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Revised list of drosophilid species recorded in the Brazilian Savanna.

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Introduction

The Brazilian Savanna, an environment also known as Cerrado, is found within the interior of Brazil and originally covered an area of about 2 million km² in South America (Oliveira and Marquis, 2002). The landscape's typical vegetation consists of savanna and small forests with significantly varying structures (Oliveira-Filho and Ratter, 2002) that contribute to its status as the most biodiverse savanna on Earth. Over the last few decades, large-scale cattle ranching and the emergence of industrial plantations, such as those used for soybeans, *Glycine max* [L.] Merr. have extensively transformed the Brazilian Savanna. Disturbances caused by both the urban, and agricultural expansion have increasingly threatened its rich biodiversity (Klink and Machado, 2005). Currently, this region is considered one of 34 *biodiversity hotspots* around the world because of its high endemism and the extreme threats that it faces (Mittermeier *et al.*, 2005). Accordingly, documenting biodiversity in this area is an important step toward obtaining critical subsidies necessary for its preservation and conservation.

The most recent compilation of drosophilid species recorded in the Brazilian Savanna was provided by Roque and Tidon (2013). This list was based upon unpublished data, along with that available in Chaves and Tidon (2005, 2008), Roque *et al.* (2006), Blauth and Gottschalk (2007), Roque and Tidon (2008), Mata *et al.* (2008), and Valadão *et al.* (2010). They concluded that drosophilid fauna of the Cerrado consisted of 128 species. Subsequent findings by Blauth *et al.* (2013), Paula *et al.* (2014), Junges and Gottschalk (2014), and Vidal and Vilela (2015) eventually added more species to this list.

In this study, we analyzed the current records of drosophilid species proposed by Roque *et al.* (2006), Mata *et al.* (2008), Roque and Tidon (2008, 2013), and Valadão *et al.* (2010). We then updated the existing list of species, adding the information available after 2013. The revised list better organizes the existing knowledge and presents a more realistic checklist of the drosophilids recorded in the Brazilian Savanna.

Material and Methods

Initially, we analyzed the most current, existing, records of drosophilids for the Cerrado, provided by Roque *et al.* (2006), Mata *et al.* (2008), Roque and Tidon (2008, 2013), and Valadão *et al.* (2010). We went through each of the original species descriptions and verified the specific characteristics for each. Afterwards

Table 1. Drosophilids of the Brazilian Savanna. Detailed informations on the geographic distribution of theses insects can be obtained in the following references: Chaves and Tidon (2005; 2008); Roque *et al.* (2006); Blauth and Gottschalk (2007); Mata *et al.* (2008); Roque and Tidon (2008; 2013); Valadão *et al.* (2010); Blauth *et al.* (2013); Junges and Gottschalk (2014); Paula *et al.* (2014); Vidal and Vilela (2015).

Subfamily	Genus	Subgenus	Species
Drosophilinae	<i>Drosophila</i>	<i>Dorsilopha</i>	* <i>D. busckii</i> Coquillett
		<i>Drosophila</i>	<i>D. annulimana</i> Duda
			<i>D. aragua</i> Vilela and Pereira
			<i>D. arapuan</i> da Cunha and Pavan
			<i>D. ararama</i> Pavan and da Cunha
			<i>D. arauna</i> Pavan and Nacur
			<i>D. aureata</i> Wheeler
			<i>D. bromelioides</i> Pavan and da Cunha
			<i>D. atrata</i> Burla and Pavan
			<i>D. calloptera</i> Schiner
			<i>D. quadrum</i> (Wiedemann)
			<i>D. schildi</i> Malloch
			<i>D. annulosa</i> Vilela and Bächli
			<i>D. canalinea</i> Patterson and Mainland
			<i>D. cardini</i> Sturtevant
			<i>D. cardinoides</i> Dobzhansky and Pavan
			<i>D. neocardini</i> Streisinger
			<i>D. neomorpha</i> Heed and Wheeler
			<i>D. polymorpha</i> Dobzhansky and Pavan
			<i>D. coffeata</i> Williston
			<i>D. fuscolineata</i> Duda
			<i>D. pagliolii</i> Cordeiro
			<i>D. camargoi</i> Dobzhansky and Pavan
			<i>D. dreyfusi</i> Dobzhansky and Pavan
			<i>D. griseolineata</i> Duda
			<i>D. guaraja</i> King
			<i>D. guaru</i> Dobzhansky and Pavan
			<i>D. maculifrons</i> Duda
			<i>D. ornatifrons</i> Duda
			* <i>D. immigrans</i> Sturtevant
			<i>D. pallidipennis</i> Dobzhansky and Pavan
			<i>D. antonietae</i> Tidon-Sklorz and Sene
			<i>D. borborema</i> Vilela and Sene
			<i>D. buzzatii</i> Patterson and Wheeler
			<i>D. coroica</i> Wasserman
			<i>D. eleonora</i> Tosi <i>et al.</i>
			<i>D. gouveai</i> Tidon-Sklorz and Sene
			<i>D. hydei</i> Sturtevant
			<i>D. ivai</i> Vilela
			<i>D. mapiriensis</i> Vilela and Bächli
			<i>D. mercatorum</i> Patterson and Wheeler

