



## SURVEY OF ODONATE FAUNA (INSECTA: ODONATA) IN A STRETCH OF THE MARACAJU HILLS, STATE OF MATO GROSSO DO SUL, BRAZIL

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**Abstract:** The scarcity of studies on fauna inventories, especially those addressing insects, is a large problem in many regions of Brazil. To contribute to taxonomic knowledge and broaden the distribution of the order Odonata, we present a survey of odonate fauna of the Maracaju Hills in the state of Mato Grosso do Sul, Brazil. Ten samplings were performed between September 2013 and April 2015, totaling 38 h of active searches. A total of 386 individuals belonging to five families, 21 genera and 37 species were collected. Eleven species belonged to the suborder Zygoptera and 26 belonged to the suborder Anisoptera. The family Libellulidae was the richest and most abundant (25 species; 285 individuals), followed by Coenagrionidae (nine spp.; 81 individuals). Lestidae, Gomphidae and Calopterygidae were each represented by a single species and totaled little more than 5% of the overall sample. Among the genera, *Erythrodiplax* stood out in terms of richness (eight spp.), followed by *Erythemis* (three spp.). The most abundant species were *Erythrodiplax paraguayensis* (N = 75), *Erythrodiplax famula* (n = 50), *Ischnura fluviatilis* (N = 48) and *Micrathyria spuria* (N = 45). The sampling effort represented by the species accumulation curve indicated that the richness of Odonata is close to actual richness, since the curve approached the asymptotic one. *Aphylla molossus*, *Erythemis mithroides* and *Oxyagrion basale* constitutes new records for the state of Mato Grosso do Sul, raising the richness of the state to 212 species.

**Keywords:** aquatic insects; Anisoptera; Brazilian savanna; dragonflies; Zygoptera.

### INTRODUCTION

The execution of basic studies, such as the survey of species in a given region, is fundamental, as it is the only means by which to know the local biodiversity and is one of the most important tools for decision making regarding the management of

natural areas (Silveira *et al.* 2010). In Brazil, there is a strong discrepancy among the different regions of the country in terms of knowledge on biodiversity, with the central western region lacking data on its fauna (Lewinsohn & Prado 2002).

The state of Mato Grosso do Sul is part of the *Cerrado* (savanna) and *Pantanal* (wetland) biomes

and includes the Atlantic Forest to the south, which are composed of complex physiognomies. The Maracaju Hills extend in the north-south direction throughout the entire state, serving as a divider of waters between the hydrographic basins of the Upper Paraguai River to the west and the Upper Paraná River to the east (Boggiani *et al.* 1998). According to Damasceno-Júnior *et al.* (2000), the Maracaju Hills are mainly covered by a forested savanna, semi-deciduous seasonal forests, riparian vegetation and swampy plains. However, livestock development has reduced and drastically altered the natural landscape of the region, the remnants of which are immersed in a matrix of exotic pastures and monoculture plantations (Harris *et al.* 2006).

Few studies have focused on the flora and fauna of the region. Considering the strong anthropogenic pressure, there is an urgent need for studies that take an inventory of the local flora and fauna. The order Odonata is among the different groups for which there are no inventories in the Maracaju Hills. These insects are considered important components of the food chain of aquatic ecosystems. Moreover, some species are sensitive to pollution and changes in the environment, which enables their use as indicators of water equality and environmental conditions (Souza & Costa 2006). According to De Marco-Junior & Vianna (2005), only 29% of Brazil has data on the richness of odonate species, with most information concentrated mainly in the states of the southeastern region of the country, which constitutes an obstacle to the conservation of the group.

The number of odonates estimated in the world totals approximately 7,000 species (Kalkman *et al.* 2008). Approximately 800 species are found in Brazil and are distributed among 14 families and 128 genera (Souza *et al.* 2007). According to Koroiva *et al.* (2017), Rodrigues & Roque (2017) and Rodrigues *et al.* (2018), 209 species have proven occurrence in the state of Mato Grosso do Sul. However, there are gaps in knowledge, as few regions have been explored and little information is available on richness and distribution, including the region that serves as the study area in the present investigation.

Therefore, the aim of the present study was to perform an inventory of odonate fauna in the Maracaju Hills, contributing ecological knowledge and broadening the distribution records of the group in a region for which no previous information on the order is found in the state.

