

## ***Amanahyphes saguassu*, a new genus and species of LeptoHyphidae (Ephemeroptera: Ephemerelloidea) from northern Brazil**

FREDERICO F. SALLES<sup>1</sup> & CARLOS MOLINERI<sup>2</sup>

<sup>1</sup>*Museu de Entomologia, Departamento de Biologia Animal, Universidade Federal de Viçosa, MG, Brazil, and* <sup>2</sup>*INSUE-CONICET-Facultad de Ciencias Naturales, Universidad Nacional de Tucumán, Argentina*

### **Abstract**

*Amanahyphes saguassu* gen. et sp. n. from the Amazon basin is described and illustrated from all life stages. This is the second known genus in LeptoHyphidae to show divided eyes in the male, a rather infrequent characteristic in the family. Some defining characters of this new taxon include: adults dipterous, forewings with Cu-A lobe not enlarged, forceps bisegmented, and nymphs slender with very long legs, abdominal gills on segments II–V, and subquadrate operculate gills on abdominal segment II.

**Keywords:** *Amanahyphes saguassu*, new genus, taxonomy, Amazonia, Neotropics

### **Introduction**

The family LeptoHyphidae (Ephemeroptera) is endemic to the Western Hemisphere, and is one of the most representative groups of mayflies in South America. All of the leptoHyphid genera (Molineri & Zúñiga 2004; Emmerich 2004; Dias et al. 2005) are represented in South America. *LeptoHyphes*, *LeptoHyphodes*, *Macunahyphes*, *Traverhyphes*, *Tricorythodes*, and *Tricorythopsis* are recorded from Brazil (Molineri 2004; Salles et al. 2004).

Recently, during field trips in the city of Manaus and in bordering areas of Brazil's Amazon basin, an unusual nymph of LeptoHyphidae with enlarged eyes was found. After associating these nymphs with adults presenting the same character, we concluded that they represent a new genus and species.

In the present paper *Amanahyphes saguassu* gen. et sp. n. is described based on eggs, nymphs and adults to include these specimens.

### **Material and methods**

Collected material was preserved in 75% ethanol. Body parts of nymphs and adults were mounted on microscope slides in Canada balsam and drawn with a camera lucida attached to a stereo microscope. Eggs were extracted from a mature nymph, dehydrated in a graded ethanol

---

Correspondence: Frederico Falcão Salles, Universidade Federal de Viçosa, Museu de Entomologia, Departamento de Biologia Animal, CEP 36570-000, Viçosa, Minas Gerais, Brazil. Fax: +55 31 3899 2537. E-mail: ffsalles@gmail.com

series, dried by critical point-method, mounted on SEM stubs and sputter-coated with gold; then observed and photographed with a Zeiss VP30X scanning electron microscope. Terms used in descriptions of thorax are from Kluge (1992, 2004). Material deposition is abbreviated as follows: Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA), Instituto-Fundación Miguel Lillo, Tucúman, Argentina (IFML).

## Systematic account

### *Amanahyphes* Salles & Molineri, gen. n.

Type species: *Amanahyphes saguassu* Salles & Molineri, sp. n.

Included species: *Amanahyphes saguassu* Salles & Molineri, sp. n.

*Distribution.* Northern Brazil (Amazon basin).

*Etymology.* Arbitrary combination of the words “Amanã” (rain water) in the Tupi-guarani language, and the Greek suffix “hyphes” (reticulate or webbed), commonly used in leptohiphid generic names.

### *Description*

*Imago.* All appendages broken-off and lost; wings and body damaged.

*Male genitalia.* Forceps two-segmented, segments subequal in length, distal segment distally pointed (Figures 1–9); styliger plate posteriorly projected, forming a columnar base for each forceps (this may be confused with an additional forceps segment); penes dorsoventrally flattened, distal portion somewhat rounded laterally, with a median incision; lateral margins with many tiny spines on ventral side (Figure 9).

*Female* unknown.

