UNIVERSIDADE FEDERAL DO TOCANTINS
CAMPUS DE PORTO NACIONAL
PROGRAMA DE PÓS-GRADUAÇÃO MESTRADO ACADÊMICO EM BIODIVERSIDADE, ECOLOGIA E CONSERVAÇÃO

THALES YANN DA SILVA ORLANDO

INVENTÁRIO DE LEPTOPHLEBIIDAE BANKS, 1900 (EPHEMEROPTERA) NO ESTADO DO TOCANTINS

Porto Nacional/TO
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Dissertação apresentada ao Programa de Pós-Graduação em Biodiversidade, Ecologia e Conservação. Foi avaliada para obtenção do título de Mestre em Biodiversidade, Ecologia e Conservação e aprovada em sua forma final pelo orientador e pela Banca Examinadora.

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2020

Dados Internacionais de Catalogação na Publicação (CIP)
Sistema de Bibliotecas da Universidade Federal do Tocantins

O71i Orlando, Thales Yann da Silva.

INVENTÁRIO DE LEPTOPHLEBIIDAE BANKS, 1900 (EPHEMEROPTERA) NO ESTADO DO TOCANTINS . / Thales Yann da Silva Orlando. – Porto Nacional, TO, 2020.

95 f.

Dissertação (Mestrado Acadêmico) - Universidade Federal do Tocantins – Câmpus Universitário de Porto Nacional - Curso de Pós-Graduação (Mestrado) em Biologia, Ecologia e Conservação, 2020.

Orientador: Tiago Kütter Krolow

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1. Ephemeroptera. 2. Inventário. 3. Insetos aquáticos. 4. Leptophlebiidae. I. Título

CDD 577

Elaborado pelo sistema de geração automática de ficha catalográfica da UFT com os dados fornecidos pelo(a) autor(a).

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Data de aprovação: 19/02/2020

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Porto Nacional - TO, 2020

AGRADECIMENTOS

Gostaria de começar agradecendo aos meus pais, Maria do Socorro e Almir. Eu que não sou pai de ninguém acho engraçado como algumas pessoas se dedicam tanto a outras, independente das escolhas, do caráter ou de qualquer traço da personalidade delas. Os pais dedicados estão sempre lá para dividir momentos, bons ou ruins, com seus filhos. Me sinto privilegiado por poder compartilhar essa conquista que foi terminar o mestrado, mesmo que às vezes eles não entendam muito bem os meus planos e o rumo que estou dando para a minha vida. Não se preocupem, eu também não faço ideia do que estou fazendo, mas estou feliz e sei que vocês também ficarão por isso.

As próximas pessoas que gostaria de agradecer são os responsáveis diretos ou indiretos para que esse trabalho fosse concluído. Primeiramente ao meu orientador, professor Tiago Krolow. Muito obrigado pelos ensinamentos, por ser tão metódico e atencioso aos detalhes, por ser um exemplo de profissional e de pessoa, pelas suas opiniões, por exigir tanto de todos nós, por estar preocupado com as próximas gerações de pesquisadores e fomentar discussões que engrandecem a nossa formação, mas principalmente por você ser um orientador. Sei que sou uma pessoa bem difícil de conviver (que fique claro que eu nunca mais vou admitir esse fato), mas acredito que aprendi bastante trabalhando com você. Obrigado também à sua companheira Jerusa por sempre nos receber com carinho.

Ao meu coorientador, professor Rafael Boldrini. Muito obrigado por me acompanhar nos estudos desse grupo que para mim era uma novidade e principalmente por aceitar treinar uma pessoa com nenhuma experiência prévia com os efemerópteros. Agradeço imensamente por ele e sua esposa Bianca terem me recebido em Boa Vista e me buscado de madrugada no aeroporto. Admiro muito sua trajetória como pesquisador e dedicação à sua carreira.

Ao André, que atualmente é o técnico do Laboratório de Entomologia da UFT mais talentoso que já se viu na história. Além de profissional biólogo, ele conserta qualquer coisa com um pouco de fita e talvez um pedaço de arame se a situação estiver bem feia. Agradeço imensamente por ter participado no desenvolvimento desse projeto e por todos os comentários, sugestões e discussões. Você sem dúvida foi meu terceiro orientador.

A grande amiga que fiz durante esse curso, Mellis. Obrigado por ter sido a ponta de lança que abriu os caminhos dos insetos aquáticos no nosso laboratório. Sem o seu excelente trabalho, possivelmente minha vida teria sido muito mais complicada. Obrigado pela companhia nos finais de semana no laboratório, pelas conversas e pelos lanches. Tenho certeza

que ainda vamos nos topar muito nesse mundo dos insetos aquáticos. Agradeço também o companheiro da Mellis, o Fábio pela ajuda com photoshop e as coisas de computador.

Aos colegas de laboratório, Breno, Iury, Lucas e todos os outros estagiários. Muito obrigado pela ajuda no campo e pela descontração. Sem vocês esse período teria sido infinitamente menos produtivo e massante. A Pietra, uma das mais novas e talentosas biólogas em formação no laboratório. Me diverti bastante esse tempo todo com a sua companhia. Falta só ela decidir se quer se dedicar às mídias sociais ou à ciência!

Ao corpo docente do curso de pós-graduação em Biodiversidade, Ecologia e Conservação. A competência e dedicação de vocês nos inspira ser profissionais melhores. Agradecimento especial à professora Solange Lolis por ter aplicado a prova de seleção que participei, ao professor Fabyano pelas excelentes aulas que me deram muitas ideias e ao professor Fernando Pelicice pelo entusiasmo que ele dedica às suas aulas. Vocês todos foram muito importantes nesse processo!

A Mayra um agradecimento muito especial. Essa grande amiga que sempre me recebe animadíssima em Goiânia quando retorno. Pessoa mais talentosa que já andou por esses lados. Através de você pude conhecer tanta coisa linda que contribuiu tanto para formar a pessoa que sou hoje. Você é a irmã que nasceu em outra mãe e achei por acaso lá no IBGE. Agradeço também o apoio da sua família. Vocês são incríveis!!!

A secretária do curso, Ana Paula, pela disponibilidade e presteza em todas as vezes que me atendeu.

A UFT por ter me proporcionado uma formação de qualidade. Tenho muito orgulho de ter estudado em uma universidade federal na região norte do país.

À CAPES (Coordenação de Aperfeiçoamento e Pessoal de Nível Superior) pela bolsa de mestrado concedida e auxílio financeiro.

A todos os proprietários das áreas que fizemos coletas, inclusive aqueles que deveríamos ter pago mas esquecemos. Muito obrigado por nos receber e deixar usar a energia de suas casas e fazendas. Por mais pessoas que admirem e acolham o nosso trabalho!

Enfim, a todos que conviveram comigo, fica esse recado. Vocês são guerreiros!!!!

RESUMO

Leptophlebiidae Banks, 1900, constitui uma família de efemerópteros que representam um agrupamento monofilético onde todos os membros na região Neotropical pertencem à subfamília Atalophlebiinae. No Brasil são registrados 27 gêneros e 124 espécies de efemerópteros pertencentes ao grupo. Eles se destacam como excelentes indicadores do estado de preservação de sistemas aquáticos e desempenham uma variedade de serviços ecossistêmicos como a ciclagem de nutrientes, a fragmentação de partículas em suspensão nos ambientes aquáticos e a bioturbação. O presente estudo buscou atualizar os registros para a família Leptophlebiidae no estado do Tocantins, fornecendo comentários sobre as espécies encontradas na região e descrever possíveis novos táxons. As coletas foram conduzidas entre os meses de agosto de 2017 e agosto de 2019, durante 12 expedições em visita a 20 localidades, distribuídas em 14 municípios no estado. As formas imaturas foram coletadas durante o dia com auxílio de uma rede "D" nas rochas, areia, cascalho e aderidos à vegetação nos ambientes aquáticos e os adultos foram capturados com auxílio de armadilhas luminosas (lençol iluminado, Pennsylvania e caixa U.V). Como resultado foram acrescentados 15 registros de espécies e 9 gêneros, sendo estas novas ocorrências para a região, e feita a descrição de uma nova espécie, *Simothraulopsis primus* Orlando, Krolow & Boldrini, 2019.

Palavras-chaves: Cerrado, Amazônia, insetos aquáticos, taxonomia.

ABSTRACT

Leptophlebiidae Banks, 1900, constitutes a family of ephemeropterans that represent a monophyletic group where all members in the Neotropical region belong to the Atalophlebiinae subfamily. In Brazil, 27 genera and 124 species of ephemeropterans belonging to the group are registered. They stand out as excellent indicators of the state of preservation in aquatic systems and perform a variety of ecosystem services such as nutrient cycling, fragmentation of suspended particles in aquatic environments and bioturbation. The present study sought to update the records for the family Leptophlebiidae in the state of Tocantins, providing comments on the species found in the region and describing possible new taxa. The collections were carried out between August 2017 and August 2019, during 12 expeditions visiting 20 locations, distributed in 14 municipalities in the state. Immature forms were collected during the day with the aid of a "D" net on rocks, sand, gravel and attached to vegetation in aquatic environments and adults were captured with the aid of light traps (white sheet light trap, Pennsylvania and U.V pan trap). As a result, 15 species records and 9 genera were added, these being new occurrences for the region, and a description of a new species, *Simothraulopsis primus* Orlando, Krolow & Boldrini, 2019, was made.

Key-words: Cerrado, Amazon, aquatic insects, taxonomy.

LISTA DE ABREVIATURAS E SIGLAS

UFT	Universidade Federal do Tocantins
C	Costal (veia na asa)
SC	Subcostal (veia na asa)
R1	Radial 1 (veia na asa)
R2	Radial 2 (veia na asa)
MA	Medial anterior (veia na asa)
MP	Medial Posterior (veia na asa)
CuA	Cubital anterior (veia na asa)
CuP	Cubital posterior (veia na asa)
A	Anal (veia na asa)
Aw	Clima tropical de savana
EMZV	Escola de Medicina Veterinária e Zootecnia (UFT – campus Araguaína)
U.V	Ultravioleta

SUMÁRIO

1 INTRODUÇÃO

Para fins de organização e adequação às normas da instituição a dissertação apresentou a seguinte estruturação: Introdução, Objetivos, Metodologia, Resultados e Discussão, Conclusão e Anexos. Os resultados e a discussão foram apresentados na forma de dois capítulos, referentes aos artigos produzidos durante o período de estudos. Esses capítulos foram redigidos em língua inglesa e formatados nos padrões das revistas científicas a qual pretendemos submetê-los. O capítulo um até o momento da defesa dessa dissertação não havia sido publicado enquanto o capítulo dois se encontra publicado desde 25 de setembro de 2019 na revista científica Zootaxa.

1.1 Ordem Ephemeroptera

Ephemeroptera compreende o grupo mais basal de insetos pterigotos viventes e são os únicos que apresentam uma forma alada intermediária entre a ninfa e o adulto (Sartori & Brittain 2015). A esse estágio que antecede a fase adulta, utiliza-se o termo subimago, que é caraterizado por ser menos ativo, possuir asas opacas e ser sexualmente imaturo (Edmunds & McCaffert 1988). Em algumas regiões do Brasil são popularmente conhecidos como siriruias ou efemérides. Os efemerópteros são insetos hemimetábolos e podem ser encontrados em todos os continentes com exceção a Antártida e algumas ilhas remotas (Da-Silva & Salles 2012).

As ninfas normalmente apresentam sete pares de brânquias abdominais e podem ter dois ou três filamentos ao final do último segmento do abdômen. Frequentemente apresentam corpo achatado dorsoventralmente, olhos compostos bem desenvolvidos, cabeça com formato variável e três ocelos entre os olhos. As peças bucais são funcionais e podem ser orientadas de forma a se projetarem para frente (prognato) ou ventralmente (hipognato) e são extremamente importantes na identificação do grupo. Vivem obrigatoriamente na água associadas a rochas, galhos, folhas, areia e sedimentos onde podem permanecer de três semanas até mais de dois anos (Salles *et al.* 2018).

As ninfas apresentam uma ampla variedade de grupos funcionais alimentares incluindo os coletores, raspadores, filtradores, predadores e suas respectivas subcategorias, cada uma delas apoiada por uma diversidade de morfologias e adaptações comportamentais (Tsui & Hubbard 1979; Merritt & Cummins 1996; Baptista *et al*. 2006; Barber-James *et al*. 2008; Boldrini & Cruz 2014; Brasil *et al*. 2014; Jacobus *et al*. 2019).

Os subimagos e imagos, que correspondem às fases aladas, apresentam cabeças pequenas, peças bucais vestigiais e não se alimentam, dependendo inteiramente dos nutrientes absorvidos quando imaturos para sobreviver (Domínguez *et al*. 2006). Estão restritos aos ambientes terrestres e na maioria das espécies, a forma adulta tem curta duração, variando entre algumas horas até poucos dias, visto que o principal objetivo nesse estágio de vida é a reprodução. Os olhos compostos e as pernas anteriores frequentemente estão evidenciados no dimorfismo sexual, com os machos tendo essas estruturas maiores que as fêmeas. Alguns machos representantes das famílias Baetidae e Leptophlebiidae possuem ainda uma estrutura conhecida como olho turbinado, que aumenta a precisão e ajuda a encontrar fêmeas durante as revoadas (Brittain & Sartori 2009).

Os efemerópteros também se destacam como excelentes indicadores do estado de preservação de um sistema aquático devido ao fato de existirem grupos sensíveis ou tolerantes a determinadas mudanças nas condições físicas locais (Poff & Ward 1990; Anderson 1992; Buss *et al*. 2003; Cummins *et al*. 2005; Bispo & Oliveira 2007; Shimano & Juen 2016; De-Faria *et al*. 2017). Eles desempenham uma variedade de serviços ecossistêmicos como fragmentação de madeira e vegetação, bioturbação, ciclagem de nutrientes e representam parte significativa da biomassa em sistemas aquáticos, servindo de alimento para diversos outros grupos (Karr 1999; Bauernfeind & Moog 2000; Buss & Salles 2007; Jacobus *et al*. 2019).

1.2 Família Leptophlebiidae

1.2.1 Caracterização morfológica e ecológica

As ninfas de Leptophlebiidae apresentam o seguinte conjunto de características: 1) cabeça hipognata ou prognata; 2) hipofaringe bem desenvolvida, usualmente com processo lateral bem desenvolvido; 3) palpos maxilares com três segmentos; 4) palpos labiais com três segmentos; 5) brânquias presentes nos segmentos abdominais I-VII, I-VI ou II-VII, brânquias com formato achatado ou lamelas ventrais e dorsais finas (porção ventral pode estar ausente) (Adaptado de Domínguez *et al*. 2006).

Esse grupo se alimenta principalmente de partículas presentes no biofilme (formado por algas, bactérias, fungos e detritos) e frequentemente são associadas ao grupo alimentar raspador, embora haja evidências de que alguns gêneros possuam estruturas e comportamentos

especializados que são empregados na filtragem e fragmentação do alimento. Seus representantes são morfologicamente diversificados e desempenham um papel importante como herbívoros/detritívoros em sistemas aquáticos (Polegatto & Froehlich 2003).

Uma grande variedade de gêneros dessa família encontram maior sucesso em ambientes lóticos, principalmente onde há acúmulo de material alóctone (como folhiço em decomposição) (Figura 1). A única exceção, no entanto, são as áreas de forte correnteza, onde as ninfas são geralmente encontradas embaixo de pedras ou em áreas protegidas do impacto direto (Da-Silva & Salles 2012).

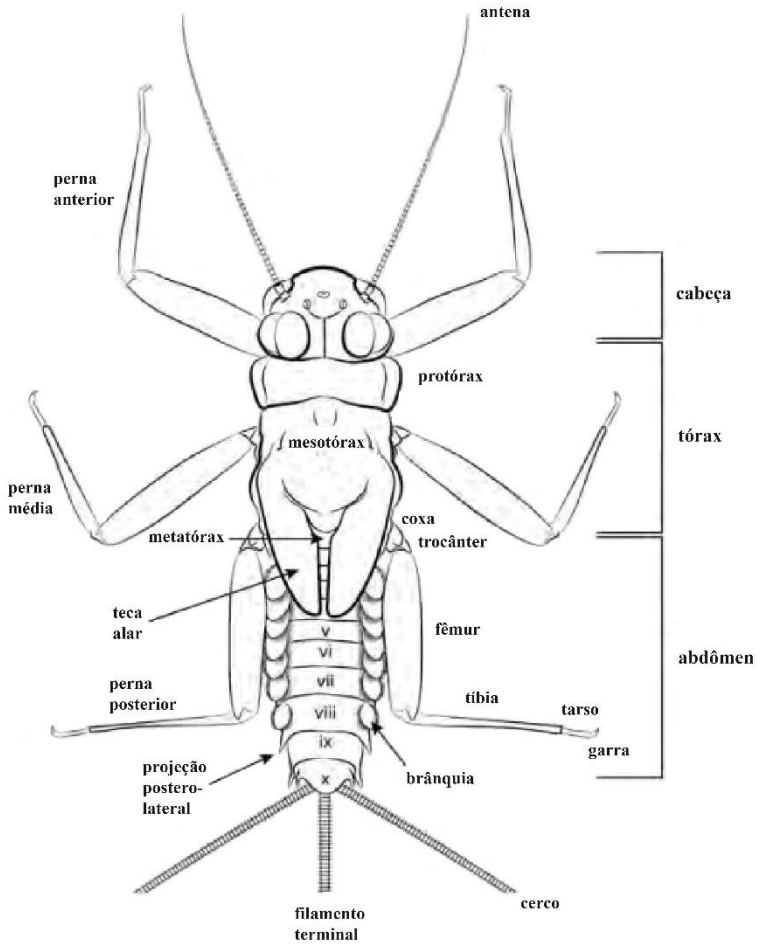

Figura 1 – Desenho esquemático de ninfa da ordem Ephemeroptera em vista dorsal. Ilustração adaptada de Salles *et al*. 2018

Os adultos do grupo são frequentemente reconhecidos através do conjunto de caracteres listados a seguir: 1) Olhos dos machos divididos em porção ventral e dorsal; 2) duas a quatro veias intercalares longas entre CuA e CuP; 3) Asas posteriors presentes e bem desenvolvidas

variando até pequenas ou ausentes; 4) fórceps da genitália do macho dividida em dois a quatro segmentos, segmentos II e III ou segmento II (se III não exisitir) mais curto que o segmento I (segmento IV presente apenas em um gênero Norte Americano); 5) lobos do pênis divididos até completamente fundidos (Adaptado de Domínguez *et al*. 2006).

Tipicamente os efemerópteros possuem facetas da porção dorsal dos olhos em formato hexagonal enquanto os membros da subfamília Atalophlebiinae apresentam formato quadrático. As formas adultas podem ser encontrados em revoadas no final da tarde ou início da manhã e são frequentemente utilizados nas identificações por parte dos especialistas, principalmente por se tratar de insetos maiores se comparados a outros grupos (Figura 2) (Da-Silva & Salles 2012).

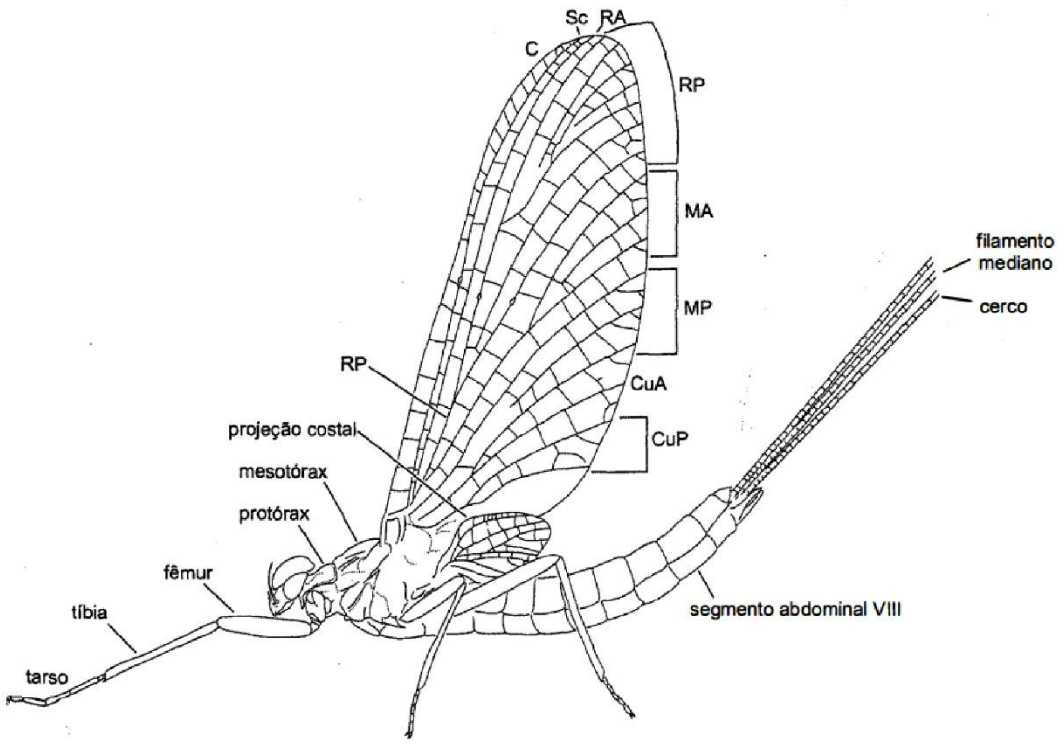

Figura 2 – Desenho esquemático de adulto de *Massartella brieni* (Lestage 1924), Leptophlebiidae, macho. Ilustração retirada de Da-Silva & Salles 2012.

1.2.2 Taxonomia

A monofilia de Leptophlebiidae Banks, 1900 foi testada através de análise de evidência total por Ogden & Whiting (2005) e posteriormente por Ogden *et al*. 2009, que confirmaram a hipótese. São amplamente distribuídos, presentes em todos os continentes com exceção à Antártida. A origem da família é provavelmente associada à Pangéia, porém, atualmente a maior diversidade e maior grau de endemismo são encontrados nas regiões Neotropicais e Australasiana (Barber-James *et al*. 2008).

O grupo que atualmente representa a família Leptophlebiidae foi reconhecida pela primeira vez por Eaton (1883-1888), sob a designação "*Leptophlebia*", um gênero da família Ephemeridae. Banks (1900), observando a proximidade entre os gêneros *Leptophlebia* e *Heptagenia* propôs que os dois fossem agrupados na tribo "Leptophlebini". Posteriormente, Edmunds Jr. & Traver (1954) em um trabalho que reclassificou a ordem, dividiram-na em superfamílias, uma delas reunindo Leptophlebiidae, Banks 1900, Ephemerellidae Klapálek, 1909 e Tricorythidae Lestage, 1942 sob a designação "Leptophlebioidea". A classificação anterior foi revisada e modificada por Peters & Edmunds Jr. (1972), que dividiu os Leptophlebiidae em duas subfamílias, Leptophlebiinae e Atalophlebiinae, sistema que atualmente se encontra em uso (Dominguez *et al*. 2006).

Segundo Savage (1987), todos os membros da família na região Neotropical pertencem à subfamília Atalophlebiinae, um grupo de efeméropteros com origem Gonduânica que se dispersaram no final do período Mioceno em direção à América Central, incluindo diversas ilhas oceânicas na região. Curiosamente, nenhum membro da subfamília Leptophlebiinae, de origem Laurásica, dispersou da América do Norte para a América Central, mas existem registros de membros da sufamília Atalophlebiinae na América do Norte (Savage 1987; Domínguez *et al*. 2006).

1.2.3 Diversidade

Mundialmente, Leptophlebiidae é tido como a família mais diversa ao nível genérico, apresentando aproximadamente 134 gêneros e a segunda mais diversa quando considerado o número de espécies, com aproximadamente 623 representantes (Brittain & Sartori 2009). No Brasil são registrados 27 gêneros e 124 espécies para a família (Salles & Boldrini 2020).