## MATERIAL AND METHODS

### *Study area*

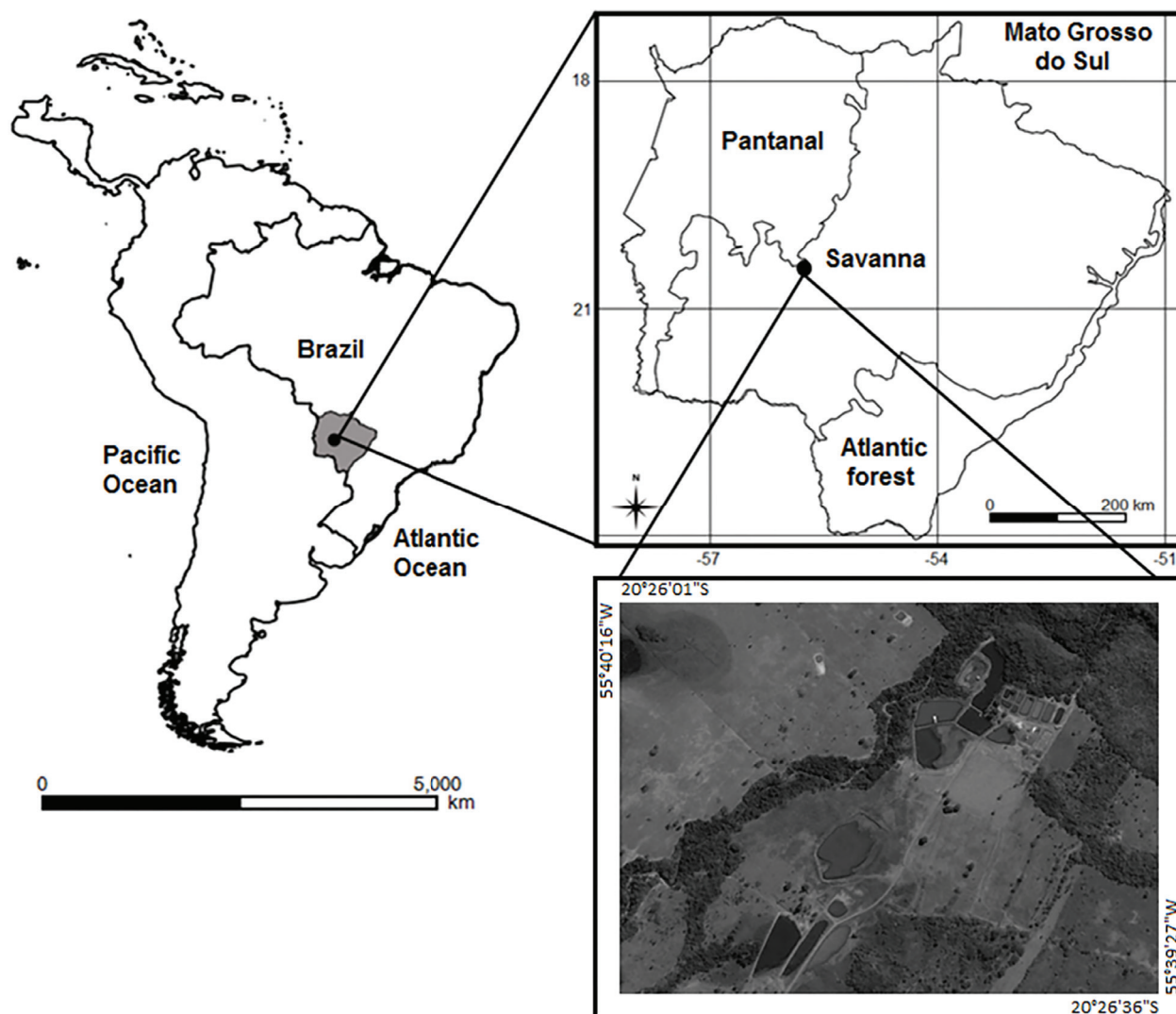
This study was conducted on the Experimental Farm of the State University of Mato Grosso do Sul, which is located in the Maracaju Hills in the municipality of Aquidauana in the state of Mato Grosso do Sul, Brazil (Figure 1). The farm has 806 ha, with 300 ha occupied by pasture areas and approximately 160 ha of permanent preservation area. Sampling was performed mainly in artificial lake environments with aquatic macrophytes associated with an area of swampy plain and near Fundo Creek, which was also sampled. The surrounding area is characterized by seasonal semi-deciduous forest, pastures and fruit groves. The climate of the region is tropical rainy savanna (subtype Aw cf.; Peel *et al.* 2007), with two well-defined seasons: a cold dry winter (May to September) and a warm rainy summer (October to April). Mean annual precipitation is 1,200 mm, with maximum and minimum temperatures of 33 and 19°C, respectively (Schiavo *et al.* 2010).