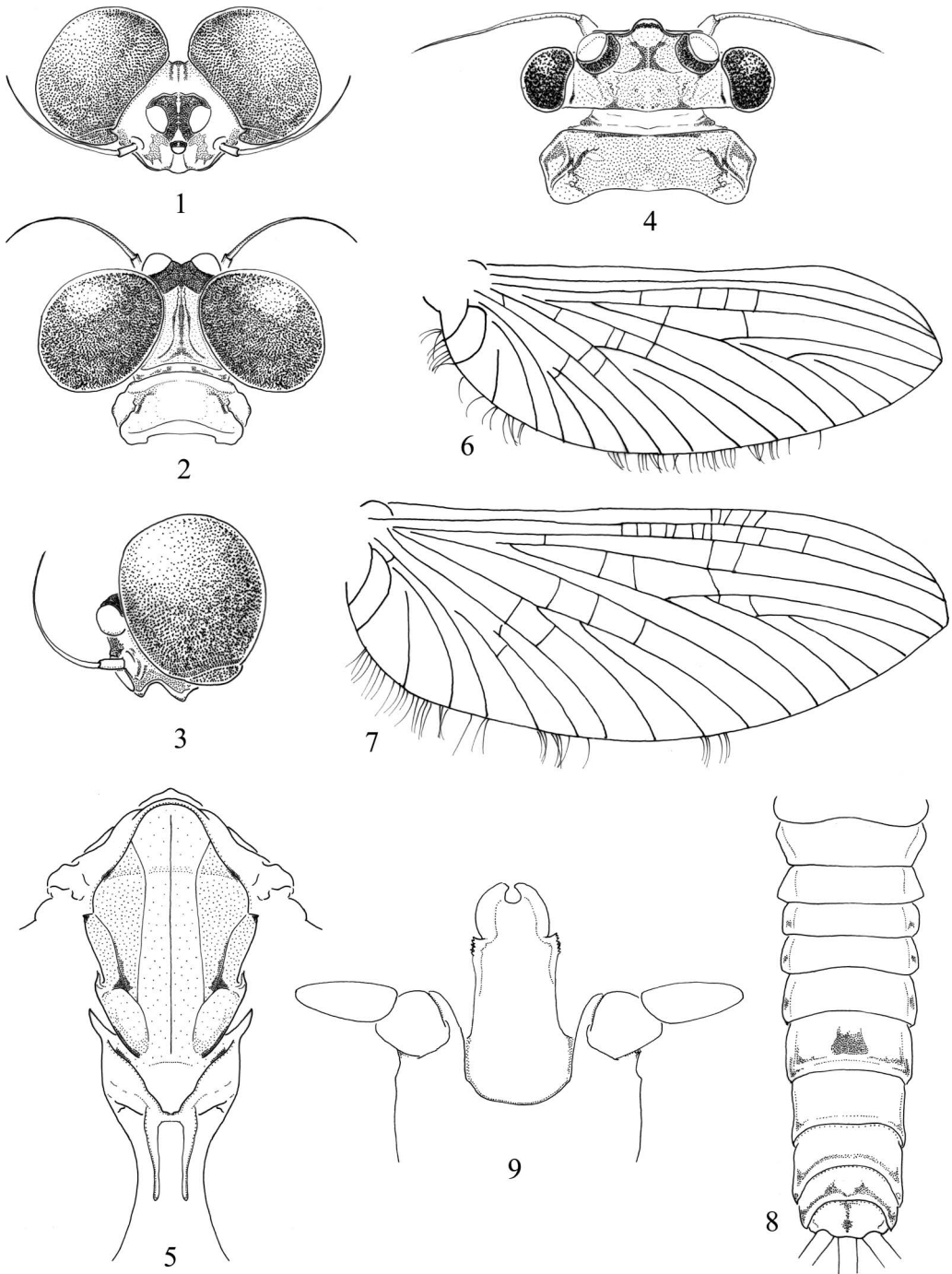
*Subimago.* Length of male: body, 2.8–3.5 mm; forewings, 3.5–3.9 mm. Length of female: body, 3.0–3.6 mm; forewings, 3.5–4.2.

*Head.* Eyes of male enlarged, divided in large upper and small lower portions (Figures 1–3); eyes of female undivided (Figure 4). Antennae. Scape short, pedicel 2.6 times length of scape; flagellum 6.7 times length of pedicel.

*Thorax* (Figure 5). Mesonotum with anterior and posterior parapsidal sutures running independently until transversal interscutal suture; sulcus absent; membranous filaments of mesoscutellum present, long.

*Wings.* Hind wings absent in both sexes. Forewings (Figures 6–7) without enlarged cubito-anal lobe, similar in both sexes; longitudinal veins IMP and MP<sub>2</sub> subequal in length, MP fork absent (MP<sub>2</sub> ending free in membrane); vein ICu<sub>1</sub> long and almost fused with CuP basally (almost forming a triad); vein CuP recurved and basally joined to vein A.

*Legs.* Ratios of male and female fore, middle and hind femora, 1 (0.55–0.6 mm): 1.3 : 1.2. Ratios of tibiae and tarsi (combined) of male, 1 (0.75–0.8 mm): 1.3 : 1.3–1.6, and of female



Figures 1–9. *Amanahyphes saguassu*, adult (all figures from subimagines, except when indicated). (1) Male head, frontal view; (2) same, d.v. (dorsal view); (3) same, l.v. (lateral view); (4) female head and pronotum, d.v.; (5) male mesonotum, d.v.; (6) male forewing; (7) female forewing; (8) male abdomen, d.v.; (9) male genitalia, d.v. (imago).

1 (0.9 mm): 1.3 : broken-off and lost. First tarsal segment partially fused with tibiae; tibiae not projected distally; tarsal claws of a pair dissimilar, one blunt and one apically hooked.

*Abdomen.* Male genitalia. Forceps two-segmented, short, penes with small apical furrow. Caudal filaments [broken-off and lost in female] shorter than body, cerci shorter than terminal filament, covered with small setae.