Atualmente, o estado do Tocantins conta com três gêneros (*Simothraulopsis* Demoulin, 1966; *Tikuna* Savage, Flowers & Porras, 2005; *Ulmeritoides* Traver, 1959) e quatro espécies registradas [*Simothraulopsis demerara* (Traver, 1947); *Simothraulopsis primus* Orlando, Krolow & Boldrini, 2019; *Tikuna bilineata* (Needham & Murphy, 1924) e *Ulmeritoides flavopedes* (Spieth, 1943)]. Esses dados indicam que a área se encontra sub-representada, uma vez que estados vizinhos como Goiás contam com seis gêneros e oito espécies registradas, Bahia com 14 gêneros e 28 espécies, Pará com sete gêneros e 11 espécies e Mato Grosso com 10 gêneros e 15 espécies (Boldrini & Krolow 2017; Orlando *et al*. 2019; Salles & Boldrini 2020).

Muitos dos gêneros atualmente encontrados no Brasil possuem distribuições que se estendem por diferentes bioregiões, sendo comum sua presença em mais de uma delas (Salles & Boldrini 2020). Essa situação é exemplificada por *Simothraulopsis*, um grupo amplamente distribuído pelo país que até o ano de 2019 não possuia representantes para o estado do Tocantins (Nascimento *et al*. 2017).

É esperado para a área um número de espécies maior do que o atualmente registrado, uma vez que outros 13 gêneros (*Askola* Peters, 1969; *Farrodes* Peters, 1971; *Fittkaulus* Savage & Peters, 1978; *Hagenulopsis* Ulmer, 1920; *Hermanella* Needham & Murphy, 1924; *Terpides* Demoulin, 1966; *Hydrosmilodon* Flowers & *Dominguez*, 1992; *Microphlebia* Savage & Peters, 1983; *Miroculis* Edmunds, 1963; *Thraulodes* Ulmer, 1920; *Paramaka* Savage & Domínguez, 1992; *Needhamella* Domínguez & Flowers, 1989 e *Ulmeritus* Traver, 1956) estão presentes em pelo menos um dos estados vizinhos ao Tocantins (Cardoso *et al*., 2015).

1.3 Inventários de fauna

Não se sabe com precisão quantas e quais são todas as formas viventes encontrada no planeta (Mora *et al*. 2011). A fim de diminuir essa lacuna no conhecimento biológico os taxonomistas são os responsáveis por descreverem os seres vivos, designando a eles nomes que se referem somente aquele organismo em particular e tornando público os dados relativos ao seu trabalho. Porém, os trabalhos de descrição de espécies por si só correspondem apenas a uma fração do entendimento referente à área de distribuição de determinado grupo (Winston, 1999).

Por esse motivo as listas de espécies são consideradas ferramentas de grande valor, utilizadas para retratar a diversidade biológica. Elas consistem em uma ordenação de grupos

nominais (espécies, gêneros, famílias, tribos) associada em muitos casos a referências taxonômicas e nomenclaturais, organizadas em um formato acessível. Comumente, esse tipo de trabalho se limita a discutir a distribuição de determinado grupo em uma região geográfica limitada, assim, facilitando a busca de informações referentes à presença de espécies em um local (Silveira *et al*. 2010).

As listas de espécies são tipicamente restritas a uma área específica onde faltam dados relativos ao grupo estudado. Um objetivo comum é avaliar a presença ou inferir a ausência de espécies em uma localidade. A presença é identificada de forma relativamente simples, uma vez que ao se detectar uma espécie, ela usará a área. No entanto, a falha na detecção de uma espécie não significa necessariamente que ela esteja ausente quando você amostrou ou que ela nunca usa a área (Morisson *et al*. 2008).

Diversas listas de espécies e catálogos foram produzidos para os efemerópteros com ocorrência no território brasileiro ao longo do anos. Destacam-se os trabalhos de Francischetti et al. 2004; Salles *et al*. 2004; Mariano & Polegatto 2011; Belmont *et al*. 2012; Boldrini *et al*. 2012; Lima *et al*. 2012; Raimundi *et al*. 2013; Boldrini & Cruz 2014; Angeli *et al*. 2015; Lima *et al*. 2015; Campos *et al*. 2016; Lima *et al*. 2016; Takiya *et al*. 2016; Da-Silva & Salles 2017 e Raimundi 2019 como trabalhos que amostram a ordem como um todo, sem foco para determinada família. Os trabalhos desenvolvidos especificamente com Leptophlebiidae foram os de Lopes *et al*. 2007; Da-Silva *et al*. 2010; Gama Neto & Hamada 2014 e Costa *et al*. 2018. Para o estado do Tocantins, existe apenas Boldrini & Krolow (2017) que foi desenvolvido a partir de dados de coletas na região da Serra do Lajeado. Isto reforça a importância de um estudo mais abrangente para a região.

A falta de conhecimento da distribuição das espécies de efemerópteros no estado do Tocantins é justificada, principalmente, pela deficiência na amostragem e pela dificuldade de se produzir estudos que objetivam inventariar a fauna local. Por esse motivo o desenvolvimento desse estudo é importante, principalmente porque a partir dos dados coletados teremos uma nova perspectiva sobre a distribuição de Leptophlebiidae.

2 OBJETIVOS

2.1 Objetivo Geral

O presente estudo tem por objetivo contribuir para o conhecimento da taxonomia da família Leptophlebiidae no estado do Tocantins.

2.2 Objetivos Específicos

- Inventariar a fauna de Leptophlebiidae no estado do Tocantins.

- Fornecer diagnoses e fotos para identificação das espécies da região.

- Contribuir com a melhor compreensão da distribuição de Leptophlebiidae.

- Descrever eventuais novos táxons.

3 METODOLOGIA

3.1 Área de estudo

O estado do Tocantins é a unidade da federação mais nova, criada em 1988 e possui uma área de aproximadamente 278.000 km^2. A área pertence à região norte do país e faz parte da Amazônia Legal, uma divisão político-econômico-social instituída em 1953 que não possui ligação direta com propósitos ambientais (Lei 5.173/1966; Lei Complementar nº 12/2007).

Há uma dominância do Cerrado no estado, representado pela ocupação de aproximadamente 91% de todo o território, enquanto os domínios amazônicos representam cerca de 9% da área (IBGE 2019). Segundo Walter *et al*. (2008), o Cerrado pode ser tratado como um complexo vegetacional que possui relações ecológicas e fisionômicas com as savanas africanas e australianas e que fatores como clima, solo, topografia, frequências de queimadas, pastejo e fatores antrópicos influenciam na distribuição da flora. As fitofisionomias presentes nas áreas de domínio Amazônico estão relacionadas a floresta ombrófila densa, floresta ombrófila aberta, floresta estacional sempre-verde e campinarana embora na área de estudo haja predominância das duas primeiras formações. As fitofisionomias típicas de Cerrado compreendem a floresta estacional decidual e semidecidual, cerrado, cerradão, campo-cerrado, parques, campo limpo e campo ruprestre (Silva, 2007).

De acordo com o sistema de classificação de Köppen, a região apresenta um clima tipo Aw, com um inverno quente e seco (maio a setembro) e um verão quente e chuvoso (outubro a abril) (Alvares *et al*. 2013).

3.2 Coleta e identificação do material

As coletas foram conduzidas entre os meses de agosto de 2017 e agosto de 2019, durante 12 expedições em visita a 20 localidades, distribuídas em 14 municípios no estado. A maior parte do esforço amostral esteve concentrada em expedições de curta duração, que duraram menos de um dia por localidade, porém, o distrito de Taquaruçu recebeu em algumas ocasiões expedições com período prolongado (mais de três dias). Esse fato é explicado pelas exigências logisticas e o alto potencial para a coleta de táxons que a região apresenta.

Cada expedição teve como objetivo amostrar as mais diversas áreas possíveis, abordando pequenos e médios rios, ricos em cascalho e com fluxo rápido de água até rios de grande porte, caracterizados pelo seu fluxo mais lento. Nem todos os pontos de coletas em ambientes aquáticos, durante o dia, corresponderam aos pontos onde aconteceram as coletas noturnas com armadilhas luminosas. Esse fato é explicado pela dificuldade logística que alguns locais apresentam e também para fins de padronização de tempo de coleta em cada ponto. As noites mais escuras foram priorizadas uma vez que os insetos são mais atraídos pela luz.

Tabela 1 – Lista dos pontos de coleta com respectivas coordenadas geográficas e coletores dos efemerópteros capturados.

Município	Local de coleta	Coordenadas	Coletores
Araguaína	EMZV	7° 6'7.13"S, 48°12'6.40"O	Krolow, T.K, Orlando, T.Y.S & Rippel, M.L.S
Arraias	Rio Palmas	12°49'50.66"S, 46°54'32.61"O	Alvim, B.G.C
Aurora	Rio Azuis	12°34'49.64"S, 46°24'26.96"O	Krolow, T.K e equipe
Bomfim	Rio Manoel Alves	11°51'11.69"S, 47°37'51.90"O	Krolow, T.K e equipe
Dianópolis	Balneário Cachoeira da Luz	11°28'5.97"S, 46°48'51.63"O	Krolow, T.K e equipe
Lavandeira	Balneário (Rio Palmas)	12°47'37.26"S, 46°30'38.83"O	Krolow, T.K e equipe
Monte do Carmo	Fazenda Maria – Rio Sucuri	10°46'21.49"S, 48° 5'19.80"O	Fernandes, A.S e equipe
Natividade	Cachoeira Paraíso	11°39'33.60"S, 47°41'20.84"O	Krolow, T.K e equipe
Palmas – Distrito de Taquaruçú do Porto	Vale do Vai Quem Quer	10°22'0.91"S, 48° 8'1.39"O	Krolow, T.K e equipe
Palmas – Distrito de Taquaruçú do Porto	Fazenda Buritizal	10°17'9.69"S, 48° 3'13.77"O	Fernandes, A.S e equipe

Palmas – Distrito de Taquaruçú do Porto	Cachoeira do Evilson	10°14'0.21"S, 48° 7'17.82"O	Fernandes, A.S e equipe
Palmas – Distrito de Taquaruçú do Porto	Fazenda Encantada	10°16'48.64"S, 48° 9'36.06"O	Krolow, T.K
Palmas – Distrito de Taquaruçú do Porto	Cachoeira Sambaíba	10°22'33.53"S, 48° 7'24.82"O	Krolow, T.K e equipe
Pedro Afonso	Rio Sono	9° 3'49.68"S, 48° 6'15.11"O	Krolow, T.K e Orlando, T.Y.S
Pedro Afonso	Rio Tocantins	8°58'16.37"S, 48°10'19.44"O	Krolow, T.K e Orlando, T.Y.S
Pium	Centro de Pesquisas Canguçu	9°58'37.74"S, 50° 1'59.65"O	Krolow, T.K e equipe
Rio da Conceição	Cachoeira do Cavalo Queimado	11°24'12.85"S, 46°51'30.20"O	Krolow, T.K e equipe
Rio da Conceição	Rio Manoel Alves	11°37'24.31"S, 47° 0'39.94"O	Krolow, T.K e equipe
Taguatinga	Caminho Cachoeira do Registro (Ribeirão Sobrado)	12°30'20.88"S, 46°18'17.41"O	Krolow, T.K e equipe
Wanderlândia	Assentamento Costa Rica (Balneário águas lindas)	6°52'3.53"S, 47°56'46.93"O	Krolow, T.K, Orlando, T.Y.S & Rippel, M.L.S

3.2.1 Coleta de adultos

A fim de capturar o maior número possível de adultos, foram empregadas diversas técnicas. Alguns grupos de efemerópteros possuem horários bastante específicos para emergência (alvorada ou crepúsculo) e podem ou não sair em revoadas. Todas as armadilhas luminosas utilizadas nas coletas foram instaladas no final da tarde e permaneceram ligadas até as primeiras horas da manhã.

Uma das técnicas mais utilizadas para amostragem dos indivíduos adultos consistiu na utilização de lâmpadas mistas de mercúrio de 250 W pendurada em um suporte em frente a um lençol branco (figura 3A). O método é conhecido como lençol iluminado e funciona a partir do principio que a maioria dos insetos apresentam fototropismo positivo, ou seja, são atraídos pela luz, permitindo que o coletor capture apenas aqueles indivíduos alvo pousados no lençol. Nessa fase das coletas todos os efemerópteros foram capturados sem distinção. Foi utilizada uma combinação com uma lâmpada de mercúrio em um dos lados e uma lâmpada ultravioleta "lâmpada negra" do outro (figura 3B), ligadas à rede elétrica por meio de cabos de extensão, aumentando a possibilidade de diferentes táxons serem atraídos e capturados. (Resh & Cardé 2009).

Figura 3 A-B – (A) Lençol iluminado com lâmpadas de mercúrio 250W. (B) combinação de lâmpada de mercúrio e ultravioleta.

Por se tratar da única ordem onde os indivíduos alados ainda executam uma muda, os insetos capturados foram acondicionados em frascos apropriados aos seus tamanhos onde permaneceram por volta de 12 horas até alcançarem a fase de imago e depois disso fixados em álcool 80%.

Adicionalmente ao lençol iluminado, outras armadilhas luminosas foram utilizadas. A armadilha Pennsylvania, cuja estrutura consiste em quatro superfícies estendidas (aletas), um funil, uma tampa, um frasco contendo álcool e a fonte de luz (podendo ser incandescente, U.V ou mista), posicionada no centro da armadilha (Figura 4), permaneceu ligada durante toda a

noite, sendo alimentada por uma bateria de 5 amperes e 12 volts, pendurada próximos ao curso d'água. Os insetos foram atraídos e caíram dentro de um recipiente com álcool (Frost 1957).

Figura 4 – Armadilha Pennsylvania posicionada em clareira.

O último tipo de armadilha luminosa utilizada foi a caixa iluminada, que consiste em bandejas com álcool, posicionadas a baixo de lâmpadas ultravioleta (Figura 5) (Calor & Mariano 2012). Na presença de rede de energia todas as armadilhas luminosas permaneceram ligadas entre os horários das 17:30 às 06:30, preferencialmente afastadas de outras fontes luminosas para evitar a interferência. Algumas localidades não contaram com acesso à rede elétrica, assim, um gerador a gasolina foi utilizado das 17:30 às 22:00.

Figura 5 –Caixa iluminada instalada próximo ao curso do rio.

3.2.2 Coleta de ninfas

As coletas das formas imaturas dos efemerópteros aconteceram durante o dia e foram feitas manualmente com o coletor em busca de ninfas na areia, folhiço, aderidas a raízes, rochas e cascalho. De forma a auxiliar a busca foram utilizadas redes D com malha de 0,5mm para agitar o fundo do rio e levantar, juntamente com os sedimentos, as ninfas. Para triagem inicial do material, foram utilizadas bandejas brancas, tubos tipo ependorf com álcool 80% e pinças do tipo relojoeiro (figura 6 A-B). Imediatamente após a coleta, aqueles indivíduos não destinados à associação ninfa-adulto, foram acondicionados em álcool 80% para posterior triagem e identificação.

Figura 6 A-B – (A) Coletor triando o material. (B) Bandeja com raízes, pinça e frascos (ependorf) com álcool a direita.

3.2.3 Associação ninfa-adulto

A abordagem utilizada para a associação entre as formas imaturas aquáticas e a fase adulta foi a criação das ninfas, principalmente por se tratar de uma das formas de menor custo para o coletor (Kluge 2004).

Algumas ninfas de efemerópteros, especialmente aquelas capturadas em áreas de remanso, são mais resistentes a ofertas menores de oxigênio dissolvido, portanto, se desenvolvem bem no ambiente de um laboratório (figura 7A). Segundo Boldrini & Cruz (2013), principalmente quando a forma imatura apresenta grande esclerotização das tecas alares, o que sinaliza proximidade às ultimas mudas, as ninfas podem ser mantidas em copos plásticos submersos em água (figura 7B).

O pote de criação é uma técnica simples que consiste em substituir boa parte do fundo do copo descartável por uma malha fina colando-a preferencialmente com cola quente. Os copos foram dispostos dentro da água no próprio local de coleta e em algumas situações transportados para o Laboratório de Entomologia da UFT em caixa de isopor. A flutuabilidade foi garantida por uma folha de E.V.A e a abertura foi coberta por filó preso com elástico a fim de evitar que as formas aladas escapem. Após a ecdise subimaginal, a forma alada foi transferida para um recipiente seco para concluir a ecdise imaginal.

Figura 7 A-B – (A) Ninfas se desenvolvendo nas dependências do laboratório de entomologia da UFT. (B) Potes de criação de ninfas de Ephemeroptera dispostos na placa de E.V.A em campo.

3.2.4 Identificação dos espécimes

As genitálias masculinas de todos os exemplares foram examinadas em álcool gel e os espécimes preservados em álcool 80%. Quando necessário, as pernas e genitália dos machos foram dissecadas e montadas em Euparal®, e as asas montadas a seco. Os espécimes foram fotografados usando um microscópio estereoscópio binocular Nikon SMZ 1500 (Sight DS-Ri1) e um microscópio Leica ICC50 W.

As identificações foram baseadas em Domínguez *et al*. (2006) com auxilio de chaves de identificações, revisões e descrições originais (Polegatto & Batista 2007; Salles & Domínguez 2012; Salles *et al*. 2014; Nascimento *et al*. 2017; Salles *et al*. 2018; Campos *et al*. 2019). O material examinado foi depositado nas seguintes instituições: Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia, Manaus–AM; Coleção Zoológica da Universidade Federal de Roraima (UFRR) Boa Vista–RR e Coleção de Entomologia da Universidade Federal do Tocantins (CEUFT), Porto Nacional–TO.

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CAPÍTULO 1 - Updated records for Leptophlebiidae (Insecta: Ephemeroptera) from Tocantins state, Northern Brazil

Updated records for Leptophlebiidae (Insecta: Ephemeroptera) from Tocantins state, Northern Brazil

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4.1 ABSTRACT

This paper presents updated records for Leptophlebiidae (Insecta: Ephemeroptera) fauna gathered along several short expeditions throughout the Tocantins state and provide a list with additional information about them. In this study, 15 species and 9 genera are recorded for the first time, increasing in more than 400 % the knowledge related to the family in the area. With these results, Tocantins becomes the second state with highest number of species for Leptophlebiidae in Northeastern region of Brazil.

Keywords: Atalophlebiinae**,** checklist, Cerrado, Amazon, mayfly.

4.2 Introduction

The Ephemeroptera order is an ancestor group of flying insects directly associated with water courses. They are unique among all extant insects due to the existence of the subimago, a winged stage between the nymph and the adult. Both subimagos and imagos, the terrestrial forms, lack the functional mouthparts and digestive systems, depending on the nutrition acquired on the nymphal stage (Sartori & Brittain 2015). They perform a vast array of supporting services in ecosystems such as decomposing wood and vegetation, bioturbation, nutrient cycling and are extremely versatile indicators of ecosystem health (Karr 1999; Bauernfeind & Moog 2000; Buss & Salles 2007; Jacobus *et al.* 2019).

Worldwide, Leptophlebiidae Banks, 1900 is considered to be the most diverse at generic level, presenting approximately 131 genera and the second most diverse when deemed the number of species, with a number close to 608 (Barber-James *et al.* 2008). This pattern repeats itself on the Neotropical region and in Brazil, with approximately 27 genera and 124 species of mayflies reported to the family (Salles & Boldrini 2020).

All of the Neotropical members are known to belong to Atalophlebiinae Peters, 1980, a group of Gondwanian originated mayflies, who have reached its highest diversity in streams of the Southern Hemisphere (Savage 1987; Domínguez *et al*. 2006).

Currently, only three genera and four species belonging to Leptophlebiidae have been reported to the state of Tocantins, placing the area behind several other states and becoming one of the least documented in the Northern Region of Brazil (Boldrini & Krolow 2017; Orlando *et al*. 2019; Salles & Boldrini 2020).

In the present paper, the Leptophlebiidae fauna gathered along several short expeditions throughout the Tocantins state is recorded. We add to the knowledge of the ephemeropteran fauna several first records of genera and species and provide a list with additional information about them.

4.3 Materials and methods

4.3.1 *Study area*

Created in 1988, Tocantins is the most recent state in Brazil with an area of 278.000 km^2. According to IBGE 2019, although formally belonging to the northern region, the state is placed into a transition area between Amazon and Cerrado, called Legal Amazon.

The Legal Amazon was instituted in Brazil in 1953, but its boundaries reflect social and economic planning rather than environmental purposes. The limits of the Legal Amazon extend beyond the Amazon domain and also encompassing part of the Cerrado and the Pantanal. Today, the states that make it up are Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins, and part of Maranhão.

The Amazon domain occupies about 9% of the territory, located mainly on the northern region of the state and the Cerrado is the dominant formation, covering 91% of the area, with different vegetation types ranging from open grassland with scattered trees to savanna woodlands with a fairly continuous tree canopy and a scanty ground cover of grasses (Ratter *et al*. 1973; Silva 2007).

Following the Köppen classification system (Alvares *et al*. 2013), the region has an Aw-type climate, with hot and dry winter (May to September) and a hot and rainy summer (October to April).

4.3.2 *Collection, identification and deposition*

Collections were conducted between August 2017 to August 2019 in 13 localities of 10 municipalities from Tocantins state (Fig. 1). Most of the effort consisted of short expeditions that expended no more than one day in each locality, although, the district of Taquaruçu received on more than one occasion an expedition with prolonged time (three to four days). This fact is explained by the logistic requirements and the high potential for the occurrence of new taxa.

The subimagos were captured with a hand net and light traps (white and U.V) from 18:00 until 06:30 hrs., then kept for about twelve hours in individual microtubules, until they moulted to the imago stage. Male genital structures were examined in alcohol gel, and the specimens were preserved in 80% ethanol. When necessary, male legs and genitalia were dissected and mounted in Euparal®, and wings were dry mounted. Only the adult form was used in this paper. Specimens were photographed using a Nikon SMZ 1500 (Sight DS-Ri1) stereomicroscope and a Leica ICC50 W microscope. Distribution maps with collection sites were prepared using QGIS® 3.8.0.

Only male imagos were used in this study. For the samples with a large number of specimens, 20 individuals representing the most frequent size variations were selected and measured. For samples with less than 20 individuals, all specimens were measured.

Identification were based on Domínguez *et al*. (2006) with the aid of identification keys, revisions and original descriptions (Polegatto & Batista 2007; Salles & Domínguez 2012; Nascimento *et al*. 2017; Campos *et al*. 2019; Campos & Mariano, 2019). The material examined is deposited in the following institutions in Brazil: Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia, Manaus–AM; Coleção Zoológica da Universidade Federal de Roraima (UFRR) Boa Vista–RR and Coleção de Entomologia da Universidade Federal do Tocantins (CEUFT), Porto Nacional–TO.