### *Data collection*

Ten samplings were performed between September 2013 and April 2015. The method employed was a time-limited active search, with a 2-hour sampling effort performed by two collectors (total of four hours per month) on a 400-meter stretch around the water bodies, totaling 38 h of sampling. Adult individuals were caught with an entomological net. Identification was performed to the lowest possible taxonomic level with the aid of specialized literature (Garrison *et al.* 2006, 2010, Lencioni 2005, 2006, 2017, Heckman 2006,) and the assistance of a specialist. Voucher specimens were deposited in the Zoological Reference Collection of the Federal University of Mato Grosso do Sul (ZUFMS-ODO00352 to ZUFMS-ODO00382).

### *Statistical analysis*

For the determination of the sampling effort, we used species accumulation curves for the randomization (with 1000 iterations) of different sample sizes (numbers of individuals) using the EcoSim 7 program (Gotelli & Entsminger 2001). We used the nonparametric Chao 1 estimator to estimate species richness in the study area.



**Figure 1.** Location of study area in Maracaju Hills, municipality of Aquidauana, state of Mato Grosso do Sul, Brazil.

## RESULTS

A total of 386 individuals belonging to five families, 21 genera and 37 species were caught. Eleven species were from the suborder Zygoptera and 26 were from the suborder Anisoptera (Table 1). The sampling effort represented by the species accumulation curve indicated that the richness of Odonata is close to actual richness, since the curve approached the asymptotic one (Figure 2). As richness was estimated to be 53 species, approximately 70% of the species occurring in the study area were sampled.

The family Libellulidae had the greatest richness (25 species) and accounted for 73.8% of the individuals. This was followed by Coenagrionidae (nine species), accounting for

20.9% of the individuals. Lestidae, Gomphidae and Calopterygidae were each represented by a single species and, together, totaled little more than 5% of the individuals collected.

Among the genera, *Erythrodiplax* stood out in terms of richness (eight spp.), followed by *Erythemis* (three spp.). The most abundant species were *Erythrodiplax paraguayensis* (N = 75), *Erythrodiplax famula* (N = 50), *Ischnura fluviatilis* (N = 48) and *Micrathyria spuria* (N = 45). Ten species were represented by a single individual. *Aphylla molossus*, *Erythemis mithroides* and *Oxyagrion basale* constitutes new records for the state of Mato Grosso do Sul, raising the richness of the state to 212 species.

**Table 1.** Species of Odonata recorded in Maracaju Hills, municipality of Aquidauana, state of Mato Grosso do Sul, Brazil.