*Mature nymph* (Figure 10). Length of male: body, 3.4 mm; mesonotum, 0.7 mm; caudal filaments, 1.9 mm. Length of female: body, 3.4 mm; mesonotum, 0.6 mm; caudal filaments, 1.7 mm. Body relatively long and slender without tubercles.

*Head* hypognathous. *Antennae* with thin scape and pedicel, slightly wider than flagellum; scape 1/3 length of pedicel, flagellum slightly longer than head.

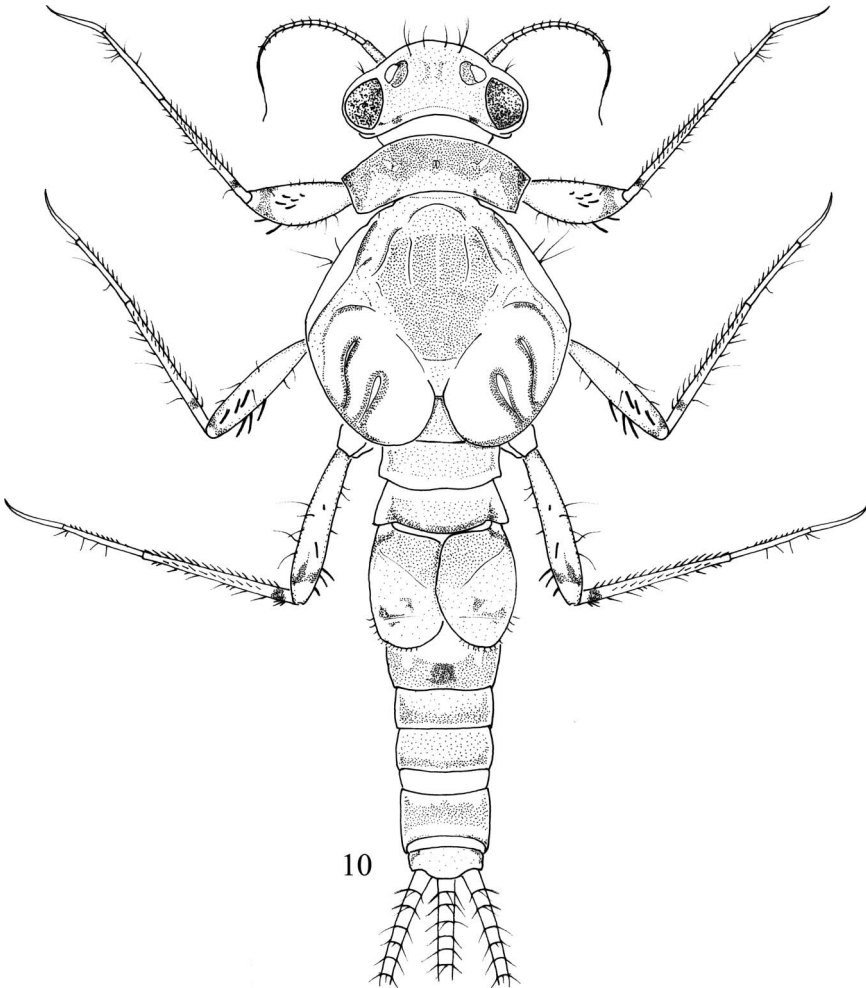


Figure 10. *Amanahyphes saguassu*, habitus of nymph.

*Mouthparts* (Figures 11–20). *Clypeus* and *labrum* of subequal width, anteromedian emargination of labrum shallow (Figure 11). *Hypopharynx* (Figure 12): lingua subrectangular with slightly concave anterior margin. *Mandibles* (Figures 13, 15, 29–32) with weakly curved outer margin and with a large ventral concavity near the apex; outer canines four-pointed, inner canines two-pointed (both with ventral brushes of small setae, Figure 30); left prosthema (Figures 14 and 32) with stout base and seven plumose setae apically, right prosthema slender with 3–4 plumose setae. *Maxillae* (Figures 16 and 33) long and slender, outer margin with thin setae on basal half; inner margin with a row of five marginal and one ventral long setae; galea and lacinia separated by a thin line; apex of galea (Figure 19) with two canines and with a brush of less than 20 curved setae; apex of lacinia with one canine, and with seven sharp setae (two larger than the rest, dentisetae) on the distomedial margin; maxillary palpi setiform located on a tiny palpifer (Figures 17 and 18). *Labium* (Figures 20 and 21): submentum laterally rounded with anterolateral corners projected and margins fringed with setae; prementum small, wider at base, glossae and paraglossae slightly differentiated (Figure 21); palpi three-segmented, apical segment constricted at middle.

*Thorax*. Pronotum sub-cylindrical, small, without anterolateral projections (Figure 10). Mesonotum wider than the rest of body (Figure 10), metanotum small without hind wing pads. *Legs* (Figures 10, 22, 23, 34, 35) very long and slender; dorsum of all femora with subdistal transversal band of long spatulate and apically fringed spines (Figure 36); mediolongitudinal rows of spines also present on dorsum of mid- and hind femora; tibiae with three longitudinal rows of spines (Figure 37); tarsi with longitudinal row of spines on inner margin; entire legs with scattered long and very thin twin-setae; tarsal claws (Figure 38) elongated, with a marginal row of 4–6 denticles near the base, and with a double row of 1–3 subapical submarginal denticles.

