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Ephemeroptera, Plecoptera e Trichoptera assemblages in Miranda River basin, Mato Grosso do Sul State, Brazil

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RIGHI-CAVALLARO, K.O., SPIES, M.R. & SIEGLOCH, A.E. **Ephemeroptera, Plecoptera and Trichoptera assemblages in Miranda River basin, Mato Grosso do Sul State, Brazil.** Biota Neotrop. 10(2): <http://www.biotaneotropica.org.br/v10n2/en/abstract?inventory+bn02210022010>.

Abstract: The knowledge on the Ephemeroptera, Plecoptera and Trichoptera (EPT) assemblages in running waters of Mato Grosso do Sul State is still deficient. As a contribution to improve this situation, this study presents an inventory of immature EPT assemblages in Miranda River basin. The samples were collected between January and September 2006 from 4th to 7th orders river reaches. A total of 3069 larvae were collected, belonging to 49 genera and 17 families. The caddisflies presented the greatest abundance while the mayflies presented the greatest richness. Of the larvae collected, 22 genera of Ephemeroptera and 20 of Trichoptera are new occurrences for the State. The high genera richness observed in this study, with sites subjected to moderate to high human impacts, as well as the high genera richness indicated by non-parametric estimators and by the genera accumulation curve, indicate that the EPT richness of Miranda River basin is high. This result seems to be related to the environmental heterogeneity of the basin catchment (Cerrado and Pantanal biomes; carbonate, sedimentary and basaltic rocks). Additionally, these results should incentive future ecological and environmental integrity studies in the region, which are urgent in a landscape under fast anthropogenic impacts.

Keywords: aquatic insects, inventory, taxonomic composition, Pantanal, Cerrado.

RIGHI-CAVALLARO, K.O., SPIES, M.R. & SIEGLOCH, A.E. **Composição da fauna de Ephemeroptera, Plecoptera e Trichoptera na bacia do Rio Miranda, Estado do Mato Grosso do Sul, Brasil.** Biota Neotrop. 10(2): <http://www.biotaneotropica.org.br/v10n2/pt/abstract?inventory+bn02210022010>.

Resumo: As comunidades de Ephemeroptera, Plecoptera e Trichoptera (EPT) em ambientes lóticos no Estado do Mato Grosso do Sul são pouco conhecidas. Assim, este estudo teve o objetivo de inventariar a fauna de EPT na bacia do Rio Miranda. As amostras foram coletadas entre janeiro e setembro de 2006, em rios de 4^a a 7^a ordens. Foram coletadas 3069 larvas, pertencentes a 49 gêneros e 17 famílias. Trichoptera apresentou a maior abundância e Ephemeroptera a maior riqueza. Entre as larvas coletadas, 22 gêneros de Ephemeroptera e 20 de Trichoptera são registros novos para o estado. A alta riqueza encontrada nesse estudo, com sítios sujeitos a moderada a alta interferência antrópica, bem como a alta riqueza de gêneros indicada pelos estimadores não-paramétricos e pela curva de acumulação de gêneros, indicam que a riqueza de EPT da bacia do Rio Miranda é alta. Este resultado parece relacionado à heterogeneidade ambiental da área drenada pela bacia hidrográfica estudada (biomas Cerrado e Pantanal; rochas calcárias, sedimentares e basálticas). Além disso, estes resultados servem como incentivo para o desenvolvimento de trabalhos futuros sobre ecologia de insetos aquáticos e integridade ambiental na região estudada, os quais são urgentes em uma paisagem sob rápida degradação ambiental.

Palavras-chave: insetos aquáticos, inventário, composição taxonômica, Pantanal, Cerrado.

Introduction

Aquatic insects are important elements in the ecological dynamics and energy flow of lotic environments, presenting high abundances and wide diversity of trophic strategies and habitat occupied (Hynes 1970). Among the aquatic insects, Ephemeroptera, Plecoptera and Trichoptera (EPT) are considered an important taxonomic group at this environment, primarily due their wide distribution, high abundance and species richness and also by represents abundant resources in the food web of streams. These organisms are sensitive to environmental perturbations and usually live mainly in clean and well oxygenated waters (e.g. Lemly 1982, Buss et al. 2004, Bispo et al. 2006). Due to those characteristics, this fauna is commonly considered to be a good indicator of water quality (Rosenberg & Resh 1993). Moreover, this group represents the same ecological patterns of the whole macroinvertebrates community and, for this reason, ecological studies can be restricted to that assemblage (Marchant et al. 1995, Melo 2005).