Suborder/Family/Species	Abundance
<b>ZYGOPTERA</b>	
<b>Calopterygidae</b>	
<i>Hetaerina rosea</i> Selys, 1853	2
<b>Coenagrionidae</b>	
<i>Acanthagrion cuyabae</i> Calvert, 1909	4
<i>Acanthagrion gracile</i> Rambur, 1842	4
<i>Argia mollis</i> Selys, 1865	3
<i>Argia reclusa</i> Selys, 1865	10
<i>Homeoura nepos</i> (Selys, 1876)	8
<i>Ischnura capreolus</i> (Hagen, 1861)	1
<i>Ischnura fluviatilis</i> (Selys, 1876)	48
<i>Oxyagrion basale</i> (Selys, 1876)	1
<i>Telebasis carmesina</i> Calvert, 1909	2
<b>Lestidae</b>	
<i>Lestes forficula</i> Rambur, 1842	14
<b>ANISOPTERA</b>	
<b>Gomphidae</b>	
<i>Aphylla molossus</i> Selys, 1869	4
<b>Libellulidae</b>	
<i>Diastatops obscura</i> (Fabricius, 1775)	4
<i>Erythemis peruviana</i> (Rambur, 1842)	1
<i>Erythemis mithroides</i> (Brauer, 1900)	1
<i>Erythemis vesiculosa</i> Fabricius, 1775	1
<i>Erythrodiplax basalis</i> (Kirby, 1897)	3
<i>Erythrodiplax famula</i> Erichson, 1848	50
<i>Erythrodiplax juliana</i> Ris, 1911	3
<i>Erythrodiplax latimaculata</i> Ris, 1911	9
<i>Erythrodiplax maculosa</i> (Hagen, 1861)	6
<i>Erythrodiplax paraguayensis</i> (Förster, 1905)	75
<i>Erythrodiplax castanea</i> (Burmeister, 1839)	15
<i>Erythrodiplax umbrata</i> (Linnaeus, 1758)	2
<i>Idiataphe amazonica</i> (Kirby, 1889)	4
<i>Libellula herculea</i> Karsch, 1889	3
<i>Miathyria marcella</i> (Selys, 1857)	34
<i>Miathyria simplex</i> (Rambur, 1842)	1
<i>Micrathyria iheringi</i> Santos, 1946	3
<i>Micrathyria spuria</i> (Selys, 1900)	45

Table 1. Continued on next page...

Table 1. ...Continued

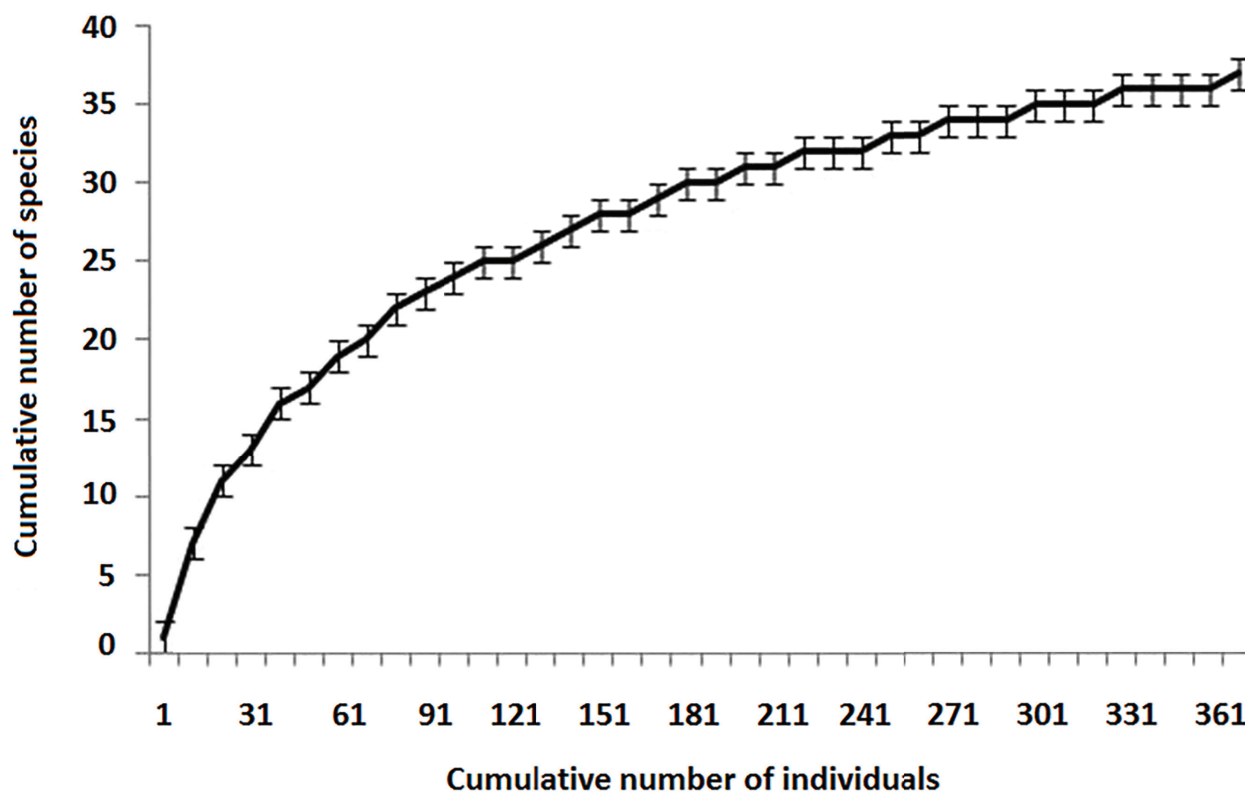
Suborder/Family/Species	Abundance
<i>Oligoclada laetitia</i> Ris, 1911	4
<i>Orthemis cultriformis</i> Calvert, 1899	1
<i>Orthemis discolor</i> (Burmeister, 1839)	9
<i>Perithemis lais</i> (Perty, 1834)	1
<i>Perithemis mooma</i> Kirby, 1889	8
<i>Tauriphila argo</i> (Hagen, 1869)	1
<i>Tramea binotata</i> (Rambur, 1842)	1
<b>Total number of individuals</b>	<b>386</b>