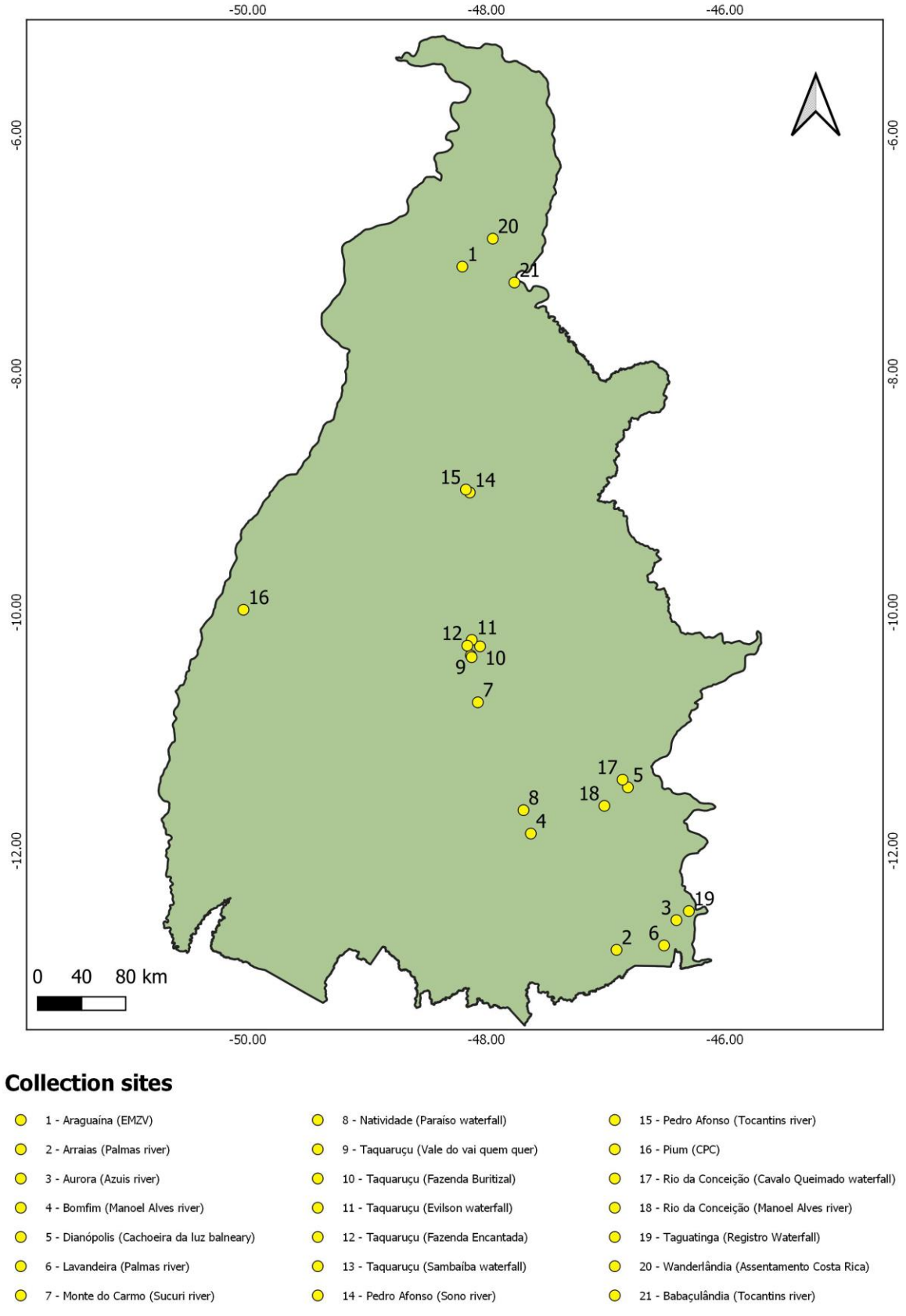


FIGURE 1. Collection sites of Leptophlebiidae (Ephemeroptera) in the state of Tocantins.

4.4 Results

This study records 21 species belonging to the Leptophlebiidae family for the state of Tocantins. Of this total, only *Simothraulopsis demerara* (Traver, 1947), *Simothraulopsis primus* Orlando, Krolow & Boldrini, 2019, *Tikuna bilineata* (Needham & Murphy, 1924) and *Ulmeritoides flavopedes* (Spieth, 1943) were already recorded for the area, although the genus *Tikuna* Savage, Flowers & Porras, 2005 was the only previously recorded that was not found on the samples.

Despite not representing the genus with the largest number of species in the country, *Simothraulopsis* Demoulin, 1966 was the group with the largest amount of representatives for the state (4 species), followed by *Thraulodes* Ulmer, 1920 and *Ulmeritoides* Traver, 1959 with 3 species each. *Hydrosmilodon* Flowers & Domínguez, 1992, *Terpides* Demoulin, 1966, *Hagenulopsis* Ulmer, 1920 and *Hydromastodon* Polegatto & Batista, 2007 were the rarest genera in the samples, with only one species each.

The checklist represents an increase of over 400% on the knowledge of Leptophlebiidae in the state, with a total of 15 new records. Two new species (*Paramaka* sp. nov. and *Miroculis* sp. nov.) are in the description process and two morphospecies await further analysis to confirm its status as new species (*Thraulodes* sp.1 and *Thraulodes* sp.2). With the contribution of this work, the area now counts with 12 genera and 18 species, being considered the second most documented on the Northern region, only behind Roraima state (Salles & Boldrini, 2020).

4.5 List of species

Family Leptophlebiidae

Genus *Askola* Peters, 1969

Askola emmerichi Domínguez, Molineri & Mariano, 2009

Fig. 2A-C

Askola emmerichi Domínguez, Molineri & Mariano, 2009: 31 (original description); Nascimento *et al*., 2011: 200 (key and catalog); Domínguez *et al*., 2014: 302 (catalog); Santos & Boldrini, 2016: 2 (catalog); Campos *et al*., 2019: 87 (review).

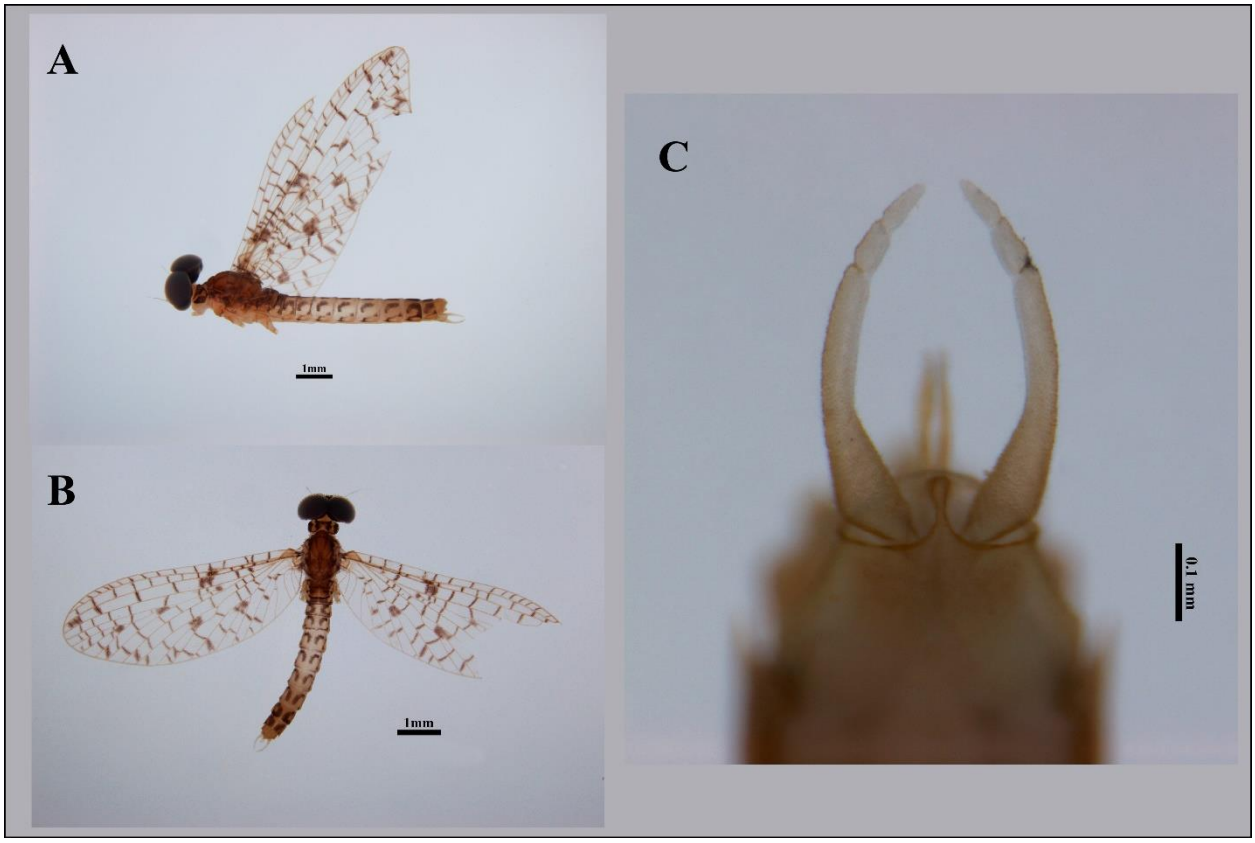
Previous distribution: Brazil (Amazonas, Roraima, Bahia, Pernambuco), Colombia and Venezuela.

Diagnosis: Imago – 1) eyes widely meeting dorsally on meson of head; 2) blackish marks on thorax and abdomen, forming a pair of sublateral longitudinal lines; 3) wings with blackish marks and with four brown spotted cross veins basal to bulla; 4) penis extending well beyond posterior margin of styliger plate (Domínguez at al. 2019).

Measurements data: body = 5.3 mm, n = 4; fore wing = 5.2 mm, n = 4.

Examined material: BRAZIL, *Tocantins*, Wanderlândia, Assentamento Costa Rica (águas lindas balneary), 6°52'3.53"S/47°56'46.93"W, white sheet light trap, 09-10.x.2018, Krolow, T.K. and team cols. (1 ♂, CEUFT); idem, Pennsylvania light trap, 08-10.x.2018, Krolow, T.K. and team cols. (1 ♂, CEUFT); Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, U.V. light pan trap, 04-07.xii.2018, Fernandes, A.S. and team cols. (1 ♂, CEUFT); Monte do Carmo, Fazenda Maria (Sucuri river), 10°46'21.49"S/48° 5'19.80"W, U.V. light pan trap, 13-14.ii.2019, Fernandes, A.S. and team cols. (1 ♂, CEUFT).

Remarks: First record for the state. Body size within a larger range than the original description (4.8mm-6.1mm). The marks on the abdomen of the analyzed specimens, additionally to the pair of sublateral longitudinal lines, present an anterolateral curve.



FIGURES 2A-C. *Askola emmerichi*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Askola paprockii Domínguez, Molineri & Mariano, 2009

Fig. 3A-C

Askola paprockii Domínguez, Molineri & Mariano 2009: 32 (original description); Nascimento *et al*., 2011: 198 (key); Campos *et al*., 2019: 89 (review).

Previous distribution: Brazil (Minas Gerais).

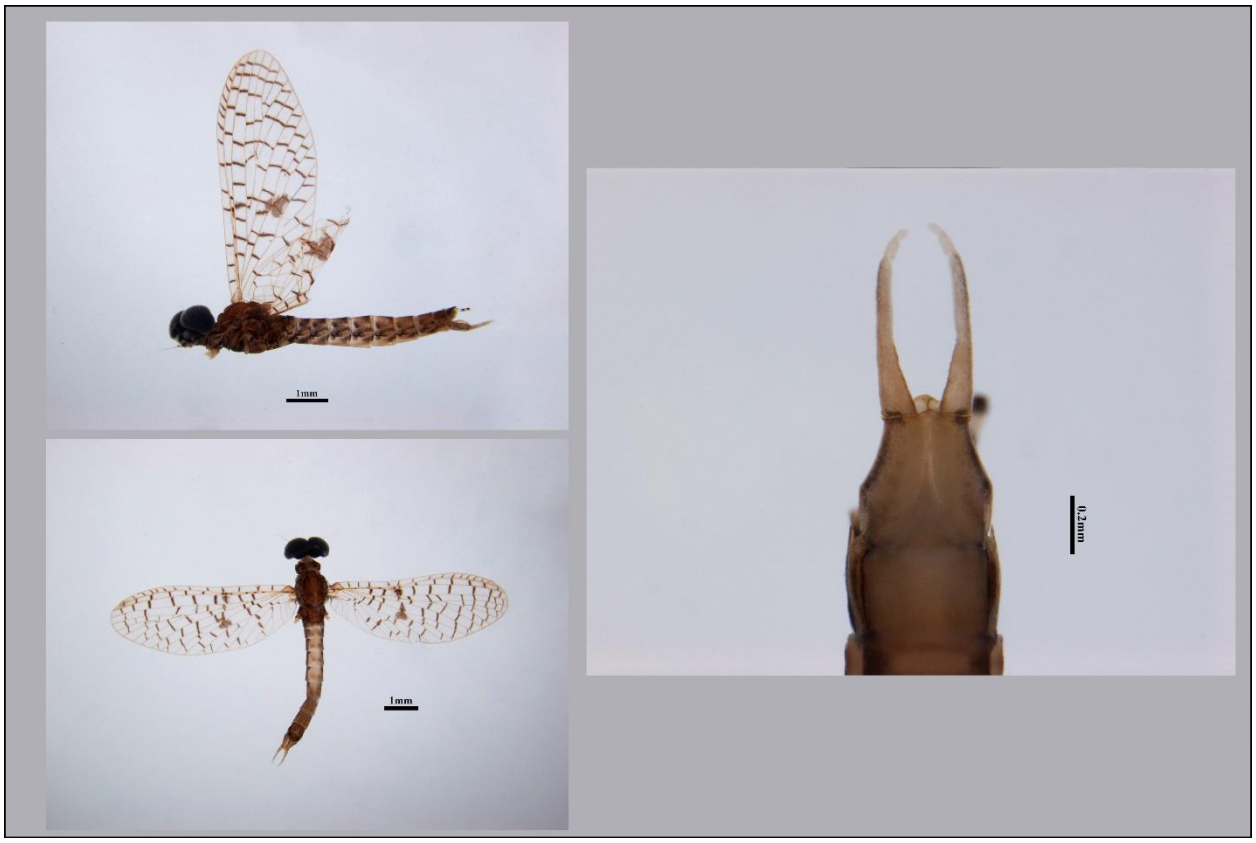
Diagnosis: Imago – 1) eyes widely meeting dorsally on meson of head; 2) wings translucent with grayish spots and four costal cross vein basal to bulla; 3) penis not extending beyond posterior margin of styliger plate (Domínguez *et al*. 2009).

Measurements data: body = 6.18 mm, n = 11; fore wing = 5.98 mm, n = 11.

Examined material: BRAZIL, *Tocantins*, Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 13-14.xi.2017, white sheet light trap, Krolow, T.K.

coll. (2 ♂, CEUFT); idem, 14-16.xi.2017, U.V. light pan trap, Krolow, T.K. coll. (5 ♂, CEUFT); idem, 04-07.xii.2018, U.V. light pan trap, Fernandes, A.S. and team cols. (6 ♂, CEUFT).

Remarks: First record for the state and expansion of 1000 km north from the type locality. Body size within a smaller range than the original description (5.5 mm–7 mm). Thorax and abdomen dark brown to black.



FIGURES 3A-C. *Askola paprockii*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Farrodes* Peters, 1971

Farrodes xingu Domínguez, Molineri & Peters, 1996

Fig. 4A-C

Farrodes xingu Domínguez, Molineri & Peters, 1996: 97 (original description – male and female); Domínguez, 1999: 175 (citation); Domínguez *et al*., 2002: 462 (citation); Salles *et al.*, 2004: 23 (list of species); Domínguez *et al.*, 2006: 377 (book); Santos *et al.*, 2019: 203 (intersexuality).

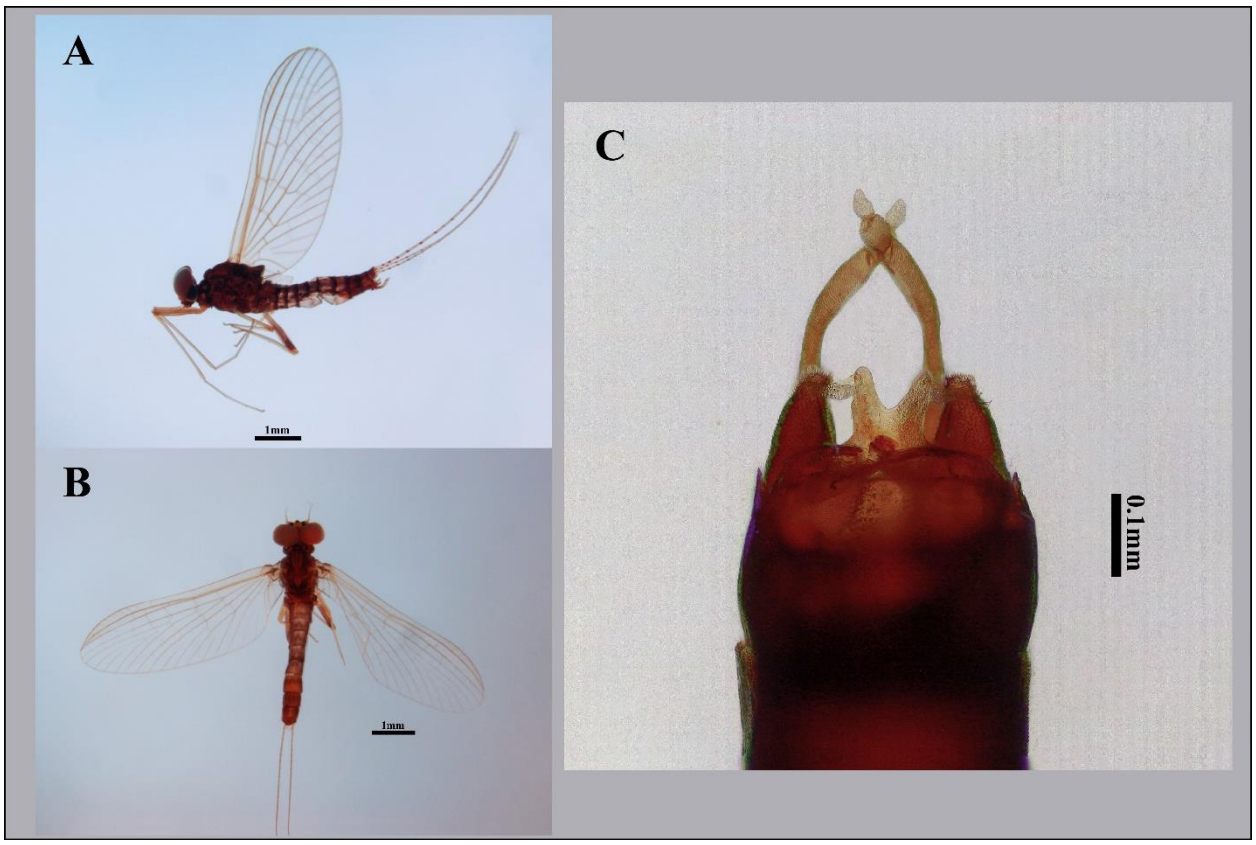
Previous distribution: Brazil (Pará and Goiás).

Diagnosis: Male Imago – 1) abdominal segments with whitish marks; 2) projections of styliger plate long and narrow, with apex rounded; 3) approximately basal 1/3 of penes fused; 4) lateral projections of penes cylindrical, long, ending in a short flap. (adapted from Domínguez *et al*. 1996).

Measurements data: body = 4.27 mm, n = 20; fore wing = 4.39 mm, n = 20; hind wing: 0.57 mm, n = 20.

Examined material: BRAZIL, *Tocantins*, Wanderlândia, Assentamento Costa Rica (águas lindas balneary), 6°52'3.53"S/47°56'46.93"W, 09-10.x.2018, white sheet light trap, Krolow, T.K. and team cols. (23 ♂, CEUFT); Araguaína, river close to the bridge (EMZV), 7°6'7.13"S/48°12'6.40"W, 08.x.2018, white sheet light trap, Krolow, T.K. and team cols. (5 ♂, CEUFT); Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 15-16.xi.2017, U.V. light pan trap, Krolow, T.K. coll. (2 ♂, CEUFT); idem, 11-12.vii.2018, white sheet light trap, Fernandes, A.S. and team cols. (1 ♂, CEUFT); idem, 05-06.xii.2018, white sheet light trap, Fernandes, A.S. and team cols. (1 ♂, CEUFT); idem, 27-30.viii.2019, white sheet light trap, Fernandes, A.S. and team cols. (30 ♂, CEUFT); idem, Fazenda Buritizal, 10°17'9.69"S/48°3'13.77"W, 28.iii.2018, white sheet light trap, Fernandes, A.S. and team cols. (3 ♂, CEUFT); idem, Evilson waterfall, 10°14'0.21"S/ 48°7'17.82"W, 13.vii.2018, white sheet light trap, Fernandes, A.S. and team cols. (22 ♂, CEUFT); Monte do Carmo, Fazenda Maria (Sucuri river), 10°46'21.49"S/48° 5'19.80"W, 13-14.ii.2019, U.V. light pan trap, Fernandes, A.S. and team cols. (8 ♂, CEUFT); idem, 03-05.iv.2019, white sheet light trap, Fernandes, A.S. and team cols. (34 ♂, CEUFT); idem, 03-05.iv.2019, U.V. light pan trap, Fernandes, A.S. and team cols. (11 ♂, CEUFT); idem, 04-05.iv.2019, Pennsylvania light trap, Fernandes, A.S. and team cols. (1 ♂, CEUFT); Taguatinga, on the way to Registro waterfall (Sobrado creek), 12°30'20.88"S/ 46°18'17.41"W, 14.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (7 ♂, CEUFT); Lavandeira, Palmas river, 12°47'37.26"S/46°30'38.83"W, 13-14.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (10 ♂, CEUFT).

Remarks: First record for the state. Hind wing presented greater discrepancy when compared to the data of the original description (0.4mm-0.78mm). The species can easily be confused with *F. tepui* and the main form to differentiate them depends on abdominal and forceps pigmentation, character that suffers great intraspecific variation.



FIGURES 4A-C. *Farrodes xingu*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Hagenulopsis* Ulmer, 1920

Hagenulopsis minuta Spieth, 1943

Fig. 5A-C

Hagenulopsis minutus Spieth, 1943: 10 (original description - female); Traver, 1946: 427 (male); Hubbard, 1982: 264.

Hagenulopsis minuta; Peters & Domínguez, 2001: 354 (epithet change); Domínguez *et al*., 2002: 463 (list of species); Boutonnet *et al*., 2004: 84 (citation); Domínguez *et al*., 2006: 386 (book); Lopes *et al*., 2007: 141 (catalog); Chacón *et al*., 2009: 726 (list of species); Domínguez *et al*., 2009: 43 (review and key); Domínguez *et al*., 2014: 304 (catalog); Lima *et al*., 2016: 217 (catalog); Costa *et al*., 2018: 4 (list of species).

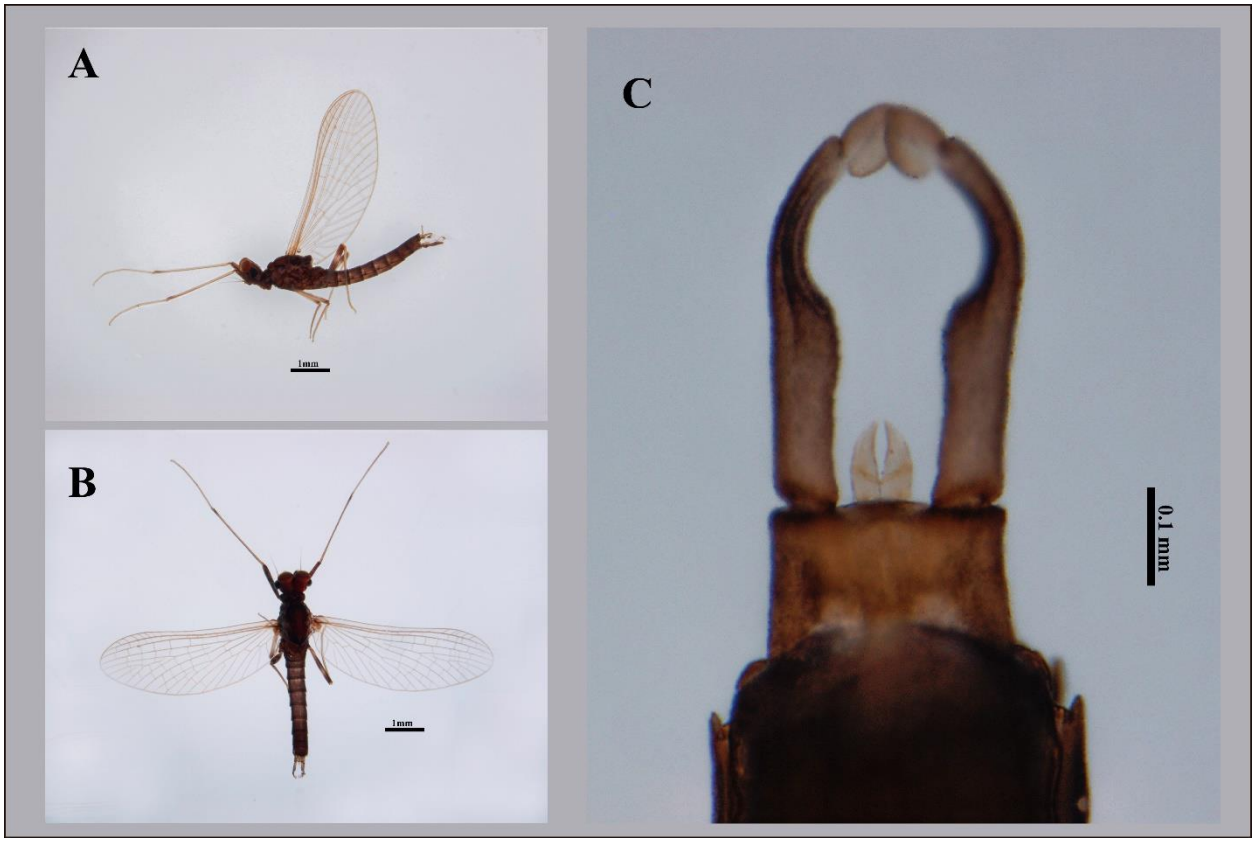
Previous distribution: Brazil (Pará, Amazonas, Roraima, Bahia), Guyana, Surinam and Venezuela.