In Brazil, in recent years, the number of ecological studies on lotic macroinvertebrates communities has increased considerably (e.g. Galdean et al. 2000, 2001, Melo & Froehlich 2001, Buss et al. 2002, Roque et al. 2003, Baptista et al. 2007, Costa & Melo 2008). Studies on distribution of immature aquatic insects (Diniz-Filho et al. 1997, Baptista et al. 1998, 2001) and on Ephemeroptera, Plecoptera and Trichoptera fauna are also becoming more frequent (e.g. Oliveira et al. 1997, Oliveira & Froehlich 1997, Bispo & Oliveira 1998, 2007, Bispo et al. 2001, 2006, Crisci-Bispo et al. 2007). The EPT assemblages are still ill-known in Mato Grosso do Sul State, especially as regards the ecological and biological aspects of those groups. Most published papers in this state have emphasized only taxonomical and geographic distribution aspects (e.g. Flint 1983, Salles et al. 2004, Froehlich 2007, Righi-Cavallaro et al. 2008). The information on aquatic macroinvertebrate communities in Mato Grosso do Sul State are also scarce (Takeda et al. 1991, Favero & Conte 2003, Tanaka et al. 2006), besides of the high ecological importance of this region, which includes the Pantanal and part of the Cerrado biomes.

The Pantanal is one of the largest continuous wetlands of the world, occupying a large portion of the floodplain of the upper Paraguay River basin. The mosaic of habitats resulting from the combination of different soil types and the seasonality of the hydrological regime of the flood-pulse, which regulate the ecological dynamics, are responsible for the extraordinary richness of aquatic and terrestrial biota found in this biome (Pott & Adámoli 1999, Medina-Junior & Rietzler 2005).

The Cerrado is the second largest biome in Brazil, one of the 25 hotspots of the world (i.e. characterized by a high concentration of endemic species) and had suffered great habitat loss (Myers et al. 2000). Furthermore, the Cerrado include the headwaters of main watershed of South America, such as of the headwaters of Parana and Paraguay basins (Pagotto et al. 2006).

The Pantanal and Cerrado biomes are suffering recently a great process of destruction and transformation of its landscape (i.e. natural habitat conversion into deforested agriculture landscape). Their biodiversity, however, is still very high and little known. Therefore, contributions to improve the poor knowledge of EPT assemblages in Mato Grosso do Sul State are extremely necessary. We inventoried immature EPT assemblages, at genus level, in the Miranda River basin. We also include comments on its taxonomic composition, new genera records for Mato Grosso do Sul State and the possible implications this poses for promoting conservation of the region.

Material and Methods

1. Study area

The study was carried out in the Miranda River basin, a subunit of the Upper Paraguay River basin, which includes part of the Pantanal wetlands. The Miranda River basin has an area of roughly 43,000 km² and comprises the Miranda River and the Aquidauana River sub-basins. Included in this area are 23 municipalities of Mato Grosso do Sul State (12% of the area of the state). The altitude in the region of Miranda River basin varies from 80 to 700 m. The climate is tropical, with marked wet (October-May) and dry (June-September) seasons. The annual rainfall ranges from 1,200 to 1,700 mm (Tanaka et al. 2006).

This basin includes the transition zone between physiographic regions of the Pantanal lowlands (periodically flooded) and the surrounding uplands (not flooded) (Pereira et al. 2004). In the upper Aquidauana River, the topology presents a series of levels and scarps with volcanic rocks, rarely found in the headwaters of the Miranda River (Pereira et al. 2004). Besides, in the latter sub-basin, the influence of the Pantanal lowlands is larger and there is dominance of Precambrian carbonate rocks (Pereira et al. 2004).

The original vegetation in the area close to the headwaters of the Miranda River basin was composed by savannas (cerrado) and forests (cerradão) included in the Cerrado biome. Currently, most of the vegetation is restricted to isolated fragments. The lower part of the Miranda River catchment is included in Pantanal biome, where flood-pulse dynamics constitute the primary factor regulating the ecology of these plains (Medina-Junior & Rietzler 2005).

