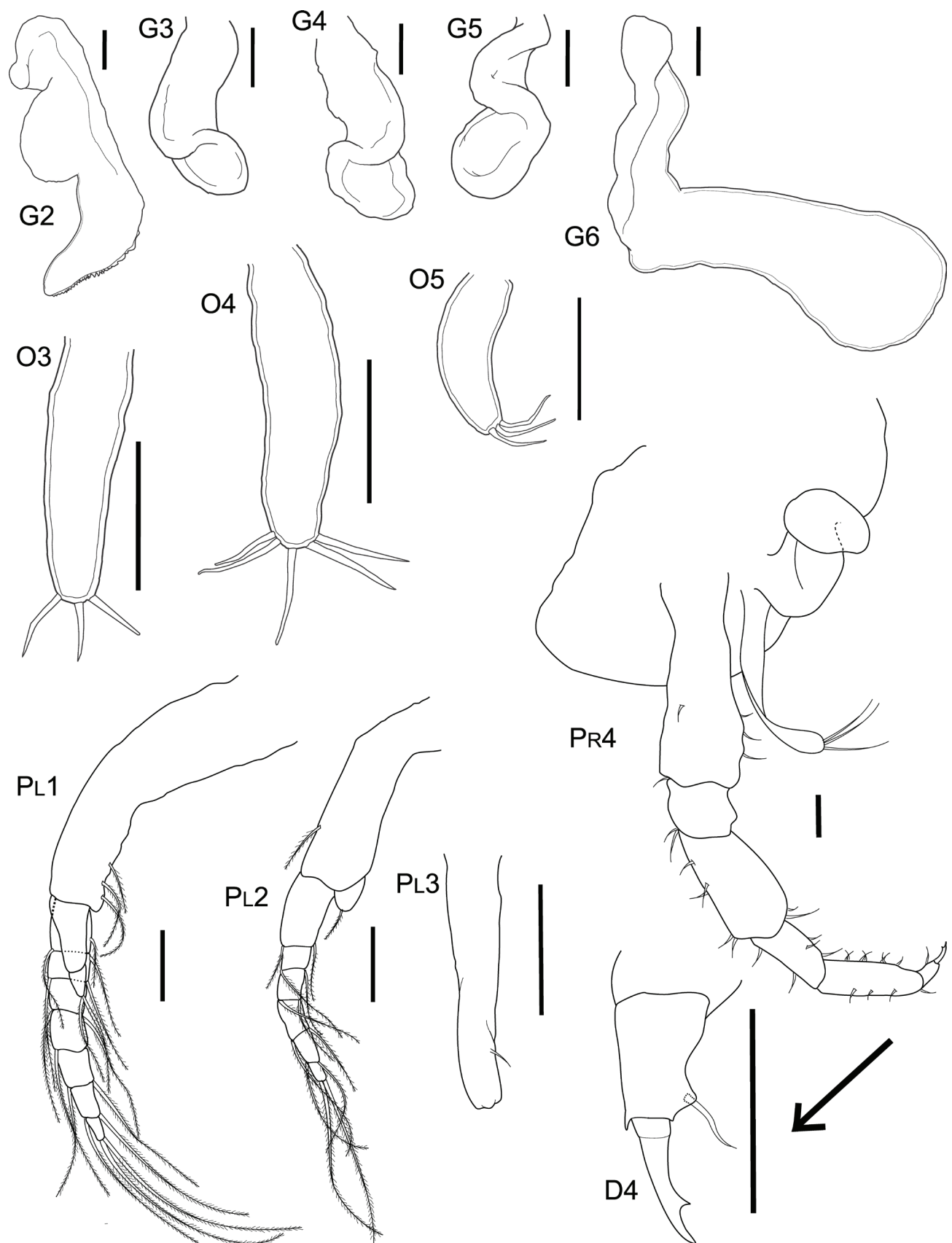
**Figure 1.** *Talitroides alluaudi* (Chevreux, 1896). Female 6.2 mm, MNRJ 9717: Mouthparts. Scales = 0.1 m.

with set of pappose setae and 3 robust triangular setae on each side; outer plate rounded; 4-articulated palp, articles 1–3 with single seta in lateral-distal angle (1-1-1), article 4 triangular and small.

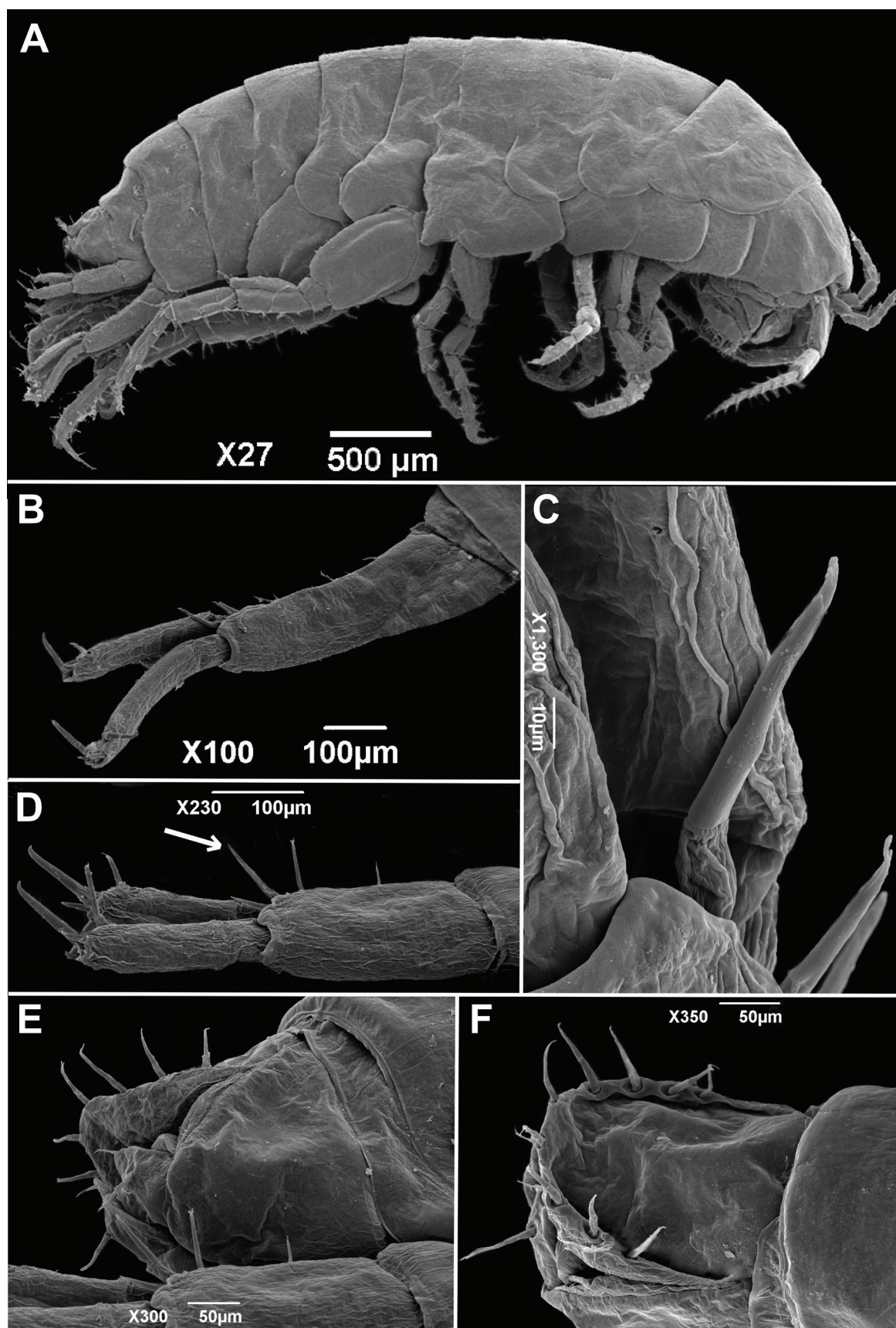
Gnathopod 1 simple; dactyl cuspidate. Gnathopod 2 coxa almost 2x width of coxa 1, as wide as deep; ischium 2x as long as ischium of gnathopod 1; merus and carpus with posterodistal tumescence; propodus mitten-shaped, with posterior lobe; small dactyl about half length of lobe. Pereopod 3 slightly longer than