Diagnosis: Male Imago – 1) upper portion of male eyes separated basally, meeting medially with well-developed eye bridge on inner margin of upper portion; 2) absence of blackish clouds (fringes) around cross veins in the fore wings; 3) indistinct subbasal and apical blackish-brown bands on the mesothoracic femora (adapted from Peters & Domínguez, 2001).

Measurements data: body = 4. 86 mm, n = 3; fore wing = 4.53 mm, n = 3.

Examined material: BRAZIL, *Tocantins*, Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 27-30.viii.2019, white sheet light trap, Fernandes, A.S. and team cols. (3 ♂, CEUFT).

Remarks: First record for the state. As discussed by Peters & Domínguez 2001, the specimens examined from Surinam and Pará (Brazil), are within the range of measurements given in the description, but specimens from Venezuela are larger. The adults sampled in the state of Tocantins are slightly bigger than the Venezuelan specimens (4.7mm-5.1mm). Additionally, we found differences in the length of the penis (one and half times the size of the styliger plate) and the eye bridge on inner margin of upper portion (present, but poorly developed). We understand that those individuals who do not have a well-developed bridge as illustrated in previous works of *H. minuta*, have their eyes meeting dorsally on meson of head, since there are no described specimens up to this moment with a poorly developed bridge. Despite the observed variations, the specimens will be considered conspecific based on the diagnostic characters observed.



FIGURES 5A-C. *Hagenulopsis minuta,* adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Hydromastodon* Polegatto & Batista, 2007

Hydromastodon sallesi Polegatto & Batista, 2007

Fig. 6A-C

Hydromastodon sallesi Polegatto & Batista, 2007: 55 (original description – nymph); Salles *et al*., 2016: 52 (catalog); Da-Silva & Salles, 2017: 2 (list of species).

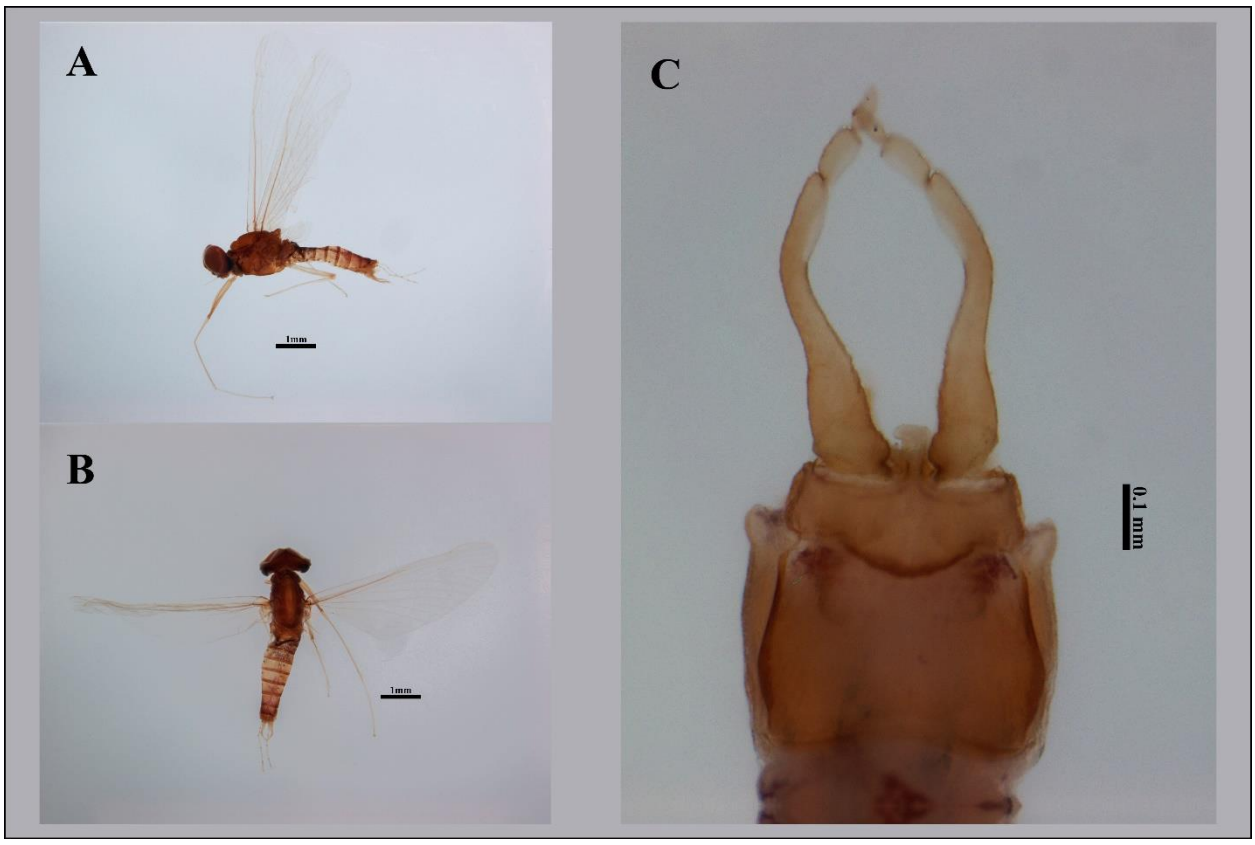
Previous distribution: Brazil (Roraima, Rondônia and Mato Grosso do Sul).

Diagnosis: Male imago – 1) presence of a strong and dorsally curved, medial projection at the styliger plate; 2) Penis divided, each lobe with a long spine ventromedially directed (adapted from Salles *et al*. 2016).

Measurements data: body = 5. 16 mm, n = 3; fore wing = 4.86 mm, n = 3; hind wing: 0.92 mm, n = 3.

Examined material: BRAZIL, *Tocantins*, Arraias, Palmas river, 12°49'50.66"S/46°54'32.61"W, 04.vii.2018, white sheet light trap, Alvim, B.G.C. coll. (3 ♂, CEUFT).

Remarks: First record for the state. As discussed by Salles *et al*. 2016, this species is found in transitional areas between the Amazon forest and Brazilian savannah, making the state of Tocantins an area with high possibility of occurrence of the group and confirming the observations made by the authors mentioned before.



FIGURES 6A-C. *Hydromastodon sallesi*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Hydrosmilodon* Flowers & Dominguez, 1992

Hydrosmilodon gilliesae Thomas & Perú, 2004

Fig. 7A-C

Hydrosmilodon gilliesae Thomas & Perú in Thomas *et al., 2004: 66* (original description - nymph); Domínguez *et al*., 2006: 405 (book); Salles *et al*., 2010: 306 (list of species); Mariano & Polegatto, 2011: 594 (list of species); Lima *et al*., 2012b: 203 (catalog); Lima *et al*., 2012a: 310 (catalog); Domínguez *et al*., 2014: 306 (catalog); Massariol *et al*., 2014: 365 (citation); Lima *et al*., 2015: 7 (list of species); Salles *et al*., 2016: 47 (catalog); Campos *et al*., 2016: 310 (list of species).

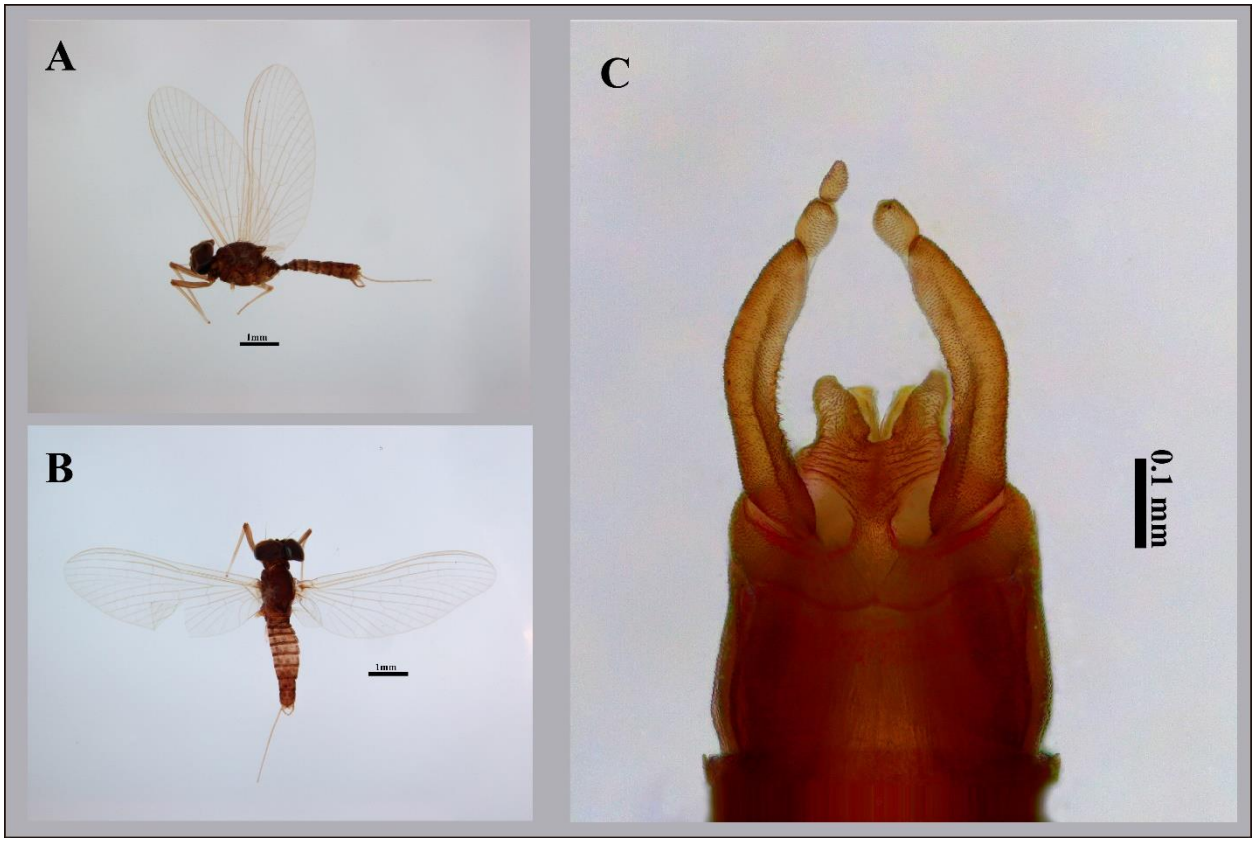
Previous distribution: Brazil (Amazonas, Bahia, Pernambuco, Mato Grosso, Espírito Santo), French Guiana and Venezuela.

Diagnosis: Male Imago – 1) Eyes separated on meson of head by a short distance — less than 0.5 times width of median ocellus; 2) styliger plate with spines close to base of forceps or with two wide projections; 3) styliger plate with two wide projections that nearly cover the penis; 4) Penis lobes totally divided with distomedial spines converging medially (adapted from Salles *et al*., 2016).

Measurements data: body = 4.54 mm, n = 20; fore wing = 4.74 mm, n = 19; hind wing: 0.81 mm, n = 20.

Examined material: BRAZIL, *Tocantins*, Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, 11-12.x.2018, white sheet light trap, Krolow, T.K. and team cols. (25 ♂, CEUFT); Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 05-06.xii.2018, white sheet light trap, Fernandes, A.S. and team cols. (2 ♂, CEUFT); Rio da Conceição, Cavalo Queimado waterfall, 11°24'12.85"S/ 46°51'30.20"W, 15.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (10 ♂, CEUFT).

Remarks: First record for the state. Fore wings were slightly smaller than the literature consulted (3.5mm-6.0mm). The record for Tocantins connects the distribution that until now was isolated in two areas, the first represented by Amazonas and Mato Grosso followed by Bahia, Pernambuco and Espirito Santo.



FIGURES 7A-C. *Hydrosmilodon gilliesae,* adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Miroculis* Savage & Peters, 1983

Miroculis (Miroculis) marauiae Savage & Peters, 1983

Fig. 8A-C

Miroculis (Miroculis) marauiae Savage & Peters, 1983: 517 (male, female and nymph); Domínguez *et al*., 2002: 463 (list of species); Salles *et al*., 2004: 26 (list of species); Domínguez *et al*., 2006: 445 (book); Lopes *et al*., 2007: 141 (catalog); Ribeiro *et al*., 2008: 597 (INPA catalogue); Domínguez *et al*., 2014: 407 (catalog).

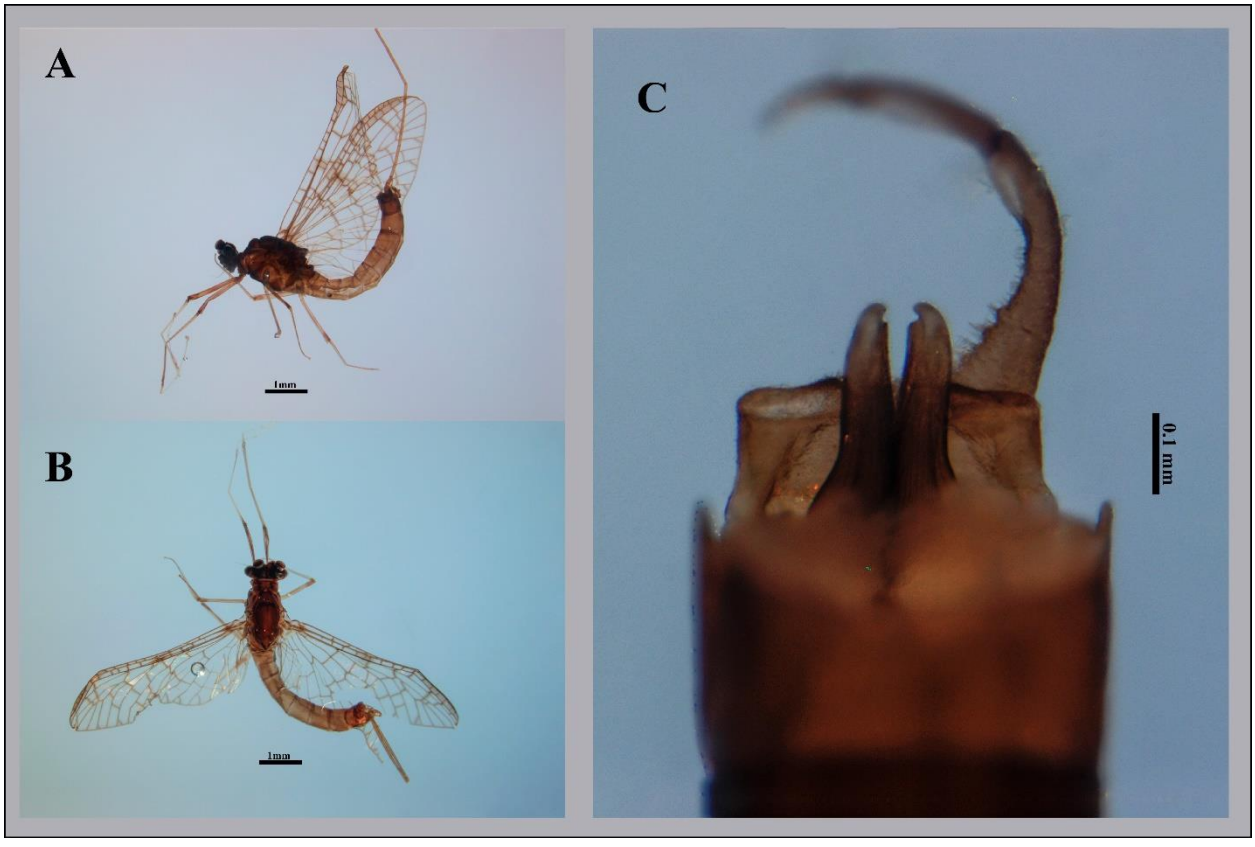
Previous distribution: Brazil (Amazonas), Surinam and Venezuela.

Diagnosis: Male Imago – 1) upper portion of male eye has 8-9 facets in longest row; 2) membrane of wings is hyaline; cross veins yellowish brown. 3) lobes of penis are tubular, apex excavated.

Measurements data: body = 5.45 mm, n = 9; fore wing = 5.3 mm, n = 9; hind wing: 1.37 mm, n = 8.

Examined material: BRAZIL, *Tocantins*, Palmas, district of Taquaruçu do Porto, Fazenda Encantada, 10°16'48.64"S/48°9'36.06"W, 26-30.viii.2017, hand net, Krolow, T.K. coll. (5 ♂, CEUFT); idem, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 27-30.viii.2019, white sheet light trap, Fernandes, A.S. and team cols. (4 ♂, CEUFT).

Remarks: First record for the state and expansion of 2000 km southeast from the type locality. Part of the material was collected during a flight using hand net and part caught in light trap. The samples were collected two years apart from each other in august, suggesting that month as a common period for flights.



FIGURES 8A-C. *Miroculis* (Miroculis) *marauiae*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

***Miroculis (Miroculis)* sp.**

Fig. 9A-C

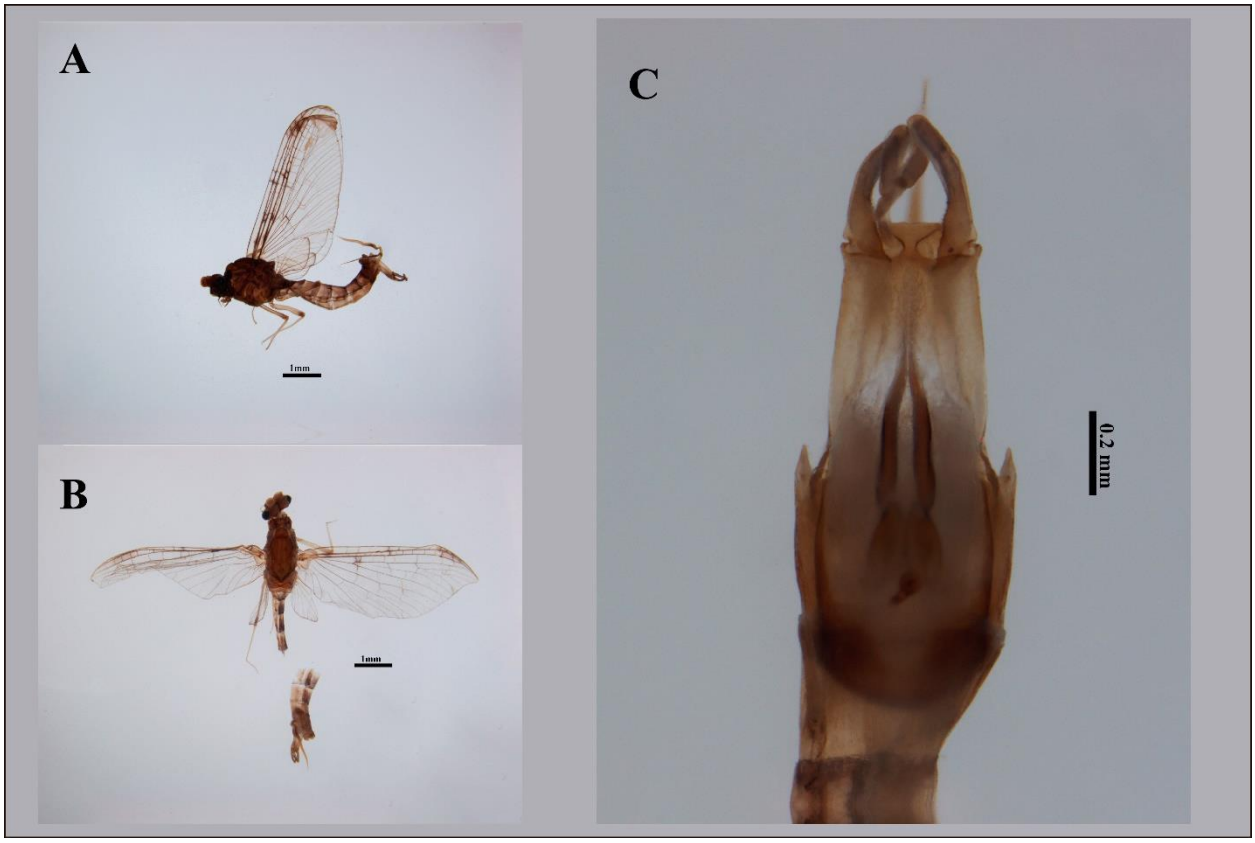
Previous distribution: unknown

Diagnosis: Male Imago – 1) compound eyes on a long stalk (eyes approximately same length of head); 2) membrane of fore wings hyaline, except for the presence of brown spots around a few crossveins between C and Sc and between Sc and R1; 3) Long penis (approximately 4 times the length of segment I of the forceps).

Measurements data: body = 5.3 mm, n = 2; fore wing = 4.1 mm, n = 2; hind wing: 1.3 mm, n = 2.

Examined material: BRAZIL, *Tocantins*, Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 13-14.xi.2017, white sheet light trap, Krolow, T.K coll. (1 ♂, CEUFT); idem, 27-30.viii.2019, white sheet light trap, Fernandes, A.S. and team cols. (1 ♂, CEUFT)

Remarks: The specimen found in the samples corresponds to *Miroculis exilibranchia**, a new species described in Erikcsen Augusto Raimundi thesis. According to articles 8 and 9 of the International Code on Zoological Nomenclature, a thesis does not constitute a published work and therefore the species is not valid. It was found only two specimen on the samples.



FIGURES 9A-C. *Miroculis (Miroculis)* sp, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Paramaka* Savage & Domínguez, 1992

Paramaka convexa (Spieth, 1943)

Fig. 10A-C

Thraulus convexus Spieth, 1943: 10 (original description).

Paramaka convexa Savage & Domínguez, 1992: 244 (redescription); Blanco-Belmonte *et al*., 2003: 119 (nymph description). Salles *et al*., 2004: 26 (list of species); Domínguez *et al*., 2006: 463 (book); Chacón *et al*., 2009: 728 (list of species); Mariano, 2011: 46 (key); Domínguez *et al*., 2014: 307 (list of species); Raimundi *et al*., 2017: 581 (list of species).

Homothraulus convexus Traver, 1960: 73 (list of species); Hubbard, 1982: 265 (catalog).
Hermanella sp. 2. Demoulin, 1966: 12 (nymph).

