

Checklist of Caddisflies (Insecta, Trichoptera) from Mato Grosso do Sul State, Brazil

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ABSTRACT. Trichoptera presents about 15,000 species described globally, of which 2,562 are recorded in the Neotropics and 642 in Brazil, distributed in 70 genera and 16 families. In Brazil, knowledge of the distribution and species richness of Trichoptera is incipient and heterogeneous, especially in some states such as Mato Grosso do Sul. In this work, we present an updated checklist of caddisflies for Mato Grosso do Sul state, representing nine families, 24 genera, and 16 species, four of them are new species records. Additionally, a new record of species for the Brazilian country is presented.

KEYWORDS. Aquatic insects, caddisfly, new records, distribution, Biota-MS Program.

RESUMO. Lista dos tricópteros (Insecta, Trichoptera) do estado do Mato Grosso do Sul, Brasil. A ordem Trichoptera possui aproximadamente 15.000 espécies descritas no mundo, dentre as quais 2.562 possuem registro na Região Neotropical e 642 delas no Brasil, distribuídas em 70 gêneros e 16 famílias. No Brasil, o conhecimento de distribuição e riqueza de espécies de Trichoptera é incipiente e heterogêneo, principalmente em alguns estados, como o Mato Grosso do Sul. Nesse trabalho, apresentamos uma checklist atualizada dos tricópteros do estado do Mato Grosso do Sul, representando nove famílias, 24 gêneros e 16 espécies, destas quatro são novos registros para o estado. Adicionalmente, é apresentado um novo registro de espécie para o Brasil.

PALAVRAS-CHAVE. Distribuição, insetos aquáticos, novos registros, tricópteros, Programa Biota-MS.

Caddisflies (Trichoptera) constitute the most diverse clade of exclusively aquatic insects, recording about 15,000 described species worldwide (HOLZENTHAL *et al.*, 2011), of which 2,562 occur in the Neotropical region (MORSE, 2011) and 619 in Brazil, distributed in 70 genera and 16 families (SANTOS *et al.*, 2015).

Since the first checklist of Brazilian caddisflies, the numbers of species and distribution records have increased exponentially. PAPROCKI *et al.* (2004) reported only 378 species in 61 genera, and SANTOS *et al.* (2015) elevated it 642 species and 70 genera. In last decades, some publications on distributional notes or regional checklists were published (e.g., BLAHNIK *et al.*, 2004; DUMAS *et al.*, 2010; CALOR, 2011; NOGUEIRA & CABETTE, 2011; COSTA *et al.*, 2014; QUINTEIRO *et al.*, 2014) and around 100 new species were described from Brazil, but there are at least another 300 new species to be described, deposited in museums (CALOR, 2011). Despite the increase of knowledge of Brazilian caddisflies, the records were especially concentrated in Southeastern and Northern regions (related to the location of traditional research groups on aquatic insects). Therefore, some species have

“fragmented” distribution (probably due to some states with no survey yet) and others have punctual distribution (only known from holotype locality). In this way, although there is still a big number of undescribed species, the known species present geographical distributions poorly understood, with many record gaps leading to an unreal disjunct distribution. Thus, Linnean and Wallacean shortfalls (LOMOLINO, 2004; WHITTAKER *et al.*, 2005) were not overcome yet. Additionally, two other subjects draw attention: the cited increase of knowledge was based especially on adults, and the majority of taxa were described without a phylogenetic approach. As the knowledge of the caddisflies immature stages is around 2% only (HOLZENTHAL, 2004) and these aquatic stages are very useful for monitoring programs of water quality, there is a new case of shortfall, named here as Müllerian shortfall, in reference to Fritz Müller, a dedicated naturalist who sought to understand more of the immature stages of caddisflies.

The purpose of this paper is to continue the formal documentation of Brazilian caddisflies based on material obtained from Mato Grosso do Sul State to minimize the shortfalls and consequently to collaborate with the database on biodiversity of state, as part of the goals of BIOTA-MS.

MATERIAL AND METHODS

Study area. The state of Mato Grosso do Sul (17° to 24°S, 51° to 58°W) encompass about 4.2% of the Brazilian territory (CÁCERES *et al.*, 2008). The state is considered by some authors a transitional area due the presence of at least three major biomes: Cerrado in the center and northeastern regions, Atlantic Forest in the southern and eastern regions and Pantanal in the northwestern region (CÁCERES *et al.*, 2008). These biomes are composed by decidual and semidecidual forests. The climate is considered tropical in the state, but it tends to subtropical in the southern portion (CÁCERES *et al.*, 2008). The rainfall is about 1,250 to 1,500 mm during the months of October to March, being the remaining months the dry season (CÁCERES *et al.*, 2008). Moreover, it is a frontier land with Bolivia and Paraguay, which implies that part of the fauna may be shared among Mato Grosso do Sul and these countries.