pereopod 4; dactyl with smooth prominence on posterior margin. Pereopod 4 with dactylar dentition. Pereopod 5 similar, but smaller than pereopods 6 and 7; coxa anterior lobe wider and deeper than posterior. Pereopod 6 coxa posterior lobe wider and deeper than anterior; basis wider than that of pereopod 5. Pereopod 7 slightly longer than pereopod 6; coxa short; basis subcircular. Pereopods 3–7 cuspidactylate. Coxal gills on gnathopod 2 to pereopod 6. Coxal gill 2 with 2 lobes and crenulations on distal margin. Gills of





**Figure 2.** *Talitroides alluaudi* (Chevreux, 1896). Female 6.2 mm, MNRJ 9717: Gills and oostegites; Female, 5.7 mm, MNRJ 9717: Pleopods and pereopod 4. Scales = 0.1 mm.



**Figure 3.** SEM photomicrographs of *Talitroides alluaudi* (Chevreux, 1896). A) Female MNRJ 9717: Habitus; B – F) Female, MNRJ 9717: B) Uropod 1, C) Distolateral robust seta of uropod 1 with simple apex, D) Uropod 2 (arrow indicate the larger middle postero-distal setae), E) Uropod 3, F) Telson.

pereopod 3–5 twisted, similar sizes, smaller than gill of gnathopod 2. Coxal gill 6 L-shaped, without lobes. Oostegites present on pereopods 3–5.

Epimera 1–3 with postero-ventral angle pointed. Pleopod 1 outer ramus 7-articulated and inner ramus 2-articulated, with 2 apical plumose setae. Pleopod 2 outer ramus 6-articulated and inner ramus 1-articulated, with 1–2 apical plumose setae. Pleopod 3 lacking ramus. Uropod 1 peduncle with distolateral robust seta with annulation slightly marked distally, without strangulation, apex not abruptly narrowed (simple apex) (Fig. 3C); rami subequal, shorter than peduncle; inner ramus with 5 apical robust setae; outer ramus with 4 apical robust setae. Uropod 2 peduncle with 3 posterodistal robust setae, middle robust seta the longest and distal robust seta the shortest; rami subequal, same length of peduncle; inner ramus with 5 robust apical setae; outer ramus with 4 robust apical setae. Uropod 3 uniramous, peduncle with 1 lateral robust seta; ramus about 1/3 peduncle length, not exceeding distal end of telson, with 1 robust apical seta. Telson distally rounded without dorsal midline, with 4–5 robust setae on each side.

Male, 4 mm, MNRJ 9717. No sexual dimorphism.

*Type locality:* Serres de La Ville de Paris, Boulogne sur Seine, France (Morino and Ortal, 1993).

*Distribution:* Indo-Pacific: Seychelles (Chevreux, 1901), Java Island, Gambier Islands, Taumotue Islands, Magareva Island (Shoemaker, 1936), Polynesian Islands (Hurley, 1975), Australia region (Friend and Richardson, 1986). Hawaii: Kauai Island (in caves) (Bousfield and Howarth, 1976), O’ahu (Richardson, 1991). Asia: Israel (Morino and Ortal, 1993). Europe: Netherlands, Finland, Sweden, Denmark, Scotland, England, Germany, Belgium, France, Switzerland, Hungary and Poland (Stephensen, 1924; Vader,

1972). Canary Islands, Azores (Hurley, 1975). Africa: Madagascar (Ruffo, 1958). North America: greenhouses in Ohio (Visscher and Heimlich, 1930), New Jersey (Shoemaker, 1936), South Carolina (Biernbaum, 1980); Canada (Hurley, 1975). Brazil: Rio de Janeiro (Lemos de Castro and Pereira, 1978), São Paulo and Rio Grande do Sul (present study) (Fig. 7).

*Ecology.* Found in forests of tropics, subtropics and warm temperate regions, and also from greenhouses of Europe and North America (Friend and Richardson, 1986). In Brazil, *T. alluaudi* was also found in urban areas of Rio de Janeiro, in a moist environment under rubbish (Lemos de Castro and Pereira, 1978) and among the litter of green areas of Universities of São Paulo and Rio Grande do Sul (present study).

*Remarks.* Some differences among *T. alluaudi* descriptions were noticed, even among Chevreux (1896) and Chevreux and Fage (1925), which treated material from the same locality (Tab. 1).