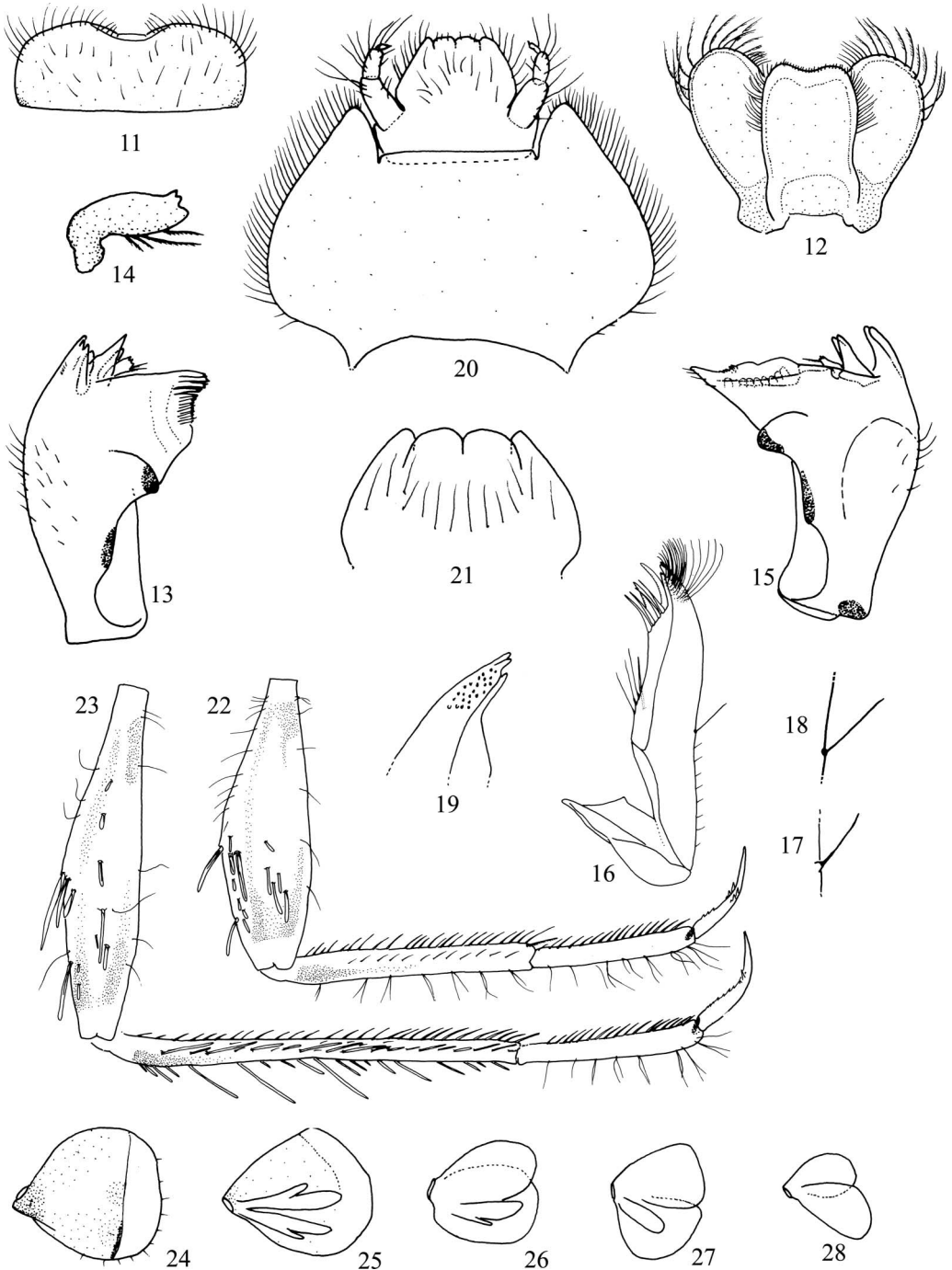
*Abdomen* (Figures 10 and 39) almost cylindrical, slightly wider at base, without lateral flanges or posterolateral spines; hind margins of terga II–V smooth (Figure 40), but with small spicules on terga VI–IX; bases of gills on segment II projected posteriorly (Figure 40).

*Gills* present on abdominal segments II–V, the first pair operculate completely covering the remaining gills (Figures 10, 39, 40); operculate gills subquadrate and broadly rounded apically, overlapping, with a transverse weaker line near apex (Figures 24, 39, 40), ventrally with two pairs of smaller lobes (Figure 25); gills on abdominal segments III, IV and V progressively smaller with 4, 3, and 2, lobes respectively (Figures 26–28). *Caudal filaments* with whorls of long spines at each articulation; terminal filament as long as cerci.