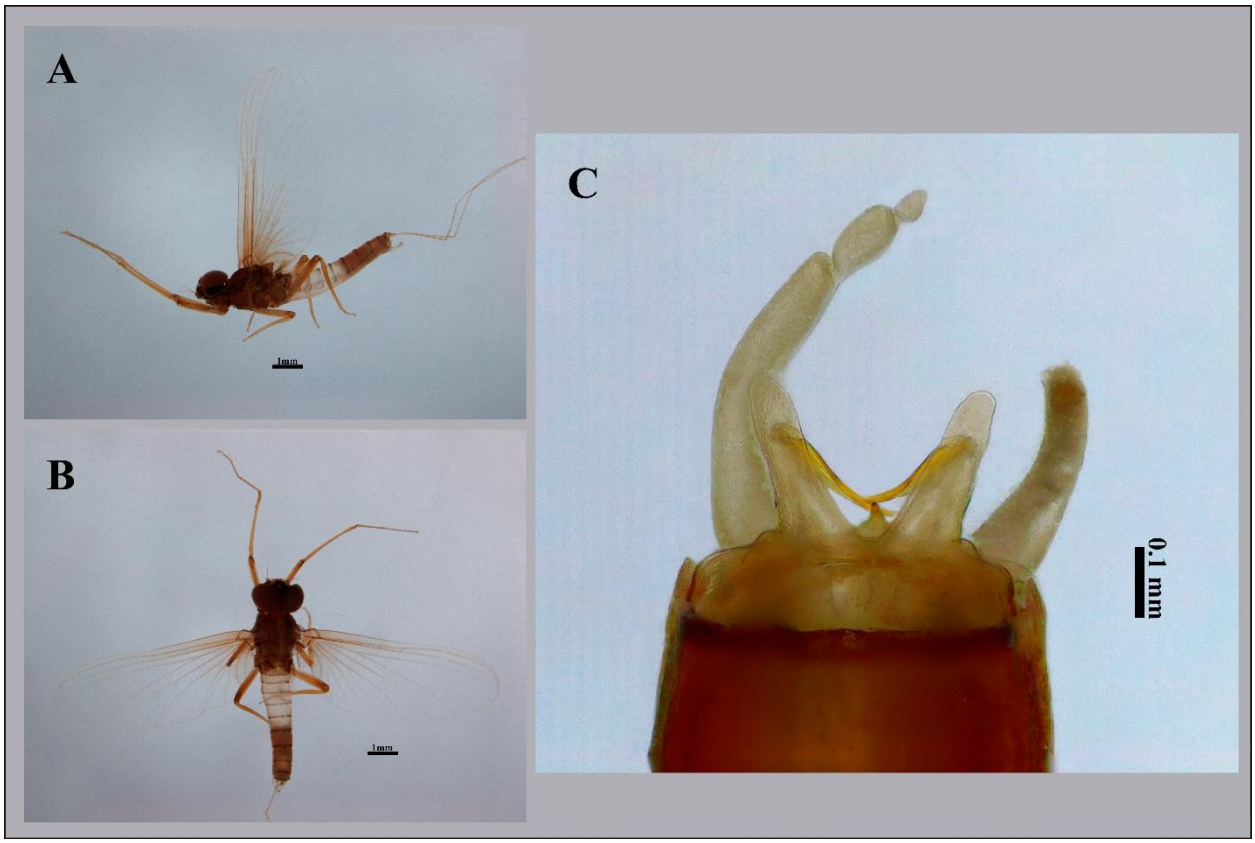
Previous distribution: Brazil (Pará, Roraima, Bahia, Mato Grosso), Surinam, French Guiana, Venezuela and Colombia.

Diagnosis: Male Imago - 1) hyaline fore and hind wing membrane, except yellowish basal region; 2) translucent yellowish abdominal segments II-VI, I and VII-X dark brown; 3) genitalia with ventral spine-like projections directed anteromedially; 4) posteromedial projection of styliger plate dorsally curved. (adapted from Savage & Domínguez, 1992).

Measurements data: body = 7.24 mm, n = 20; fore wing = 7.45 mm, n = 19; hind wing = 1.33 mm, n = 20.

Examined material: BRAZIL, *Tocantins*, Wanderlândia, Assentamento Costa Rica (águas lindas balneary), 6°52'3.53"S/47°56'46.93"W, white sheet light trap, 09-10.x.2018, Krolow, T.K. and team cols. (20 ♂, CEUFT); Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, 11-12.x.2018, white sheet light trap, Krolow, T.K. and team cols. (6 ♂, CEUFT); idem, 08-10.x.2018, Pennsylvania light trap, Krolow, T.K. and team cols. (2 ♂, CEUFT); Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 13-14.xi.2017, white sheet light trap, Krolow, T.K. coll. (2 ♂, CEUFT); idem, 15-16.xi.2017, U.V. light pan trap, Krolow, T.K. coll. (2 ♂, CEUFT); idem, 27-30.viii.2019, white sheet light trap, Fernandes, A.S and team (1 ♂, CEUFT); idem, Fazenda Buritizal, 10°17'9.69"S/48°3'13.77"W, 28.iii.2018, white sheet light trap, Fernandes, A.S. and team cols. (2 ♂, CEUFT); idem, Evilson waterfall, 10°14'0.21"S/48°7'17.82"W, 13.vii.2018, white sheet light trap, Fernandes, A.S. and team cols. (2 ♂, CEUFT); Monte do Carmo, Fazenda Maria (Sucuri river), 10°46'21.49"S/48° 5'19.80"W, 03-05.iv.2019, white sheet light trap, Fernandes, A.S. and team cols. (10 ♂, CEUFT); idem, U.V. light pan trap, Fernandes, A.S. and team cols. (3 ♂, CEUFT); Rio da Conceição, Cavalo Queimado waterfall, 11°24'12.85"S/ 46°51'30.20"W, 15.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (1 ♂, CEUFT); Natividade, Paraíso waterfall, 11°39'33.60"S/ 47°41'20.84"W, 12.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (1 ♂, CEUFT).

Remarks: First record for the state. Body size within a larger range than original description (5.4 mm-8.6mm).



FIGURES 10A-C. *Paramaka convexa*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

***Paramaka* sp.**

Fig. 11A-C

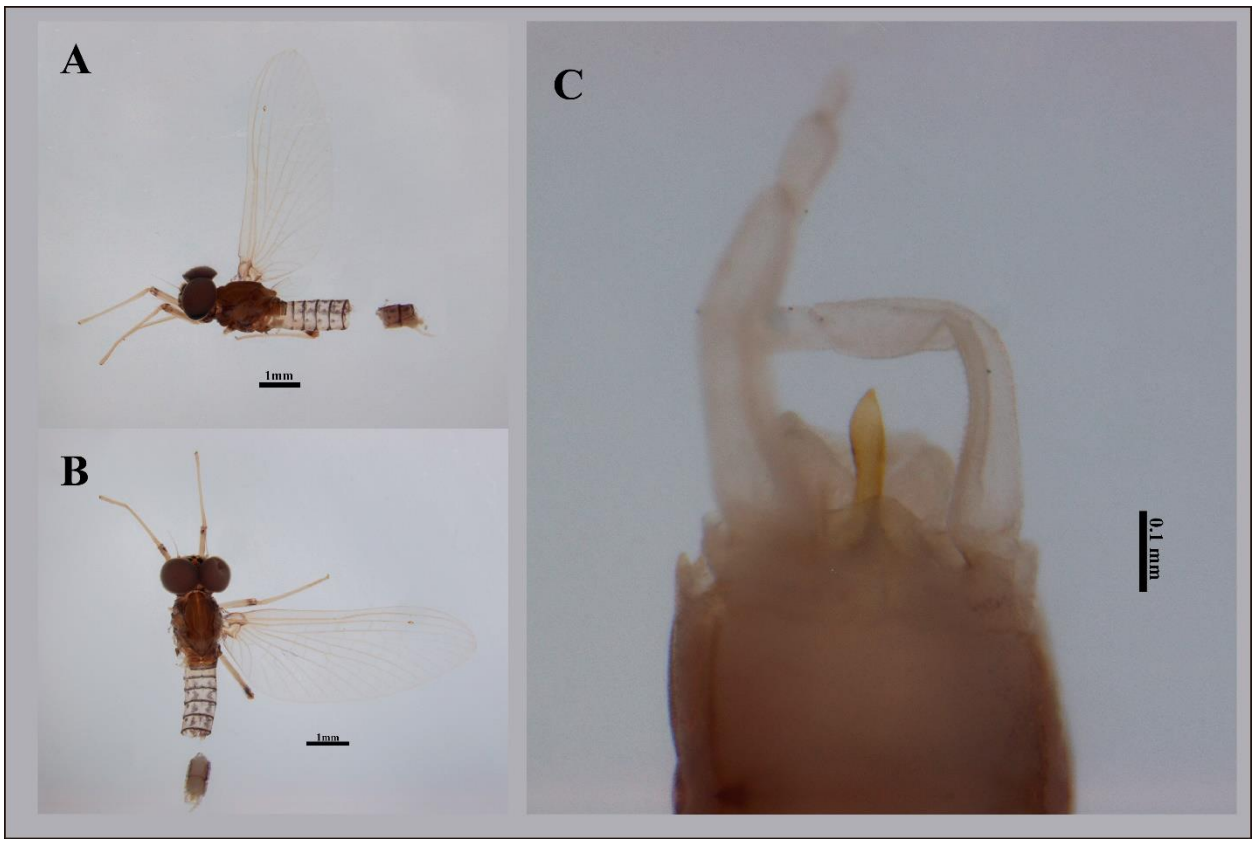
Previous distribution: unknown

Diagnosis: Male Imago – 1) abdominal segments IV-IX with a pair of submedian grayish maculae; 2) medial projection of the styliger plate as long as the lobes of the penis; posterior area of the medial projection ventrally curved.

Measurements data: body = 5.2 mm, n = 1; fore wing = 5.8 mm, n = 1; hind wing = 1.1 mm, n = 1.

Examined material: BRAZIL, *Tocantins*, Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, white sheet light trap, 11-12.x.2018, Krolow, T.K. and team cols. (1 ♂, CEUFT).

Remarks: This record represent a new species in process of description by Dr. Frederico Falcão Salles (UFV). It was found only one specimen on the samples. Although the shape of the styliger plate resembles *P. pearljam,* the projection (sharp instead curved apically), the size in relation to the lobes of the penis, the general color and the pattern of spots on the abdomen are different from the species mentioned. This species appears to be very close to the *Paramaka* sp. mentioned in Lima *et al*., 2016 from the state of Bahia.



FIGURES 11A-C. *Paramaka sp*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Simothraulopsis* Demoulin, 1966

Simothraulopsis demerara (Traver, 1947)

Fig. 12A-C

Thraulus demerara Traver, 1947: 150 (original description); (1960): 73.
Simothraulopsis demerara Domínguez *et al*., 1997: 146 (nymph redescription); Domínguez *et al*., 2002: 463 (list of species); Salles *et al*., 2004: 27 (list of species); Domínguez *et al*. 2006: 486 (book); Chacón *et al*., 2009: 728 (list of species); Salles *et al.*, 2010: 306 (list of species); Mariano & Polegatto, 2011: 594 (list of species); Domínguez *et al*., 2014: 313 (list of species); Massariol *et al*., 2014: 370 (citation); Lima *et al*., 2015: 5 (catalog); Takiya *et al*., 2016: 127 (catalog); Boldrini & Krolow, 2017: 3 (catalog); Nascimento *et al*., 2017: 9 (review); Raimundi *et al*., 2017: 581 (catalog); Lima, 2018: 253 (citation); Faria & Salles, 2019: 375 (catalog); Orlando *et al*., 2019: 363 (citation).
Simothraulopsis surinamensis Demoulin, 1966: 18 (catalog); Hubbard, 1982a: 266 (catalog).

Previous distribution: Brazil (Pará, Amazonas, Acre, Roraima, Amapá, Rondônia, Tocantins, Ceará, Bahia, Piauí, Pernambuco, Mato Grosso, Goiás, Espírito Santo, Paraná), Guyana, French Guiana, Surinam, Venezuela, Colombia, Ecuador, Bolivia and Argentina.

Diagnosis: Male Imago – 1) fore wings with two costal cross veins basal to bulla; 2) abdominal segments II–V with translucent white basal bands; 3) penis projection spine-like, long (approximately as long as total length of penis lobes) and anteriorly directed; penis lobes fused on basal 1/3 (adapted from Nascimento *et al*., 2017).

Measurements data: body = 4.67 mm, n = 2; fore wing = 5.22 mm, n = 2; hind wing: 0.64 mm, n = 2.

Examined material: BRAZIL, *Tocantins,* Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, 11-12.x.2018, white sheet light trap, Krolow, T.K. and team cols. (3 ♂, CEUFT); Palmas, district of Taquaruçu do Porto, Fazenda Buritizal, 10°17'9.69"S/48°3'13.77"W, 28.iii.2018, white sheet light trap, Fernandes, A.S. and team cols. (1 ♂, CEUFT).

Remarks: The species were previously recorded for the area in the work of Boldrini & Krolow 2017. It is a group originally described from French Guiana and Surinam and widely distributed in the north and northeast of Brazil with the furthest limit reaching the state of Paraná (Faria &

Salles 2019). Although the specimens captured in Tocantins differs little in size and color pattern when compared to the literature, it is important to highlight the work of Domínguez *et al*. 1997 in which the authors discussed the intraspecific variations found in the analyzed series as an excellent model for this type of work.

FIGURES 12A-C. *Simothraulopsis demerara*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Simothraulopsis janae Mariano, 2010

Fig. 13A-C

Simothraulopsis janae Mariano, 2010: 132 (original description); Lima *et al*., 2012: 311 (catalog); Nascimento *et al*., 2017: 37 (review); Costa *et al*., 2018: 4 (list of species); Lima, 2018: 253 (citation).

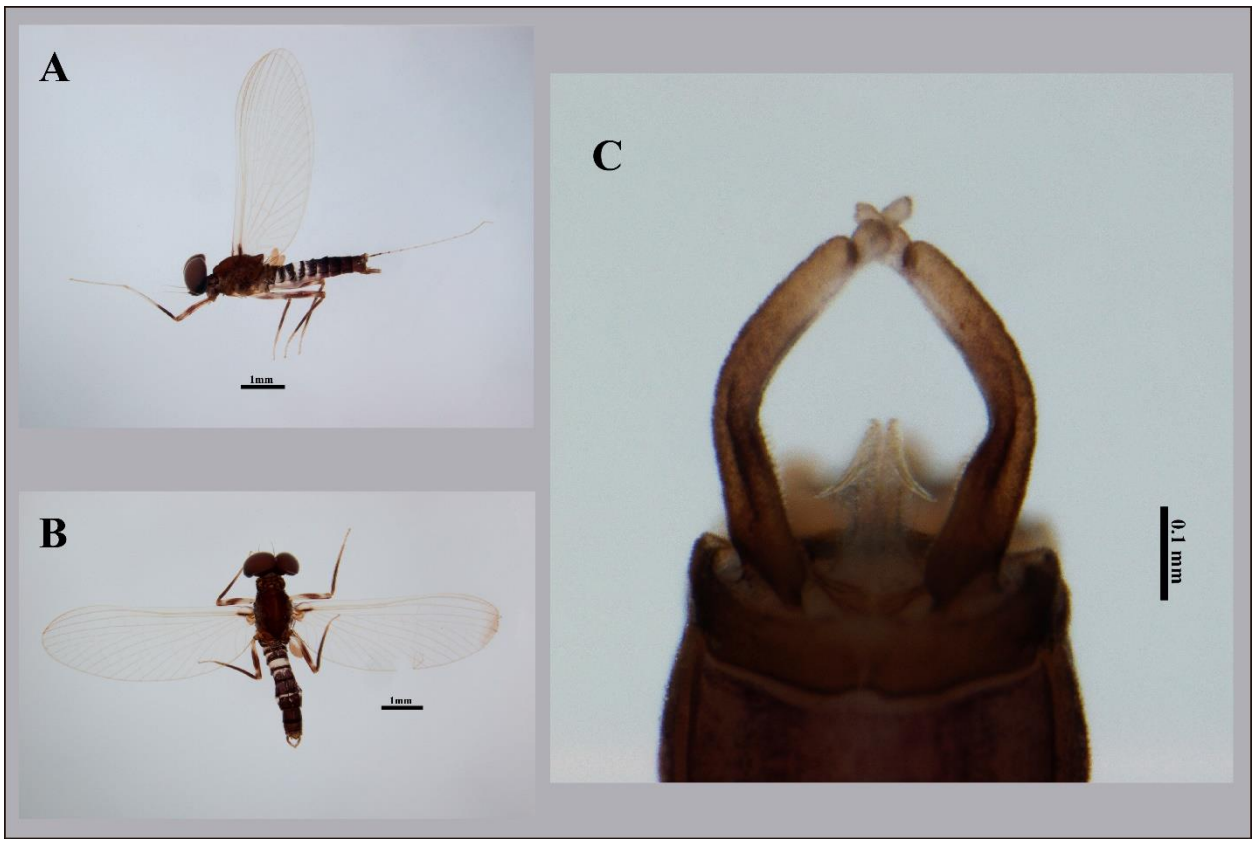
Previous distribution: Brazil (Pará, Roraima, Rondônia, Bahia, Pernambuco, Mato Grosso and Minas Gerais).

Diagnosis: Male Imago – 1) abdominal segments II–VI with translucent white basal bands; 2) penis lobes with sclerotized thin plate on dorsal region; 3) penis lobes slender, fused on basal 2/3; 4) penis projection spine-like, of median size (approximately half of the total length of penis lobes) and laterally directed (adapted from Nascimento *et al*. 2017).

Measurements data: body = 4.27 mm, n = 19; fore wing = 4.66 mm, n = 16; hind wing: 0.62 mm, n = 18.

Examined material: BRAZIL, *Tocantins*, Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, 11-12.x.2018, white sheet light trap, Krolow, T.K. and team cols. (19 ♂, CEUFT).

Remarks: First record for the state. Fore and hind wings were slightly smaller than the literature consulted (3.8mm-5.1mm; 0.48mm-0.72mm). The record for Tocantins connects the distribution that until now was isolated in two areas, the first represented by Pará, Roraima, Rondônia and Mato Grosso and the second by Bahia, Pernambuco and Minas Gerais.



FIGURES 13A-C. *Simothraulopsis janae*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Simothraulopsis primus Orlando, Krolow & Boldrini, 2019

Fig. 14A-C

Simothraulopsis primus Orlando, Krolow & Boldrini, 2019: 364 (original description)

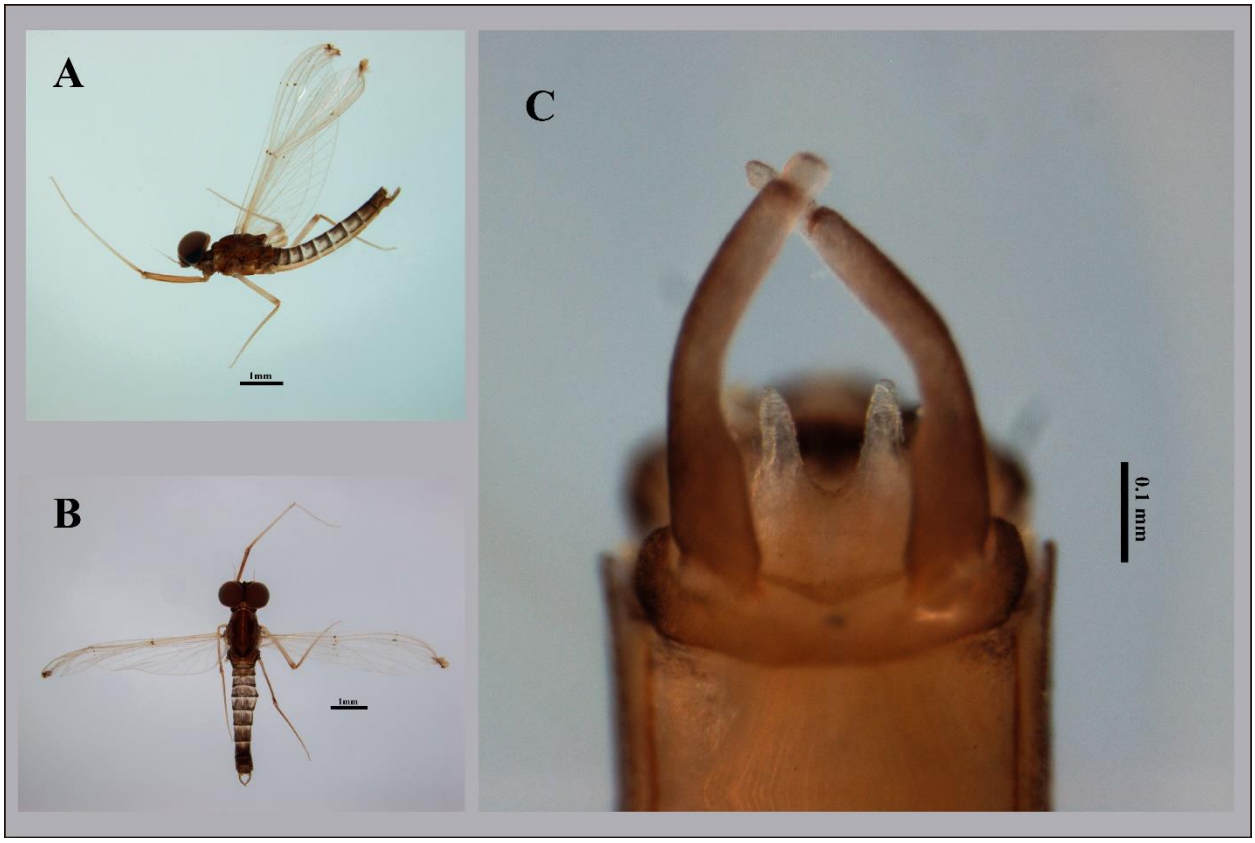
Previous distribution: Brazil (Tocantins).

Diagnosis: Male Imago – 1) hind wing with costal projection almost forming right angle, located approximately half distance from base to apex of wing; 2) abdominal terga yellowish brown, VIII and X washed brown, IX washed with dark brown; 3) penis projection lanceolate, straight, and of short size (less than half of the total length of penis lobes), anteriorly directed; 4) penis lobes fused on basal half, separated by a distance approximately twice the width of one penis lobe, with a shallow concavity in the junction of the lobes (adapted from Orlando *et al*. 2019).

Measurements data: body = 5.26 mm, n = 6; fore wing = 6.06 mm, n = 6; hind wing: 0.76 mm, n = 6.

Examined material: BRAZIL, *Tocantins*, Pedro Afonso, Sono river, 9°3'49.68"S/48°6'15.11"W, 11-12.x.2018, white sheet light trap, Krolow, T.K. & Orlando, T.Y.S cols. (1 ♂, UFRR; 1 ♂ INPA; 4 ♂ CEUFT); Rio da Conceição, Cavalo Queimado waterfall, 11°24'12.85"S/ 46°51'30.20"W, 15.vi.2018, white sheet light trap, Krolow, T.K. & Orlando, T.Y.S cols. (1 ♂, CEUFT).

Remarks: The species was recently described by Orlando *et al*. 2019 and thus far is considered endemic to Pedro Afonso and Rio da Conceição municipalities, Tocantins state. The spine-like projection on the penis is very similar to *S. inequalis*.



FIGURES 14A-C. *Simothraulopsis primus*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Simothraulopsis sabalo Kluge, 2007

Fig. 15A-C

Simothraulopsis sabalo Kluge, 2007: 389 (original description); Mariano, 2010: 134 (citation); Lima *et al*., 2012a: 311 (catalog); Lima *et al*. 2015: 5 (citation); Nascimento *et al*., 2017: 23 (review); Lima, 2018: 253 (citation); Faria & Salles, 2019: 375 (citation).

Previous distribution: Brazil (Amazonas) and Peru.

Diagnosis: Male Imago – 1) forewing with two costal cross veins basal to bulla; 2) abdominal segments I–V with translucent white basal bands; 3) forceps: basal region of segment I with a small concavity; 4) penis projection spine-like, of median size (approximately half of the total

length of penis lobes) and anteriorly directed; penis lobes fused on basal 1/2 (adapted from Nascimento *et al*. 2017).

Measurements data: body = 4.58 mm, n = 11; fore wing = 5.1 mm, n = 11; hind wing: 0.57 mm, n = 11.

Examined material: BRAZIL, *Tocantins*, Araguaína, river close to the bridge (EMZV), 7°6'7.13"S/48°12'6.40"W, 08.x.2018, white sheet light trap, Krolow, T.K. and team cols. (5 ♂, CEUFT); Lavandeira, Palmas river, 12°47'37.26"S/46°30'38.83"W, 13-14.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (6 ♂, CEUFT).

Remarks: First record for the state and expansion of 2800 km east from the type locality. Fore wings slightly bigger than literature consulted. (4.9mm-5.3mm). The individuals in the sample have the concavity at the base of the forceps characteristic of the species, however, the pigmentation on the hind wings varies considerably within the sample.

FIGURES 15A-C. *Simothraulopsis sabalo*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Terpides* Demoulin, 1966

Terpides sooretamae Boldrini, Salles & Cabette 2009

Fig. 16A-C

Terpides sooretamae Boldrini, *et al*., 2009: 222 (original description); Salles *et al*., 2010: 306 (list of species); Lima *et al*., 2012a: 314 (catalog); Massariol *et al*., 2014: 370 (list of species); Angeli *et al*., 2015: 202 (catalog).