The specimens analyzed herein agree with the description of the lectotype in presenting diagnostic features such as: absence of oostegite 2; inner ramus of pleopod 1 2-articulated; inner ramus of pleopod 2 1-articulated and dactylar dentition present in pereopod 4. Morino and Ortal (1993) described the article 4 of maxilliped as partially fused to article 3. The material analyzed herein showed a complete separation between articles 3 and 4. Difference in the number of robust setae on telson was noticed, with the Brazilian material having from 4–5 setae on each side instead of 3–4 setae described by these authors. Nevertheless, dactylar dentition noticed by these authors in pereopod 4 was also seen in all our specimens, including the juveniles, being an important diagnostic feature to be considered. Morino and

**Table 1.** Literature descriptions of *Talitroides alluaudi* (Chevreux, 1896) among early and more recent studies. P = pereopod.

|                       | Chevreux (1896) | Chevreux (1901) | Chevreux and Fage (1925) | Morino and Ortal (1993)                          | Present study            |
|-----------------------|-----------------|-----------------|--------------------------|--------------------------------------------------|--------------------------|
| Oostegite 2           | Present         | Present         | Absent                   | Absent                                           | Absent                   |
| Inner ramus pleopod 1 | Not described   | 1-articulated   | 3-articulated            | 2-articulated (variation: 1, 3 or 4-articulated) | 2-articulated            |
| Inner ramus pleopod 2 | Not described   | 3-articulated   | 1-articulated            | 1-articulated (variation: 3-articulated)         | 1-articulated            |
| Dactylar dentition    | Not described   | Present in P5   | Not described            | Strong in P4, weak in P3                         | Strong in P4, weak in P3 |



Ortal (1993) also described a slight prominence in the dactyl of pereopod 3 in most of his material, but individuals from Azores had a dactylar dentition similar to that of the pereopod 4. In all specimens analyzed herein the dactylar dentition in pereopod 3 was much weaker than that of pereopod 4. In individuals collected in IPH (Instituto de Pesquisas Hidráulicas), UFRGS, Rio Grande do Sul, also a prominence in dactyl of pereopods 5 was observed, similar to that of pereopod 3. Chevreux (1901) also mentioned a dactylar dentition on pereopod 5.

Variations in pleopods 1–3 are also a recurrent theme in studies of *T. alluaudi* as shown by Palmén (1947) with specimens from Finland. The pleopod 1 may have 1 or 2 articles in the inner ramus; pleopod 2 may have the first article of inner ramus more or less developed; pleopod 3 can be 1- or 2-articulated, in which the second is reduced and can have an apical seta. Morino and Ortal (1993) described inner ramus of pleopod 1 mostly with 2 articles, but there may be a variation of 1–4 articles, while the pleopod 2 always showed 1 article in the outer ramus, but one specimen in material from Azores had 3 articles. The samples analyzed here showed no variation in the number of articles in pleopods 1–3. They follow the predominant pattern described by Anderson (1962) and Morino and Ortal (1993).

### ***Talitroides topitotum* (Burt, 1934)**

(Figs. 4–6)

*Talitrus (Talitropsis) topitotum* Burt, 1934: 184, fig.

1. – Hurley, 1975: 162.

*Talitrus decoratus* Carl, 1934: 742, figs. 1–6.

*Talitrus sylvaticus* Stephensen, 1935: 19, figs. 1–3. – Shoemaker, 1936: 60, fig. 1 (non Haswell, 1879).

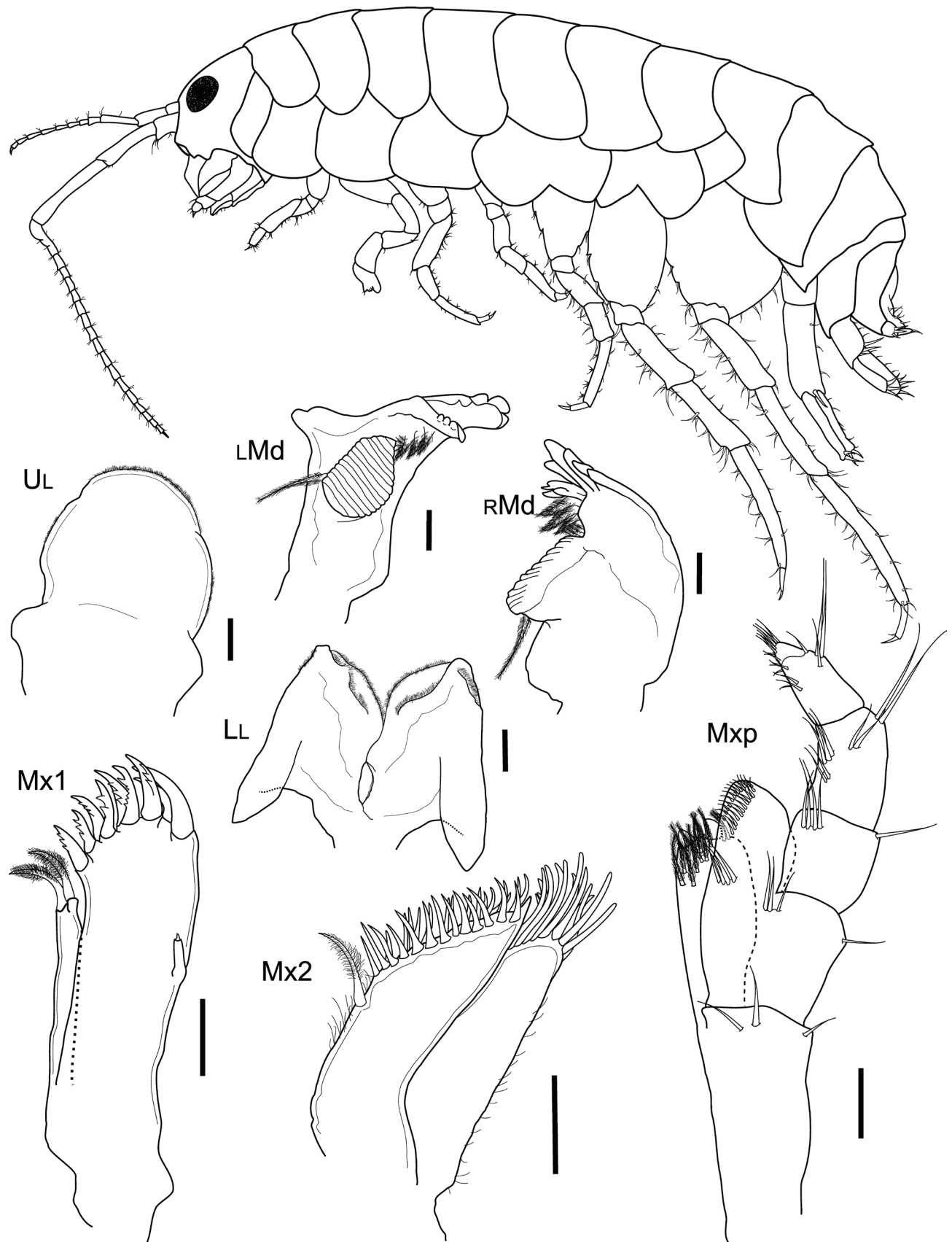
*Talitroides sylvaticus* Stephensen, 1943: 296 (non Haswell, 1879).

