M., R.F. Berman, S.M. Irtenkauf, M.I. Evans, and D.B. Cotton 1992, American Journal of Obstetrics and Gynecology 167: 1605-1610; Kuebler, D., and M.A. Tanouye 2000, Journal of Neurophysiology 83: 998–1009; Lutas, A., and G. Yellen 2013, Trends in Neurosciences 36: 32-40; Nyako, M., C. Marks, J. Sherma, and E.R. Reynolds 2001, Biochemical Genetics 39: 339 –349; Pavlidis, P., M. Ramaswami, and M.A. Tanouye 1994, Cell 79: 23–33; Reynolds, E.R., E.A. Stauffer, L. Feeney, E. Rojahn, B. Jacobs, and C. McKeever 2004, Journal of Neurobiology 58: 503-513; Royden, C.S., V. Pirrota, and L.Y. Jan 1987, Cell 51: 165–173; Yuen, A.W.C., and J.W. Sander 2012, Epilepsy Research 100: 152-156.

Drosophilid assemblages in burned and unburned vegetation in the Brazilian Savanna.

Leão, B.F.D., R.A. Mata, M.A. Paula, and R. Tidon. Instituto de Biologia, Universidade de Brasília, Brasília, DF, Brasil; Corresponding author: rotidon@pq.cnpq.br

Introduction

The Brazilian Savanna, locally known as Cerrado, is a unique savanna hotspot covering about 2,000,000 km² of South America. It contains savanna vegetation of highly variable structure on the well-drained interfluves, with gallery forests or other wetland vegetation following the watercourses (Oliveira and Marquis, 2002). This biome is highly seasonal, characterized by a distinct dry season from May to September. Wildfire events have been occurring for a long time in this region, as evidenced by the unique array of fire-adapted plant species.

Natural populations of drosophilids have been investigated in this biome, particularly over the past two decades, revealing that the strong environmental heterogeneity impacts the structure of drosophilid assemblages. Communities and populations of these insects decrease through the dry seasons, expand during the rainy seasons, and differ remarkably among vegetation types (Tidon, 2006; Mata *et al.*, 2015). Anthropogenic disturbances, such as urbanization and forests in successional stages, also play a role in drosophilid communities (Ferreira and Tidon, 2005; Mata and Tidon, 2013). Although fire is recognized as a significant form of disturbance due to its potential to influence global ecosystem patterns and processes (Bowman *et al.*, 2009), little is known about the post-fire effects on these flies' assemblages.

In this study, we investigated drosophilid assemblages from forest and savanna patches two years after they had been affected by a severe fire, as well as nearby long-unburned patches used as control sites.

Material and Methods

This research was conducted in the Ecological Reserve of IBGE, located 35 km south of Brasília, the capital of Brazil. This reserve is part of a continuous Environmental Protection Area of 10,000 ha, which has been considered since 1993 by UNESCO to be a core area of the Cerrado Biosphere Reserve. In September 2011, two years before our collections, an accidental and severe fire affected about 90% of the IBGE Reserve and changed its landscape harshly.

Drosophilid samples were carried out bimonthly, from October 2013 to August 2015. On each sampling occasion, four sites representing different habitat types were sampled: (1) burned forest, (2) unburned forest, (3) burned savanna, and (4) unburned savanna. To control for the high heterogeneity of the savanna vegetation, our collections (3 and 4) were made in *cerrado sensu stricto*, a type of savanna very common in the biome. In each site, three sampling units (SU) were established at least 30 m apart. Each SU contained three retention traps (Roque *et al.*, 2011) arranged 10 meters apart. Thus, we came to a standardized sampling effort of three replicates in each one of the four sampled habitats, corresponding to 36 traps per sampling occasion.

The traps were baited with bananas fermented with *Saccharomyces cerevisiae* for 24 hours, and then they were left in the field for four consecutive days. The drosophilids were identified, whenever possible, to the species level. Vouchers of the captured species were deposited at the Collection of the *Laboratório de Biologia Evolutiva da Universidade de Brasilia.*

The diversity between burned and unburned patches was evaluated by rarefaction curves ($S_{est,}$ plus 95% confidence intervals) (Colwell *et al*., 2012). The comparison of species richness was done by rescaling the expected *sample-based* species rarefaction curves by *individuals*, instead of leaving them scaled by samples, as recommended by Gotelli and Colwell (2001). Presenting the curves scaled by samples, however, allowed evaluating the suitability of the sampling. The data for the curves were generated in the software EstimateS 9.1 (Colwell, 2013).

