SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY
Leptohyphidae (Insecta: Ephemeroptera) from Northeastern Brazil

PV CRUZ, EL BELMONTE, R BOLDRINI, N HAMADA

Lab de Citotaxonomia e Insetos Aquáticos, Instituto Nacional de Pesquisas da Amazônia – INPA, 69011-970 Manaus, AM, Brasil

Keywords
Aquatic insect, Ephemerelloidea, Tricorythopsis, Tricorythodes

Abstract

New records of Leptohyphidae for Northeastern Brazil are provided. Previously, only Tricorythopsis bahiensis Dias, Salles & Ferreira had been recorded in this region, but we now record one species of Amanahyphes Salles & Molineri, one of Leptohyphes Eaton, three of Traverhyphes Molineri, three of Tricorythodes Ulmer, and seven of Tricorythopsis Traver. Two of these species are recorded for the first time in Brazil. As all of these species are reported, the Northeastern Brazil became the second most diverse geographic region in Brazil in Leptohyphidae.

Introduction

Leptohyphidae is considered to be one of the most diverse families of Ephemeroptera in South America, after Baetidae, Leptophlebiidae and Polymitarcyidae (Salles 2006). Leptohyphidae has a Pan-American distribution and is represented by approximately 138 species (Barber-James et al 2008), 35 of which, belonging to Amanahyphes, Leptohyphes, Leptohyphodes, Macunahyphes, Traverhyphes, Tricorythodes and Tricorythopsis, are reported for Brazil (Salles et al 2010a, b).

There is a lack of knowledge of the Ephemeroptera fauna in the Center-West and Northeastern Brazil, especially for the family Leptohyphidae (Salles et al 2004). The Northeast is one of the least sampled regions of Brazil, and consequently it has the most incipient taxonomic knowledge on Ephemeroptera when compared to the Southern and Southeastern Brazil (Lima et al 2010). In most cases, species distribution can only be accessed in often old and not easily accessible descriptive studies (e.g. Allen 1967, 1977). The lack of information of this nature limits the analysis of biogeographic patterns and precludes the development of regional identification keys and systematic studies. Therefore, our objective is to contribute to the increasing knowledge of the distribution of the Leptohyphidae fauna in Northeastern Brazil.

Material and Methods

Collections were done between July and August 2010 in four northeastern states of Brazil: Maranhão, Piauí, Ceará and Bahia. Additionally, samples collected in the state of Goiás, Center-West of Brazil, were included because the sampled area is located near the border with state of Bahia (Fig 1). Data pertaining to each sampled locality are provided in Table 1.

Nymphs were collected with an aquatic entomological net, while adults were captured with light traps. Specimens were fixed in 80% ethanol and permanent slides, whenever needed, were prepared in Euparal®. Species identification was based on Domínguez et al (2006) and Dias et al (2007a, b), but several relevant publications for each taxon were used as well (e.g. Molineri 2001a,b, Dias & Salles 2005, Salles & Molineri 2006). The photographs were taken using a Leica...
(M165C) stereomicroscope with a DFC420 digital camera.

Species that had only one specimen collected were deposited in the Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia – INPA, Manaus, Amazonas, Brazil. Species represented by several specimens also had specimens deposited in the Coleção de Invertebrados do Centro Universitário Norte do Espírito

Table 1 Sampled sites in Northeastern region of Brazil and in Goiás state near the border with Bahia state, followed by locality, geographic coordinates, date and collectors.