The Pantanal lowlands were originally covered by grassland vegetation called "campo limpo", now largely replaced by pasturelands with exotic grass species (Pereira et al. 2004). Moreover, there are "caapões" and "cordilheiras", arboreous vegetation located in areas subjected to occasional or no flood (Pott, A. & Pott, V.J. 2004.), and monospecific forests (e.g., Babaçual, Macaubal, Guerobal, Palmeiral) (Ribeiro & Walter 1998).

The floodplain of the Miranda River basin is about 12,224 km² (Hamilton et al. 1996) and are subjected to strong influence of the flood pulse compared to highland areas in the plateau, most influenced by rains. The Pantanal of Miranda and Aquidauana Rivers are considered sub-regions of the Pantanal, comprising about 9% of the total area of this biome. The Miranda River sub-basin has approximately 22,000 km², which represents 42.6% of the Miranda River Basin, and includes 11 municipalities. This sub-region includes the susceptible region of limestones, which are being exploited by mining activities near the Bodoquena municipality and by ecotourism activities mainly in Bonito and Jardim municipalities (Pereira et al. 2004). The Aquidauana River sub-basin has approximately 21,000 km², which represents 47% of the total area of Miranda River basin, and includes 14 municipalities. Its main environmental problems are impacts of pig ranching and erosion in São Gabriel do Oeste municipality, which is located in the headwaters of the sub-basin. So, the environmental impacts are transported downstream and affect many regions of the sub-basin including the fishing ecotourism (Pereira et al. 2004).

2. Collection and identification

The present study was carried out in 20 sampling sites, which belongs to the region of the Miranda River basin (Figure 1). All sampling sites were near to cities, and presented moderate to high anthropogenic impacts. They showed marked differences in physic and chemical characteristics (Table 1). Width, depth, transparency, electric conductivity, turbidity, dissolved oxygen and alkalinity were

EPT assemblages in Miranda River basin

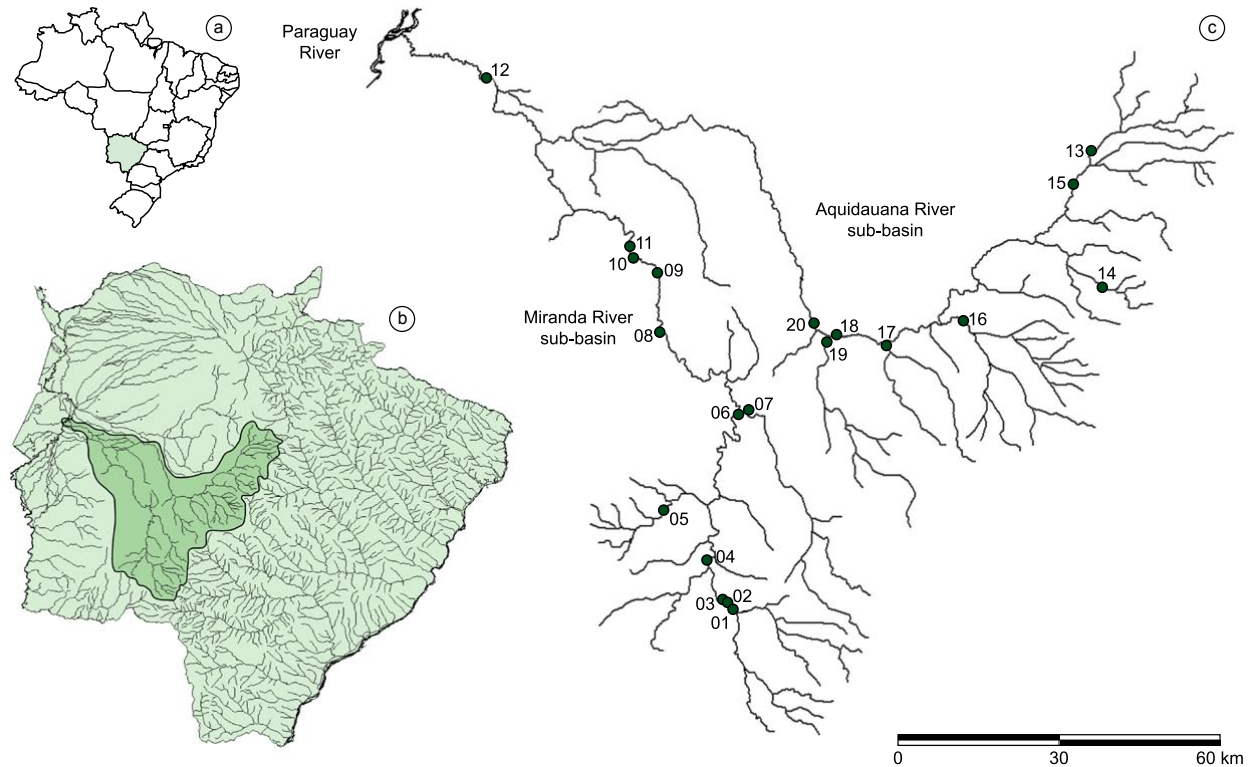


Figure 1. a) Map showing the localization of the sampled area inside Brazil; b) Mato Grosso do Sul State; and c) Localization of the sampling sites inside Miranda River basin.