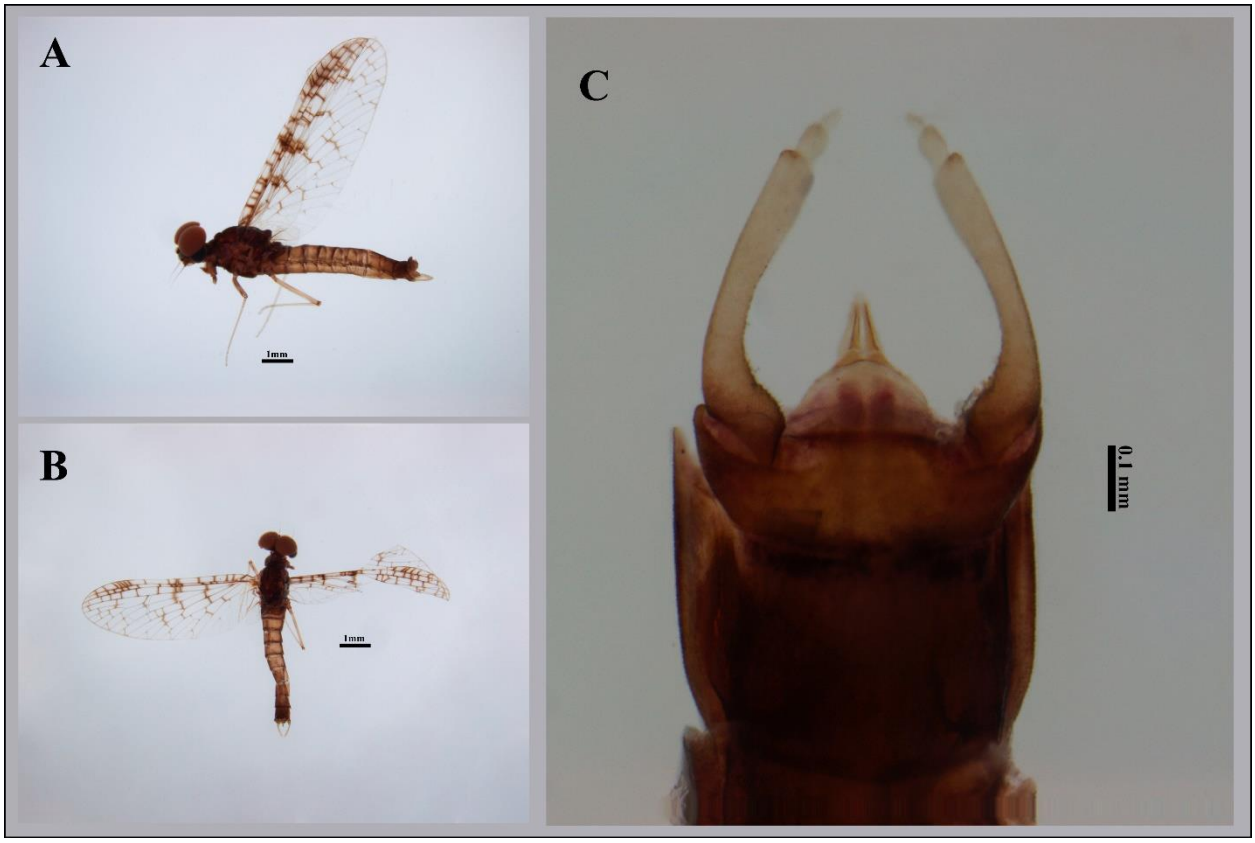
Previous distribution: Brazil (Pernambuco, Mato Grosso and Espírito Santo).

Diagnosis: Male Imago – 1) upper portion of eyes orange; 2) cross veins of fore wings surrounded with small brown clouds; 3) genitalia with penis gradually narrowing toward apex (Boldrini *et al*. 2009).

Measurements data: body = 6. 6 mm, n = 2; fore wing = 6.05 mm, n = 2; hind wing: 0.99 mm, n = 1.

Examined material: BRAZIL, *Tocantins*, Monte do Carmo, Fazenda Maria (Sucuri river), 10°46'21.49"S/48° 5'19.80"W, U.V. light pan trap, 03-04.iv.2019, Fernandes, A.S. and team cols. (2 ♂, CEUFT).

Remarks: First record for the state. Body size presented bigger size when compared to the data of the original description (6.3mm-6.9mm). The genitalia from members of the genus has a characteristic disposition with two lobes of the penis very close to each other that gradually narrow, however, the shape for this species, different from the others, is an isosceles triangle.



FIGURES 16A-C. *Terpides sooretamae*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Thraulodes* Ulmer, 1920

***Thraulodes* sp. 1**

Fig. 17A-C

Previous distribution: unknown

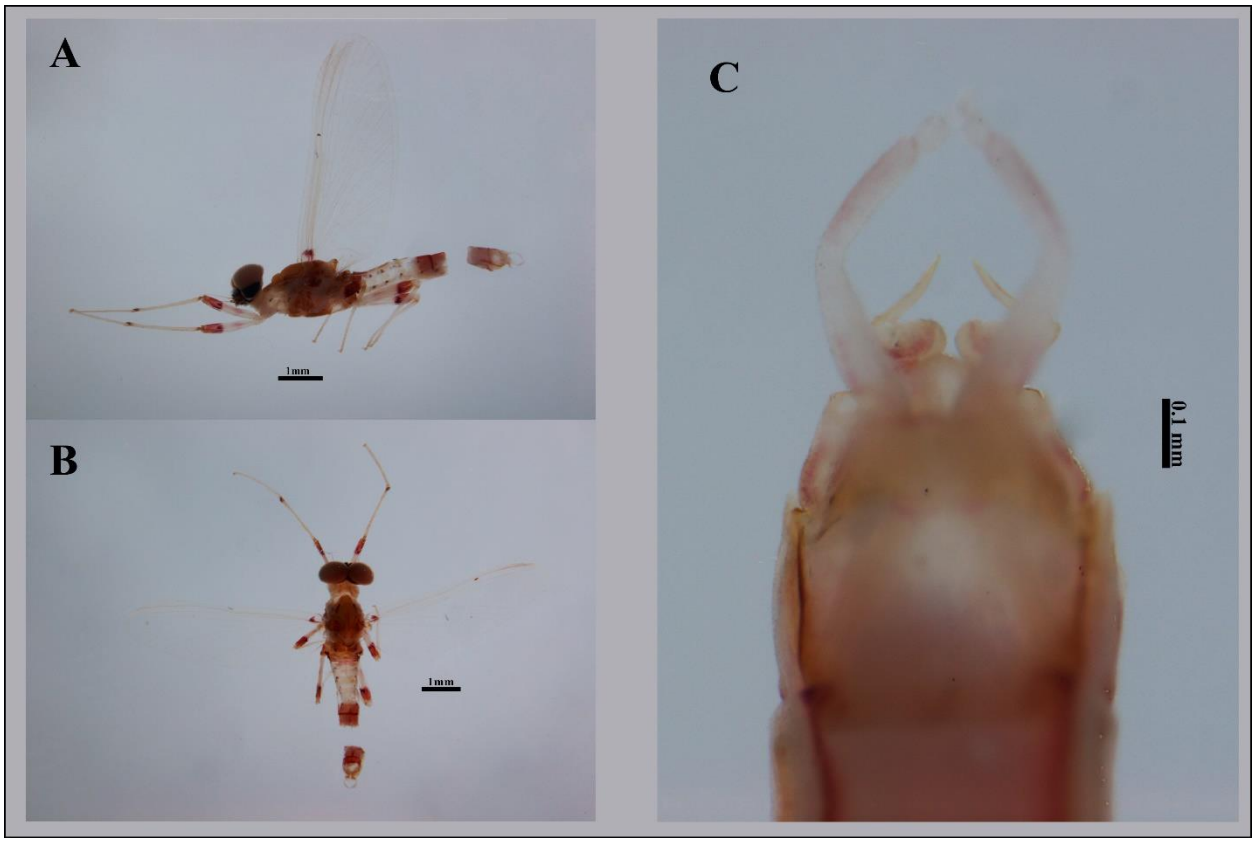
Diagnosis: Male Imago – 1) fore wings hyaline with costal and subcostal weakly colored yellowish; 2) costal membrane basal to bulla without cross veins; 3) abdominal segments II-V

translucent yellowish, VI-X brown with submedian grayish maculae on segments II-V; 4) femora with one band; 5) penis lobes each with a lateral pouch and slender curved spines.

Measurements data: body = 5.3 mm, n = 1; fore wing = 5.3 mm, n = 1; hind wing: 1.16 mm, n = 1.

Examined material: BRAZIL, *Tocantins*, Arraias, Palmas river, 12°49'50.66"S/46°54'32.61"W, 04.vii.2018, white sheet light trap, Alvim, B.G.C. coll. (1 ♂, CEUFT).

Remarks: Only one specimen was captured, although, a different species of *Thraulodes* is present in the sample. This species resembles *Thraulodes schlingeri* Traver & Edmunds, 1967 based on the diagnostic characters observed. The individual possibly represents a new species, however, due to the limited number of specimen, future analyzes will confirm its status.



FIGURES 17A-C. *Thraulodes sp.*1, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

***Thraulodes* sp. 2**

Fig. 18A-C

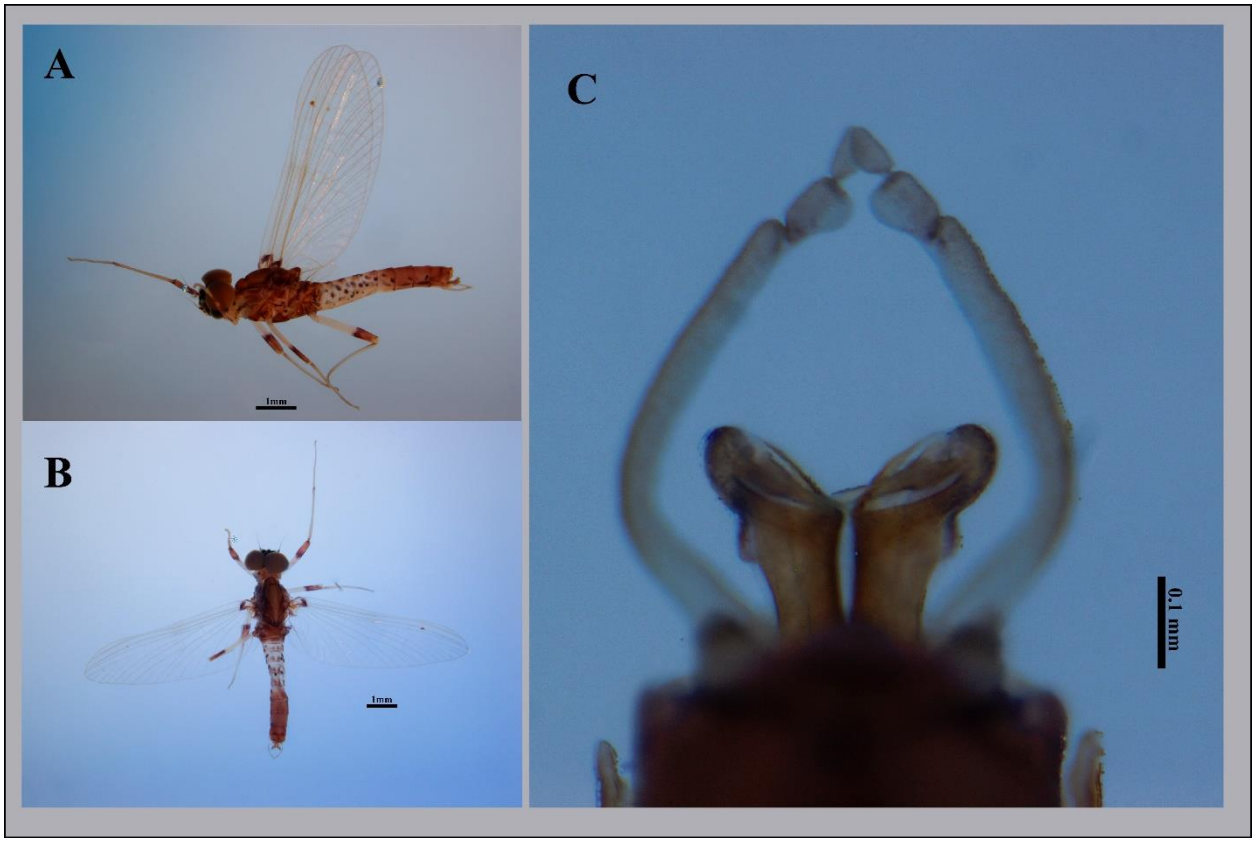
Previous distribution: unknown

Diagnosis: Male Imago – 1) costal membrane basal to bulla without cross veins; 2) costal and subcostal areas without pigmentation; 3) abdominal terga I and VI-X yellowish brown, II-VI translucent yellowish; two blackish maculae situated near posterior margins of terga I-VII, one on each side of median line, and blackish maculae at posterolateral angles and anterolaterally; 5) apicolateral area of each penis lobe forming an "ear", spine long and slender, and outer border forming a lateral pouch.

Measurements data: body = 6.16 mm, n = 20; fore wing = 5.68 mm, n = 20; hind wing: 1.05 mm, n = 20.

Examined material: BRAZIL, *Tocantins,* Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 13-14.xi.2017, white sheet light trap, Krolow, T.K. coll. (2 ♂, UFRR; 2 ♂, CEUFT); idem, 15-16.xi.2017, U.V. light pan trap, Krolow, T.K. coll. (1 ♂, CEUFT); idem, 04-06.xii.2018, white sheet light trap, Fernandes, A.S. and team cols. (10 ♂, CEUFT); idem, 27-30.viii.2019, white sheet light trap, Fernandes, A.S. and team cols. (62 ♂, CEUFT); idem, Evilson waterfall, 10°14'0.21"S/ 48°7'17.82"W, 13.vii.2018, white sheet light trap, Fernandes, A.S. and team cols. (11 ♂, CEUFT).

Remarks: This species resembles *Thraulodes traverae* Thew, 1960 based on the diagnostic characters observed. In the original description, regarding the pigmentation on the femura, the authors mention 2 bands, while in specimens collected in Tocantins, there is only 1 band in the medial portion and a light brown spot in the basal portion. Due to the great potential to find new taxa on this genus and the divergence presented to the original description future analyzes will confirm its status as a new species.



FIGURES 18A-C. *Thraulodes sp.* 2, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Thraulodes xavantinensis Mariano, Flowers & Froehlich, 2011

Fig. 19A-C

Thraulodes xavantinensis Mariano *et al*., 2011: 388 (original description); Lima *et al*., 2013: 231 (key); Raimundi, 2019: 40 (list of species).

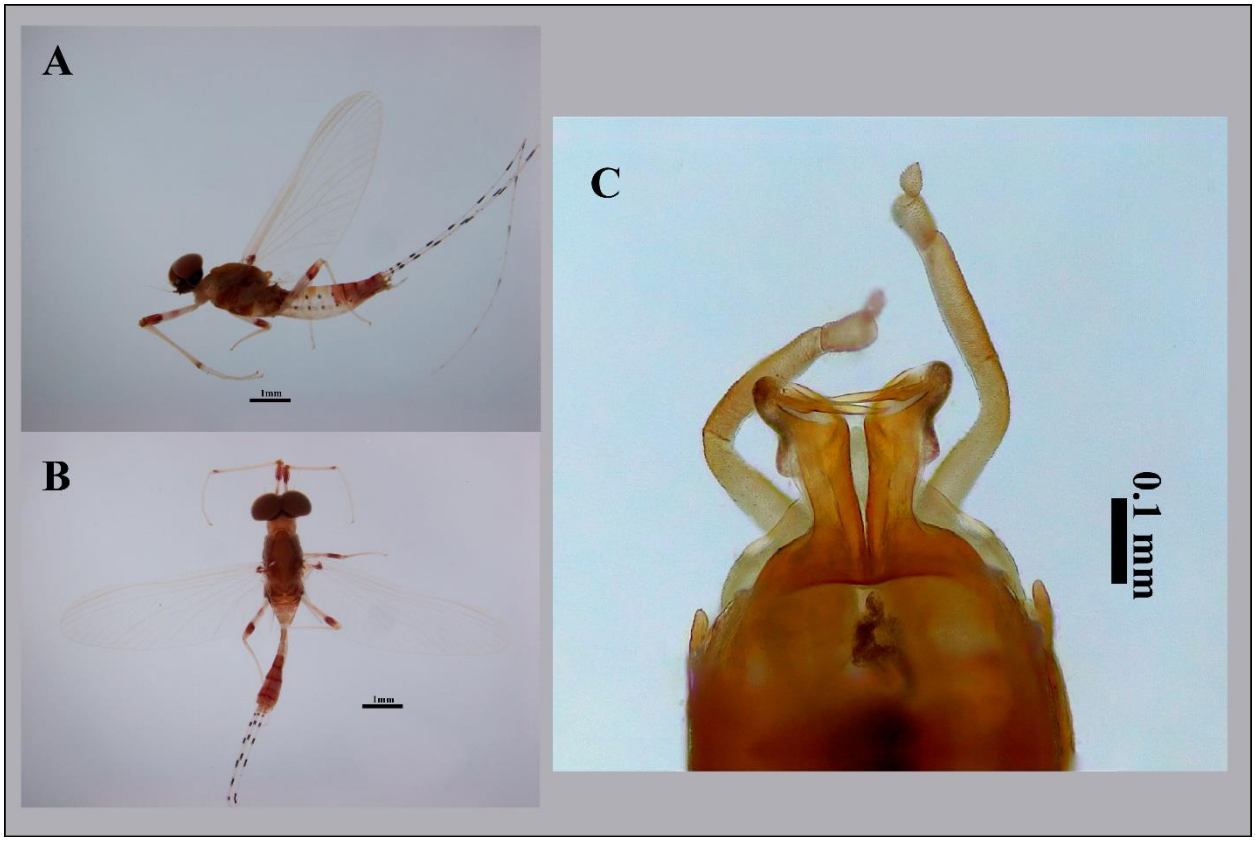
Previous distribution: Brazil (Mato Grosso and Goiás).

Diagnosis: Male Imago – 1) costal membrane of forewing basal to bulla without cross veins; 2) one band and a blackish macula extending from median to basal region on femora; 3) spines of penes long and narrow; apicolateral area forming a "ear"; external margin forming lateral pouch; 4) posterior part of the subgenital plate with triangular shape; rounded medial projection reaching 2/3 of penis length; 5) penes spines medially directed (Adapted from Mariano *et al*., 2011).

Measurements data: body = 6 mm, n = 7; fore wing = 5.8 mm, n = 7; hind wing: 1.25 mm, n = 7.

Examined material: BRAZIL, *Tocantins*, Arraias, Palmas river, 12°49'50.66"S/46°54'32.61"W, 04.vii.2018, white sheet light trap, Alvim, B.G.C. coll. (7 ♂, CEUFT).

Remarks: First record for the state. Fore and hind were the measurements that differed most from the original description (5.4mm-6.1mm; 1.02mm-1.4mm).



FIGURES 19A-C. *Thraulodes xavantinensis*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Genus *Ulmeritoides* Traver, 1959

Ulmeritoides angelus Souto, Da-Silva, Nessimian & Gonçalves, 2016

Fig. 20A-C

Ulmeritoides angelus Souto, Da-Silva, Nessimian & Gonçalves, 2016: 130 (original description and key); Costa *et al*., 2018 (list of species).

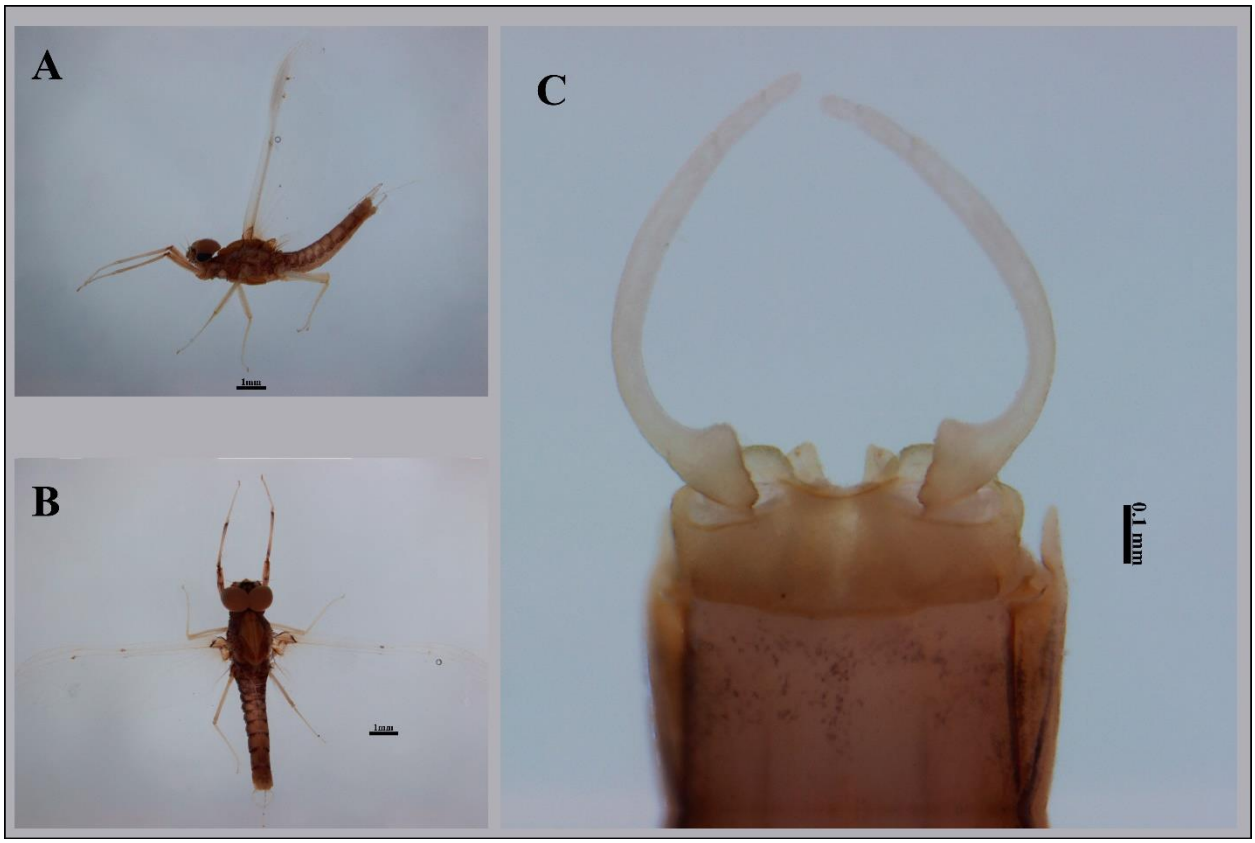
Previous distribution: Brazil (Minas Gerais and Bahia).

Diagnosis: Male Imago – 1) forewings hyaline, base dark brown; 2) dark brown spots on bullae of veins Sc and R2; 3) apex of penis lobes somewhat rounded, each with one central spine (adapted from Souto *et al*., 2016).

Measurements data: body = 7.47 mm, n = 7; fore wing = 7.95 mm, n = 6; hind wing: 1.3 mm, n = 7.

Examined material: BRAZIL, *Tocantins,* Palmas, district of Taquaruçu do Porto, Vale do Vai Quem Quer, 10°22'0.91"S/48°8'1.39"W, 04-06.xii.2018, white sheet light trap, Fernandes, A.S. and team cols. (7 ♂, CEUFT).

Remarks: First record for the state. All the measures were considerably smaller than the literature consulted (6.4mm-8.9mm; 7.7mm-8.2mm; 1.2mm-1.4mm). Penis shape and spine, styliger plate and spots on bullae of veins Sc and R2 match the original description, however, the number of cross veins basal to the bullae does not (from 8 to 11 in the original description and 6 in the observed individuals).



FIGURES 20A-C. *Ulmeritoides angelus*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Ulmeritoides flavopedes (Spieth, 1943)

Fig. 21A-C

Thraulodes flavopedes Spieth, 1943: 11 (original description).