	<i>D. meridionalis</i> Wasserman
	<i>D. moju</i> Pavan
	<i>D. neorepleta</i> Patterson and Wheeler
	<i>D. nigricurua</i> Patterson and Mainland
	<i>D. onca</i> Dobzhansky and Pavan
	<i>D. papei</i> Bächli and Vilela
	<i>D. paranaensis</i> Barros
	<i>D. pseudorepleta</i> Vilela and Bächli
	<i>D. querubimae</i> Vilela
	<i>D. repleta</i> Wollaston
	<i>D. rosinae</i> Vilela
	<i>D. serido</i> Vilela and Sene
	<i>D. seriema</i> Tidon-Sklorz and Sene
	<i>D. zottii</i> Vilela
	<i>D. albirostris</i> Sturtevant
	<i>D. bandeirantorum</i> Dobzhansky and Pavan
	<i>D. bifilum</i> Frota-Pessoa
	<i>D. cuaso</i> Bächli, Vilela and Ratcov
	<i>D. medioimpressa</i> Frota-Pessoa
	<i>D. mediopicta</i> Frota-Pessoa
	<i>D. mediopunctata</i> Dobzhansky and Pavan
	<i>D. mediotriata</i> Duda
	<i>D. mesostigma</i> Frota-Pessoa
	<i>D. nappae</i> Vilela et al.
	<i>D. neoguaramunu</i> Frydenberg
	<i>D. paraguayensis</i> Duda
	<i>D. paramediotriata</i> Townsend and Wheeler
	<i>D. roehrae</i> Pipkin and Heed
	<i>D. trapeza</i> Heed and Wheeler
	<i>D. unipunctata</i> Patterson and Mainland
	* <i>D. virilis</i> Sturtevant
	<i>D. caponei</i> Pavan and da Cunha
	<i>D. impudica</i> Duda
<i>Phloridosa</i>	<i>D. denieri</i> Blanchard
	<i>D. lutzii</i> Sturtevant
<i>Sophophora</i>	* <i>D. ananassae</i> Doleschall
	* <i>D. kikkawai</i> Burla
	* <i>D. malerkotliana</i> Parshad and Paika
	* <i>D. melanogaster</i> Meigen
	* <i>D. simulans</i> Sturtevant
	* <i>D. suzukii</i> Matsumura
	<i>D. austrosaltans</i> Spassky
	<i>D. neocordata</i> Magalhães
	<i>D. neoelliptica</i> Pavan and Magalhães
	<i>D. prosaltans</i> Duda
	<i>D. pseudosaltans</i> Magalhães