Figura 1. a) Mapa mostrando a localização da área de estudo no Brasil; b) Estado do Mato Grosso do Sul; and c) Localização dos pontos amostrados na bacia do Rio Miranda.

Table 1. Environmental characterization of the sampling sites in the Miranda River basin, in Mato Grosso do Sul State, sampled between January and September 2006. Temp. = water temperature; O₂ = dissolved oxygen, pH = hydrogenionic potential; Cond. = electric conductivity; Trans. = transparency; Turb. = turbidity; Alka. = alkalinity; CS = coarse substrate; FS = fine substrate.

Tabela 1. Caracterização ambiental dos pontos amostrados na bacia do Rio Miranda, Mato Grosso do Sul, amostrados entre janeiro e setembro de 2006. Temp. = temperatura da água; O₂ = oxigênio dissolvido, pH = potencial hidrogeniônico; Cond. = condutividade elétrica; Trans. = transparência; Turb. = turbidez; Alka. = alcalinidade; CS = porcentagem de substrato grosseiro; FS = porcentagem de substrato fino.

Points	Latitude	Longitude	Order	Temp. (°C)	O ₂ (mg.L ⁻¹)	pH	Cond. (uS.cm ⁻¹)	Trans. (m)	Turb. (NTU)	Depth (m)	Width (m)	Alka. (mEq.L ⁻¹)	CS (%)	FS (%)
1	21° 28' 56" S	56° 07' 13" W	5	24.7	6.9	7.3	94.4	0.3	48.8	1.1	32.3	940.4	18.9	70.3
2	21° 28' 06" S	56° 07' 30" W	4	25.5	6.7	7.4	104.9	0.4	70.8	1.2	27.0	1085.5	4.1	35.4
3	21° 26' 56" S	56° 08' 48" W	5	25.6	7.0	7.5	102.5	0.4	49.2	1.1	36.3	1014.0	39.9	55.3
4	21° 17' 34" S	56° 13' 52" W	4	24.2	7.0	8.0	262.2	0.6	30.6	1.3	27.2	3177.4	96.2	2.9
5	21° 06' 50" S	56° 23' 02" W	4	23.7	8.0	8.0	338.9	2.7	7.0	4.0	23.5	3902.0	45.6	6.8
6	20° 45' 57" S	56° 04' 53" W	5	24.1	6.6	7.2	100.9	0.3	79.1	2.2	28.1	1031.9	33.5	59.7
7	20° 45' 55" S	56° 05' 24" W	6	24.8	7.3	7.7	171.2	0.4	92.5	2.5	55.8	1799.3	37.7	19.7
8	20° 29' 14" S	56° 23' 20" W	4	25.7	5.7	7.8	333.8	0.5	29.0	2.8	17.4	3887.6	65.4	2.0
9	20° 16' 21" S	56° 23' 26" W	6	26.3	5.8	7.6	175.7	0.2	86.2	3.1	55.0	3710.1	3.6	55.2
10	20° 13' 21" S	56° 29' 35" W	5	25.6	4.8	7.7	449.5	2.6	2.8	3.1	38.4	5427.6	56.3	4.6
11	20° 11' 15" S	56° 30' 19" W	6	26.3	5.4	7.7	220.6	0.3	67.9	5.7	67.6	2398.9	3.7	34.3
12	19° 34' 38" S	57° 01' 05" W	7	26.8	4.6	7.3	143.6	0.5	45.4	3.3	101.0	1335.4	0.3	69.2
13	19° 50' 17" S	54° 49' 43" W	5	23.9	7.8	6.7	44.0	0.3	97.9	1.3	30.9	434.6	0.2	88.5
14	20° 18' 27" S	54° 46' 59" W	4	23.9	7.7	7.5	113.8	0.3	31.6	0.6	10.1	1173.7	86.8	5.3
15	19° 57' 30" S	54° 53' 39" W	5	24.7	8.0	7.0	49.5	0.3	77.5	1.7	33.8	413.5	1.3	95.9
16	20° 26' 30" S	55° 17' 20" W	6	24.6	7.5	7.2	97.4	0.4	58.7	1.8	27.9	1087.1	40.0	55.7
17	20° 31' 54" S	55° 34' 37" W	5	25.6	7.5	7.2	88.9	0.5	100.7	1.8	25.5	811.3	18.3	63.7
18	20° 29' 37" S	55° 46' 42" W	7	25.0	7.4	7.0	65.9	0.3	106.5	2.5	65.4	987.0	7.2	59.3
19	20° 29' 51" S	55° 46' 56" W	5	25.0	6.8	6.9	76.5	0.5	54.9	4.3	33.6	679.6	86.4	6.5
20	20° 27' 35" S	55° 49' 51" W	7	25.3	7.4	7.1	66.2	0.2	106.5	2.4	70.6	589.9	4.4	57.5