*Eggs* (Figures 41–43). Length: 168  $\mu\text{m}$ . Maximum width: 78  $\mu\text{m}$ . Ovoid, one polar cap present, polar cap (Figure 43) apically blunt or pointed. Egg surface completely covered by scale-like imbricated plates, these plates subrectangular to subtriangular with margins slightly elevated. On the uncapped pole a cap-like structure is present, formed by six large triangular plates tightly joined (Figure 42). Relatively long adhesive filaments present, scattered on egg surface, attached between the chorionic plates (more numerous on uncapped pole) (Figure 42).

### *Diagnosis*

Unique characters defining this genus in the imago are the male genitalia: penes with tiny ventral spines on subapical lateral margins (Figure 9); and in the nymphs: gills present on abdominal segments II–V, gill formulae 5/4/3/2 (Figures 25–28).

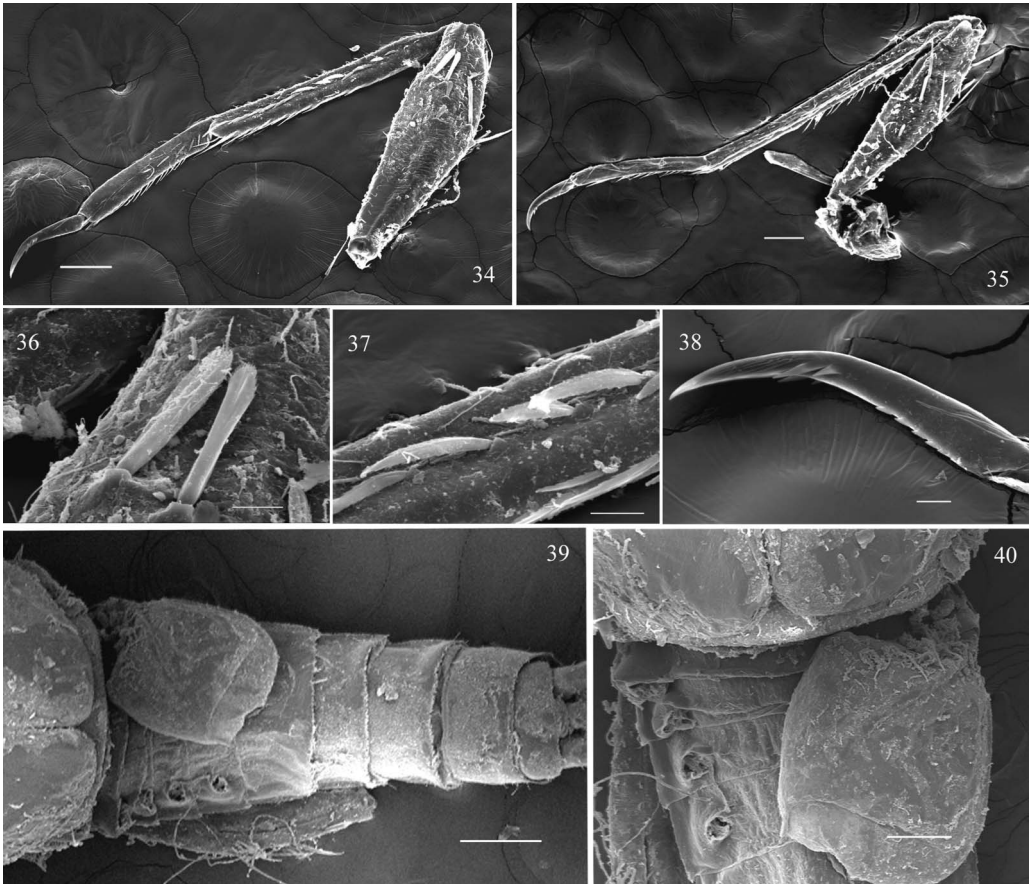


Figures 11–28. *Amanahyphes saguassu*, nymph. (11) Labrum, d.v.; (12) hypopharynx, v.v.; (13) left mandible, d.v.; (14) same, detail of prosthema; (15) right mandible, d.v.; (16) right maxillae, d.v.; (17–18) details of maxillary palp; (19) detail of apex of maxillae, d.v.; (20) labium, v.v.; (21) detail of glossae and paraglossae, v.v.; (22) foreleg; (23) hind leg; (24) gill 2, d.v.; (25) gill 2, v.v.; (26–28) gills 2–5, v.v.



Figures 29–33. *Amanahyphes saguassu*, SEM photographs. Nymphal mouthparts: (29) right mandible, v.v.; (30) same, detail of canines; (31) left mandible, v.v.; (32) same, detail of mola; (33) right maxillae, v.v. Scale bars = 30  $\mu$ m (Figures 29, 33), 10  $\mu$ m (Figures 30, 32), 20  $\mu$ m (Figure 31).