<table>
<thead>
<tr>
<th>Sample suite</th>
<th>State</th>
<th>Locality</th>
<th>Geographic coordinates</th>
<th>Date</th>
<th>Collectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT 01</td>
<td>Maranhão</td>
<td>Ribamar Riquente, MA-010, Rio Lajeado</td>
<td>06° 04' 15.6&quot;S 47° 22' 56.6&quot;W</td>
<td>21.vii.2010</td>
<td>NH, PVC, RB</td>
</tr>
<tr>
<td>PT 02</td>
<td>Maranhão</td>
<td>Porto Franco, MA-010, Rio Farinhas</td>
<td>06° 31' 47.3&quot;S 47° 28' 11.4&quot;W</td>
<td>22.vii.2010</td>
<td>NH, PVC, RB</td>
</tr>
<tr>
<td>PT 03</td>
<td>Maranhão</td>
<td>Carolina, Disable Hydroelectric, Rio Itapecuru</td>
<td>07° 24' 53.2&quot;S 47° 12' 54.9&quot;W</td>
<td>22.vii.2010</td>
<td>NH, PVC, RB</td>
</tr>
<tr>
<td>PT 04</td>
<td>Piauí</td>
<td>São João da Fronteira, Rio Jenipapo</td>
<td>04° 00' 15.8&quot;S 41° 26' 53.8&quot;W</td>
<td>26.vii.2010</td>
<td>NH, PVC, RB, RQ</td>
</tr>
<tr>
<td>PT 05</td>
<td>Ceará</td>
<td>Ubajara, Rio Jaburu, Boi Morto Waterfall</td>
<td>03° 52' 36.2&quot;S 41° 10' 0.08&quot;W</td>
<td>26.vii.2010</td>
<td>NH, PVC, RB, RQ</td>
</tr>
<tr>
<td>PT 06</td>
<td>Bahia</td>
<td>Camacan, Reserva Particular de Patrimônio Natural Serra Bonita</td>
<td>15° 22' 59.1&quot;S 39° 33' 21.2&quot;W</td>
<td>02.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 07</td>
<td>Bahia</td>
<td>Rio de Contas, Pico do Itobira, Rio Comburú</td>
<td>13° 24' 19.1&quot;S 41° 52' 53.9&quot;W</td>
<td>04.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 08</td>
<td>Bahia</td>
<td>Piatã, Rio de Contas</td>
<td>13° 07' 23.6&quot;S 41° 50' 14.1&quot;W</td>
<td>05.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 09</td>
<td>Bahia</td>
<td>Correntina, Rio Correntina, near the restaurant</td>
<td>13° 19' 59.6&quot;S 44° 36' 08.0&quot;W</td>
<td>07.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 10</td>
<td>Bahia</td>
<td>Correntina, Rio Correntina, near Posto Cachoeira</td>
<td>13° 31' 09.6&quot;S 45° 21' 01.8&quot;W</td>
<td>08.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 11</td>
<td>Goiás</td>
<td>Posse, Rio do Prata, Bahia/Goiás border</td>
<td>14° 14' 46.4&quot;S 46° 33' 07.0&quot;W</td>
<td>09.viii.2010</td>
<td>NH, RB, RQ</td>
</tr>
<tr>
<td>PT 12</td>
<td>Bahia</td>
<td>Correntina, Prainha community, Rio Arrojado</td>
<td>13° 31' 25.1&quot;S 44° 43' 30.7&quot;W</td>
<td>05.viii.2010</td>
<td>NH, FFS</td>
</tr>
</tbody>
</table>
Santo – CEUNES, São Mateus, Espírito Santo, Brazil.
For each species recorded, data on the known stages,
distribution with emphasis on Brazil, comments (if
necessary), and a list of examined material is provided.
Abbreviations and symbols used: “I” = imago, “N” =
nymph, “PT” = collection site.

Results
A total of 159 specimens belonging to 15 species in five
genera were collected.

Amanahyphes Salles & Molineri
Amanahyphes saguassu Salles & Molineri (2006) (Fig 2a)
Known stages. I ♂, N
Distribution. Brazil: states of Amazonas (Manaus and
Presidente Figueiredo municipalities) (Salles & Molineri
2006), Pará (Parauapebas municipality) (Gonçalves &
Da-Silva 2010); new record: state of Maranhão (Carolina
municipality).
Comments. This is a very common species in the states
of Amazonas and Pará, usually collected on roots with
sediment.
Material examined. PT3: (1N), 22.vii.2010, INPA.

Leptohyphes Eaton
Leptohyphes petersi Allen (1967) (Fig 2b)
Known stages. I ♀♂, N.
Distribution. Peru (Allen 1967); new record: Brazil: state
of Bahia (Camacan municipality).
Material examined. PT6: (4N), 02.viii.2010, two in INPA,
two in CEUNES.

Traverhyphes Molineri
Traverhyphes (Mocohyphes) edmundsi (Allen 1973) (Fig
2c)

Fig 2 Dorsal habits of nymphs: a) Amanahyphes
saguassu; b) Leptohyphes petersi; c) Traverhyphes
(Mocohyphes) edmundsi; d) Traverhyphes
(Mocohyphes) yuati; e) Traverhyphes
(Traverhyphes) indicator; f) Tricorythodes
mirza; g) Tricorythodes quizeri; h) Tricorythopsis
araponga; i) Tricorythopsis minimus; j)
Tricorythopsis pseudogibbus; k) Tricorythopsis
chiriguano.
Known stages. I ♀♂, N.