Sampling. The checklist was based on the literature (FLINT *et al.*, 1999; PAPROCKI *et al.*, 2004; SANTOS *et al.*, 2015; COSTA *et al.*, 2014; QUINTEIRO *et al.*, 2014); examined material from Museu de Zoologia da Universidade de São Paulo (MZSP), and Museu de Zoologia da Universidade Federal da Bahia, Collection of Aquatic Insects (UFBA). The specimens were collected using entomological nets, and the light pan traps (CALOR & MARIANO, 2012). Specimens were fixed and preserved in 80% ethanol. The species were identified by comparison with other identified specimens and primary literature. The collected material was deposited in the Museu de Zoologia da Universidade Federal da Bahia (UFBA), Salvador, BA, Brazil. Additional genera records were based on the literature as cited in the Additional genera records section.

Acronyms for the Brazilian States are the following: Acre (AC), Alagoas (AL), Amazonas (AM), Amapá (AP), Bahia (BA), Ceará (CE), Goiás (GO), Espírito Santo (ES), Maranhão (MA), Mato Grosso (MT), Mato Grosso do Sul (MS), Minas Gerais (MG), Pará (PA), Paraíba (PB), Paraná (PR), Pernambuco (PE), Piauí (PI), Rio de Janeiro (RJ), Rio Grande do Norte (RN), Rio Grande do Sul (RS), Rondônia (RO), Roraima (RR), Santa Catarina (SC) and São Paulo (SP), Sergipe (SE), Tocantins (TO).

RESULTS AND DISCUSSION

Sixteen species of caddisflies were recorded in Mato Grosso do Sul distributed in five families (Calamoceratidae, Hydropsychidae, Leptoceridae, Odontoceridae, and Polycentropodidae), and six genera (*Cyrnellus*, *Leptonema*, *Marilia*, *Oecetis*, *Phylloicus*, and *Smicridea*) (Tab. I). Four new records of species (*Phylloicus angustior*, *P. lituratus*, *Leptonema viridianum*, *Smicridea mangaratiba*), three new records of genera, and one new record to family (Calamoceratidae) are provided to state of Mato Grosso do Sul. Additionally, a new species record for Brazil is also presented.

Tab. I. Species record distribution of Trichoptera by state in Brazil. The state of Mato Grosso do Sul is in bold [modified PAPROCKI *et al.* (2004) and SANTOS *et al.* (2014)]. Updated numbers consider the total number of species presented by SANTOS *et al.* (2015), COSTA *et al.* (2015), QUINTEIRO *et al.* (2014), PAPROCKI & FRANCA (2014), QUINTEIRO & CALOR (2015), plus the new records. *Total number of Brazilian caddisflies species considering the data from SANTOS *et al.* (2015) plus five species (*Atanatolica bonita* Costa & Calor, 2014; *Macrostemum bravoii* Franca, Paprocki & Calor, 2013; *Macrostemum nigrum* Franca, Paprocki & Calor, 2013; *Smicridea mangaratiba* Almeida & Flint, 2002).

Brazilian State	PAPROCKI <i>et al.</i> (2004)	SANTOS <i>et al.</i> (2015)	Updated checklist
AC	0	1	5
AL	0	0	0
AM	109	175	176
AP	0	1	1
BA	8	40	54
CE	1	12	12
DF	8	-	8
ES	12	53	53
GO	11	17	17
MA	0	1	0
MG	101	177	178
MS	3	11	16
MT	8	24	26
PA	54	78	78
PB	1	4	6
PE	0	29	31
PI	0	2	2
PR	55	71	71
RJ	76	160	161
RN	0	0	1
RO	14	18	19
RR	17	21	21
RS	4	4	4
SC	97	121	121
SE	0	1	1
SP	69	130	132
TO	0	0	0
Brazil	378	642	643*

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CALAMOCERATIDAE

Phylloicus angustior Ulmer, 1905

Type locality: Brazil, Rio Grande do Sul. Material examined: Brazil, **Mato Grosso do Sul**: Bonito, Gruta Azul road, Rio Seco, 21°01'51"S, 56°37'25"W, 480 m, 24.vi.2009, light trap, Lecci, L., Schulz, G., Stefin, G., 2♂. Distribution: Argentina, Brazil (GO, MG, MS, PR, RS, SC), Colombia, Paraguay, Uruguay, Venezuela.

