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UMA NOVA ESPECIE DE *CHIMARRA* STEPHENS, 1829 (TRICHOPTERA: PHILOPOTAMIDAE) E NOVOS REGISTROS PARA O RIO GRANDE DO NORTE, BRASIL

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Resumo

Trichoptera é mais diversa ordem de insetos exclusivamente aquáticos com cerca de 15.000 espécies descritas e distribuição cosmopolita. Na Região Neotropical, há cerca de 2.700 espécies descritas, destas, 725 têm ocorrência no Brasil, mas apenas 99 espécies destas registradas na região Nordeste do país. Nos últimos anos, o conhecimento da tricopterofauna desta região tem aumentado, porém há ainda grandes lacunas, entre elas o estado do Rio Grande do Norte com apenas um registro. Nesse contexto, o presente trabalho tem como objetivo identificar e ilustrar uma espécie nova de material proveniente do Rio Grande do Norte, além de apresentar novos registros para este estado. Os espécimes foram coletados entre 2004 e 2014 em três municípios do Rio Grande do Norte: Caicó (06º26'52,7"S, 37º08'23,8"W), Serra Negra do Norte (06º34'45,6"S, 37º15'20"W) e Portalegre (06º00'23"S, 38º02'35,8"W). Os espécimes foram coletados utilizando lençol e bandeja associados a luz UV/branca, armadilhas do tipo Malaise e rede entomológica, posteriormente armazenados em álcool 80%. As genitálias foram removidas e diafanizadas usando uma solução de KOH 10% e, posteriormente, armazenados em recipientes do tipo Eppendorf contendo glicerina. O material tipo será depositado no Museu de Zoologia da Universidade de São Paulo (São Paulo, Brasil) e Museu de Zoologia da Universidade Federal da Bahia (Salvador, Brasil). A nova espécie, *Chimarra* (*Chimarra*) *potiguar* pode ser distinguida dos congêneres pelas seguintes características: ápice do apêndice inferior possui uma projeção aguda, vista lateral; lóbulo lateral do segmento X com ápice arredondado, vista lateral; segmento X com ápice bifurcado, vista dorsal; segmento IX longo e estreito na região medial, vista dorsal. Adicionalmente, duas ~~novas~~ espécies foram registradas: *Smicridea* (*Smicridea*) *palifera* (Hydropsychidae) e *Cyrnellus fraternus* (Polycentropodidae) para o Rio Grande do Norte.

Abstract

Trichoptera Kirby, 1813 is the most diverse aquatic insect order with about 15.000 described species and cosmopolitan distribution. In Neotropics, 2.700 species have been described, 725 of these occur in Brazil, however only 99 species were recorded to Brazilian Northeastern region. Besides our know ledge on caddisfly fauna has been increased in the last years, there are some gaps, as Rio Grande do Norte state, with a single recorded caddisfly species. In this way, this study aims to identify and illustrate a new species from Rio Grande do Norte state as well present new records to this state. The specimens were collected between 2004 and 2014 in three municipalities of Rio Grande do Norte: Caicó (06°26'37" S, 52.7°08'23.8" W), Serra Negra do Norte (06°34'45.6" S, 37°15'20" W) and Portalegre (06°00'23"S, 38°02'35.8" W). Adults were collected using light attraction, UV light pan traps, Malaise traps, and entomological nets. The collected material was preserved in 80% ethanol. The genitalia were removed and cleared using a 10% KOH solution, and stored in microvials with glycerin. The types will be deposited at the Museu de Zoologia, Universidade de São Paulo (São Paulo, Brasil) and Museu de Zoologia da Universidade Federal da Bahia (Salvador, Brasil). A new species, *Chimarra* (*Chimarra*) *potiguar*, is described and illustrated. The new species can be easily distinguished from congeners by the following features: an acute projection on the inferior appendage apex, lateral view; lateral lobe of segment X with rounded apex, lateral view; segment X with apex bifid, dorsal view; segment IX long and narrow in the medial region, dorsal view. Additionally, two other species were recorded, *Smicridea* (*Smicridea*) *palifera* (Hydropsychidae) and *Cyrnellus fraternus* (Polycentropodidae), to Rio Grande do Norte state.

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Índice

Introdução Geral

Trichoptera é a mais diversa ordem de insetos exclusivamente aquáticos com cerca de 15.000 espécies descritas e distribuição cosmopolita (Morse, 2016). Na Região Neotropical, há cerca de 2.700 espécies descritas, 725 destas com ocorrência para o Brasil (Santos *et al*., 2016).