This genus can be distinguished from the other genera of the family by the following combination of characters. In the adults: (1) eyes of male enlarged, divided into upper and lower portions, both portions similar in color, blackish (Figures 1–3); (2) forewings widest medially, without marked sexual dimorphism (Figures 6 and 7); (3) hind wings absent in both sexes; (4) membranous filaments of mesoscutellum present, long (Figure 5); (5) styliiger posteriorly projected as a columnar base for each forceps (Figure 9); (6) forceps two-segmented (Figure 9); (7) penes fused except apical furrow (Figure 9), and with tiny spines on lateral ventral margin. In the nymphs: (1) maxillary palpi reduced, with two small segments, without apical seta (Figures 16–18, 33); (2) legs very long and slender (Figure 10); (3) gills present on abdominal segments II–V (Figures 25–28), lamellae of gills with entire margin (without a series of imbricated lobes as in *Leptohiphodes*); (4) operculate gills subquadrate and broadly rounded apically, touching on median line, with a weaker transverse line (Figures 24 and 40); (5) gill basket absent; (6) dorsum of femora of all legs with 5–7 spatulate spines, forming a subdistal transverse row (Figures 22, 23, 34, 35); (7) tarsal claws long and slender, with 4–6 marginal denticles and a double row of 1–3 submarginal denticles (Figure 38).



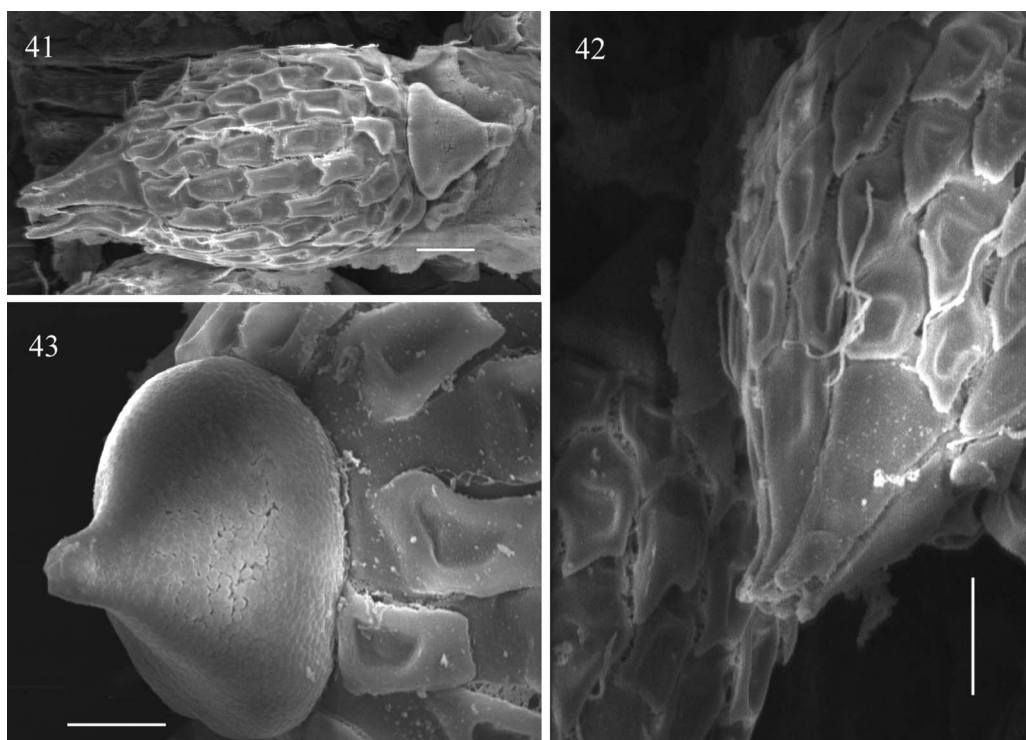
Figures 34–40. *Amanahyphes saguassu*, SEM photographs. Nymphal legs and abdomen: (34) foreleg; (35) hind leg; (36) detail of fore-femoral spines; (37) detail of foretibial spines; (38) detail of foretarsal claw; (39) abdomen, d.v. (left gills removed); (40) same, detail of operculate gill. Scale bars = 100  $\mu\text{m}$  (Figures 34, 35, 40), 200  $\mu\text{m}$  (Figure 39), 20  $\mu\text{m}$  (Figures 36–38).

### Discussion

*Amanahyphes* shows a striking assemblage of characters distinguishing it from other genera of Leptohiphidae. However, the forewing form and venation are similar to *Leptohiphodes* (an endemic Brazilian taxon); both genera also share similarities in the male genitalia (styliiger plate posteriorly projected, forceps form) and, most notably, large divided eyes in the male. As male imagines of *Amanahyphes* are badly damaged we could not confirm the shape of the foretarsal claws, the synapomorphic character of Leptohiphidae (Molineri et al. 2002), but we expect *Amanahyphes* to have this character state.

The nymphal mouthparts are similar to those of *Tricorythopsis*, as are the abdominal gills (operculate gills with transverse weak band and with four ventral lamellae, gills on III–V with similar gill formula). The absence of gills on abdominal segment VI is a feature shared with *Leptohiphodes* and *Coryphorus*. The legs are very long and the posterior margins of the gill-bearing segments are smooth, as in the group formed by *Leptohiphodes*, *Haplohyphes* and *Tricorythodes*.