*Talitrus (Talitroides) pacificus* Hurley, 1955: 155, fig. 3. – Ruffo, 1958: 41. – Lemos de Castro, 1972: 201, figs. 1–7. – Lemos de Castro and Pereira, 1978: 47.

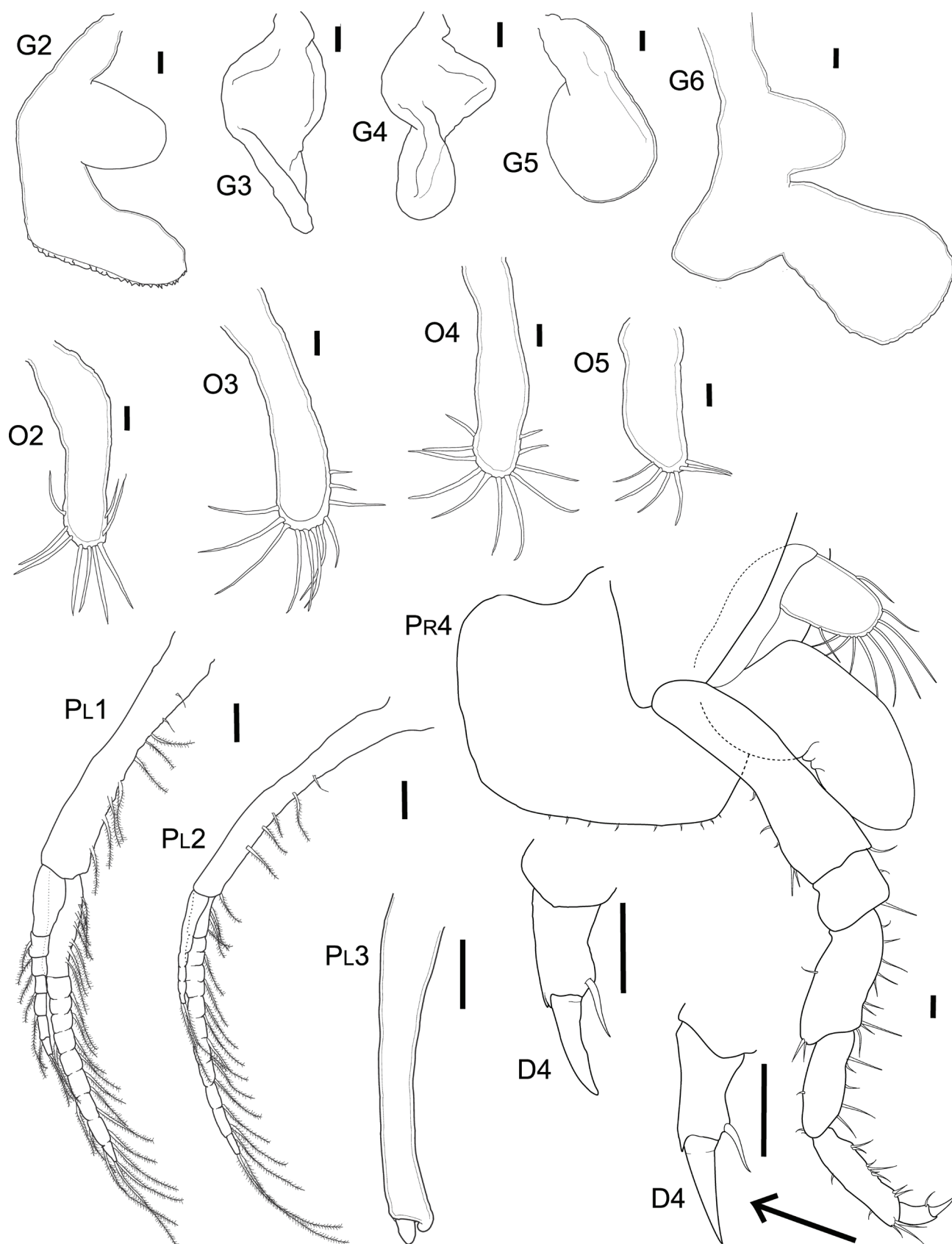
*Talitroides topitotum* Vader, 1972: 33. – Biernbaum, 1980: 108. – Bousfield and Howarth, 1976: 150. – Bousfield, 1982: 55 (key). – Friend and Lam, 1985: 27, figs. 1–2. – Richardson, 1991: 200 (key). – Morino, 2013: 193, figs. 1–4.