Results and Discussion

In this study, we collected 34,968 drosophilids representing 45 nominal species in the genera *Drosophila*, *Rhinoleucophenga*, *Scaptodrosophila*, or *Zaprionus*. The abundance of flies declined in the burned areas (unburned forest: n = 11,952 and mean = 332.00; burned forest: n = 8,510 and mean = 236.39; unburned savanna: n = 9,444 and mean = 262.33; burned savanna: n = 5,062 and mean = 140.61). As the sampling effort was standardized among burned and unburned sites, this difference probably reflects biologically meaningful patterns of resource availability and growth conditions. High severity fires have previously been shown to reduce the abundance of many insect groups, because niche diversity and availability is lower in recently burned habitats (Swengel, 2001; Buckingham *et al*., 2015). After being affected by fire, forests and savannas may become drier and lack feeding and breeding sites for drosophilids.

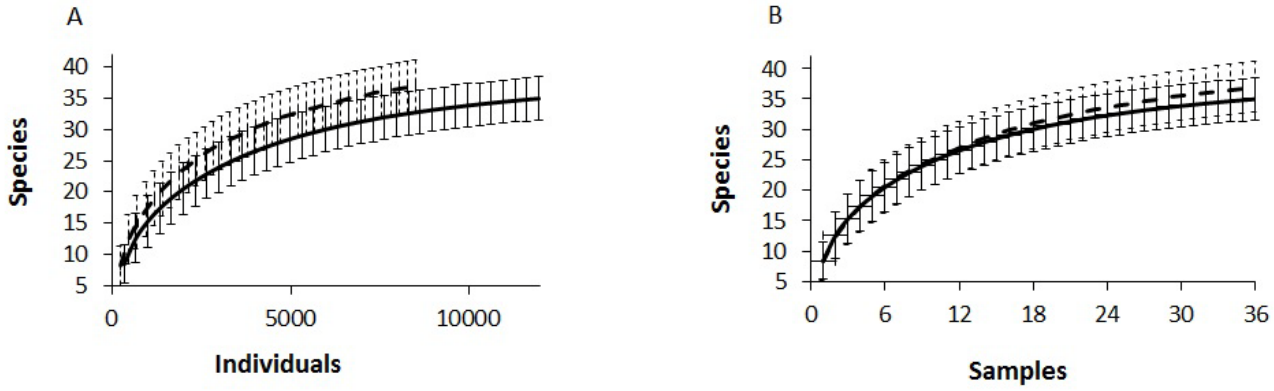

Figure 1. Rarefaction curve of drosophilid species (S_{stat}; ± 95% IC) recorded at burned (dashed line) and unburned (bold line) forests in the Ecological Reserve of IBGE between October 2013 and August 2015 scaled by A) individuals and B) samples.

Species richness and distribution of abundances did not differ between burned and unburned forest patches (Figures 1 and 2). In the savanna, on the other hand, the burned curve tends to stabilize at around 20 species, whereas the unburned curve is still rising (Figure 3). Moreover, the burned savanna patch has lost rare species and is strongly dominated by *Zaprionus indianus* (Figure 4). These results contrast with those obtained by Mata and Tidon (2013), who found differences between disturbed and undisturbed forests but not between disturbed and undisturbed savannas. This apparent incongruence, nonetheless, may be explained by two factors. First, it can be due to methodological inadequacies in the sampling design adopted by Mata and Tidon (op cit.). These authors compared undisturbed habitats with a group of habitats under different types and levels of disturbance such as fire, anthropic buildings, and dusty roads. The different effect of each type of disturbance could puzzle the results. Alternatively, the inconsistency pointed here can be due to sampling insufficiency of the present study. For each vegetation type (forest or savanna), we compared only one burned

site with its unburned control. Although each site sampled here had three replicates, we are aware that if we had searched a wider geographical area the result would have been different.