Phylloicus lituratus Banks, 1920

Type locality: Colombia, Mariquito. Material examined: Brazil, **Mato Grosso do Sul**: Bonito, Fazenda Pitangueiras, Córrego Pitangueiras, 20°52'03"S, 56°35'24"W, 463 m, 23.vi.2009, entomological net, Lecci, L., Schulz, G., Stefin, G., ♂; **Rondônia**: Campo Novo de Rondônia, Linha C9, Poço do Marimbondo,

10°35'26"S, 63°28'15.5"W, Malaise 39, 246 m, 23-25.v.2012, Urso-Guimarães & eq. Col. Distribution: Brazil (MS, RO), Colombia, Costa Rica, Nicaragua, Panama and Venezuela.

Notes: This species had records in Colombia, Costa Rica, Nicaragua, Panama and Venezuela (PRATHER, 2003). It is the first record of this species for Brazil.

HYDROPSYCHDAE

Leptonema aspersum (Ulmer, 1907)

Type locality: Brazil, Santa Rita (in *Neoleptonema*). Distribution: Brazil (BA, MS), Guyana, Surinam, Venezuela.

Leptonema columbianum Ulmer, 1905

Type locality: Brazil, Santa Rita. Distribution: Argentina, Bolivia, Brazil (RO, AM, PA, BA, MG, SP, MS, GO, DF), Colombia, Guyana, Paraguay, Peru, Surinam, Venezuela.

Leptonema viridianum Navás, 1916

Type locality: Brazil, Bahia. Material examined: Brazil, **Mato Grosso do Sul**: Costa Rica, Rio Sucuriú, 18°59'03"S, 53°10'10"W, 02.xi.2004, light trap, Froehlich, O., ♂, 2♀. Distribution: Argentina, Bolivia, Brazil (DF, ES, GO, MG, PA, RJ, MS), Colombia, Ecuador, Guyana, Paraguay, Peru, Venezuela.

Smicridea (Rhyacophylax) mangaratiba Almeida & Flint, 2002

Type locality: Brazil, Rio de Janeiro: Mangaratiba. Material examined: Brazil, **Mato Grosso do Sul**: Costa Rica, Rio Sucuriú, 18°59'03"S, 53°10'00"W, 02.xi.2004, light trap, Froehlich, O., 33♂, 21♀. Distribution: Brazil (RJ, MS).

LEPTOCERIDAE

Oecetis amazonica (Banks, 1924)

Type locality: Brazil, Manaus (in *Oecetina*). Material examined: Brazil, **Mato Grosso do Sul**: Serra da Bodoquena, Acampamento Adventista, 30.vii.2006, Froehlich, O., ♂, ♀. Distribution: Argentina, Bolivia, Brazil (AM, MS), Peru, Venezuela.

Oecetis angelae Henriques-Oliveira, Dumas & Nessimian, 2014

Type locality: Brazil, Mato Grosso do Sul, Ladário. Distribution: Brazil (MS).

Oecetis dominguezi Rueda-Martín, Gibon & Molina, 2011

Type locality: Bolivia, Beni, Lake Colorada. Distribution: Bolivia, Brazil (MS).

Oecetis excisa Ulmer, 1907

Type locality: Argentina, Chaco de Santa Fé, Las Garzas. Material examined: Brazil, Mato Grosso do Sul, Serra da Bodoquena, Acampamento Adventista, 30.vii.2006, Froehlich, O., 3♂, 2♀.

Distribution: Argentina, Bolivia, Brazil (BA, CE, GO, MS, PA, PE, SP), Mexico, Paraguay, Venezuela.

Oecetis paranensis Flint, 1982

Type locality: Argentina, Chaco, Riacho Barranqueras, Puerto Vilelas. Distribution: Argentina, Bolivia, Brazil (BA, MG, MS, PE), Paraguay, Peru.

ODONTOCERIDAE

Marilia lateralis Flint, 1983

Type locality: Paraguay, Dpto. San Pedro, arroyo Tapiracuay, San Estanislao. Distribution: Brazil (MS), Colombia, Paraguay, Uruguay.