Estes insetos fazem parte do clado Holometabola, organismos com metamorfose completa, passando pelo estagio de larva, pupa e adulto. Vivem a maior parte de suas vidas (fases larvais e pupa) em corpos d'água, principalmente em ambientes lóticos; existem também, algumas espécies marinhas como, por exemplo, Chatamiidae na região Australiana (Calor, 2007). As espécies da ordem constituem uma parte importante da comunidade de macroinvertebrados bentônicos e, geralmente, são intolerantes à poluição, um fator que facilita a sua utilização em programas de biomonitoramento de água doce (Morse, 1997).

Trichoptera é grupo-irmão de Lepidoptera, constituindo a superordem Amphiesmenoptera. Este clado possui mais de 20 sinapomorfias (Kristensen, 1984). A parede semipermeável do casulo da pupa, sinapomorfia de Trichoptera, provavelmente tem relação intima com a invasão do ambiente aquático pelos ancentrais da ordem. Como Lepidoptera, os adultos de Trichoptera são terrestres e têm suas asas cobertas com cerdas (secundariamente modificadas em escamas no caso dos Lepidoptera) e as larvas produzem seda, que são usadas na construção de retiros, redes e casas portáteis. Essa adaptação foi fundamental no sucesso evolutivo, bem como na diversidade ecológica da ordem como um todo (Holzenthal *et al.*, 2007; Mackay & Wiggins, 1979).

A ordem Trichoptera esta bem posicionada na filogenia de Insecta, possuindo alta estabilidade como grupo irmão de Lepidoptera, como visto anteriormente, porém as relações dentro do clado tem sido bastante discutidas.

Trichoptera era tradicionalmente dividida em três subordens, baseada na morfologia e o comportamento de adultos e imaturos: Annulipalppia Martynov,

1924, Integripalpia Martynov, 1924 e Spicipalpia Wiggins & Wichard, 1989 (Malm *et al.,* 2013). As subordens Annulipalpia e Integripalpia constituem grupos monofiléticos fortemente corroborados, porém a monofilia e o posicionamento das famílias da subordem Spicipalpia tem sido bastante questionados (Malm *et al.,* 2013). Spicipalpia já foi considerado como grupo-irmão de Annulipalpia (Weaver & Morse, 1986) e, posteriormente, como grupo-irmão de Annulipalpia + Integripalpia (Wiggins & Wichard, 1989). No trabalho de Malm *et al.* (2013), as famílias de Spicipalpia não formam um grupo monofilético e, portanto, apenas Annulipalpia e Integripalpia são considerados táxons válidos.

A subordem Annulipalpia apresenta 12 famílias, ocorrendo apenas cinco no Brasil (Ecnomidae Ulmer, 1903; Hydropsychidae Curtis, 1835; Philopotamidae Stephens, 1829; Polycentropodidae Ulmer, 1903; Xiphocentronidae Ross, 1949). Por sua vez, a subordem Integripalpia apresenta 36 famílias, sendo 11 registradas para o Brasil. Na Região Nordeste, até o ano de 2014 haviam sido registradas 78 espécies de Trichoptera (3 para o Piauí, 13 Ceará, 5 Paraíba, 2 Pernambuco, 1 Sergipe e 54 Bahia) (Costa *et al.*, 2014). Atualmente 99 espécies são registradas para o Nordeste (Santos *et al.*, 2016). Algumas regiões têm suas faunas menos conhecidas do que outras e a falta de conhecimento da fauna de tricópteros na Região Nordeste tem sido bastante relatada (e.g., Calor, 2011;). Segundo Costa *et al.* (2014), o conhecimento da diversidade taxonômica de Trichoptera tem aumentado, das 16 famílias registradas no Brasil (algumas delas com apenas um gênero e/ou bastante restritas geograficamente), 11 delas são registradas no semiárido nordestino. É perceptível que região não é pouco diversa, e que a concentração de grupos de pesquisa em taxonomia nas regiões Sul e Sudeste repercutiu no melhor conhecimento da tricopterofauna daquelas regiões.

Atualmente, com a implementação de grupos e programas de pesquisas (*e.g.* Programa de Pesquisa em Biodiversidade no Semiárido - PPBio), o número de registros para a referida região vem crescendo, mas algumas lacunas ainda persistem, caso do estado do Rio Grande do Norte, que apresenta um único registro, *Oecetis excisa* Ulmer, 1907 (Quinteiro & Calor, 2015).