Figures 41–43. *Amanahyphes saguassu*, SEM photographs. Eggs: (41) general aspect; (42) detail of uncapped pole; (43) detail of polar cap. Scale bars = 20  $\mu\text{m}$  (Figures 41, 42), 10  $\mu\text{m}$  (Figure 43).

The eggs are surprisingly similar to those of the African genus *Ephemerythus* (Ephemerythidae) (Sartori, pers. comm.), mainly by the presence of a conical cap-like structure on the uncapped pole, formed by elongated chorionic plates.

This set of shared characteristics suggests that *Amanahyphes* occupies a rather basal position in Leptoehyphidae. Preliminary cladistic analyses (Molineri, unpub. data) suggest that *Amanahyphes* constitutes the sister taxon of all other Leptoehyphidae except of *Tricorythopsis*.

### ***Amanahyphes saguassu* Salles & Molineri, sp. n.**

*Material examined.* Holotype ♂ subimago: Brazil, Amazonas state, Manaus, Reserva Florestal Adolpho Ducke, Igarapé do Tinga, light trap, 10–13.VI.2002, A.M.O. Pes leg (INPA).

*Paratypes.* Brazil, Amazonas state: 5 ♀ and 13 ♂ subimagines, same data as holotype (INPA); 2 ♂ imagines, same data as holotype, except Igarapé do Barro Branco, 16–20.IX.2002, M.J. Ferreira leg (INPA); 6 nymphs, Presidente Figueiredo, Igarapé do Sr. José, km 24, road AM 240, 9.X.2003, F.F. Salles leg (INPA); 1 nymph, Presidente Figueiredo, Igarapé Santa Cruz, 8.X.2003, F.F. Salles leg (IFML); 1 nymph, Presidente Figueiredo, Iracema Falls, 8.X.2003, F.F. Salles leg (IFML); two ♂ subimagines, 1 ♀ subimago, Presidente Figueiredo, 31/vi/2000, light trap, N. Hamada, J.L. Nessimian legs (IFML); 2 nymphs, Presidente Figueiredo, Igarapé da Onça, Balneário Sossego da Pantera, 7.X.2003, F.F. Salles leg (INPA).

*Etymology.* From *saguacu*, meaning “eyes enlarged” in the Tupi-guarani language. An allusion to the male’s compound eyes.

*Description*

*Male subimago* (in alcohol). General coloration yellowish shaded with grey.

*Head* whitish yellow shaded with black as in Figures 1 and 2, ocelli surrounded with black. Antennae whitish translucent.

*Thorax.* Pronotum and propleurae yellowish translucent slightly shaded with grey; prosternum yellowish shaded with grey. Mesonotum with mesoscutum yellow, anteronotal protuberance whitish yellow; submesoscutum and sublateroscutum yellowish entirely shaded with grey; posterior scutal protuberances yellow shaded with grey at posterior margin; mesoscutellum yellowish translucent; anterolateral corners of mesonotum, submesoscutum and sublateroscutum strongly shaded with grey. Metanotum yellow. Pleurae sclerites of pterothorax yellow, with several areas strongly shaded with grey, membranes whitish translucent. Mesosternum with basisternum brown, furcasternum yellowish light brown; median membranous zones of mesosternum whitish translucent. Metasternum whitish translucent.

*Legs.* Coxae of all legs yellow shaded with grey. Femora of all legs whitish slightly shaded with grey and with greyish subapical mark; forefemora darker than mid- and hind femora. Tibiae and tarsi of all legs whitish; tibiae with greyish basal mark.

*Wings* (Figure 6). Membrane and veins whitish; veins C and Sc of some individuals tinged with light brown.

*Abdomen* (Figure 8) translucent whitish yellow, except segments IX and X whitish yellow. Terga III–V with posterolateral blackish marks; tergum VI with posterolateral margins blackish, subtriangular blackish mark medially; posterior margins of terga VIII–IX blackish; tergum X shaded with black along midline. Abdominal sterna VI–IX shaded with grey, except midline of sterna VI–VII; other sterna translucent whitish. *Penes* and caudal filaments translucent whitish.

*Female subimago* (in alcohol). General colouration yellowish brown shaded with grey.

*Head* (Figure 4) completely shaded with grey. Antennae whitish translucent.

*Thorax.* Pronotum completely shaded with grey, with unpigmented and blackish marks as in Figure 4. Prosternum whitish slightly shaded with grey. Mesonotum brown shaded with grey, except anteronotal projection yellowish brown; sutures strongly shaded with grey. Metanotum brown shaded with grey (Figure 4). Mesosternum brown, membranous zone translucent. Metasternum translucent. Legs as male subimago, except grey shading more distinct. Wings (Figure 7). Membrane and veins whitish.

*Abdomen.* Translucent whitish yellow, almost completely shaded with grey, mid-region of tergum VI with subtriangular blackish mark. Abdominal sterna translucent whitish yellow, shaded with grey mainly on segments VI–IX. Caudal filaments whitish translucent shaded with grey.