*Material examined.* State of Rio de Janeiro – 9 females (4 ovigerous), Teresópolis, 18/12/1975, MNRJ 9754; 13 females, 5 juveniles, Teresópolis, 25/01/1981, MNRJ 9755; 188 females (32 ovigerous), 13 juveniles, Petrópolis, 1974, MNRJ 11476; 1 female, Teresópolis, Cachoeira de Imbuí, 29/01/1976, MNRJ 11477; 15 females (2 ovigerous), 4 juveniles, Teresópolis, 30/01/1956, MNRJ 11478; 25 females (1 ovigerous), 3 juveniles, Rio de Janeiro, Parque Nacional da Tijuca, Cachoeira do Horto, 27/02/2000, MNRJ 21531; 1 female, Rio de Janeiro, Parque Nacional da Tijuca, Cachoeira do Primata, 06/03/2000, MNRJ 21532; 51 females (5 ovigerous), 63 juveniles, Rio de Janeiro, Cachoeira do Horto, Parque Nacional da Tijuca, 28/03/1999, MNRJ 21533; 18 females (3 ovigerous), 1 juvenile, Teresópolis, Parque Nacional da Serra dos Órgãos, 06/09/2012, MNRJ 24812; 4 females (3 ovigerous), Teresópolis, Parque Nacional da Serra dos Órgãos, 31/08/2013, MNRJ 24811. State of São Paulo – 26 females (8 ovigerous), São Paulo, 03/1972, MNRJ 9696; 2 females, 1 juvenile, Barueri, Capoeirão, 15/08/1971, MNRJ 9749; 2 females (1 ovigerous), 3 juveniles, Barueri, Capoeirão, 23/02/1970, MNRJ 9751; 34 females, 10 juveniles, São Paulo, Universidade de São Paulo (USP), Depósito de Fisiologia, 1972 MNRJ 9752; 15 females (6 ovigerous), São Paulo, Alto de Pinheiros, 31/03/1970, MNRJ 9753; 68 females (26 ovigerous), 1 juvenile, São Paulo, woods of Universidade de São Paulo (USP), MNRJ 14470; 8 females, 3 juveniles, road between BR-116 and Barra do Turvo, Terra Seca, 10 km from the BR-116, 20/11/1999, MNRJ 14543; 40 females (6 ovigerous), Ribeirão Grande, Sumidouro, 03/2004, MNRJ 24804. State of Minas Gerais – 13 females (6 ovigerous), Belo Horizonte, Nova Suíça, 1976, MNRJ 9756. State of Paraná – 9 females (2 ovigerous), 5 juveniles, Piraquara, 05/04/1999, MNRJ 14468; 9 females, 29 juveniles, Balsa Nova, Serra de São Luiz, 07/03/1999, MNRJ 14469; 1 male; 37 females (5 ovigerous), 97 juvenile, São José dos Pinhais, dam of hydroelectric plant of Guaricana, 08/03/1999, MNRJ 14474; 7 females (1 ovigerous), 9 juvenile, Morretes, Parque Estadual Pico do Marumbi, 06–09/04/1999, MNRJ 14477. State of Santa Catarina – 23 females (3 ovigerous), 47 juveniles, Blumenau, 29/03/1999, MNRJ 14479; 43 females (22 ovigerous), 38 juveniles, BR-280, 6 km from São

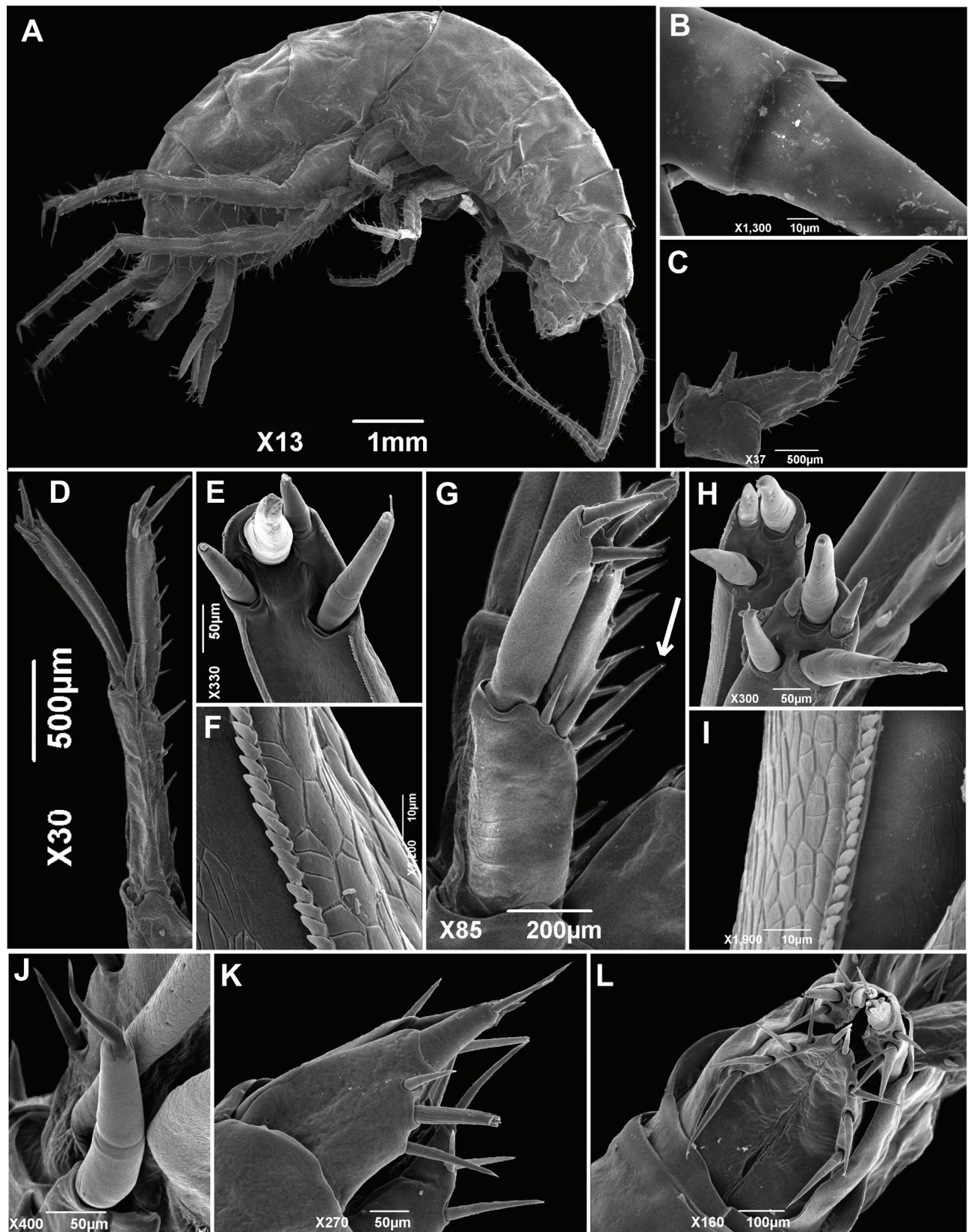




**Figure 4.** *Talitroides topitotum* (Burt, 1934). Female, 11.9 mm, MNRJ 14470: Habitus; Female, 12.2 mm, MNRJ 14470: Mouthparts. Scales = 0.1 mm.



**Figure 5.** *Talitroides topitotum* (Burt, 1934). Female, 11.9 mm, MNRJ 14470: Gills, pleopods and pereopod 4 (dactyl indicated by arrow); Female, 12.2 mm, MNRJ 14470: Oostegites; Female, 15.3 mm, MNRJ 24811: Dactyl of pereopod 4 with variation. Scales = 0.1 mm.



