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The first record of *Zygothrica orbitalis* (Sturtevant, 1916) for the state of Rio Grande do Sul and the southernmost limits for seven species of Drosophilidae (Insecta: Diptera).

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Introduction

Although the state of Rio Grande do Sul (RS) has been one of the most well-surveyed Brazilian states for Drosophilidae, with 86 species records, most of these surveys were conducted in the Atlantic Forest Biome, whereas the Pampa Biome has been less explored in terms of species occurrence (Gottschalk *et al.*, 2008; Poppe *et al.*, 2012). Furthermore, most collections were made exclusively using banana-bait traps in the city of Porto Alegre (Silva *et al.*, 2005; Garcia *et al.*, 2008; Garcia *et al.*, 2012) and its surroundings, *e.g.*, at Itapuã State Park (Valente and Araújo, 1991) and in fields of native grasses at Guaíba (Saavedra *et al.*, 1995). Recently, collections were made using the same bait in a transitional area between the Pampa and Atlantic Forest Biome by Hochmüller *et al.* (2010) and near the northern border of the Pampa Biome by Poppe *et al.* (2012). In this study, we aim to record the Drosophilidae species trapped in McPhail traps with Karo[®] Syrup bait in the Pampa Biome, southern Brazil. These records show the southern-most limit of distribution for eight species and one new record for RS.

Materials and Methods

In January 2010, flies were collected in a Restinga forest area of 23 ha belonging to the Federal Preservation Unit Horto Botânico Irmão Teodoro Luís (HBITL) (31°48'54"S; 52°25'48"W), southern RS, Brazil (Figure 1).

HBITL is located in the Pampa Biome and has a strong influence of Seasonal Forest Semideciduous Submontane. The climate is Mesothermal Bland Superhumid, without distinct dry

season (IBGE, 1997). According to the Köppen–Geiger climate classification system, this area belongs to the Cfa type. Data provided from Agrometeorological Station of Pelotas (distant 8.7 Km from sample site) showed that the average of the annual temperature is 17.8°C, with a maximum and minimum average of 28.2°C and 8.6°C, respectively. Rainfall is 1367 mm a year, with about 120 rainy days. The relative annual humidity is 80%. HBITL is close to the cultivated area and open environments with grassland vegetation, characteristic of the Pampa Biome.

The sample was collected with two McPhail traps, each containing 200 mL of 10% Karo[®] Syrup. The traps were placed at a distance of 50 m from each other on the boundary of the forest area and were set for three days. The specimens collected were maintained in 70% ethanol for fixation. External morphology and male terminalia were used to identify the flies. Dissection of male terminalia was performed according to Bächli *et al.* (2004). Two species of *Leucophenga* were characterized by differences in their pigmentation and morphological patterns, but they could not be determined.

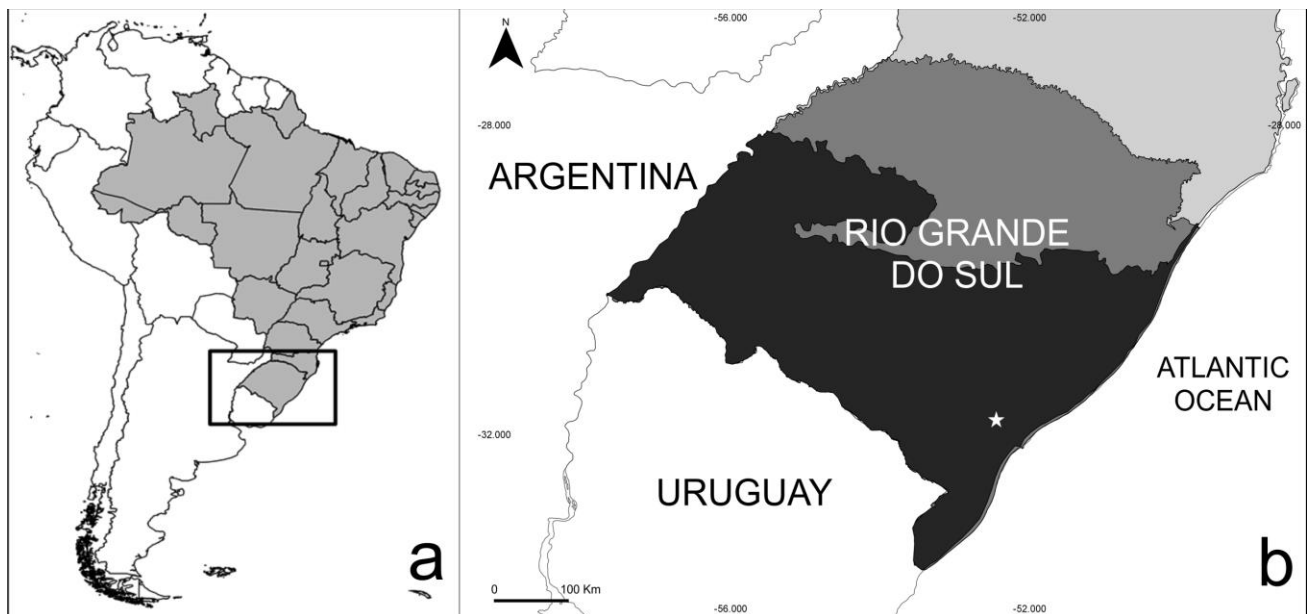


Figure 1. Location of the study area. a) Map of South America, with Brazil in gray and the state of Rio Grande do Sul highlighted. b) Map of Rio Grande do Sul, with the location of the Horto Botânico Irmão Teodoro Luís indicated by a star. Pampa Biome in black; Atlantic Rain Forest Biome in dark gray.

