Short comment on Chironomidae (Insecta: Diptera) from Brazil's Federal District

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Abstract

There is much left to learn about the diversity of Chironomidae in Brazil. To help to resolve this problem, a preliminary study of the Chironomidae present in a stream located in center of Brazil was proposed. The aim of this research was to provide a first record of the Chironomidae assemblage at Sarandi stream, in the Brazilian Cerrado. Samples were taken using a handheld D-net from the stream in October 2009. The samples were transported to the laboratory where the material was processed and the Chironomidae specimens were slide mounted, counted and identified to genera. Ninety individuals belonging to 15 genera were found, Chironomini was the richest tribe, with seven genera, while Tanytarsini showed the highest abundance of individuals (55.6%). Overall, *Rheotanytarsus* (20%), *Tanytarsus ortoni*-group (16.7%) and *Lopescladius* (14.4%) were the most abundant genera.

Introduction

The Brazilian Cerrado biome is a parallel to the African Savannah; it covers 25% of the core of the Brazilian territory (Carvalho et al. 2009) (Fig. 1) and is considered a hotspot area of biodiversity (Brasil 2006). The biome has a particular and highly significant role in Brazilian aquatic resources since it contributes to the formation of eight out of twelve of Brazil's largest river basins (Lima and Silva 2008). Estimates indicate there are 6,000 species of trees and 800 of birds. In the last decades, the Cerrado has been seen as an alternative to the Amazonian region for agriculture purposes (MMA 2007); aside from agricultural use, up to 60% of the biome is preserved (Sano et al. 2001).

Although the biology and ecology of the Chironomidae in some of the Brazilian biomes has been extensively studied (Sanseverino and Nessimian 2008, Silva et al. 2009), the composition of the aquatic entomofauna in a great part of the Cerrado remains unclear. The limited knowledge in chironomid biodiversity is not necessarily due to lack of research conducted within the Cerrado, but rather the extensive area that the biome occupies. Additionally, few focus exclusively on Chironomidae (Sonoda et al. 2009a, Sonoda et al. 2009b, Saito and Fonseca-Gessner 2014, Mazão et al. 2016). When considering the Federal District region, we notice that most studies analyze the entire aquatic entomofauna and the influence of human activities on

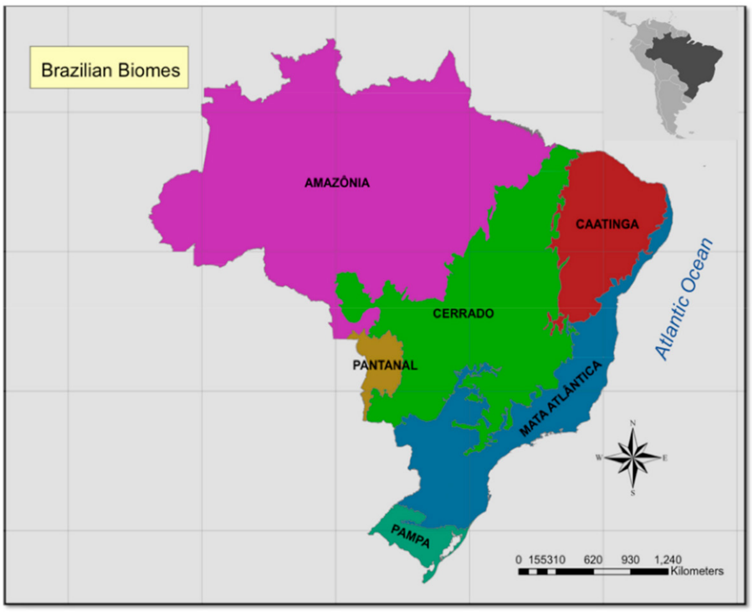

Figure 1. Map of Brazilian Biomes, Cerrado in green. From Merrick et al. (2019).

it (Silva 2007); there are few gray studies available focusing on the chironomid fauna in the Federal District in which results were not published.

While many studies registered Brazil's chironomid fauna (Oliveira and Laurindo 2011, Floss et al. 2012, De Toni et al. 2014), it is believed that only a small fraction of members of the family inhabiting aquatic ecosystems from the Neotropical Region have been described and recognized (Armitage et al. 1995, Spies and Reiss 1996, Ferrington 2008). The last update of the taxonomic catalogue of Brazilian fauna (MMA 2021) registered 632 species in Brazil, comprising 100 genera. Fittkau's remarkable Amazonian survey registered 200 species and stated that there are at least 1,000 species in the region (Fittkau 2001), illustrating the urgent need for Chironomidae biodiversity surveys.