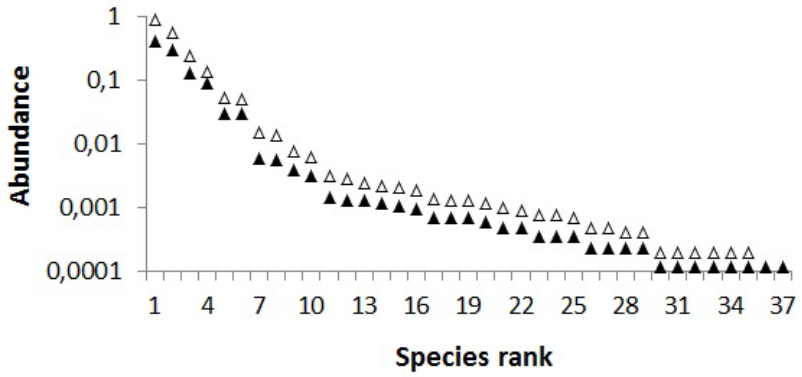

Figure 2. Rank-abundance plot of the drosophilid species collected at burned (black triangles) and unburned (empty triangles) forests in the Ecological Reserve of IBGE between October 2013 and August 2015. The relative abundance of each species is shown on a log 10 scale.

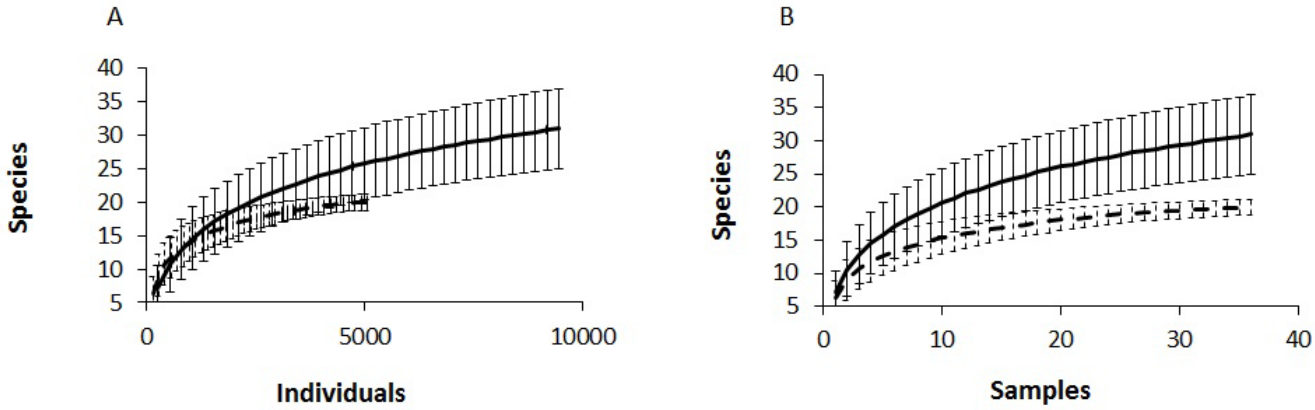

Figure 3. Rarefaction curve of drosophilid species (S_{stat}; ± 95% IC) in burned (dashed line) and unburned (bold line) savannas in the Ecological Reserve of IBGE between October 2013 and August 2015 A) scaled by individuals, and B) scaled by samples.

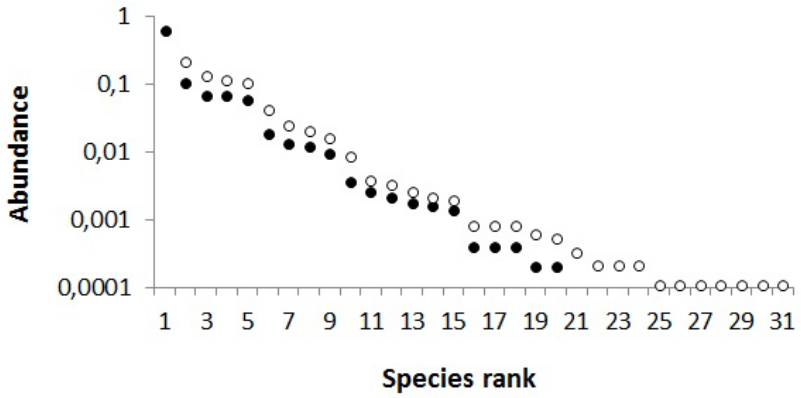

Figure 4. Rank-abundance plot of the drosophilid species collected at burned (black circles) and unburned (empty circles) savanna in the Ecological Reserve of IBGE between October 2013 and August 2015. The relative abundance of each species is shown on a log 10 scale.