Material examined. PT1: (5N), 21.vii.2010; PT2: (3N), 22.vii.2010; PT6: (5N), 02.viii.2010; PT11: (1N), 09.viii.2010, seven in INPA, seven in CEUNES.

Traverhyphes (Mocohyphes) yuati Molineri (2004) (Fig 2d)

Known stages. N.

Distribution. Argentina (Molineri 2004); Brazil: states of São Paulo (Campos do Jordão, Salesópolis and Itaranga municipalities) (Molineri 2004, Dias et al. 2007b), Rio de Janeiro (Nova Friburgo and Itatiaia municipalities) (Molineri 2004, Dias et al. 2007a), Minas Gerais and Espírito Santo (Espírito Santo de José municipality) (Salles et al. 2010a); new records: states of Maranhão (Ribamar Riquente and Porto Franco municipalities), Piauí (São João da Fronteira municipality) and Goiás (Posse municipality).

Comments. The collected nymphs have a series of characteristics that deviate from the original description of T. yuati. However, according to Carlos Molineri (personal communication), nymphs of this species can have large morphological variation. The differences observed were: 1) coxae with black mark; 2) femur with subapical black mark dorsally and on outer and inner surface; 3) maxillary palp 2-segmented, very long, more than 2.5× longer than wide, with fine and long apical setae; 4) tarsal claws with 5-7 marginal denticles and 4+3-2 submarginal denticles, with apical setae.


Material examined. PT1: (8N), 21.vii.2010; PT2: (2N), 22.vii.2010; PT9: (4N), 07.viii.2010; PT10: (2N), 08.viii.2010; PT11: (1N), 09.viii.2010, seven in INPA, ten in CEUNES.

Material examined. PT1: (1N), 09.viii.2010, nine in INPA, eight in CEUNES.

Traverhyphes (Traverhyphes) indicator (Needham & Murphy 1924) (Fig 2e)

Known stages. I ♀♂, N.

Distribution. Argentina (Needham & Murphy 1924, Molineri 2001a), Uruguay (Traver 1958), Brazil: states of São Paulo (Ribeirão Preto, Ribeirão Grande and Itaranga municipalities) (Dias et al. 2007a,b) and Espírito Santo (Pinheiros municipality) (Salles et al. 2010a); new records: states of Maranhão (Ribamar Riquente and Porto Franco municipalities), Bahia (Correntina municipality) and Goiás (Posse municipality).

Material examined. PT1: (2N), 22.vii.2010; PT3 (3N), 22.vii.2010; PT5: (1I), 26.vii.2010, INPA.

Material examined. PT2: (2N), 22.vii.2010; PT3 (3N), 22.vii.2010; PT5: (1I), 26.vii.2010, INPA.

Tricorythodes Ulmer

Tricorythodes mirca Molineri (2002) (Fig 2f)

Known stages. I ♀♂, N.

Distribution. Bolivia (Molineri 2002); Brazil: states of Espírito Santo (São Mateus and Sooretama municipalities) (Salles et al. 2010a); new records: states of Maranham (Ribamar Riquente and Porto Franco municipalities) and Piauí (São João da Fronteira municipality).

Comments. Tricorythodes mirca and T. arequita T. have similar nymphs. Tricorythodes mirca has tarsi without black mark, while the nymph of T. arequita has tarsi with black mark. However, some of our T. mirca specimens have a small black mark on the tarsi. Other variations observed in the specimens collected in this study were: 1) tarsal claws with 8-11 marginal denticles, without submarginal denticles (as previously cited by Salles et al. 2010a); 2) maxillary palp with apical and subapical setae.


Tricorythodes quizeri Molineri (2002) (Fig 2g)

Known stages. I ♀♂, N.

Distribution. Bolivia (Molineri 2002); Brazil: state of Mato Grosso (Nova Xavantina municipality) (Dias et al. 2009); new record: state of Goiás state (Posse municipality).

Comments. Since the locality where the specimens were collected is near to the border with Bahia, it is likely that this species may also occurs in the latter state.

Material examined. PT11 (1N), 09.viii.2010, INPA.

Tricorythodes sp. 1

Known stages. N.

Distribution. new records: Brazil: states of Bahia (Correntina municipality) and Maranhão (Ribamar Riquente and Porto Franco municipalities).

Comments. It was not possible to identify the collected specimens. They probably represent an undescribed species.

Material examined. PT2 (2N), 22.vii.2010; PT3 (3N), 22.vii.2010; PT5: (1I), 26.vii.2010, INPA.
Tricorythopsis *Traver*

**Tricorythopsis araponga** Dias & Salles (2005) (Fig 2h)

*Known stages.* N.