*Mature nymph* (Figure 10). General colouration whitish yellow with grey to black markings. *Head* whitish yellow with irregular greyish marks between ocelli and blackish oblique band posterior to compound eyes. Antennae whitish translucent. Mouthparts yellowish.

*Thorax* whitish yellow shaded with grey, especially on anterior half of pro- and mesonotum; metanotum whitish yellow strongly shaded with grey. Thoracic pleurae and sterna whitish yellow, shaded with grey on pleurae. *Legs* whitish yellow with grey subapical mark on femora and grey basal mark on tibiae.

*Abdomen* whitish yellow shaded with grey on posterolateral regions of terga VI–IX; tergum I almost completely shaded with grey; median zone of tergum VI, and posterolateral corners of terga V and VI shaded with black; tergum X whitish yellow. Abdominal sterna with transverse greyish band.

*Gills*. Operculate lamellae whitish yellow shaded with grey as in Figure 24; remaining gills translucent whitish yellow. *Caudal filaments* whitish yellow with whorls of spines at articulations becoming longer towards the apex.

### *Diagnosis*

As this genus remains monospecific, those characters used in the generic section should also be used for specific diagnosis.

### *Biology*

The material of *Amanahyphes saguassu* is represented by 10 nymphs, and most of them were found inhabiting areas of the streams with a slow current. In Igarapé do Sr. José, nymphs were found among small roots and sand, together with several other nymphs of mayflies, such as *Coryphorus aquilus* Peters (Coryphoridae), *Tricorythodes* sp. (Leptohiphidae), *Apobaetis* sp., *Gloeodes auwe* Salles & Batista (Baetidae), *Farrodes* sp. (Leptophlebiidae). In Igarapé da Onça, Igarapé Santa Cruz and Iracema Falls, nymphs were found among aquatic vegetation. An attempt to collect more nymphs was made in November 2004, but only three very immature nymphs were found.

Subimagines were all caught in light traps, most in the Reserva Florestal Adolpho Ducke (INPA), an area of undisturbed *terra firme* forest, with little light penetration and streams from first to third order (Holzenthal & Pes 2004). Igarapé do Tinga is a third order stream where the subimagines were collected. In the same collection, undetermined adults of Baetidae and several imagines and subimagines of *Farrodes ochraceous* Domínguez, Molineri & Peters were caught.

### **Acknowledgements**

We are grateful to Núcleo de Microscopia e Microanálise da Universidade Federal de Viçosa, and Dr. José E. Serrão, for making available the scanning electron microscope, and to Dr. Maria José N. Ferreira and Dr. Neusa Hamada (Instituto Nacional de Pesquisas da Amazônia) for supplying some of the Brazilian specimens. The first author is also grateful to Neusa Hamada and Ana M. O. Pes for their assistance in collecting trips in Manaus and Presidente Figueiredo. We also thank the CNPq for providing funds to FFS to conduct doctoral studies at the Universidade Federal de Viçosa; and the CONICET for financial support to CM.

### **References**

- Emmerich D. 2004. Primer reporte de *Vacupernius* Wiersema & McCafferty 2000 (Ephemeroptera: Leptohiphidae) para América del Sur. *Entomotropica* 19(2):105–106.

- Dias LG, Salles FF, Molineri C. 2005. *Macunahyphes*: a New Genus for *Tricorythodes australis* (Ephemeroptera: Leptohiphidae). *Annales de Limnologie* 4(3):195–201.
- Holzenthal RW, Pes AMO. 2004. A new genus of long-horned caddisfly from the Amazon basin (Trichoptera: Leptoceridae: Grumichellini). *Zootaxa* 621:1–16.
- Kluge NJ. 1992. Redescription of *Leptohiphes eximius* EATON and diagnoses of the genera *Leptohiphes* and *Tricorythodes* based on the structure of pterothorax (Ephemeroptera: Tricorythidae, Leptohiphinae). *Opuscula zoologica fluminensia* 98:1–16.
- Kluge NJ. 2004. The phylogenetic system of Ephemeroptera. Dordrecht/Boston/London: Kluwer Academic Publishers. p 442.
- Molineri C. 2004. Phylogeny of the *Allenhyphes-Traverhyphes* group (Ephemeroptera: Leptohiphidae), with new subgenera, species and combinations. *Tijdschrift voor Entomologie* 147:197–220.
- Molineri C, Peters JG, Zúñiga de Cardoso, MC. 2002. A new family, Coryphoridae (Ephemeroptera: Ephemerelloidea), and description of the winged and egg stages of *Coryphorus*. *Insecta Mundi* 15:117–122.
- Molineri C, Zúñiga, MC. 2004. *Lumahyphes*, a new genus of Leptohiphidae (Ephemeroptera). *Aquatic Insects* 26(1):19–30.
- Salles FF, Da-Silva ER, Hubbard MD, Serrão JE. 2004. As espécies de Ephemeroptera (Insecta) registradas para o Brasil. *Biota Neotrópica* 4(2):1–34.