Dentre as famílias com ocorrência no Brasil, Philopotamidae é uma das mais diversas e tem distribuição cosmopolita, com aproximadamente 1.270 espécies descritas em 19 gêneros (Vilarino & Calor, 2015). A família é dividida em três subfamílias: Rossodinae Özdikmen & Darilmaz, 2008 (16 espécies); Philopotaminae Stephens, 1829 (cerca de 400 espécies) e Chimarrinae Rambur, 1842 (cerca de 800 espécies), a mais diversa subfamília. Esta última subfamília contém três gêneros: *Chimarra* Stephens 1829, *Chimarrhodella* Lestage 1925 and *Edidiehlia* Malicky 1993 (Vilarino & Calor, 2015; Wahlberg & Johanson, 2014).

Chimarra, o maior gênero da família, apresenta cerca de 780 espécies descritas para o mundo (Wahlberg *et al.,* 2014) e está classificado em quatro subgêneros: *Chimarra* Stephens, 1829; *Curgia* Walker, 1860; *Chimarrita* Blahnik, 1997 e *Otarrha* Blahnik, 2002 (Vilarino & Calor, 2015). No Brasil, 45 espécies são conhecidas, 27 do subgênero *Curgia,* duas de *Otarrha,* três de *Chimarra,* 12 de *Chimarrita* e a *incertae sedis Chimarra usitatissima* Flint, 1971 (Vilarino & Calor, 2015).

O subgênero *Chimarra*, por sua vez, pode ser diagnosticado por possuir asas anteriores com veias com curvatura conspícua e com inflexão antes da célula discal; ramificação assimétrica e ramo posterior mais desviado (Blahnik, 1998).

No presente trabalho, uma nova espécie, *Chimarra* (*Chimarra*) *potiguar* **n. sp.**, é descrita e ilustrada, assim como duas espécies são registradas para o estado Rio Grande do Norte.

CAPITULO I

Este capítulo apresenta o manuscrito intitulado: “A new species of *Chimarra* Stephens, 1829 (Trichoptera: Philopotamidae) and new records to Rio Grande do Norte state, Brazil”, a ser submetido para o periódico científico *Zootaxa.*

A new species of *Chimarra* Stephens, 1829 (Trichoptera: Philopotamidae) and new records to Rio Grande do Norte state, Brazil

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Abstract

Trichoptera is the largest order of exclusively aquatic insects, comprises about 15,000 described species and presents a cosmopolitan distribution. There are 725 species recorded from Brazil, but the distribution of knowledge is concentrated in part of Amazon, and Southeast and South regions. Among the states of the Brazilian Northeast region, Rio Grande do Norte state has only one species recorded of the order (*Oecetis excisa* Ulmer, 1907). A new species, *Chimarra* (*Chimarra*) *potiguar*, is described and illustrated. The new species can be easily distinguished from congeners by the following features: It has an acute projection on the inferior appendage apex, in lateral view; lateral lobo of segment X with rounded apex in lateral view; segment X with apex

bifid in dorsal view; segment IX long and narrow in the medial region in dorsal view. Two species are also recorded for the first time to state: *Smicridea* (*Smicridea*) *palifera* (Hydropsychidae) and *Cyrnellus fraternus* (Polycentropodidae).

Keywords: aquatic insects; caddisfly; distributional notes; Neotropics; taxonomy.

Introduction

Trichoptera is the most species-rich clade of exclusively aquatic insects with 15.000 species described with cosmopolitan distribution (Morse 2016). In the Neotropical region are described 2,609 species (Dias *et al.* 2015) with 725 occurring in Brazil, distributed in 70 genera and 16 families (Santos *et al.* 2016). Trichoptera records in the Brazil are concentrated in the North, Southeast and South regions (Calor 2011). In Brazilian Northeast region, only 99 caddisfly species have been recorded (Santos *et al.* 2016), however Rio Grande do Norte state has only one species recorded of the order (*Oecetis excisa* Ulmer 1907) (Quinteiro & Calor 2015).

Philopotamidae is a cosmopolitan family with approximately 1,270 described species in 19 extant genera (Vilarino & Calor 2015). The family is divided into three sub-families: Rossodinae Özdikmen & Darilmaz 2008 (16 species), Philopotaminae Stephens 1829 (circa 400 species) and Chimarrinae Rambur 1842. This latter has about 800 species and three genera: *Chimarra* Stephens 1829, *Chimarrhodella* Lestage 1925 and *Edidiehlia* Malicky 1993 (Vilarino & Calor 2015; Wahlberg & Johanson 2014).