the most pronounced. Their width ranged from 10.1 to 101.0 m, depth from 0.6 to 5.7 m, transparency from 0.2 to 2.7 m, electric conductivity from 44.0 to 449.5 $\mu\text{S}\cdot\text{cm}^{-1}$, dissolved oxygen from 4.6 to 8.0 $\text{mg}\cdot\text{L}^{-1}$, turbidity 2.8 to 106.5 NTU and alkalinity 413.5 to 5427.6 $\text{mEq}\cdot\text{L}^{-1}$. The water temperature and pH values were similar among the sampling sites. The granulometric percentage of coarse substrate ranged from 0.2 to 96.2% while fine substrate ranged from 2.0 to 95.9%. The hydrological order followed Strahler's (1957) classification, and was based in 1:100,000 maps. The sampling sites were of orders 4 to 7 (Table 1).

The EPT assemblages were collected using four distinct sampling methods. A Surber sampler (0.0250 m^2 and 0.250 mm mesh) was used to sample riffles and an Ekman grab sampler (0.026 m^2) was used in pools. At each point, three sampling units were taken in each mesohabitat (riffle and pool) in January and September 2006. Additionally, four sampling units of artificial substrates, prepared with plastic screen bags (25 \times 15 \times 6 cm), filled with expanded clay balls and some ballast stones, were placed in each sampling site in four dates (February, April, June and August 2006) and remained for colonization during 60 d each. A D-frame net (0.250 mm mesh) was used to sample qualitatively in litter, roots and aquatic macrophytes. The two last sampling methods were used only when the condition of sites allowed the use these methods.

The samples were fixed with 10% formaldehyde. In the laboratory, the material was sorted out under a stereomicroscope and the organisms preserved in 80% ethanol. EPT larvae were identified to genus level using the taxonomic identification keys of Domínguez et al. (2006) for Ephemeroptera, Froehlich (1984) for Plecoptera and Angrisano & Korob (2001), Pes et al. (2005) and Wiggins (1996) for Trichoptera.

3. Data analysis

The efficiency of the sampling effort was evaluated by a genera accumulation curve obtained by averaging 1000 curves generated with random addition of samples without replacement (Colwell & Coddington 1994). Besides, the total richness of Miranda River basin was estimated by the qualitative non-parametric estimators Bootstrap, Chao 2 and Jackknife 1 and 2 (Santos 2003). These analyses were performed in EstimateS 8 software (Colwell 2006).

Results

A total of 3069 larvae were collected, belonging to 49 genera and 17 families of EPT (Table 2). The order Trichoptera presented the highest abundance while the order Ephemeroptera presented the highest genera richness (Figure 2). The most abundant genera of EPT were: *Smicridea* (Trichoptera), accounting for 43% of specimens sampled, *Traverhyphes*, *Americabaetis* and *Farrodes* (Ephemeroptera), representing 12, 6 and 4%, respectively. Thus, these four genera comprised 65% of the total abundance recorded in Miranda River basin.

The genera accumulation curve of EPT shows an ascendant shape with large standard deviation, demonstrating that the asymptote was not reached (Figure 3). It indicates that an increase in the number of genera is expected with more sampling effort. The qualitative richness estimators employed support this result (Figure 3), since the estimated richness range from 52.8 (Chao 2) to 58.8 genera (Jackknife 2).