Knowledge of the taxonomic composition of Brazilian fauna will provide key information for managers in charge of developing and maintaining conservation areas (Romero 2009) and is an additional step in the direction towards understanding the role of these aquatic organisms that play a major role in biological monitoring programs (Vondracek et al. 2005, Rodrigues et al. 2019).

The aim of this study is to provide an overview of the taxonomic composition of Chironomidae in a stream within Brazil's Federal district. Ultimately, this will improve the knowledge of Brazil's chironomid fauna.

Material and methods

The Sarandi stream spring is located in the Embrapa Cerrados compound (Planaltina-DF) and it runs towards the Mestre d'Armas River in the Paraná River Basin (Martins et al. 2002). At the sampling reach (15°35'41.5" S and 47°44'45.3" W) there were rapids, waterfalls and pools and the stream sediment was sandy with interspersed gravel and cobbles. Deposits of decaying leaves from the abundant riparian vegetation were found throughout the stream bottom.

The climate in the study region is tropical with marked hydrological periods, rainfall is concentrated from November to January and the drought period occurs mostly between June and August (Carvalho 2005). Sampling occurred before the beginning of the rainy season, in October 2009.

Chemical and physical variables of water were analyzed in field (temperature, pH, dissolved oxygen, conductivity) using a portable multiparameter device (Hanna HI 93703) and in the laboratory (nitrite, nitrate, ammonium, phosphate, fluoride, magnesium) using ionic chromatography (Compact IC 761) and UV spectrophotometry to measure total phosphorus (APHA 1998). A handheld D-net was used for sampling (0.2 mm mesh size); two replicates of 5 minutes each were taken from different habitats along the stream reach. The samples were transported to the laboratory where each sample was washed under running water over a 0.2 mm mesh sieve (Trivinho-Strixino and Strixino 1998). The material retained within the sieve was placed in clear plastic trays over a trans-illumination device and insects were sorted and preserved in 70% alcohol (Pinder 1989). The Chironomidae larvae were slide mounted, counted, and identified to genera following Trivinho-Strixino and Strixino (1995).

The community was analyzed both as raw numbers and percentage of individuals per genus. McIntosh's diversity (McIntosh 1967), Margalef's richness and McIntosh's evenness (calculated considering McIntosh diversity) were calculated. The formulae are presented below:

Margalef's Richness: $D = (S-1)/\log N$ equation 1

McIntosh's Evenness: $E = (N-U)/[N-(N/\sqrt{S})]$ equation 2

$U = \sqrt{\sum(n_i)^2}$ equation 3

McIntosh's Diversity: $D = (N-U)/(N-\sqrt{N})$ equation 4

Where n = number of individuals from each taxon, N = total number of individuals, S = number of taxa.

McIntosh (1967) proposed equation 3, however it is extremely influenced by the sample size. Afterwards, Pielou (1969) proposed equation 4 to eliminate the negative effect of the sample size. We opted to use McIntosh's index because it better suits samples with smaller sizes as it squares abundance and also dominant taxa are weighted greater than rare ones (Semensatto Jr. 2003).

Evenness values range from 0 and 1, values closer to 1 suggest better distribution/participation among taxa.

Results

Ninety Chironomidae larvae were collected from the Sarandi stream, comprising 15 genera (Table 1). Chironomini was the most abundant tribe with seven genera, whereas Tanytarsini had a higher abundance of individuals (55.6%). Three Orthocladiini genera were present and accounted for 25.6% individuals of the entire community. Pentaneurini was present with only one genus and in low quantity.

Table 1. List of genera and corresponding percent abundance collected at the Sarandi stream.

Taxon	Percentage
Chironomini	
Beardius Reiss & Sublette, 1985	2.2
Endotribelos Grodhaus,1987	7.8
Lauterborniella Thienemann & Bause, 1913	4.4
Nimbocera Reiss, 1972	4.4
Polypedilum Kieffer, 1912	4.4
Stenochironomus Kieffer, 1919	1.1
Tanytarsini	
Tanytarsus ortoni-group Lin et al., 2018	16.7
Constempellina Brundin, 1947	1.1
Rheotanytarsus Thienemann & Bause, 1913	20.0
Stempellina Thienemann & Bause, 1913	3.3
Tanytarsini #1 (unknown)	7.8
Orthocladiini	
Corynoneura Winnertz, 1846	7.8
Lopescladius Oliveira, 1967	14.4
Nanocladius Kieffer, 1913	3.3
Pentaneurini	
Thienemannimyia Fittkau, 1957	1.1