Ulmeritoides flavopedes Domínguez, 1991: 162 (book); Domínguez *et al*., 2006: 524 (book); Shimano *et al*., 2012: 304 (list of species); Salles & Domínguez 2012: 59 (key); Lima *et al*., 2015: 5 (catalog); Takiya *et al*. 2016: 129 (catalog); Boldrini & Krolow, 2017: 3 (catalog); Costa *et al*., 2018: 1 (citation).

Atalophlebioides flavopedes, Traver, 1946: 426.

Ulmeritus (Pseudulmeritus) flavopedes; Traver 1959: 8

Ulmeritoides oepa Lopes, Da-Silva & Py-Daniel, 2003: 195 (nymph); Salles *et al*., 2004: 28 (list of species); Domínguez *et al*., 2006: 527 (book); Ribeiro *et al*., 2008: 598 (catalog).

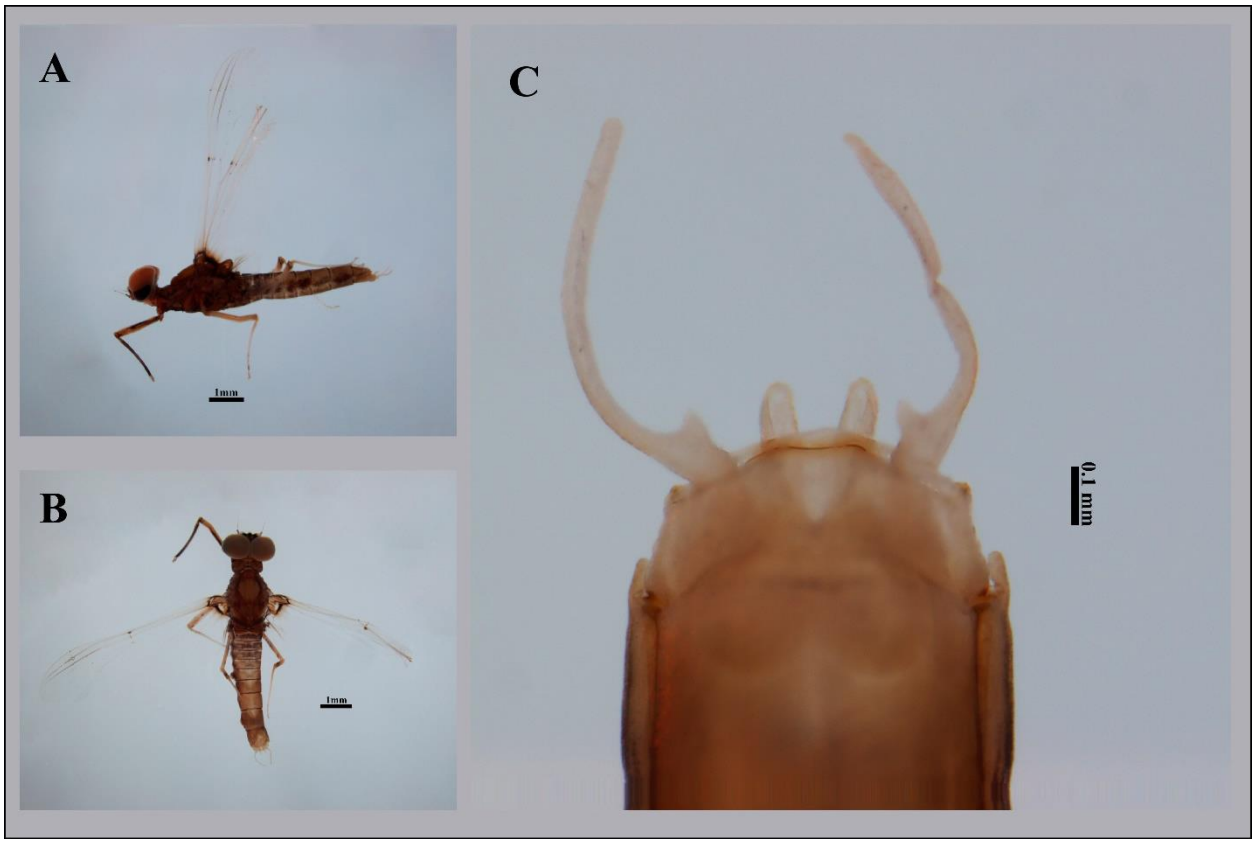
Previous distribution: Brazil (Roraima, Tocantins, Bahia, Piauí, Pernambuco, Mato Grosso) and Surinam.

Diagnosis: Male Imago – 1) Membrane of fore wings hyaline, wing bases brown; 2) abdominal terga orange-brown, posterior margins blackish; 3) apex of penis lobes rounded, each with a lateral groove. (Domínguez *et al*., 2006).

Measurements data: body = 7.06 mm, n = 3; fore wing = 6.7 mm, n = 2; hind wing: 1.04 mm, n = 3.

Examined material: BRAZIL, *Tocantins*, Wanderlândia, Assentamento Costa Rica (águas lindas balneary), 6°52'3.53"S/47°56'46.93"W, white sheet light trap, 09-10.x.2018, Krolow, T.K. and team cols. (1 ♂, CEUFT); Araguaína, river close to the bridge (EMZV), 7°6'7.13"S/48°12'6.40"W, 08.x.2018, white sheet light trap, Krolow, T.K. and team cols. (2 ♂, CEUFT).

Remarks: The species were previously recorded for the area in the work of Boldrini & Krolow 2017. Black markings on the bullae similar to *U. angelus.*



FIGURES 21A-C. *Ulmeritoides flavopedes*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

Ulmeritoides uruguayensis (Traver, 1959)

Fig. 22A-C

Ulmeritus (Ulmeritoides) uruguayensis Traver, 1959: 8 (original description - male, female); Hubbard, 1982: 268 (catalog).
Ulmeritoides uruguayensis; Domínguez*, 1991: 162;* Domínguez*, 1995a: 21;* Salles *et al*., 2004: 28 (list of species); Domínguez *et al*., 2006: 528 (book); Mariano & Froehlich, 2007: 61 (nymph); Mariano & Polegatto, 2011: 594 (list of species); Salles & Domínguez, 2012: 51 (key); Raimundi *et al*., 2013: 64 (citation); Souto *et al*., 2016: 135 (key).
Ulmeritus uruguayensis; Thew, *1960: 123.*
Ulmeritus adustus Thew, 1960: 126 (male, female).

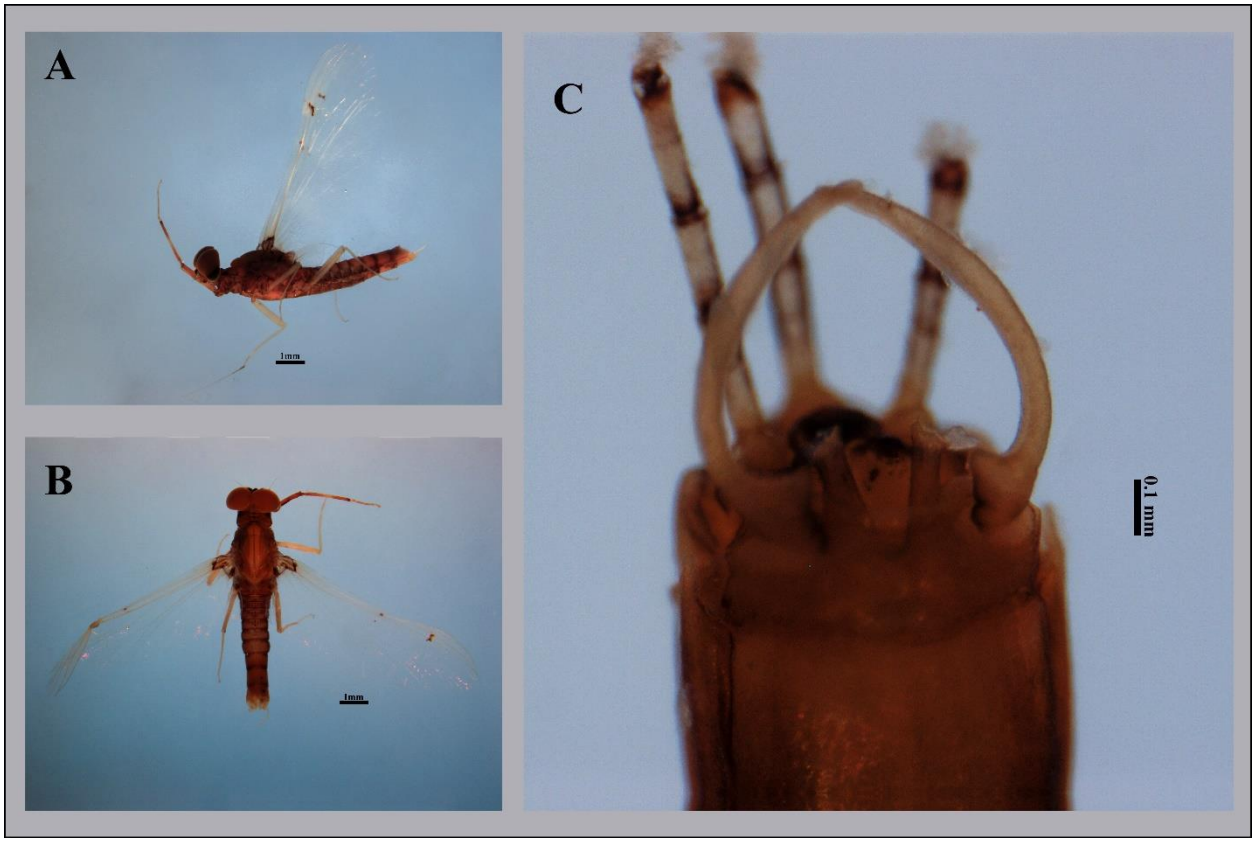
Previous distribution: Brazil (Roraima, Maranhão, São Paulo, Santa Catarina) and Uruguai.

Diagnosis: Male Imago – 1) fore wings hyaline, with brown spot at base; 2) abdominal terga with black markings enclosing a lighter central area; 3) penis lobes ending in an acute apical projection, and without small spines on margin.

Measurements data: body = 7.36 mm, n = 5; fore wing = 6.76 mm, n = 5; hind wing: 1.15 mm, n = 5.

Examined material: BRAZIL, *Tocantins*, Monte do Carmo, Fazenda Maria (Sucuri river), 10°46'21.49"S/48° 5'19.80"W, white sheet light trap, 03-04.iv.2019, Fernandes, A.S. and team cols. (1 ♂, CEUFT); Natividade, Paraíso waterfall, 11°39'33.60"S/ 47°41'20.84"W, 12.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (1 ♂, CEUFT); Taguatinga, on the way to Registro waterfall (Sobrado creek), 12°47'37.26"S/46°30'38.83"W, 14.vi.2018, white sheet light trap, Krolow, T.K. and team cols. (1 ♂, CEUFT); Arraias, Palmas river, 12°49'50.66"S/46°54'32.61"W, 04.vii.2018, white sheet light trap, Alvim, B.G.C. coll. (2 ♂, CEUFT).

Remarks: First record for the state. It is a species with a highly fragmented distribution. Its records extend from Uruguay to the northern region of Brazil.



FIGURES 22A-C. *Ulmeritoides uruguayensis*, adult male. (A) lateral view; (B) dorsal view; (C) genitalia.

4.6 Discussion

The present study represents an update on the data provided by Boldrini & Krolow 2017 with addition of 18 new species records, 9 new genera records, considerations regarding their distributions and intraspecific variations for Leptophlebiidae in the state of Tocantins. Among the greatest extensions of distribution patterns, the following stand out: *Askola paprockii* Domínguez, Molineri & Mariano, 2009, which until then was only known to the state of Minas Gerais, *Miroculis* (*Miroculis*) *marauiae* Savage & Peters, 1983 and *Simothraulopsis sabalo* Kluge, 2007 recorded only for the state of Amazonas.

These species exemplify the high level of undocumented species for the region and how the lack of information about the distribution of certain groups is a recurrent situation in studies with ephemeropteran fauna in Brazil (Turchetto-Zolet *et al*., 2012; Cardoso *et al*., 2015; Dos Santos *et al*., 2018).

It is remarkable how the knowledge about mayflies has increased in the last decade, following an increase of local taxonomists and inventories, however, there is still a deficiency on what we know about the distribution of many species in Brazil (Salles *et al*., 2010; Mariano & Polegatto, 2011; Boldrini *et al*., 2012; Lima *et al*., 2012a; Gama Neto & Hamada, 2014; Angeli *et al*., 2015; Campos *et al*., 2016; Da-Silva & Salles, 2016; Lima *et al*. 2016; Takiya *et al*., 2016; Boldrini & Krolow, 2017; Costa *et al*., 2018; Raimundi, 2019).

This reinforces the importance of inventories, not only because this work brings a new perspective about the distribution of the group but also because they are crucial tools in the management of wildlife resources (Morrison *et al*., 2008; Silveira *et al*., 2010).

Acknowledgments

The first author thanks CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the grant and PPGBec (Programa de Pós-Graduação em Biodiversidade, Ecologia e Conservação) for financial support. The third author thanks CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) (process 401784/ 2016-9). We sincerely thank the team from CEUFT for the field and logistic support, comments and suggestions in the manuscript.

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CAPÍTULO 2 - A new species of *Simothraulopsis* Demoulin, 1966 (Ephemeroptera: Leptophlebiidae) from Tocantins state, Brazil

A new species of *Simothraulopsis* Demoulin, 1966 (Ephemeroptera: Leptophlebiidae) from Tocantins state, Brazil

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5.1 ABSTRACT

There are seven genera and eight species of mayflies recorded for Tocantins state, Brazil, but only three belonging to the Family Leptophlebiidae. Based on male imagoes, *Simothraulopsis primus* **sp. nov.** is described from Tocantins state, Northern Brazil. The species is characterized by the male genitalia being short, lanceolate, with a straight spine and by the "U" shape between the penis lobes. Other distinguishing features are the brown thorax and yellowish brown abdomen.

Keywords: mayfly, imago, Neotropics, taxonomy, Atalophlebiinae.

5.2 Introduction

Simothraulopsis Demoulin, 1966 is a Neotropical genus, comprised of 11 species with records from Colombia, French Guyana, Guyana, Surinam, Venezuela, and Brazil in several Amazonic, Atlantic Forest and Cerrado areas (Demoulin 1966; Domínguez *et al.* 1997; Mariano 2010; Nascimento *et al*. 2017; Lima 2018; Faria & Salles 2019).

The genus is characterized by the fusion on the base of the penis, divided in the apical ½ to ¾, with a spine on apex of each penis lobe. Another important diagnostic characteristic, the forceps socket fused forming a single cavity, was not reported in the early works on the genus (Traver 1947; Domínguez *et al*. 1997; Kluge 2007), but according to Nascimento *et al.* (2017), it is present among all analyzed specimens. Yet another distinguishing characteristic of the genus is the pigmentation in the hind wing on the apical lower portion.

According to Sartori & Brittain (2015) there are approximately 130 genera and 820 species of mayflies reported from the Neotropical region, while in Brazil the number of representatives of this insect group is 81 genera and 398 species (Salles & Boldrini 2020). The knowledge about mayflies in Tocantins state in northern Brazil is limited to the work of Boldrini *et al*. (2012), Boldrini & Krolow (2017) and Lima & Boldrini (2018), who have reported seven genera and eight species, numbers considered far from adequate by Cardoso *et al*. (2015) when compared to neighboring states. Currently, *Simothraulopsis demerara* (Traver, 1947) is the only representative of the genus in Tocantins State (Boldrini & Kolow, 2017).

In the present paper we describe a new species of *Simothraulopsis* based on the male imago stage from Tocantins state (Fig. 1A). This is the first new species of Ephemeroptera with its type locale in the state.

5.3 Materials and methods

Collections were conducted on Rio da Conceição, from 15-16.vi.2018 at the Cavalo Queimado waterfall (Fig. 1B) and Pedro Afonso on the left bank of Sono River (Fig. 1C), from 11–12 October 2018. Subimagos were captured with light traps (white and UV) from 18:00 until 06:30 hrs., then kept for about twelve hours in empty microtubules, until they moulted to the imago stage. Male genital structures were examined in alcohol gel, and the specimens were

preserved in 80% ethanol. Male legs and genitalia were dissected and mounted in Euparal®, and wings were dry mounted.

The structures were photographed using a Samsung A8 mobile telephone attached to an Olympus SZ2-LGB stereomicroscope. Line drawings were made with the aid of Adobe Illustrator CC® 2019, and the distribution map with collection sites was prepared using QGIS® 3.8.0.

Thorax terminology follows Kluge (1994), and terms for genitalia structure are from Traver & Edmunds (1967) as modified by Domínguez *et al*. (2006). The material examined is deposited in the following institutions in Brazil: Instituto Nacional de Pesquisas da Amazônia, Manaus–AM; Zoological Collection of Universidade Federal de Roraima (UFRR) Boa Vista, RR; and Entomological Collection of Universidade Federal do Tocantins (CEUFT), Porto Nacional, Tocantins.

We utilize the morphological species concept as the basis for our species hypotheses.

***Simothraulopsis primus* sp. nov.**

(Figs. 2A–F)

Diagnosis. Male imago: 1) general coloration: thorax brown and abdomen yellowish brown (Figs. 2A–B); 2) hind wing with costal projection almost forming right angle, located approximately half distance from base to apex of wing (Figs. 2D–E); 3) abdominal terga yellowish brown, VIII and X washed brown, IX washed with dark brown (Figs. 2A–B); 4) penis projection lanceolate, straight, and of short size (less than half of the total length of penis lobes), anteriorly directed (Fig. 2F); 5) penis lobes fused on basal half, separated by a distance approximately twice the width of one penis lobe, with a shallow concavity in the junction of the lobes (Fig. 2F).

5.4 Description

Male imago (n=6): Length of body: 5.0–5.4 mm; forewings: 5.8–6.2 mm; hind wings: 0.7–0.8 mm. General color brown with yellowish brown areas.

Head (Figs. 2A–B). General coloration orangish brown. Scape and pedicel light brown. Ocelli white, surrounded by dark brown ring at base. Eyes black, turbinate portion orangish brown.

Thorax (Figs. 2A–B). General coloration yellowish brown. Pro- and mesonota dark brown. Mesonotum with longitudinal medial, medioparapsidal suture light brown, scutellum darker. Metanotum light brown (Fig. 2B). Sterna light brown. Wing membranes hyaline. Forewing (Fig. 2C) with yellowish brown veins and cross veins hyaline; basal third of costal vein brown; fork of vein MP slightly asymmetric. Hind wing with costal projection well-developed, almost forming right angle, located approximately half distance from base to apex of wing (Figs. 2D–E); veins yellowish brown, except base of vein C to costal projection brown; apical lower portion of hind wing tinged with brown (Figs. 2D–E). Coxae brown and trochanters yellowish brown. Foreleg: femur yellowish brown with apical region brown; tibia yellowish brown, basal region brown; tarsi yellowish brown. Mid- and hindlegs similar to forelegs, except for usual differences.

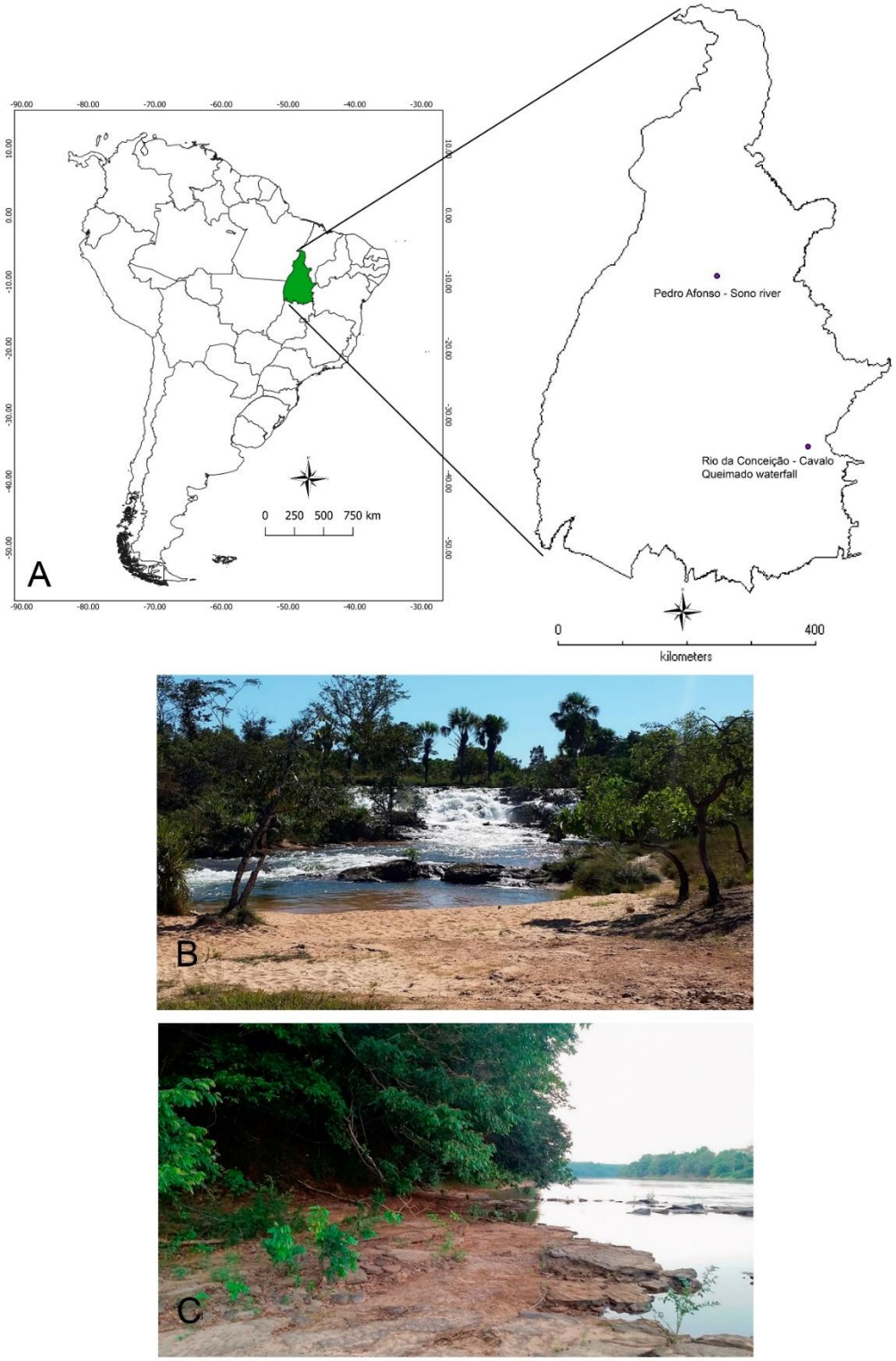
Abdomen (Fig. 1): Terga yellowish brown, VIII and X washed brown; IX washed with dark brown. Sterna yellowish brown. Genitalia (Fig. 2F): Styliger plate yellowish brown. Forceps segment I, II and III brown. Segment II 0.11 length of segment I, 1.05 length of segment III. Penis lobes yellowish brown, fused on basal half, inner margins divergent; each lobe rounded apically, but appearing almost pointed, separated by distance approximately twice width of one penis lobe, with straight lanceolate portion having short size (less than half of total length of penis lobes) projection, anteriorly directed and narrowing towards apex; inner margins of lobes divergent. Caudal filaments unknown (broken and lost).

Etymology. From the Latin word *primus*, refrring to the first Ephemeroptera species described from the state of Tocantins.

Distribution. Tocantins State, Brazil.