Chimarra is the second largest genus in the order presenting around780 described species (Wahlberg *et al.* 2014). Four subgenera are recognized in *Chimarra*: *Chimarra*

Stephens 1829 (102 species), *Chimarrita* Blahnik 1997 (20 species), *Curgia* Walker 1860 (93 species) and *Otarrha* Blahnik 2002 (32 species). In Brazil, there are 45 recorded species in the *Chimarra*, 27 of these in the subgenus *Curgia*, 2 in *Otarrha*, 3 in *Chimarra*, 12 in *Chimarrita*, and the *incertae sedis C. usitatissima* Flint 1971(Vilarino & Calor 2015). The subgenus *Chimarra* has vein of wings with stem with conspicuous curvature of inflection before discal cell; branching asymmetric, posterior branch more deflected (Blahnik 1998).

In this paper, *Chimarra* (*Chimara*) *potiguar* **n. sp.** is described and illustrated. Additionally, two other species are also recorded for the first time to Rio Grande do Norte state, Brazil.

Material and methods

~~*Study area*~~

The Semi-arid biome has a total area of 982,563km^2 and extends in Brazil from the Northeast states (except Maranhão) to the north of Minas Gerais state. In Northeast Region, the semi-arid is characterized by the occurrence of Caatinga biome. The semi-arid biome constitutes 93,4% of the territory of Rio Grande do Norte state IBGE 2016).

The specimens were collected in 2004 to 2014 in three municipalities of Rio Grande do Norte state: Caicó (06º26’52,7” S, 37º08’23,8” W), Serra Negra do Norte (06º34’45,6” S, 37º15’20” W) and Portalegre (06º00’23” S, 38º02’35,8” W), as indicated in material examined.

~~Collecting methods~~

Adults were collected using light traps, UV light pan traps (Calor & Mariano 2012), Malaise traps, and entomological nets. The collected material was preserved in 80% ethanol or pinned. The genitalia were removed and cleared using a 10% KOH solution, and stored in microvials containing glycerin, as discussed by Holzenthal & Andersen (2004) and Blahnik & Holzenthal (2004).

The specimens were illustrated using a microscope with a camera lucida. The pencil templates were traced with Adobe® Illustrator® CS 5 and the tracings refined with Adobe Photoshop ® CS 5. Morphological terminology follows Blahnik (1997).

The type material will be deposited in the Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZSP) and in the Collection of Aquatic Insects, Museu de Zoologia da Universidade Federal da Bahia, Salvador, Bahia, Brazil (UFBA), as indicated in the material examined section.

TAXONOMY

***Chimarra potiguar*, new species**

(Fig. 1)

Diagnosis. The new species differs from your congeners by the following characters: inferior appendage with an acute projection on the apex, in lateral view; lateral lobe of segment X with rounded apex in lateral view; segment X with bifid apex in dorsal view; segment IX long and narrow in the medial region in dorsal view. This species is very similar to *Chimarra* (*Chimarra*) *caribea caribea* Flint 1968 mainly by the general shape

of tergum X (divided into two side lobes, the ventral lobe is bigger than the dorsal one) and inferior appendage (long, rounded basal region and wide, mesally narrower and curve). This species can be distinguished from *Chimarra* (*C.*) *caribea* by the inferior appendage format, that presents an acute apex in the new species. Additionally, in *C.* (*Chimarra*) *caribea Chimarra caribea* presents a subapical projection on inferior appendage, however the new species does not present this projection; lateral lobe of segment X with rouded apex, unlike *C*. (*Chimarra*) *caribea* is acute and with sensillae; phallotheca with projection acute and branched, has no branch *C.* (*Chimarra*) *caribea.*

Description. Forewing length 4.04 – 4.40 mm (males, n= 5), hindwing length 2.97–3.26 mm (males, n= 5).

Head. Posterior setal head elongated and narrow warts. Thorax, color dark brown (alcohol). Palps, second segment of maxillary palp with setae and somewhat shorter than 3rd segment. Forewing, Rs straight, touching the C and 4-branched; M3-branched (M_1, $M_2$and M_3+M_4); Cu2 pigmented; 2A forked to 1A and 3A; 1A and 3A touching medially (Fig. 1A). Hind wing, Sc pigmented, R1 straight; Rs 4-branched; M 3-branched; 1A fused to 2A (Fig. 1B).

Abdomen. Segment IX anteroventral enlarged region, anterobasal margin rounded in lateral view. Ventral process rounded (Fig. 1C). Segment X long, lateral lobo forked to the mesal region in dorsal view (Fig. 1D); dorsal part with rounded apex and ventral slightly larger than the dorsal and curve in lateral view (Fig. 1C). Inferior Appendage long, rounded basal region and wide, mesally narrower and curved with acute projection on the inferior appendage apex (Fig.1G). Phallotheca tubular, with apicoventral projection, acute and forked, endotheca elongate, tubular; phallic spine two (Figs.1E, F).

Female and immatures. Unknown.