**Figure 6.** SEM photomicrographs of *Talitroides topitotum* (Burt, 1934). A) Female MNRJ 14470: Habitus; B – M) Female MNRJ 14470: B) Cuspidactylate dactyl of pereopod 5, C) Pereopod 5, D) Uropod 1, E) Apex of outer ramus of uropod 1, F) Margin of outer ramus of uropod 1, G) Uropod 2 (arrow indicate the larger proximal postero-distal seta), H) Apex of rami of uropod 2, I) Margin of outer ramus of uropod 2, J) Distolateral robust seta in peduncle of uropod 1 with complex apex, K) Uropod 3, L) Telson and uropods 3.



Bento do Sul, 19/02/1999, MNRJ 14544; 18 females, 2 juveniles, Campo Alegre, 18/08/1999, MNRJ 24807 (UFRGS 3258); 1 female, Gravatal, Termas de Gravatal, 16/05/1991, MNRJ 24803 (UFRGS 2129); 3 females (1 ovigerous), 1 juvenile, Orleães, after Barracão, MNRJ 24808 (UFRGS 3257). State of Rio Grande do Sul – 78 females, 2 juveniles, Taquara, Santa Cruz do Pinhal, 29/10/2006, MNRJ 24805; 1 female, Torres, Morro Azul, 20/08/1999, MNRJ 24806 (UFRGS 3259); 35 females (10 ovigerous), Porto Alegre, 20/11/1980, MNRJ 24797 (UFRGS 2134); 12 females, 1 juvenile, Porto Alegre, Vila Manresa, 05/04/1989, MNRJ 24801 (UFRGS 2133\*); 1 female ovigerous, 1 juvenile, Viamão, Parque Saint Hilaire, 16/02/1989, MNRJ 24798 (UFRGS 2132\*); 1 female, Pelotas, 02/10/1997, MNRJ 24809 (UFRGS 2830); 7 females, 1 juvenile, Porto Alegre, Ipanema, 01/06/1993, MNRJ 24799 (UFRGS 2131); 18 females, Porto Alegre, 12/1990, MNRJ 24802 (UFRGS 2132); 4 females, 1 juvenile, São Francisco de Paula, Rincão dos Kroeff, 11/09/1998, MNRJ 24787 (UFRGS 3233); 1 female, Itapeva, 10/09/1998, MNRJ 24788 (UFRGS 3234); 1 female, Barra do Ouro, 11/09/1998, MNRJ 24789 (UFRGS 3235); 1 female, Arroio Teixeira, 10/09/1998, MNRJ 24790 (UFRGS 3236); 3 females, 1 juvenile, São Francisco de Paula, Rincão dos Kroeff, 11/09/1998, MNRJ 24791 (UFRGS 3237); 24 females (5 ovigerous), 1 juvenile Rota do Sol, 24/09/1998, MNRJ 24792 (UFRGS 3238); 1 female ovigerous, Maquiné, 11/09/1998, MNRJ 24793 (UFRGS 3239); 1 female, #A18, MNRJ 24794 (UFRGS 3241); 1 male, 4 female, 1 juvenile, #A54, MNRJ 24795 (UFRGS 3242); 3 females, 1 juvenile #AE1, MNRJ 24796 (UFRGS 3243); 11 females, 1 juvenile, Viamão, Águas Claras, Refúgio de Vida Silvestre Banhado dos Pachecos, 28–29/06/2011, MNRJ 24810.

**Redescription.** Female, 11.9 mm, MNRJ 14470. Eyes oval. Antenna 1 reaching fifth peduncular article of antenna 2; flagellum with 9 articles. Antenna 2 reaching about 3/5 body length; flagellum with 20 articles, with 2 distal pairs of small simple setae on each article. Upper lip rounded. Mandibles incisor 5-toothed; left *lacinia mobilis* 4-toothed and right *lacinia* 3-toothed; spine row of broad plumose bristles; molar strong and triturative. Lower lip without internal

lobe; outer lobe well developed, with two rows of simple setae, marginal and sub-marginal; mandibular lobe pointed. Maxilla 1, inner plate narrow with 2 papposerrate setae distally; outer plate with 9 serrated setae distally; palp vestigial, biarticulated. Maxilla 2, inner plate distal margin oblique, distolaterally pointed, with many robust distal setae and 1 papposerrate seta; outer plate with long robust setae distally. Maxilliped, inner plate with set of pappose setae and 2 robust triangular setae on each side, both with same size; outer plate rounded; 4-articulated palp, article 1 with simple setae, articles 2 and 3 with couple of well developed simple setae in disto-lateral angle (1-2-2), article 4 triangular and reduced.

Gnathopod 1 simple; dactyl cuspidate. Gnathopod 2 coxa 2 almost 2x as wide as coxa 1; ischium 2x as long as that of gnathopod 1; merus and carpus with posterodistal tumescence; propodus mitten-shaped, with posterior lobe; dactyl small, with 1/3 lobe length. Coxae 3–4 with same size of coxa 2. Pereopod 3 similar to 4, longer than pereopod 4; dactyl with smooth prominence on posterior margin. Pereopod 4 without dactylar dentition. Pereopod 5 similar, but smaller than pereopods 6 and 7; coxa anterior lobe wider and deeper than posterior. Pereopod 6 coxa posterior lobe wider and deeper than anterior. Pereopod 7 slightly longer than pereopod 6; coxa short; basis subcircular. Pereopods 3–7 cuspidactylate. Coxal gills on gnathopod 2 to pereopod 6. Coxal gill 2 with 2 lobes and crenulations on distal margin. Gills of pereopod 3–5 twisted, similar sized, smaller than gill of gnathopod 2. Coxal gill 6 L-shaped with 2 lobes, one proximal and other in the angle between the two projections. Oostegites present on gnathopod 2 to pereopod 5.

Epimeron 1–3 with postero-ventral angle pointed. Pleopod 1 outer ramus 14-articulated, inner ramus 7-articulated. Pleopod 2 outer ramus 10-articulated, inner ramus 4-articulated. Pleopod 3 uniramous, 2-articulated, second article reduced. Uropod 1 peduncle with distolateral robust seta strangled distally, producing narrow and slightly twisted apex (complex apex) (Fig. 6J); both rami subequal, shorter than peduncle, with minute toothed margins; inner ramus with 5 apical robust setae; outer ramus with 4 robust apical setae. Uropod 2 peduncle with 3 posterodistal robust setae, proximal robust seta

the longest and distal robust seta the shortest; rami subequal, same length of peduncle, both rami with minute toothed margins; inner ramus with 5 robust apical setae; outer ramus with 4 robust apical setae. Uropod 3 peduncle with 3 robust setae in posterodorsal margin; ramus 1/2 peduncle length, reaching or exceeding distal end of telson with 2 robust apical setae. Telson distally emarginated with longitudinal midline and 5 marginal setae on each side.