**Distribution.** Brazil: states of Espírito Santo (Jerônimo Monteiro municipality) (Dias & Salles 2005), Minas Gerais (Araponga municipality) (Dias & Salles 2005), Rio de Janeiro (Itatiaia municipality) (Dias & Salles 2005), and São Paulo (Salesópolis municipality) (Dias & Salles 2005); *new record*: state of Bahia (Rio de Contas municipality).

**Comments.** The collected specimen has all diagnostic characteristics of *T. araponga*, except tarsal claw with 6-8 marginal denticles and 5-8+8-10 submarginal denticles.

**Material examined.** PT2 (1N), 22.vii.2010; PT9 (1N), 07.viii.2010, three in INPA, three in CEUNES.

---

**Tricorythopsis minimus** (Allen 1973) (Fig 2i)

*Known stages.* I ♀♂, N.

**Distribution.** Argentina (Molineri 2001b), Uruguay (Traver 1958), Brazil: states of Rio Grande do Sul (Panambi municipality) (Allen 1973) and Espírito Santo (Sooretama municipality) (Salles et al. 2010a); *new record*: state of Bahia (Correntina municipality).

**Material examined.** PT1 (4N), 21.vii.2010; PT12 (7N), 05.viii.2003, five in INPA, six in CEUNES.

---

**Tricorythopsis bahiensis** Dias, Salles & Ferreira (2008)

*Known stages.* N.

**Distribution.** Brazil: states of Roraima (Arraíá municipality) (Dias et al. 2008), Amazonas (Presidente Figueiredo municipality) (Dias et al. 2008), and Bahia (Correntina municipality) (Dias et al. 2008); *new record*: state of Maranhão (Ribamar Riquente municipality).

**Material examined.** PT1 (4N), 22.vii.2010; PT12 (7N), 05.viii.2003, seven in INPA, eight in CEUNES.

---

**Tricorythopsis pseudogibbus** Dias & Salles (2005) (Fig 2j)

*Known stages.* N.

**Distribution.** Brazil: states of Rio de Janeiro (Itatiaia municipality) (Dias & Salles 2005, Salles et al 2010a), Minas Gerais (Araponga municipality) (Dias & Salles 2005, Salles et al 2010a), and São Paulo (unknown municipality) (Mariano & Polegatto 2011); *new record*: state of Bahia (Rio de Contas municipality).

**Material examined.** PT7 (1N), 04.viii.2010, INPA.

---

**Tricorythopsis chiriguano** Molineri (2001a) (Fig 2k)

*Known stages.* I ♀♂, N.

**Distribution.** Bolivia (Molineri 2001a); *new record*: Brazil: state of Maranhão (Ribamar Riquente and Porto Franco municipalities).

**Comments.** *Tricorythopsis chiriguano* and *T. minimus* are very similar; the abdominal color pattern and length of operculate gills can be used to distinguish them.

**Material examined.** PT2 (1N), 22.vii.2010; PT3 (4N), 22.vii.2010, two in INPA, three in CEUNES.
species in five genera to the North and three species in two genera to the Center-West of Brazil.

Of the seven known Leptohyphidae genera recorded in Brazil, Macunahyphes and Leptohyphodes were the only ones missing from the Northeast. Two of the 15 species reported in this study represent new species records for Brazil: L. petersi, previously known only to Peru, and T. chiriguano only to Bolivia. One of the specimens collected (one imago represented by Traverhyphes (Traverhyphes) sp.1) could not be identified to the species level because of the poor conditions of specimen, but its record is important to the knowledge of the distribution of the genus in Brazil.

Our study reinforces the need to increase the sampling of aquatic insects in Brazil. We were able to considerably increase the number of known species for the Northeastern region, although the occurrence of a small number of streams and rivers sparsely distributed in our sampling area. Certainly, a larger collection effort, including more detailed samples in all of the biomes in the Northeast of Brazil would significantly increase our knowledge on the diversity of Ephemeroptera.

Acknowledgments

We thank Dr Carlos Molineri and Lidianne Salvatierra for all the help offered during the preparation of this paper, Dr Victor Becker allowed collection in the Serra Bonita RPPN, state of Bahia, Dr Ranyse Querino helped us during field work and Dr Philip M. Fearnside reviewed the manuscript. Financial support for travel was provided by CNPq and MCT-INPA-PP, and laboratory infrastructure was provided by the PRONEX-CNpq/FAPEAM project.

References

Leptohyphidae from Northeastern Brazil