## DISCUSSION

Considering studies by Rodrigues & Roque (2017) and Rodrigues *et al.* (2018), the state of Mato Grosso do Sul has records of the occurrence of 209 species of Odonata. The present investigation corresponds to 17.7% of this figure, which can be considered intermediate richness compared to other surveys conducted in the state. Teixeira-Gamarra *et al.* (2012) sampled 24 species in the Amolar Hills.

Dalzochio *et al.* (2011) recorded 33 species in the eastern portion of the state. Koroiva *et al.* (2017) recorded 111 species in the region of the Bodoquena Hills and Souza & Costa (2006) recorded 111 species in a study conducted in eight municipalities.

The greater richness of Libellulidae is a pattern in surveys conducted in the Neotropics. In inventories performed in the Bodoquena Hills in the state of Mato Grosso do Sul, this family represented 39% of the species caught (Dalzochio



**Figure 2.** Rarefaction curve of species of Odonata in Maracaju Hills, municipality of Aquidauana, state of Mato Grosso do Sul, Brazil. Bars indicate 95% confidence interval.



*et al.* 2011). Souza & Costa (2006) also recorded greater richness for this family (34%). Libellulidae also stood out in inventories performed in the Amolar Hills in the Pantanal wetland (Teixeira-Gamarra *et al.* 2012), accounting for 79% of species. Libellulidae is a cosmopolitan family with some species well adapted to temporary environments and with a short lifecycle (Carvalho & Calil 2000, Costa *et al.* 2002, Watanabe 2004).

According to Costa *et al.* (2000), *Erythrodiplax* is a genus with broad distribution and is generally associated with lentic environments (Assis *et al.* 2004), which may explain its greater abundance in the study area. The dominance of this genus is common in surveys (Costa *et al.* 2000, Souza & Costa 2006) and, according to a compilation by Rodrigues & Roque (2017), *Erythrodiplax* is the richest genus in the state of Mato Grosso do Sul.

In the present study, 37 species of Odonata were recorded in the Maracaju Hills, contributing to knowledge on the fauna of the region and increasing the number of species for the state of Mato Grosso do Sul to 212 (Rodrigues & Roque 2017, Rodrigues *et al.* 2018). The new record of *A. molossus*, *E. mithroides* and *O. basale* broadens its distribution to the state. In Brazilian territory the species *A. molossus* has registered for Amazonas (Belle 1992) and *E. mithroides* has registered for Rio de Janeiro (Heckman 2006). *Oxyagrion basale* were previously only recorded for the states of Espírito Santo (Costa & Oldrini 2005), Minas Gerais (Pereira 2012), São Paulo (Costa *et al.* 2000), Goiás, Mato Grosso, Rio de Janeiro and Rio Grande do Sul (Lencione 2017) in the Atlantic Forest biome or the ecotone of this biome with the *Cerrado*. The present study, with the inclusion of several species on the list of Odonata for the state, reveals the lack of sufficient knowledge on the group. Thus, there is a need for further inventories as well as systematic studies to broaden knowledge on the geographic distribution of existing species and local diversity in the various ecosystems of the region. Studies on population ecology are also needed, associating the present species to variations in abiotic characteristics of the ecosystems in which species of Odonata occur.

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