Holotype male: BRAZIL: Rio Grande do Norte, Portalegre, Córrego do Pinga, UV light pantrap, 06º01’31’’S, 37º59’31.4’’W, 26.IV.2014, Dias, E.S. & Duarte, T.S.

Paratypes: same data as holotype, except Cachoeira do Pinga, 06º01’27’’S, 37º59’31.8’’W – 3 males (alcohol, MZUSP); same data, except Cachoeira do Pinga, 06º01’27’’S, 37º59’31.8’’W, 29.IV.2014, Cordeiro, D.; Menezes, M. & Nascimento, F. E. –1 male (alcohol, UFBA); same data, except Cachoeira do Pinga, 06º01’27’’S, 37º59’31.8’’W, 29.IV.2014 – 2 males (alcohol, UFBA); same data, except Cachoeira do Pinga, 06º01’27’’S, 37º59’31.8’’W, 29.IV.2014, Bravo, F. R.Q.; Carvalho, J.; Cordeiro, D.; Menezes, M. & Nascimento; F.E.- 3 males (alcohol, UFBA); same data, except Cachoeira do Pinga, 06º01’27’’S, 37º59’31.8’’W, 29.IV.2014 – 5 males (alcohol, UFBA).

Distribution. Brazil (Rio Grande do Norte).

Etymology. Potiguar is a designation given to those born in the state of Rio Grande do Norte due to a large Tupi tribe that inhabited the coastal region of what are now the states of Rio Grande do Norte and Paraíba.

New records of caddisflies from Rio Grande do Norte, Brazil

HYDROPSYCHIDAE

***Smicridea* (*Smicridea*) *palifera* Flint, 1981**

Material examined: BRAZIL: Rio Grande do Norte, Portalegre, Córrego da Bica, 6º01'10''S, 37º59'31,7''W, UV light pantrap, 25.IV.2014, Dias, E.S. & Duarte, T.S. –7 males (alcohol, UFBA).

Remarks. *Smicridea palifera* occurs in Brazil (Mato Grosso; Rio de Janeiro; Roraimaand Rio Grande do Norte, new record), and Venezuela.

POLYCENTROPODIDAE

***Cyrnellus fraternus* Banks 1905**

Material examined: BRAZIL:Rio Grande do Norte, Caicó, Ponte do Rio Sabugi, 06º26'52,7'' S, 37º08'23,8" W, el. 141 m,27.VII.2009, UV Light Pan trap, Calor A.R. & Lecci L.S.– 1 male (alcohol, UFBA); same data, except Serra Negra do Norte, E. E. do Seridó, Açude dos Campos, 06º34'45,6"S, 37º15'20" W, el. 205 m, 27.VII.2009 – 15 males (alcohol, UFBA).

Remarks. *Cyrnellus fraternus* presents a wide distribution from U.S.A. to Argentina, including records to Costa Rica, Ecuador, El Salvador, Mexico, Nicaragua, Panama, Paraguay, Suriname, Uruguay and Venezuela. In Brazil, this species has been recorded to states of Amazonas, Bahia, Espírito Santo, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Pará, Paraná, Rio de Janeiro, Santa Catarina, and Rio Grande do Norte (new records).