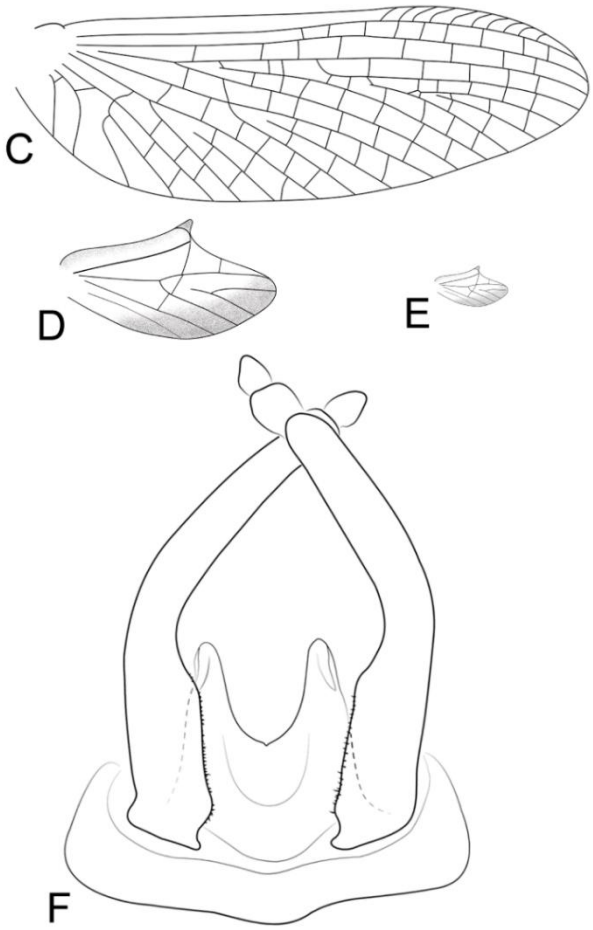
Material Examined. Holotype: 1 ♂ (preserved in alcohol), Brazil, Tocantins state, Rio da Conceição municipality, Cavalo Queimado waterfall, light trap, 11°24'13.32"S/46°51'30.56"W, 15-16.vi.2018, Krolow, T.K., Boldrini, R., Fernandes, A.S., Rippel, M.L.S. and Orlando, T.Y.S. cols (INPA)**. Paratypes:** 5 ♂ Brazil, Tocantins state, Pedro Afonso municipality, Sono river,

light trap, 8°59'45.25"S/ 48° 8'21.61"W, 11-12.x.2018, Krolow, T.K. and Orlando, T.Y.S. cols: (1 CBio/UFRR and 4 CEUFT - preserved in alcohol).



Figures 1A–C. Distribution and sampled sites of *Simothraulopsis primus* **sp. nov**: A) Map of South America, highlighting the collection sites of *Simothraulopsis primus* **sp. nov**. in

Tocantins state; B) Sono river, Pedro Afonso, Tocantins state; C) Cavalo Queimado waterfall, Rio da Conceição, Tocantins state.



Figures 2A–F. *Simothraulopsis primus* **sp. nov.**, male imago: A) body (lateral view); B) body (dorsal view); C) forewing; D) hind wing (enlarged); E) hind wing; F) genitalia (ventral view).

Comments. *Simothraulopsis primus* sp. nov. has a body color pattern and equally divergent inner margins of penis lobes similar to *S. sinuosus* Lima, 2018. The penis projection is short, lanceolate, and narrowing towards the apex, similar to that of *S. inaequalis* Nascimento, Salles & Hamada, 2017. However, *S. primus* sp. nov. is clearly distinguished from *S. sinuosus* by the shapes of penis projections; these are long, spine-like and sinuous in *S. sinuosus*, and they are short, lanceolate, and straight in *S. primus* sp. nov. Furthermore, the new species can be clearly distinguished from *S. inaequalis* by having a brown thorax, a yellowish brown abdomen, the apical lower portion of the hind wing tinged with brown, and the "U" shape between the penis lobes. In contrast, *S. inaequalis* has an orangish color, tergum VIII with a submedial black mark near the posterior margin, almost the entire lower portion of the hind wing black, and a "V" shape between the penis lobes. Beyond morphogical differences, the *S. sinuosus* occurrence area is restricted to the state of Piauí, while *S. inaequalis* can be found in Pará and Amazonas states. The only record of the genus *Simothraulopsis* in the studied area belongs to *S. demerara* (Traver, 1947), which has a wide distribution, present mainly in the north and northeast region, but it differs from *S. primus* sp. nov. by having the thorax orangish brown, the abdomen grayish brown, the costal region and almost the entire lower portion of the hind wing black, and by the "V" shape between the penis lobes. In *S. primus sp. nov.,* the thorax is brown; the abdomen is yellowish brown; the apical lower portion of the hind wing is tinged with brown; and there is a "U" shape between the penis lobes.

ACKNOWLEDGMENTS

The first author thanks CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the grant and PPGBec (Programa de Pós-Graduação em Biodiversidade, Ecologia e Conservação) for financial support. The third author thanks CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) (process 401784/ 2016-9). We sincerely thank the team from CEUFT for the field and logistic support, comments and suggestions in the manuscript.

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6 CONCLUSÕES GERAIS

O presente trabalho registrou 15 espécies, quatro morfoespécies e nove gêneros da família Leptophlebiidae para o Estado do Tocantins (Tabela 2). Adicionalmente, uma espécie nova, *Simothraulopsis primus*, foi descrita aqui. Uma lista com informações adicionais, incluindo observações sobre variações intraespecíficas foi produzida e prachas com fotos de todas as espécies e morfoespécies identificadas para o estado do Tocantins. Desse modo, uma nova perspectiva sobre a distribuição dos membros de Leptophlebiidae foi traçado a partir desse estudo.

Tabela 2 – Lista das espécies de Leptophlebiidae (Ephemeroptera) e morfoespécies identificadas no estado do Tocantins.

Gênero *Askola* Peters, 1969

- *Askola emmerichi* Domínguez, Molineri & Mariano, 2009
- *Askola paprockii* Domínguez, Molineri & Mariano, 2009

Gênero *Farrodes* Peters, 1971

- *Farrodes xingu* Domínguez, Molineri & Peters, 1996

Gênero *Hagenulopsis* Ulmer, 1920

- *Hagenulopsis minuta* Spieth, 1943

Gênero *Hydromastodon* Polegatto & Batista, 2007

- *Hydromastodon sallesi* Polegatto & Batista, 2007

Gênero *Hydrosmilodon* Flowers & Dominguez, 1992

- *Hydrosmilodon gilliesae* Thomas & Perú, 2004

Gênero *Miroculis* Savage & Peters, 1983

- *Miroculis* (Miroculis) *marauiae* Savage & Peters, 1983
- *Miroculis* (Miroculis) sp.

Gênero *Paramaka* Savage & Domínguez, 1992

- *Paramaka convexa* (Spieth, 1943)
- *Paramaka* sp.

Gênero *Simothraulopsis* Demoulin, 1966

- *Simothraulopsis demerara* (Traver, 1947)
- *Simothraulopsis janae* Mariano, 2010

- *Simothraulopsis primus* Orlando, Krolow & Boldrini, 2019
- *Simothraulopsis sabalo* Kluge, 2007

Gênero *Terpides* Demoulin, 1966

- *Terpides sooretamae* Boldrini, Salles & Cabette 2009

Gênero *Thraulodes* Ulmer, 1920

- *Thraulodes* sp. 1
- *Thraulodes* sp. 2
- *Thraulodes xavantinensis* Mariano, Flowers & Froehlich, 2011

Gênero Ulmeritoides Traver, 1959

- *Ulmeritoides angelus* Souto, Da-Silva, Nessimian & Gonçalves, 2016
- *Ulmeritoides flavopedes* (Spieth, 1943)
- *Ulmeritoides uruguayensis* (Traver, 1959)

ANEXOS – artigo publicado

Zootaxa 4674 (3): 363–368
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4674.3.4
http://zoobank.org/urn:lsid:zoobank.org:pub:5BFA8ED6-4DCF-46D9-961E-F66CB08F9C15

A new species of *Simothraulopsis* Demoulin, 1966 (Ephemeroptera: Leptophlebiidae) from Tocantins state, Brazil

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Abstract

There are seven genera and eight species of mayflies recorded for Tocantins state, Brazil, but only three belonging to the family Leptophlebiidae. Based on male imagoes, *Simothraulopsis primus* **sp. nov.** is described from Tocantins state, Northern Brazil. The species is characterized by the male genitalia being short, lanceolate, with a straight spine and by the "U" shape between the penis lobes. Other distinguishing features are the brown thorax and yellowish brown abdomen.

Key words: mayfly, imago, Neotropics, taxonomy, Atalophlebiinae

Introduction

Simothraulopsis Demoulin, 1966 is a Neotropical genus, comprised of 11 species with records from Colombia, French Guiana, Guyana, Surinam, Venezuela, and Brazil in several Amazonic, Atlantic Forest and Cerrado areas (Demoulin 1966; Domínguez *et al.* 1997; Mariano 2010; Nascimento *et al.* 2017; Lima 2018; Faria & Salles 2019).

The genus is characterized by the fusion on the base of the penis, divided in the apical ½ to ¾, with a spine on apex of each penis lobe. Another important diagnostic characteristic, the forceps socket fused forming a single cavity, was not reported in the early works on the genus (Traver 1947; Domínguez *et al.* 1997; Kluge 2007), but according to Nascimento *et al.* (2017), it is present among all analyzed specimens. Yet another distinguishing characteristic of the genus is the pigmentation in the hind wing on the apical lower portion.

According to Sartori & Brittain (2015) there are approximately 130 genera and 820 species of mayflies reported from the Neotropical region, while in Brazil the number of representatives of this insect group is 81 genera and 398 species (Salles & Boldrini 2019). The knowledge about mayflies in Tocantins state in northern Brazil is limited to the work of Boldrini *et al.* (2012), Boldrini & Krolow (2017) and Lima & Boldrini (2018), who have reported seven genera and eight species, numbers considered far from adequate by Cardoso *et al.* (2015) when compared to neighboring states. Currently, *Simothraulopsis demerara* (Traver, 1947) is the only representative of the genus in Tocantins State (Boldrini & Kolow, 2017).

In the present paper we describe a new species of *Simothraulopsis* based on the male imago stage from Tocantins state (Fig. 1A). This is the first new species of Ephemeroptera with its type locale in the state.

Materials and methods

Collections were conducted on Rio da Conceição, from 15-16.vi.2018 at the Cavalo Queimado waterfall (Fig. 1B) and Pedro Afonso on the left bank of Sono River (Fig. 1C), from 11–12 October 2018. Subimagos were captured with light traps (white and UV) from 18:00 until 06:30 hrs., then kept for about twelve hours in empty microtubules,

Accepted by L. Jacobus: 26 Aug. 2019; published: 25 Sept. 2019

until they moulted to the imago stage. Male genital structures were examined in alcohol gel, and the specimens were preserved in 80% ethanol. Male legs and genitalia were dissected and mounted in Euparal®, and wings were dry mounted.

The structures were photographed using a Samsung A8 mobile telephone attached to an Olympus SZ2-LGB stereomicroscope. Line drawings were made with the aid of Adobe Illustrator CC® 2019, and the distribution map with collection sites was prepared using QGIS® 3.8.0.

Thorax terminology follows Kluge (1994), and terms for genitalia structure are from Traver & Edmunds (1967) as modified by Domínguez *et al.* (2006). The material examined is deposited in the following institutions in Brazil: Instituto Nacional de Pesquisas da Amazônia, Manaus—AM; Zoological Collection of Universidade Federal de Roraima (UFRR) Boa Vista, RR; and Entomological Collection of Universidade Federal do Tocantins (CEUFT), Porto Nacional, Tocantins.

We utilize the morphological species concept as the basis for our species hypotheses.

***Simothraulopsis primus* sp. nov.**
(Figs. 2A–F)

Diagnosis. Male imago: 1) general coloration: thorax brown and abdomen yellowish brown (Figs. 2A–B); 2) hind wing with costal projection almost forming right angle, located approximately half distance from base to apex of wing (Figs. 2D–E); 3) abdominal terga yellowish brown, VIII and X washed brown, IX washed with dark brown (Figs. 2A–B); 4) penis projection lanceolate, straight, and of short size (less than half of the total length of penis lobes), anteriorly directed (Fig. 2F); 5) penis lobes fused on basal half, separated by a distance approximately twice the width of one penis lobe, with a shallow concavity in the junction of the lobes (Fig. 2F).

Description. Male imago (n=6): Length of body: 5.0–5.4 mm; forewings: 5.8–6.2 mm; hind wings: 0.7–0.8 mm. General color brown with yellowish brown areas.

Head (Figs. 2A–B). General coloration orangish brown. Scape and pedicel light brown. Ocelli white, surrounded by dark brown ring at base. Eyes black, turbinate portion orangish brown.

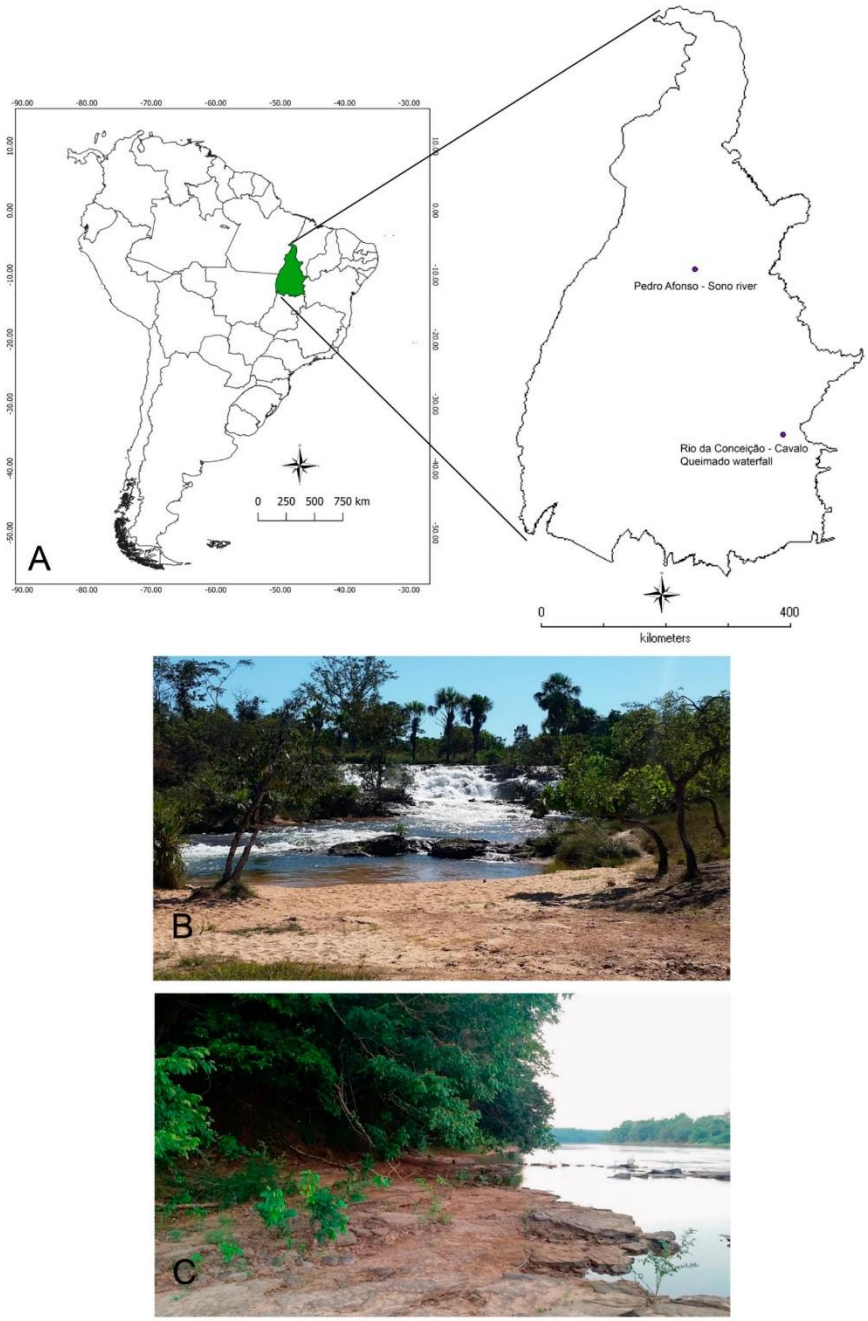
Thorax (Figs. 2A–B). General coloration yellowish brown. Pro- and mesonota dark brown. Mesonotum with longitudinal medial, medioparapsidal suture light brown, scutellum darker. Metanotum light brown (Fig. 2B). Sterna light brown. Wing membranes hyaline. Forewing (Fig. 2C) with yellowish brown veins and cross veins hyaline; basal third of costal vein brown; fork of vein MP slightly asymmetric. Hind wing with costal projection well-developed, almost forming right angle, located approximately half distance from base to apex of wing (Figs. 2D–E); veins yellowish brown, except base of vein C to costal projection brown; apical lower portion of hind wing tinged with brown (Figs. 2D–E). Coxae brown and trochanters yellowish brown. Foreleg: femur yellowish brown with apical region brown; tibia yellowish brown, basal region brown; tarsi yellowish brown. Mid- and hindlegs similar to forelegs, except for usual differences.

Abdomen (Fig. 1): Terga yellowish brown, VIII and X washed brown; IX washed with dark brown. Sterna yellowish brown. Genitalia (Fig. 2F): Styliger plate yellowish brown. Forceps segment I, II and III brown. Segment II 0.11 length of segment I, 1.05 length of segment III. Penis lobes yellowish brown, fused on basal half, inner margins divergent; each lobe rounded apically, but appearing almost pointed, separated by distance approximately twice width of one penis lobe, with straight lanceolate portion having short size (less than half of total length of penis lobes) projection, anteriorly directed and narrowing towards apex; inner margins of lobes divergent. Caudal filaments unknown (broken and lost).

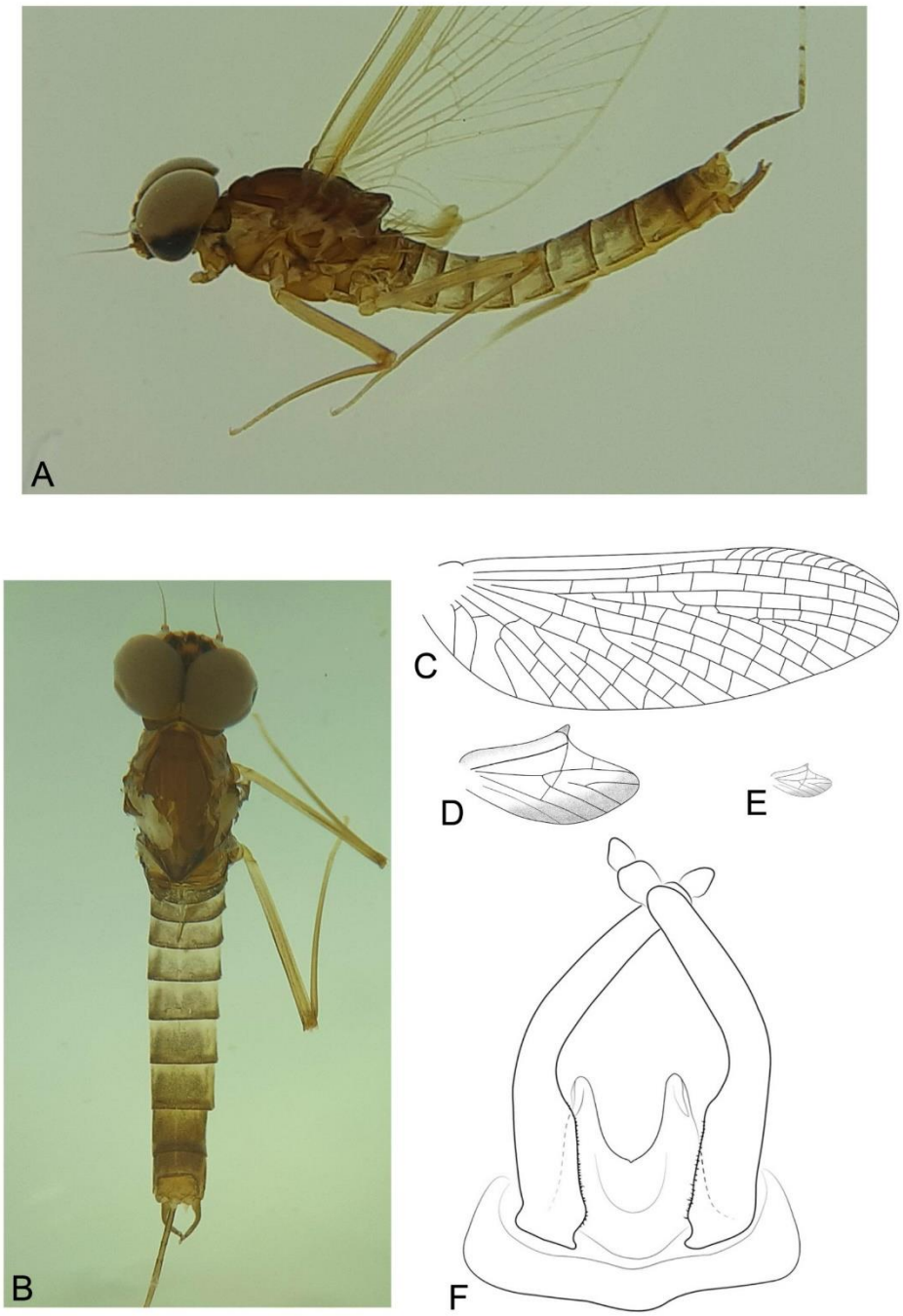
Etymology. From the Latin word *primus*, referring to the first Ephemeroptera species described from the state of Tocantins.

Distribution. Tocantins State, Brazil.

Material Examined. Holotype: 1 ♂ (preserved in alcohol), Brazil, Tocantins state, Rio da Conceição municipality, Cavalo Queimado waterfall, light trap, 11°24'13.32"S/46°51'30.56"W, 15-16.vi.2018, Krolow, T.K., Boldrini, R., Fernandes, A.S., Rippel, M.L.S. and Orlando, T.Y.S. cols (INPA). **Paratypes:** 5 ♂ Brazil, Tocantins state, Pedro Afonso municipality, Sono river, light trap, 8°59'45.25"S/ 48° 8'21.61"W, 11-12.x.2018, Krolow, T.K. and Orlando, T.Y.S. cols: (1 CBio/UFRR and 4 CEUFT—preserved in alcohol).



FIGURES 1A–C. Distribution and sampled sites of *Simothraulopsis primus* **sp. nov**: A) Map of South America, highlighting the collection sites of *Simothraulopsis primus* **sp. nov**. in Tocantins state; B) Cavalo Queimado waterfall, rio da Conceição, Tocantins state; C) Sono river, Pedro afonso, Tocantins state.



FIGURES 2A–F. *Simothraulopsis primus* **sp. nov.**, male imago: A) body (lateral view); B) body (dorsal view); C) forewing; D) hind wing (enlarged); E) hind wing; F) genitalia (ventral view).

Comments. *Simothraulopsis primus* **sp. nov.** has a body color pattern and equally divergent inner margins of penis lobes similar to *S. sinuosus* Lima, 2018. The penis projection is short, lanceolate, and narrowing towards the apex, similar to that of *S. inaequalis* Nascimento, Salles & Hamada, 2017. However, *S. primus* **sp. nov.** is clearly distinguished from *S. sinuosus* by the shapes of penis projections; these are long, spine-like and sinuous in *S. sinuosus*, and they are short, lanceolate, and straight in *S. primus* **sp. nov.** Furthermore, the new species can be clearly distinguished from *S. inaequalis* by having a brown thorax, a yellowish brown abdomen, the apical lower portion of the hind wing tinged with brown, and the "U" shape between the penis lobes. In contrast, *S. inaequalis* has an orangish color, tergum VIII with a submedial black mark near the posterior margin, almost the entire lower portion of the hind wing black, and a "V" shape between the penis lobes. Beyond morphogical differences, the *S. sinuosus* occurrence area is restricted to the state of Piauí, while *S. inaequalis* can be found in Pará and Amazonas states. The only record of the genus *Simothraulopsis* in the studied area belongs to *S. demerara* (Traver, 1947), which has a wide distribution, present mainly in the north and northeast region, but it differs from *S. primus* **sp. nov.** by having the thorax orangish brown, the abdomen grayish brown, the costal region and almost the entire lower portion of the hind wing black, and by the "V" shape between the penis lobes. In *S. primus* **sp. nov.**, the thorax is brown; the abdomen is yellowish brown; the apical lower portion of the hind wing is tinged with brown; and there is a "U" shape between the penis lobes.

Acknowledgments

The first author thanks CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the grant and PPGBec (Programa de Pós-Graduação em Biodiversidade, Ecologia e Conservação) for financial support. The third author thanks CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) (process 401784/ 2016-9). We sincerely thank the team from CEUFT for the field and logistic support, comments and suggestions in the manuscript.

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