The most numerous genera were *Rheotanytarsus* which were the most abundant (20.0%), followed by the *Tanytarsus ortoni*-group (16.7%) and *Lopescladius* (14.4%). The *T. ortoni*-group contains species previously placed in *Caladomyia* Säwedal, 1981 (Lin et al. 2018). *Corynoneura*, *Endotribelos* and Tanytarsini #1 each represented 7.8% of the total taxa. Tanytarsini #1 did not resemble a known genus and it most likely represents a new species. Three genera, *Constempellina*, *Stenochironomus* and *Thienemannimyia,* were found in extremely low numbers, with one individual each (Table 1). We attempted to rear larvae of *Constempellina* to the adult stage, however this was unsuccessful. Our observations showed that these larvae are quite sensitive and die only a few minutes after they are taken from the stream.

Indices values were as follows: McIntosh's diversity = 0.7; Margalef's richness = 2.2; McIntosh's evenness (U) = 0.9. Water quality values registered during sampling are given in Table 2.

Discussion

Some studies on the Brazilian Federal District consider the entire aquatic insects' communities, nonetheless they identify the Chironomidae larvae only to family. This type of analysis certainly decreases the time required to execute environmental studies since identification of Chironomidae to genera is time consum-

Table 2. Water quality variable values at the sampling reach of the Sarandi stream.

Water variable	Value
pH	4.5
Conductivity (µS/cm)	6.0
Temperature (°C)	21.7
Dissolved oxygen (mg/L)	7.3
Cl (mg/L)	0.23
Na (mg/L)	0.23
Ca (mg/L)	0.44
Fluoride	0.00
Nitrate	0.00
Magnesium	0.00

ing; however significant information is lost, such as the taxonomic composition, functional feeding groups, among others. In this context, a study of the same watershed examined the aquatic macroinvertebrates community composition along the Mestre d'Armas River (Silva 2007). The Chironomidae were identified to subfamily which severely limits accurate comparison with our data. They also recorded low pH levels, and this seems to be a constant among other rivers in this part of the Cerrado (Salcedo 2006, Fernandes 2007).

As the Cerrado is a biodiversity hotspot (Hopper et al. 2016), we expected to find higher taxa richness – this would certainly be the case if more streams were sampled. Fernandes (2007) conducted a study at a different stream in the same region, and registered nine taxa, eight of which were not found in our study. Combining taxa from our study and that of Fernandes (2007) yields a total of 24 taxa, increasing the richness.

Studies from other Cerrado regions have yielded higher generic richness, with 45 genera found at the State of Goiás (Mazão and Bispo 2016) and 36 at São Paulo State (Saito and Fonseca-Gessner 2014). This supports our suggestion that the true richness value in the Federal District is likely much higher than presented here.

Rheotanytarsus was documented as one of the most abundant taxa in several Brazilian studies (Sonoda et al. 2009b, Sonoda et al. 2010, Floss et al. 2012); this numerical dominance is related to agricultural land use (Sonoda et al. 2009a, Sonoda et al. 2018). Its abundance is also documented in other neotropical countries, like Trinidad (Helson et al. 2006).

At the other extreme, we found multiple rare genera, *Constempellina, Stenochironomus* and *Thienemannimyia*, which contributed with only one specimen for each genus. These genera usually are associated with good environmental conditions (Eintrekin et al. 2007, Saito and Fonseca-Gessner 2014). The abundance of *Stenochironomus* in Neotropical streams is quite variable as some authors report their rarity (Gonçalves Jr et al. 2007), while others have documented great abundances of this genus (Saito and Fonseca-Gessner 2014, Mazão and Bispo 2016). *Stenochironomus* larvae are important indicators for the preservation status of riparian forests, as they are known as shredders (Silva et al. 2009, Santos and Rodrigues 2015). Despite the low quantity of shredders in Neotropical communities (Boyero et al. 2011), they are good indicators of environmental impacts since their abundance decreases when riparian forests are deforestated (Sonoda et al. 2009a).

Conclusion and outlook

The present report of Chironomidae in the Federal District provides critical information to the scientific community that enhances the understanding of chironomid diversity within the Cerrado and provides evidence that continued efforts should be made to add information to this list, ultimately enhancing our knowledge of the spatial occurrence and elucidating the dimensions of biodiversity richness of the Chironomidae.

Several questions remain unanswered and should be addressed in future work, such as including local seasonality patterns for specific chironomid genera, influence of the weather, hydrology and other environmental attributes, and the family's influence on litter decomposition process.

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