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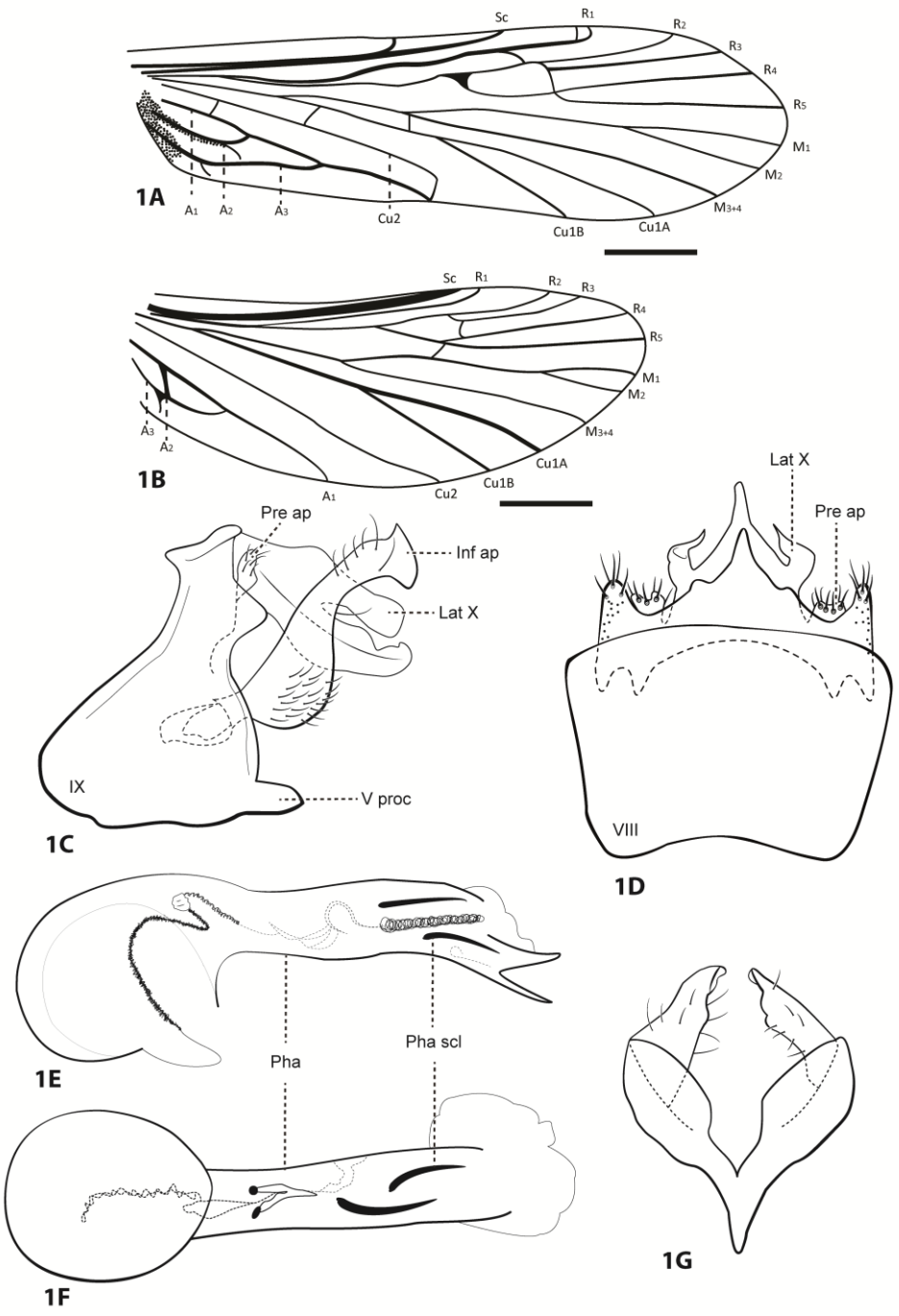
Legends of Figures

Figura 1. *Chimarra* (*Chimarra*) *potiguar*, **n. sp.**, male. A, right forewing , dorsal; B, left hin dwing , dorsal; C, genitalia, lateral; D, genitalia, ventral; E, phallotheca, lateral; F, phallotheca, ventral; G, inferior appendage, ventral. Abbreviations: A = Anal veins 1–4; Cu = Cubital veins 1–2; M = Medial veins 1–4; R = Radial veins 1–5; Sc = Subcosta vein l; IX = abdominal segment IX; VIII = abdominal segment VIII; Lat X = Lateral segment of the segment x ; Inf ap = Inferior appendage; Pha scl = Phatoltremal sclerite; Pha = Phallotheca; Pre ap = Preanal appendage; V proc = ventral process of segment IX.


Sc
R1
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R5
M1
M2
M3+4
Cu1A
Cu1B
Cu2
A1
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A3
1A
1B
Pre ap
Inf ap
Lat X
V proc
IX
1C
Lat X
Pre ap
VIII
1D
Pha
Pha scl
1E
1F
1G

Considerações Finais

A região Nordeste do Brasil ao longo dos anos tem recebido pouca atenção por parte dos taxonomistas, em especial os tricopterólogos, isso repercutiu diretamente no número de registros da ordem para a referida região. Nos últimos anos, com o implemento de grupos de pesquisa e programas que tem como finalidade o levantamento de fauna da Região Nordeste (e.g. o Programa de Pesquisa em Diversidade no Semiárido – PPBio) este quadro vem mudando. Entre 2014 e 2015, por exemplo, o número de registros da ordem aumentou de 78 para 120 espécies (Quinteiro & Calor, 2015). O Rio Grande do Norte foi um dos estados com menor número de acréscimo, possuindo apenas um registro, *Oecetis excisa* Ulmer, 1907. Com o presente trabalho o Rio Grande do Norte passa a apresentar mais três registros: *Chimarra* (*Chimarra*) *potiguar* **sp. n.** *(Philopotamidae); Smicridea* (*Smicridea*) *palifera* (Hydropsychidae) e *Cyrnellus fraternus* (Polycentropodidae), contribuindo para o aumento do conhecimento da tricopterofauna.