Results

A total of 78 drosophilids were collected. The specimens belonged to four genera of two subfamilies, Drosophilinae and Steganinae (Table 1). *Drosophila* was the genus with the greatest diversity. The most abundant species was *L. cf. maculosa*. This study reports the southernmost records for six species and the genus *Amiota*. *Zygothrica orbitalis* is recorded for the first time in the state of RS. *Drosophila* sp. Z2 is the same undescribed species cited by Gottschalk *et al.* (2007) as *Hirtodrosophila* sp. Z2, reclassified in the genus *Drosophila* after further analysis (Gottschalk, M.S. personal communication).

Table 1. Drosophilidae species trapped in the Horto Botânico Irmão Teodoro Luís in January 2010 using McPhail traps.

Taxon	Abundance		Total
	Males	Females	
<i>Amiota</i> sp. ¹ Loew 1862	0	1	1
<i>Drosophila bocainensis</i> Pavan and da Cunha 1947	1	4	5
<i>D. cardini</i> Sturtevant 1916	1	2	3
<i>D. flexa</i> ¹ Loew 1866	0	6	6
<i>D. fumipennis</i> ¹ Duda 1925	0	1	1
<i>D. griseolineata</i> ¹ Duda 1927	3	2	5
<i>D. mediopunctata</i> ¹ Dobzhansky and Pavan 1943	2	6	8
<i>D. mercatorum</i> Patterson and Wheeler 1942	1	1	2
<i>D. piratininga</i> ¹ Ratcov and Vilela 2007	1	1	2
<i>D. polymorpha</i> Dobzhansky and Pavan 1943	1	2	3
<i>D. simulans</i> Sturtevant 1919	5	5	10
<i>Drosophila</i> sp. Z2	2	2	4
<i>Drosophila</i> subgroup <i>willistoni</i>	0	3	3
<i>Leucophenga</i> cf. <i>maculosa</i> (Coquillett in Johnson 1895)	9	10	19
<i>Leucophenga</i> sp. 1	1	2	3
<i>Leucophenga</i> sp. 2	0	1	1
<i>Zygothrica orbitalis</i> ^{1*} (Sturtevant 1916)	2	0	2
Total	29	49	78

¹ Southernmost records; *First record for the state of Rio Grande do Sul.

Discussion

The results of the sample obtained with the McPhail traps with Karo[®] Syrup are in general agreement with the previous data obtained for collections made with banana bait in RS (Saavedra *et al.*, 1995; Silva *et al.*, 2005; Garcia *et al.*, 2008; Hochmüller *et al.*, 2010; Garcia *et al.*, 2012; Poppe *et al.*, 2012), in which *Drosophila* was the most species-rich genus. In these previous studies, *D. simulans* was the most abundant species and showed marked dominance, but this species was surpassed in abundance in our study by *L. cf. maculosa*. Other species highly representative of RS, such as *D. willistoni* and *Z. indianus*, were not collected. Interestingly, the use of a different bait, Karo[®] Syrup, was effective in capturing species such as *D. flexa* and *Leucophenga* spp., poorly represented in many collections for the state.

Drosophila flexa has been considered a rare species and has been absent from many collections, due most likely to biased methods of capture (Schmitz *et al.*, 2004). The presence of *D. flexa* in our collections could be related to maize cultivation near HBITL, the only breeding site previously known for this species (Vilela and Bächli, 2000).

Leucophenga species are primarily mycophagous (Throckmorton, 1975). Presumably for this reason, these flies are neglected in most studies. As a result, the ecology and biogeography of the genus are poorly known. In view of the dominance of *Leucophenga cf. maculosa* in the sample, its presence in our collection could not be occasional. We collected this species emerging from fungi fructifications in HBITL. These observations indicate that the species is abundant in this area (unpublished data). However, the species has never been found in flight over the fruiting bodies of

fungi at HBITL. Lachaise and Tsacas (1983) suggest that the adult feeding site of *Leucophenga* may differ from the larval breeding site. This suggestion could explain the abundance of *L. cf. maculosa* found by the present study.

According to Ricklefs (1973), certain climatic factors, such as seasonality, average temperature, and annual rainfall show a relatively simple relationship to latitude. And latitude, in turn, is related to diversity. Whereas low-latitude tropical regions have the highest levels of diversity, higher latitudes show a reduction in their diversity indices (Stevens, 1989). This difference could be explained by the simple observation that low-latitude regions include more types of habitats and are thus able to maintain a larger number of species (Pianka, 1966). Eight *taxa* have their southernmost record in HBITL. Thus, this result can be interpreted in the following two ways: (1) because diversity decreases with increasing latitude, this gradient could explain the absence of records of these *taxa* in countries farther south (Goñi *et al.*, 1998; Goñi *et al.*, 2012); and (2) these *taxa* are absent from collections made in areas farther south due to biased sampling methods. Thus, more effort is needed to determine where the species are distributed, both for conservation purposes and to examine their biodiversity.

This study extends previous knowledge of the diversity of Drosophilidae in the Pampa Biome, reporting the first record of *Z. orbitalis* in RS. We also extended the geographical distribution of eight *taxa* southward to latitude 31°48'S, defining the southernmost records for these *taxa* in South America. Furthermore, our results highlight the use of McPhail traps with Karo® Syrup bait as an additional tool for collecting Drosophilidae.

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