The four sampling methods used in this study were complementary because all methods sampled exclusive genera (Table 2). Five genera were uniquely sampled by artificial substrate, while Surber and D-frame net included four exclusive genera each. One genus was recorded exclusively by Ekman grab sampler (Table 2). The Ekman

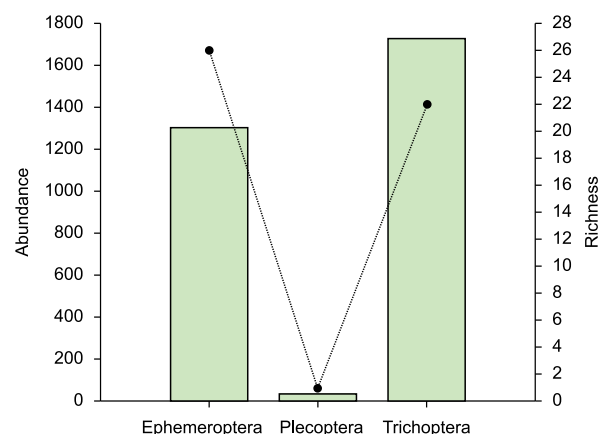


Figure 2. Abundance and richness of the Ephemeroptera, Plecoptera and Trichoptera assemblages in the Miranda River basin in Mato Grosso de Sul State, sampled between January and September 2006.

Figura 2. Abundância e Riqueza das comunidades de Ephemeroptera, Plecoptera e Trichoptera na bacia do Rio Miranda, Mato Grosso de Sul, amostradas entre janeiro e setembro de 2006.

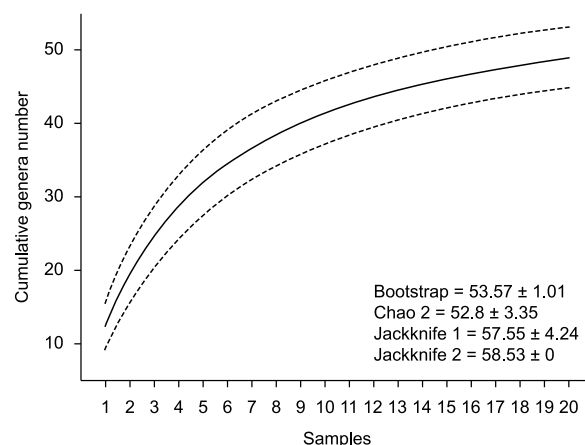


Figure 3. Genera accumulation curve and richness estimators of Ephemeroptera, Plecoptera and Trichoptera assemblages of Miranda River basin, Mato Grosso do Sul State, sampled between January and September 2006.

Figura 3. Curva de acumulação de gêneros suavizada e estimadores de riqueza das comunidades de Ephemeroptera, Plecoptera e Trichoptera da bacia do Rio Miranda, Estado do Mato Grosso do Sul, amostradas entre janeiro e setembro de 2006.

grab sampler showed lower capture efficiency than other sampling methods, totaling 18 genera. D-frame net, artificial substrate and Surber sampler sampled a total of 29, 28 and 26 EPT genera, respectively (Table 2).

Discussion

In Brazil, 66 genera of Trichoptera (Spies & Froehlich 2009) and 68 genera of Ephemeroptera (Salles 2010) are known, whereas Plecoptera has only eight genera (Froehlich 1969, 1984, Olifiers et al. 2004). Until now, the EPT fauna known for Mato Grosso do Sul State was very poor and included five genera of

Table 2. Taxonomic composition, by sampling method, of the Ephemeroptera, Plecoptera and Trichoptera assemblages in the Miranda River basin, in Mato Grosso de Sul State, sampled between January and September 2006.**Tabela 2.** Composição taxonômica por método de coleta, das comunidades de Ephemeroptera, Plecoptera e Trichoptera na bacia do Rio Miranda, Mato Grosso de Sul, amostradas entre janeiro e setembro de 2006.