Cyrnellus fraternus apresenta uma ampla distribuição dos Estados Unidos à Argentina, incluindo registros também para Costa Rica, Equador, El Salvador, México, Nicaragua, Panamá, Paraguai, Suriname, Uruguai e Venezuela. No Brasil, esta espécie foi registrada nos estados do Amazonas, Bahia, Espírito Santo, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Pará, Paraná, Rio de Janeiro, Santa Catarina e aqui, pela primeira vez, no Rio Grande do Norte.

Smicridea (*Smicridea*) *palifera* ocorre na Venezuela e no Brasil; sendo que no Brasil há registro para os estados do Mato Grosso; Rio de Janeiro; Roraima. No presente trabalho sua distribuição é ampliada para o Norte do país, sendo registrada pela primeira vez na região Nordeste.

Apesar do avanço no estudo da tricopterofauna na região Nordeste, há ainda grandes áreas pouco exploradas, como é o caso do estado de Alagoas o qual não apresenta nenhum registro para a ordem; e outras com estudo incipientes, como o Rio Grande do Norte. Desta forma, A realização de trabalhos de levantamento taxonômico e descrição de novas espécies são importantes para

o aumento do conhecimento da entomofauna aquática, além de fornecer dados para trabalhos futuros.

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Anexo I

Normas do periódico *Zootaxa* (ISSN 1175-5326 (Print Edition) & ISSN 1175-5334 (Online Edition)).

Author Guidelines

Preparation of manuscrispts

1) *General.* All papers must be in English. Authors whose native language is not English are encouraged to have their manuscripts read by a native English-speaking colleague before submission. Nomenclature must be in agreement with the *International Code of Zoological Nomenclature* (4th edition 1999), which came into force on 1 January 2000. Author(s) of species name must be provided when the scientific name of any animal species is first mentioned (the year of publication needs not be given; if you give it, then provide a full reference of this in the reference list). Authors of plant species names need not be given. Metric systems should be used. If possible, use the common font New Times Roman and use as little formatting as possible (use only **bold** and *italics* where necessary and indentions of paragraphs except the first). Special symbols (e.g. male or female sign) should be avoided because they are likely to be altered when files are read on different machines (Mac versus PC with different language systems). You can code them as m# and f#, which can be replaced during page setting. The style of each author is generally respected but they must follow the following general guidelines.

2) The **title** should be concise and informative. The higher taxa containing the taxa dealt with in the paper should be indicated in parentheses: e.g. A taxonomic revision of the genus *Aus* (Order: family).

3) The **name(s) of all authors** of the paper must be given and should be typed in the upper case (e.g. ADAM SMITH, BRIAN SMITH & CAROL SMITH). The address of each author should be given in *italics* each starting a separate line. E-mail address(es) should be provided if available.

4) The **abstract** should be concise and informative. Any new names or new combinations proposed in the paper should be mentioned. Abstracts in other languages may also be included in addition to English abstract. The abstract should be followed by a list of **keywords** that are not present in the title. Abstract and key words are not needed in short correspondence.

5) The arrangement of the **main text** varies with different types of papers (a taxonomic revision, an analysis of characters and phylogeny, a catalogue etc.), but should usually start with an **introduction** and end with a list of **references**. References should be cited in the text as Smith (1999), Smith & Smith (2000) or Smith *et al.* (2001) (3 or more authors), or alternatively in a parenthesis (Smith 1999; Smith & Smith 2000; Smith *et al*. 2001). All literature cited in the text must

be listed in the references in the following format (see a sample page here in PDF).

A) **Journal paper**:
Smith, A. (1999) Title of the paper. *Title of the journal in full*, volume number, page range.

B) **Book chapter**:
Smith, A. & Smith, B. (2000) Title of the Chapter. *In*: Smith, A, Smith, B. & Smith, C. (Eds), *Title of Book*. Publisher name and location, pp. x–y.

C) **Book**:
Smith, A., Smith, B. & Smith, C. (2001) *Title of Book*. Publisher name and location, xyz pp.

D) **Internet resources**:
Author (2002) Title of website, database or other resources, Publisher name and location (if indicated), number of pages (if known). Available from: http://xxx.xxx.xxx/ (Date of access).

Dissertations resulting from graduate studies and non-serial proceedings of conferences/symposia are to be treated as books and cited as such. Papers not cited must not be listed in the references.

Please note that:

(1) **journal titles must be written in full (not abbreviated)**

(2) **journal titles and volume numbers are followed by a ","**

(3) **page ranges are connected by "n dash", not hyphen "-", which is used to connect two words.**

For websites, it is important to include the last date when you see that site, as it can be moved or deleted from that address in the future.