Male, 8.7 mm, MNRJ 14474. No sexual dimorphism.

*Type locality.* Hatton, Sri Lanka, Indian Ocean (Burt, 1934).

*Distribution.* Indo-Pacific: Marquesas Islands, Norfolk Islands, Australia (Stephensen, 1935). Hawaii: Kauai Island (in caves) (Bousfield and Howarth, 1976), O'ahu (Richardson, 1991). Asia: India (Biernbaum, 1980), Hong Kong (Friend and Lam, 1985), Japan and Vietnam (Morino, 2013). Europe: Germany and England (Vader, 1972). Azores and Madeira (Biernbaum, 1980). Africa: Madagascar and Comoro Islands (Ruffo, 1958). North America: California (Shoemaker, 1936), Gulf coast, from Louisiana to Florida and South Carolina (Biernbaum, 1980; Bousfield, 1982). Brazil: Espírito Santo (Eutrópico and Krohling, 2013), Rio de Janeiro, São Paulo (Lemos de Castro, 1972; Lemos de Castro and Pereira, 1978; Matavelli *et al.*, 2009), Paraná (Lopes and Masunari, 2004a; 2004b), Minas Gerais, Santa Catarina and Rio Grande do Sul (present study) (Fig. 7).

*Ecology.* Found in forests of tropics, subtropics and warm temperate regions, and also from greenhouses of Europe and North America (Friend and Richardson, 1986). Most samples of the present study came from the tropical Serra do Mar Forests an ecoregion of the Brazilian Atlantic Forest, located in the south and southeastern coast of Brazil in states of Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Galindo-Leal and Câmara, 2005). *Talitroides topitotum* also seems to be associated with areas that were reforested with *Eucalyptus* spp., a culture that covers extensive areas in Brazil (Lopes and Masunari, 2004a). The individuals analyzed in present study were found between 0–1761m altitude.

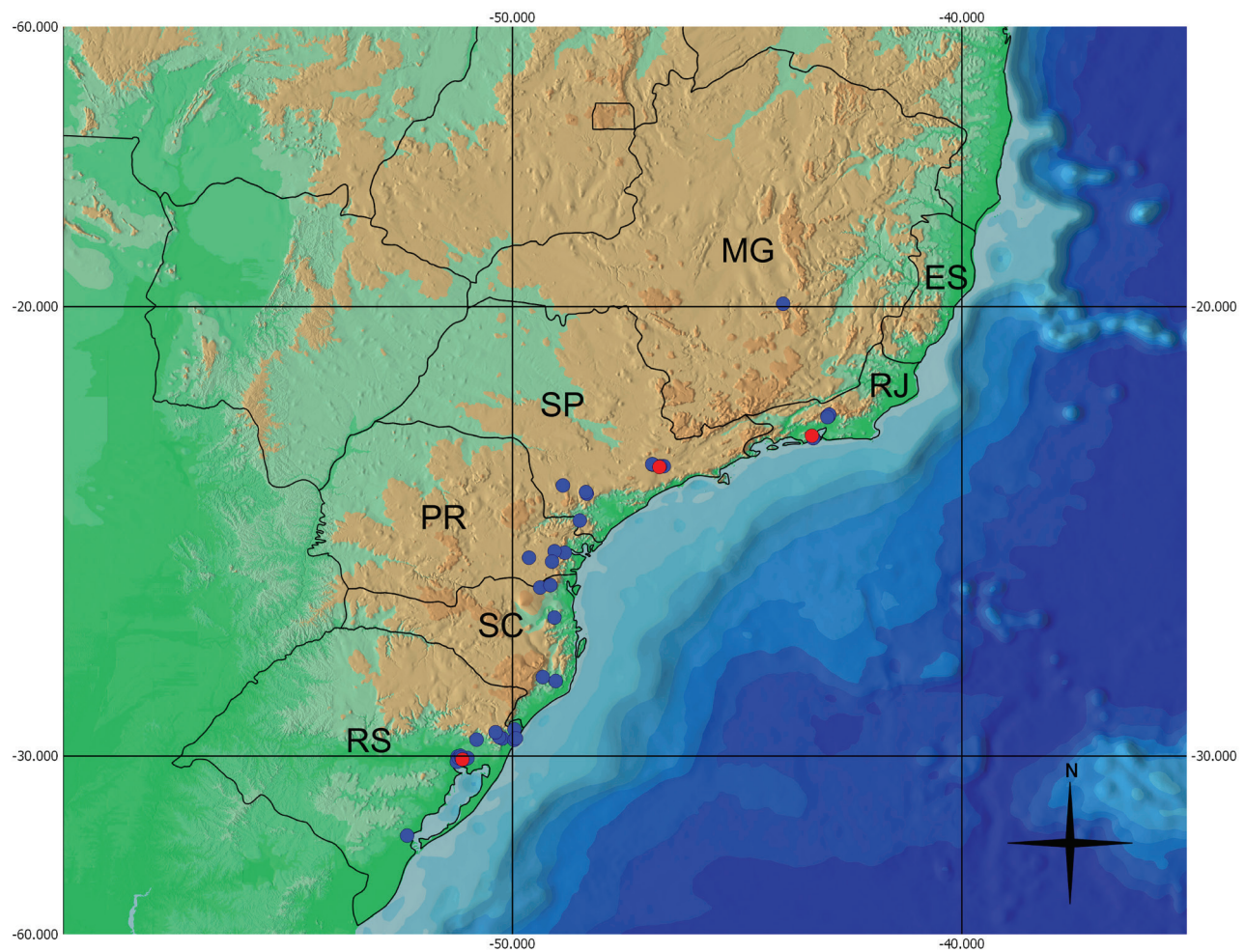
*Remarks.* The material examined generally agrees with previous descriptions of *T. topitotum* (Burt, 1934; Stephensen 1935; Morino, 2013) with few variations. Burt (1934) described the pleopod 3 with setae apically and on the peduncle. The specimens analyzed herein had no setae on pleopod 3, which agree with Stephensen (1935) and Shoemaker (1936) material. Morino (2013) described the peduncle of pleopod 3 with 1 robust sub-apical seta and 3 plumose apical setae in the reduced ramus. A variation in this character is shown by illustrations containing two robust setae on the peduncle and 1 plumose apical seta on the ramus (Morino, 2013). The number of setae can also vary on uropods. Richardson (1991) described peduncle of uropod 3 with 2 robust setae. Morino (2013) also found 2 robust setae on uropod 3, having noticed only two females with 3 robust setae. In the present study most individuals presented uropod 3 peduncle with 3 robust setae, agreeing with descriptions of other authors (Burt, 1934; Stephensen, 1935; Shoemaker, 1936; Hurley, 1955). Only few juveniles and young females had 2 robust setae. Morino (2013) described a dactylar dentition on pereopod 4 slightly weaker than that of *T. alluaudi*. Brazilian individuals of *T. topitotum* had no dactylar dentition on pereopod 4, although a slight prominence was noticed in 4 females (MNRJ 24811). However, these individuals were among the largest of the samples, reaching 15 mm. In any case, the dactyl of pereopod 4 is not like *T. alluaudi*, and this character is an important feature of differentiation between the two species (Tab. 2).