Order/Family	Genera	Sampling methods			
		Surber	Ekman grab	Artificial substrate	D-frame net
Ephemeroptera					
Baetidae	<i>Americabaetis</i> Kluge, 1992	X	-	X	X
	<i>Apobaetis</i> Day, 1955	-	X	-	X
	<i>Baetodes</i> Needham & Murphy, 1924	X	-	-	-
	<i>Callibaetis</i> Eaton, 1881	X	-	-	-
	<i>Camelobaetidius</i> Demoulin, 1966	X	-	-	X
	<i>Cloeodes</i> Traver, 1938	X	X	-	X
	<i>Guajirolus</i> Flowers, 1985	X	-	-	X
	<i>Paracloeodes</i> Day, 1955	-	-	-	X
Caenidae	<i>Caenis</i> Stephens, 1835	X	X	X	X
	<i>Cercobrachys</i> Soldán, 1986	-	X	-	X
Ephemeridae	<i>Hexagenia</i> Walsh, 1863	-	X	-	X
Leptohyphidae	<i>Leptohyphes</i> Eaton, 1882	-	-	--	X
	<i>Traverhyphes</i> Molineri, 2001	X	X	X	X
Leptophlebiidae	<i>Tricorythodes</i> Ulmer, 1920	X	X	X	X
	<i>Tricorythopsis</i> Traver, 1958	X	-	X	-
	<i>Farrodes</i> Peters, 1971	-	X	X	X
	<i>Hydrosmilodon</i> Flowers & Domínguez, 1991	X-	-	X	X
	Aff. <i>Miroculis</i> Edmunds, 1963	X	X	X	-
	<i>Needhamella</i> Domínguez & Flowers, 1989	X	-	-	-
	<i>Segesta</i> Siegloch & Polegatto, 2006	-	-	-	-
	<i>Thraulodes</i> Ulmer, 1920	X	X	X	X
	<i>Traverella</i> Edmunds, 1948	X	-	X	X
	<i>Ulmeritoides</i> Traver, 1959	-	-	X	X
Oligoneuriidae	<i>Lachlania</i> Hagen, 1868	X	-	-	X
Polymitarcyidae	<i>Campsurus</i> Eaton, 1868	X	X	-	-
	<i>Tortopus</i> Needham & Murphy, 1924	-	X	-	-
Plecoptera					
Perlidae	<i>Anacroneuria</i> Klapálek, 1909	X	-	X	X
Trichoptera					
Calamoceratidae	<i>Phylloicus</i> Müller, 1880	-	-	X	X
Ecnomidae	<i>Austrotinodes</i> Schmid, 1955	-	-	X	-
Glossosomatidae	<i>Itauara</i> Müller, 1888	-	-	-	-
	<i>Protoptila</i> Banks, 1904	X	-	-	-
	<i>Mortoniella</i> Ulmer, 1906	-	-	-	X
Helicopsychidae	<i>Helichopsyche</i> Siebold, 1856	-	X	X	X
Hydropsychidae	<i>Blepharopus</i> Kolenati, 1859	X	-	X	-
	<i>Leptonema</i> Guérin, 1843	X	X	X	X
	<i>Macromema</i> Pictet, 1836	X	-	X	-
	<i>Smicridea</i> McLachlan, 1871	X	-	X	X
Hydroptilidae	<i>Abtrichia</i> Mosely, 1939	X	-	-	X
	<i>Hydroptila</i> Dalman, 1819	-	-	X	-
	<i>Neotrichia</i> Morton, 1905	-	-	X	-
	<i>Oxyethira</i> Eaton, 1873	-	X	-	X
Leptoceridae	<i>Nectopsyche</i> Müller, 1879	-	X	X	X
	<i>Oecetis</i> McLachlan, 1877	-	-	X	-
	<i>Triplectides</i> Kolenati, 1859	-	-	X	-
	Genus 1	-	-	-	X
Philopotamidae	<i>Chimarra</i> Stephens, 1829	X	-	X	X
Polycentropodidae	<i>Cernotina</i> Ross, 1938	X	-	X	-
	<i>Cynnellus</i> Banks, 1913	-	X	X	-
	<i>Polyplectropus</i> Ulmer, 1905	-	X	X	-
Total		26	18	28	29

Ephemeroptera – *Brasilocaenis*, *Callibaetis*, *Campsurus*, *Segesta*, and *Tortopus* (Salles et al. 2004, Domínguez et al. 2006, Righi-Cavallaro et al. 2008), one genus of Plecoptera – *Anacroneuria* (Froehlich 2007), and four genera of Trichoptera – *Leptonema*, *Marilia*, *Oxyethira*, and *Polycentropus* (Paprocki et al. 2004, Souza-Franco et al. 2009). The present study increase considerable the knowledge of EPT fauna at the Mato Grosso do Sul State, through the additional records of 22 genera of Ephemeroptera and 20 genera of Trichoptera. Thus, EPT fauna at the Mato Grosso do Sul State currently account 27 mayfly genera, one stonefly genus, and 22 caddisfly genera.