			<i>D. sturtevantii</i> Duda
			<i>D. bocainensis</i> Pavan and da Cunha
			<i>D. bocainoides</i> Carson
			<i>D. capricorni</i> Dobzhansky and Pavan
			<i>D. equinoxialis</i> Dobzhansky
			<i>D. fumipennis</i> Duda
			<i>D. nebulosa</i> Sturtevant
			<i>D. parabocainensis</i> Carson
			<i>D. paulistorum</i> Dobzhansky and Pavan
			<i>D. tropicalis</i> Burla and da Cunha
			<i>D. willistoni</i> Sturtevant
		<i>Siphlodora</i>	<i>D. flexa</i> Loew
	<i>Diathoneura</i>		Undetermined species
	<i>Hirtodrosophila</i>		<i>H. morgani</i> (Mourao, Gallo and Bicudo)
			<i>H. pleuralis</i> Williston
			<i>H. subflavohalterata</i> (Burla)
	<i>Mycodrosophila</i>		<i>M. projectans</i> (Sturtevant)
	<i>Neotanygastrella</i>		<i>N. tricoloripes</i> Duda
	<i>Scaptodrosophila</i>		* <i>S. latifasciaeformis</i> (Duda)
	<i>Scaptomyza</i>	<i>Mesoscaptomyza</i>	<i>S. nigripalpis</i> Malloch
	<i>Zaprionus</i>	<i>Zaprionus</i>	* <i>Z. indianus</i> Gupta
	<i>Zygothrica</i>		<i>Z. dispar</i> (Wiedemann)
			<i>Z. microeristes</i> Grimaldi
			<i>Z. prodispar</i> Duda
			<i>Z. poeyi</i> (Sturtevant)
			<i>Z. apopoeyi</i> Burla
Steganinae	<i>Amiota</i>		Undetermined species
	<i>Leucophenga</i>	<i>Leucophenga</i>	<i>L. bimaculata</i> (Loew)
			<i>L. maculosa</i> Duda
			<i>L. montana</i> Wheeler
			<i>L. ornativentris</i> Kahl
			<i>L. varia</i> (Walker)
	<i>Rhinoleucophenga</i>		<i>R. angustifrons</i> Malogolowkin
			<i>R. lopesi</i> Malogolowkin
			<i>R. matogrossensis</i> Malogolowkin
			<i>R. montensis</i> Junges and Gottschalk
			<i>R. myrmecophaga</i> Vidal and Vilela
			<i>R. nigrescens</i> Malogolowkin
			<i>R. obesa</i> (Loew)
			<i>R. personata</i> Malogolowkin
			<i>R. punctulata</i> Duda
			<i>R. tangaraensis</i> Junges and Gottschalk

*Exotic species

the results of this analysis, along with the records published after 2013, were added to the drosophilid species list presented by Chaves and Tidon (2008). This new compilation provides an updated list of drosophilids recorded in the Brazilian Savanna.

Results and Discussion

Our analysis revealed that the specimens formerly identified as *Gitona bivisualis* are in fact *Rhinoleucophenga punctulata*, confirming the suspicions of Vidal and Vilela (2015). *R. fluminensis* and *R. brasiliensis* are also *R. punctulata*, a species that demonstrates a certain phenotypic variation in the field. After eliminating these three species and adding the records available after 2013, the new list reveals 129 drosophilid species within the Brazilian Savanna.

The 12 determined genera represent the two subfamilies of drosophilids: Drosophilinae (9) and Steganinae (3). The neotropical species are distributed among the genera *Amiota*, *Drosophila* (predominant genus, with 90 species representing four subgenera), *Diathoneura*, *Hirtodrosophila*, *Leucophenga*, *Mycodrosophila*, *Neotanygastrella*, *Rhinoleucophenga*, *Scaptomyza*, and *Zygothrica* (Table 1). Additionally, eleven species exotic to the Neotropical region are also found here. The exotic species are: *Zaprionus indianus*, *Scaptodrosophila latifasciaeformis*, and nine species of the genus *Drosophila* representing three subgenera: *Dorsilopa* (*D. busckii*), *Drosophila* (*D. immigrans* and *D. virilis*), and *Sophophora* (*D. ananassae*, *D. kikkawai*, *D. malerkotliana*, *D. melanogaster*, *D. simulans*, and the recently introduced *D. suzukii*).

Despite experience and advances in taxonomy, it is difficult to estimate the richness of insect species in a given region. This is mainly because most insects are (1) extremely seasonal, (2) resource specialists, and (3) sometimes misidentified due to uncertain taxonomy. This is the case for many tropical drosophilids, especially those outside the genus *Drosophila*, such as the genera of Steganinae. To combat this, we recommend doing more frequent inventories in this region, preferably using different methods of collection in conjunction with the enhancement of identification keys for neotropical drosophilids. These actions will help provide critical subsidies, improve knowledge of biodiversity in the tropical regions, and help with the development of conservation and management policies.

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