POLYCENTROPODIDAE

Cyrnellus arotron Flint, 1971

Type locality: Brazil, Pará, Rio Tocantins. Distribution: Argentina, Brazil (AM, MS, PA), Uruguay.

Cyrnellus bifidus Flint, 1971

Type locality: Brazil, Amazonas, Paraná do Careiro, Divinópolis. Distribution: Argentina, Brazil (AM, MS).

Cyrnellus fraternus (Banks, 1905)

Type locality: United States, Maryland, Plummer's Island (*Cyrnus*). Distribution: Argentina, Brazil (AM, BA, ES, MG, MS, MT, PA, PR, SC), Costa Rica, Ecuador, El Salvador, Mexico, Nicaragua, Panama, Paraguay, Surinam, Uruguay, United States, and Venezuela.

Cyrnellus mammillatus Flint, 1971

Type locality: Brazil, Amazonas, Lago des Rio Luna am oberen Teil. Distribution: Argentina, Brazil (AM, MG, MS, PA, PR, RJ, SP), Ecuador, Paraguay, Peru, and Uruguay.

Additional genera records. Some ecological studies recorded caddisflies from state of Mato do Grosso do Sul, but the taxonomic resolution is only until the generic level, as SOUZA-FRANCO *et al.* (2009) and RIGHI-CAVALLARO *et al.* (2010). SOUZA-FRANCO *et al.* (2009), in a study focusing on characterization of the aquatic insect community associated to *Eichhornia azurea*, presented three caddisfly genera, one genus of Hydropilidae (*Oxyethira* Eaton, 1873), one of Polycentropodidae (*Polycentropus* Curtis, 1835), and an

undetermined genus of Hydropsychidae. Posteriorly, RIGHI-CAVALLARO *et al.* (2010) presented an inventory of immature EPT in Miranda River basin with 22 caddisfly genera in nine families: *Phylloicus* (Calamoceratidae), *Austrotinodes* Schmid, 1955 (Ecnomidae), *Itauara* Müller, 1888, *Protoptila* Banks, 1904, *Mortoniella* Ulmer, 1906 (Glossosomatidae), *Helichopsyche* Siebold, 1856 (Helicopsychidae), *Blepharopus* Kolenati, 1859, *Leptonema*, *Macromema* Pictet, 1836, *Smicridea* (Hydropsychidae), *Abtrichia* Mosely, 1939, *Hydroptila* Dalman, 1819, *Neotrichia* Morton, 1905, *Oxyethira* (Hydroptilidae), *Nectopsyche* Müller, 1879, *Oecetis*, *Triplectides* Kolenati, 1859, and undetermined genus (Leptoceridae), *Chimarra* Stephens, 1829 (Philopotamidae), *Cernotina* Ross, 1938, *Cyrnellus*, *Polyplectropus* Ulmer, 1905 (Polycentropodidae). So far, the known recorded caddisfly diversity for Mato Grosso do Sul is represented by 16 species in nine families and 24 genera, being five of them new species records, including a new record for the country. Considering the reduced collect effort of caddisflies in Mato Grosso do Sul State, the natural conditions, and the difference between the number of recorded species (16 from six genera) and the records of the genera (24), we can have a close estimate of the huge challenge to the next years.

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Main knowledge gaps. Despite the increase of knowledge provided by the results presented herein, the knowledge on caddisflies in the state of Mato Grosso do Sul still remains scarce. There are just a few collection sites already sampled in the state. Moreover, the knowledge of ecology, physiology and a more accurate distribution of the species recorded in the state remain unknown. In this way, new collecting expeditions should be made in attempt to provide more information. It will refine our knowledge of the species distribution, relationships and biology, providing a better understand of the fauna in the state and, consequently, for the Brazilian fauna. It will be central for efficient conservation politics even in a national level.

An outlook for the next 10 years. The number of taxonomists working on caddisflies in Brazil has increased significantly (CALOR, 2011). Our knowledge has been improved in the same proportion. One of the main factors these increase can be attributed to, is the spread of aquatic insects research groups in diverse Brazilian regions previously devoid of this specific research. The taxonomic knowledge on caddisflies must be increased exponentially in the next years in order to enable a more precise use of these data to solve other questions, such as the biomonitoring of aquatic ecosystems. This way, it is expected that, not only the taxonomic knowledge on Trichoptera will grow in the near future, but also other scientific fields associated to it.

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