On the use of dashes: (1) Hyphens are used to link words such as personal names, some prefixes and compound adjectives (the last of which vary depending on the style manual in use). (2) En-dash or en-rule (the length of an ‘n’) is used to link spans. In the context of our journal that means numerals mainly, most frequently sizes, dates and page numbers (e.g. 1977–1981; figs 5–7) and also geographic or name associations (Murray–Darling River; a Federal–State agreement). (3) Em-dash or em-rule (the length of an ‘m’) are used far more infrequently, and are used for breaks in the text or subject, often used much as we used parentheses. In contrast to parentheses an em-dash can be used alone; e.g. What could these results mean—that Niel had discovered the meaning of life? En-dashes and em-dashes should not be spaced.

6) Legends of **illustrations** should be listed after the list of references. Small illustrations should be grouped into plates. When preparing illustrations, authors should bear in mind that the journal has a matter size of 25 cm by 17 cm and is printed on A4 paper. For species illustration, line drawings are preferred, although good quality B&W or colour photographs are also acceptable. See a guide here for detailed information on preparing plates for publication.

7) **Tables**, if any, should be given at the end of the manuscript. Please use the table function in your word processor to build tables so that the cells, rows and columns can remain aligned when font size and width of the table are changed. Please do not use Tab key or space bar to type tables.

8) **Keys** are not easy to typeset. In a typical dichotomous key, each lead of a couplet should be typed simply as a paragraph as in the box below:

1 Seven setae present on tarsus I ; four setae present on tibia I; leg I longer than the body; legs black in color ... Genus A
- Six setae present on tarsus I; three setae present on tibia I; leg I shorter than the body; legs brown in color ... 2
2 Leg II longer than leg I ... Genus B
- Leg II shorter than leg I ... Genus C

Deposition of specimens
Whenever possible, authors are advised to deposit type specimens in national or international public museums or collections. Authors are also advised to request registration numbers of deposited material in advance of the acceptance of papers to avoid unnecessary delay of publication. Some countries (e.g. Australia) require that primary type specimens be deposited in collections of the country of origin; authors are advised to take this into consideration.

Submission
Please follow the above basic guidelines and check if your manuscript has been prepared according to the style and format of the journal. Authors are encouraged to submit manuscripts by e-mail as attachments to the subject Editors responsible for your taxa or subject areas; manuscripts on small insect orders without subject editors should be submitted to Dr **Ernest Bernard** (ebernard@utk.edu); manuscripts on other invertebrate taxa without subject editors should be submitted to the Chief editor.

Prior to submitting a manuscript and figures to an editor, please check our website if there are two or more editors per subject, and then contact one of these to announce your intention to submit a manuscript for review. Please indicate the size of the manuscript, the number of figures and the format of these files. Your editor can then respond with special instructions, especially for the submission of many image files.

When you submit your manuscript to your editor, it will be more expedient to the review process if you offer the names of three or more potential reviewers with their complete postal and email addresses. It is also important to include the following statements in your cover letter:

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Otherwise, your manuscript will not be processed.

For manuscripts with numerous illustrations, which might be saved as separate TIFF or JPG files, for the purpose of review, it will be easier and more efficient for the subject editors and reviewers to have the figures converted into one larger PDF (Portable Document Format) file, instead of requiring the subject editor to save many files, cutting and copying these into a string of messages/files to the reviewers. You should retain the original figures in a higher resolution format for the final production of the accepted paper. For the text, PDF file along with RTF (Rich Text format) files are preferred. The advantage of submitting a rtf file for the text part of the manuscript is that the reviewers can emend the manuscript electronically. If you can not prepare PDF files, then submit text in RTF and the figures in TIFF (line drawing scanned at 600 dpi and half tone at 300 dpi; please use LZW compression, if you can, to reduce the size of e-files for easy transmission); if halftone TIFF files are too big (exceeding 2 MB), then submit them in jpeg. See here for detailed information on preparing plates for publication.

Vector files (charts, maps etc) are best submitted as EMF.

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In submitting the final version of revised manuscript to editors, authors are asked to provide the following information to all proper typesetting and indexing of the manuscript:

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Once the manuscript is accepted by your subject editor, final files, produced according to Zootaxa requirement, will be forwarded by your subject editor to the chief editor, who will then link with author and the printer to ensure that the paper is published without unnecessary delay. Normally the proof will be sent to the author for checking 1 to 3 weeks after the final files are accepted. The paper will usually be published with two weeks (for larger papers it will take longer) once the corrections to the proof are received.

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