Anacroneuria was the only genus of Plecoptera registered in the area. This genus is highly diversified, with 65 described species in Brazil (Froehlich 2002). It is the single genus of perlid stoneflies to have invaded the waters of the tropic lowlands and so colonized flowing water throughout the tropics and subtropics of Central and South America (Illies 1964, 1966).

The genera richness found in the present study was considerably high. Bispo et al. (2006) recorded 40 genera of EPT in streams of orders 1 to 4 in Cerrado biome (Pirenópolis, Goiás State). Crisci-Bispo et al. (2007) recorded 38 genera of EPT in a study of streams of orders 2 and 3 in the Atlantic Forest (Parque Estadual Intervales, São Paulo State). Also in Atlantic Forest, Silveira et al. (2006) found 40 genera of EPT in streams of orders 1 to 5 in Macaé River, Rio de Janeiro State. In the central region of Rio Grande do Sul, in regions of Deciduous Seasonal Forest (middle section of the Jacuá River and tributaries), previous studies recorded 44 genera of Ephemeroptera and Trichoptera in streams of orders 3, 4 and 7 in (Spies et al. 2006, Siegloch et al. 2008). However, these studies used only Surber sampler, whereas the present study used other complementary sampling methods. Additionally, those studied covered areas smaller than that of this study.

The high richness of EPT found in the studied area, 49 genera, is at least in part due to the use of distinct sampling methods, which permitted to explore different mesohabitats and so to sample a more diverse fauna of EPT (Domínguez & Fernández 2009). For instance, all four collection methods included exclusive genera and corroborated results from previous inventory studies (e.g. Spies & Froehlich 2009). Additionally, given the well known positive association between species richness and area (Magurran 2004), the large area covered by sampling design in this study also contributes for the high richness recorded.

The Miranda River basin presents 34.5% of the EPT genera known for Brazil. On the other hand, the accumulation curve and the richness estimators indicated that an increase in the number of genera is expected with further sampling, despite the use of a diverse array of sampling methods in this study. The collector curve method is a good way to evaluate how close is observed richness to the total richness of the area (Santos 2003). However, due to high proportions of rare species, species accumulation curves rarely reach an asymptote in tropical regions (Santos 2003).

The most diversified families of mayfly and caddisfly in the Miranda River basin are also the families that present the highest diversity of genera in Brazil. The Ephemeroptera families Leptophlebiidae and Baetidae include 23 and 21 genera, respectively (Salles 2010). The Trichoptera family Hydroptilidae includes 21 genera, while Hydropsychidae and Leptoceridae include nine genera each (Paprocki et al. 2004, Holzenthal & Pes 2004). Thus, diversity of mayfly and caddisfly genera found in the Miranda River basin reflects the genera diversity patterns of these families in Brazil.

The high abundance recorded for the genera *Americabaetis*, *Farrodes* and *Traverhyphes* (Ephemeroptera) and *Smicridea* (Trichoptera), at least in part, could be related to the high species

number included in these genera and by the wide range of habitats occupied. For instance, *Smicridea* is very diverse and generally abundant in Brazil (Flint et al. 1999). It is the caddisfly genus with the highest number of species reported for the country (Paprocki et al. 2004). *Americabaetis* (Baetidae) and *Farrodes* (Leptophlebiidae) occur widely in a variety of habitats and have high species richness in South America (Domínguez et al. 2006). Only the genus *Traverhyphes* shows a restricted distribution, since they are found mainly in riffle zones of rocky bottomed streams (Domínguez et al. 2006).

This paper comprises the first contribution to the knowledge of the taxonomic composition and richness of the EPT assemblages in Mato Grosso do Sul State. The high genera richness recorded in sites of the Miranda River basin sampled in this study (with moderate to high human impact), as well as the high genera richness indicated by non-parametric estimators and the ascendant shape of the genera accumulation curve, indicate that the richness of this basin is high. This result seems to be related to the environmental heterogeneity of the Miranda River basin catchment, which includes portions of Cerrado and Pantanal biomes and areas with carbonate, sedimentary and basaltic rocks. Additionally, these results should motivate future ecological and environmental integrity studies in the region, which are urgent in a landscape under fast anthropogenic impacts.

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