The effects of fire on insect assemblages have been investigated in a few insect orders, including Hymenoptera, Lepidoptera, Collembola, Hemiptera, and Coleoptera (New, 2014). Nonetheless, different groups have been shown to become variously poorer and less abundant or richer and more abundant in burned than unburned 'control' patches. Such trends are difficult to predict because insect responses are affected by the geographic region, climatic conditions, fire regime, and intensity. Clearly, more research is needed to predict population and community dynamics, as well as ecosystem and global changes (Showalter, 2012). Drosophilids are good models for investigating the effects of disturbance on natural populations, because they are diverse, easily sampled, and sensitive to environmental variations. Here, we showed differences in assemblages between burned and unburned habitats based on abundance and richness of drosophilids. Future research should refine these results by increasing the geographical scale and including community analyses that consider not only abundance and richness but also species composition.

References: Bowman, M.J.S.D., J.K. Balch, P. Artaxo, W.J. Bond, J.M. Carlson, M.A. Cochrane, C.M. D'Antonio, R.S. Defries, J.C. Doyle, S.P. Harrison, F.H. Johnston, J.E. Keeley, M.A. Krawchuk, C.A. Kull, J.B. Marston, M.A. Moritz, C. Prentice, C.I. Roos, A.C. Scott, T.W. Swetnam, G.R. Van Der Werf, and S.J. Pyne 2009, Science 324: 481-484; Buckingham, S., N. Murphy, and H. Gibb 2015, PLoS ONE 10: e0124556; Colwell, R.K., 2013, EstimateS: Statistical estimation of species richness and shared species from samples. Version 9. User's Guide and application published at: http://purl.oclc.org/estimates; Colwell, R.K., A. Chao, N.J. Gotelli, S.-Y. Lin, C.X. Mao, R.L. Chazdon, and J.T. Longino 2012, J. Plant Ecol. 5: 3-21; Ferreira, L.B., and R. Tidon 2005, Biodiv. Conserv. 14: 1809-1821;Gotelli, N.J., and R.K. Colwell 2001, Ecol. Letters 4: 379-391; Mata, R.A., H. Valadão, and R. Tidon 2015, Revta. Bras. Ent. 59: 50-57; Mata, R.A., and R. Tidon 2013, Insect Conserv. Divers. 6: 663-670; New, T.R., 2014, *Insects, Fire and Conservation*, Springer, Switzerland; Oliveira-Filho, A.T., and R.J. Marquis 2002, *The Cerrados of Brazil. Ecology and Natural History of a Neotropical Savanna*, Columbia Univ. Press, New York; Roque F., S.C.F. Oliveira, and R. Tidon 2011, Dros. Inf. Serv. 94: 140-141; Schowalter, T.D., 2012, Annu. Rev. Entomol. 57: 1-20; Swengel, A.B., 2001, Biodiv. Conserv. 10: 1141; Tidon, R., 2006, Biol. J. Linn. Soc. 87: 233-247.

Drosophilids of the Lake Urmia National Park, Iran (Dip.: Drosophilidae).

Parchami-Araghi[1]*, Mehrdad, Ebrahim Gilasian[1], Reza Vahabzadeh[2], and Gerhard Bächli[3]. [1]Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Education and Extension Organization (AREEO), Tehran 19395-1454, Iran; [2]Research Station for the Lake Urmia National Park, Rashakan, Department of Environment of West Azarbaijan Province, Urmia, Iran; [3]Zoologisches Museum, Universität Zürich, Winterthurerstrasse 190, CH-8057, Zürich, Switzerland. *Corresponding author: maraghi20@yahoo.ca

Abstract

Drosophilid fauna of the Lake Urmia National Park was studied for the first time in the framework of an ongoing survey on the economically and veterinarily important flies of the Iranian national parks. A total of 10 species have been identified, of which the genus *Lordiphosa* Basden and the three species *Drosophila hydei* Sturtevant, *Lordiphosa andalusiaca* (Strobl), and *Scaptodrosophila lebanonensis* (Wheeler) are found to be new records for the Iranian fauna. The species *D. melanogaster* Meigen, *D. phalerata* Meigen, *D. simulans* Sturtevant, *D. subobscura* Collin, *Scaptomyza flava* (Fallén), *Scaptomyza pallida* (Zetterstedt), and *Zaprionus indianus* Gupta are first recorded from the park. A key to the drosophilids of the Lake Urmia National Park and images of the genitalia of each species are presented.

Introduction

The drosophilid fauna of Iran is poorly studied, being represented by only 25 species, none of which is recorded from the western provinces (Bächli, 2016). The northwestern province of West Azarbaijan borders