## DISCUSSION

### Female/Male Ratio

The present study showed that samples were composed of a vast majority of females, with only 6 males (4 from *Talitroides alluaudi* and 2 from *Talitroides topitotum*) found in the 51 samples (1787 individuals) analyzed. The small number of males in populations was observed in studies on reproductive biology in *T. topitotum* at Serra do Mar (Lopes and Masunari, 2004b; Matavelli *et al.*, 2009). Alvarez *et al.* (2000), also studied the reproductive biology of *T. topitotum* from Mexico and found that this species reproduced all year around, and noticed a female biased sex ratio in every sample with a maximum of 4:1 in May.





**Figure 7.** Distribution of *Talitroides topitotum* (Burt, 1934) (blue dots) and *T. alluaudi* (Chevreux, 1896) (red dots) based on samples from the Collection of Museu Nacional (MNRJ). States: MG, Minas Gerais; RJ, Rio de Janeiro; SP, São Paulo; PR, Paraná; SC, Santa Catarina; RS, Rio Grande do Sul.

**Table 2.** Morphological differences between *T. alluaudi* (Chevreux, 1896) and *T. topitotum* (Burt, 1934) based on literature and observed material.

|                       | <i>Talitroides alluaudi</i>                                           | <i>Talitroides topitotum</i>                                              |
|-----------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------|
| Antenna 2 flagellum   | 8–11 articles                                                         | 16–22 articles                                                            |
| Pereopod 4            | With dactylar dentition                                               | Lack dactylar dentition                                                   |
| Oostegite             | On pereopods 3–5                                                      | On pereopods 2–5                                                          |
| Coxal gill 6 L-shaped | Without lobes                                                         | With 2 lobes, one proximal and other in the angle between two projections |
| Pleopod 1             | Outer ramus with 7 articles; inner ramus with 2 articles              | Outer ramus with 14 articles; inner ramus with 7 articles                 |
| Pleopod 2             | Outer ramus with 6 articles; inner ramus 1-articulate                 | Outer ramus with 10 articles; inner ramus 4- articulate                   |
| Pleopod 3             | 1-articulate                                                          | 2-articulate with second article reduced                                  |
| Uropod 1              | Distolateral robust seta with simple apex                             | Distolateral robust seta with complex apex                                |
| Uropod 2 peduncle     | With 3 posterodorsal setae, the middle one longer                     | With 3 posterodorsal setae, the proximal one longer                       |
| Uropod 3 peduncle     | With 1 lateral robust seta                                            | With 3 lateral robust seta                                                |
| Uropod 3 ramus        | Reduced, conic, with 1 apical seta, not reaching distal end of telson | More elongated, with 2 apical setae, reaching distal end of telson        |
| Telson                | Distally rounded, lacking medial line                                 | Distally emarginate, with medial line                                     |
| Body length           | 4 to 7 mm                                                             | 5 to 15 mm                                                                |



### Comparison between *T. alluaudi* and *T. topitotum*

Based on the literature and observed material of *T. alluaudi* and *T. topitotum*, some distinguishing characters were selected between these species (Tab. 2). Characters 9 (posterodorsal setae of peduncle of uropod 2) and 12 (presence/absence medial line of telson) of table 2 are established in this study and should be considered in future taxonomic works. Other characters were discussed and compared with the observed material. Besides, the presence of a distal point on the inner plate of maxilla 2 noticed in *T. alluaudi* by Morino and Ortal (1993) was also observed in *T. topitotum* and should not be used as a distinguishing character between these species.

*Talitroides alluaudi* and *T. topitotum* have been recorded for the first time for the states of Rio de Janeiro and São Paulo about 40 years ago (Lemos de Castro, 1972; Lemos de Castro and Pereira, 1978). Later on, Lopes and Masunari (2004a; 2004b) studied the reproductive biology and distribution of *T. topitotum*, where 2191 specimens were found in a one year collection (1985 – 1986) between two altitudes 270 m and 720 m around the Guaricana Hydroelectric Usine, at Serra do Mar, state of Paraná. Eutrópico and Krohling (2013) recorded *T. topitotum* from coffee and *Eucalyptus* plantations in the state of Espírito Santo. Considering these previous records and from data of the present study, *T. topitotum* seems to be the dominant species in our forests and silviculture areas. From the 1787 individuals analyzed (51 samples) and deposited in the Museu Nacional, 94% were identified as *T. topitotum*. *Talitroides alluaudi* appeared in only 3 samples respectively from Rio de Janeiro (RJ), São Paulo (SP) and Rio Grande do Sul (RS), representing 6% of the total number of analyzed individuals. Also, *T. topitotum* showed high abundance within some samples (up to 201 specimens), indicating that this is a well-established species. On the other hand, *T. alluaudi* appeared in a very low abundance indicating the need of more sampling in the area to a better understanding of its establishment in the region.

Several studies indicate that *T. topitotum* can become a successful established species after introduction, even displacing native species (Biernbaum, 1980; Friend and Lam, 1985; Richardson, 1992). Richardson (1992) noticed in Hawaii that no terrestrial talitrids occurred in the lowest dry part of transects studied

and the first species to appear in leaf litter of forests (guava in about 300 m) were *T. topitotum* and *T. alluaudi*, the latter being less common. This author suggested the possibility that native species have been displaced by invasive species of the genus *Talitroides*. Richardson (1992) also concluded based on the reach of *Talitroides* spp. in drier habitats of lower altitude, that these species may have better desiccation tolerance and more easily be able to get moist refuges than native species. *Talitroides topitotum* and *T. alluaudi* have also been found in Hawaiian caves in sympatry with native species (Bousfield and Howarth, 1976).

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