

Drosophila Oregon-flare and wild type strains; the resulting standard deviations do not allow to clearly establish the biological effect of this synthetic estrogen on the larvae.

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A novel record of Drosophilidae species in the Cerrado biome of the state of Mato Grosso, west-central Brazil.

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Introduction

Systematic studies on the ecology and distribution of Drosophilidae species in Brazil started in the 1940's (Dobzhansky and Pavan, 1943, 1950; Pavan, 1959). From then on, research groups were formed to investigate Drosophilidae species in different localities in Brazil, especially in the south-east and Atlantic Forest. More recently, by the end of the 1990's, systematic studies were conducted also in west-central Brazil, more specifically in the Cerrado biome (Tidon *et al.*, 2003, 2005; Tidon, 2006), in southern Brazil, in the Atlantic Forest biome (De Toni and Hofmann, 1995; Schmitz *et al.*, 2007; Gottschalk *et al.*, in press), and in the north, in the Amazonian biome (Martins,

1987, 2001).

Of the 3,952 Drosophilidae species described (Bächli, 2007), 308 have been recorded in Brazil (M.S. Gottschalk, personal communication), the majority of which are in south-eastern Brazil (Tidon-Sklorz and Sene, 1999; Medeiros and Klaczko, 2004).

Table 1. List of species with records in the state of Mato Grosso and respective references.

Species recorded in Mato Grosso, Brazil	References
<i>Chymomyza procnemis</i> (Williston, 1896)	Kahl (1917)
<i>Drosophila aguape</i> Val & Marques, 1996	Val & Marques (1996)
<i>D. bocainensis</i> Pavan & Cunha, 1947	Pavan (1959)
<i>D. capricorni</i> Dobzhansky & Pavan, 1943	Pavan (1959), Dobzhansky & Pavan (1950)
<i>D. eleonora</i> e Tosi, Martins, Vilela & Pereira, 1990	Tosi <i>et al.</i> (1990)
<i>D. equinoxialis</i> Dobzhansky, 1946	De Toni <i>et al.</i> (2005)
<i>D. fumipennis</i> Duda, 1925	Pavan (1959), Dobzhansky & Pavan (1950)
<i>D. immigrans</i> Sturtevant, 1921	Dobzhansky & Pavan (1950)
<i>D. maculifrons</i> Duda, 1927	Pavan (1959), Dobzhansky & Pavan (1950)
<i>D. malerkotliana</i> Parshad & Paika, 1964	Val & Marques (1996), De Toni <i>et al.</i> (2005)
<i>D. mediotriata</i> Duda, 1925	Pavan (1959), Dobzhansky & Pavan (1950)
<i>D. nebulosa</i> Sturtevant, 1916	Pavan (1959), Dobzhansky & Pavan (1950), Val & Marques (1996)
<i>D. neomorpha</i> Heed & Wheeler, 1957	De Toni <i>et al.</i> (2005)
<i>D. pallidipennis</i> Dobzhansky & Pavan, 1943	Dobzhansky & Pavan (1950)
<i>D. paranaensis</i> Barros, 1950	Vilela (1983)
<i>D. parthenogenetica</i> Stalker, 1953	De Toni <i>et al.</i> (2005)
<i>D. paulistorum</i> Dobzhansky & Pavan <i>in</i> Burla <i>et al.</i> , 1949	De Toni <i>et al.</i> (2005)
<i>D. polymorpha</i> Dobzhansky & Pavan, 1943	Pavan (1959)
<i>D. repleta</i> Wollaston, 1858	Vilela (1983), Val & Marques (1996)
<i>D. saltans</i> Sturtevant, 1916	De Toni <i>et al.</i> (2005)
<i>D. simulans</i> Sturtevant, 1919	Dobzhansky & Pavan (1950), Val & Marques (1996), De Toni <i>et al.</i> (2005)
<i>D. sturtevantii</i> Duda, 1927	Dobzhansky & Pavan (1950), Pavan (1959), Val & Marques (1996), De Toni <i>et al.</i> (2005)
<i>D. tropicalis</i> Burla & Cunha <i>in</i> Burla <i>et al.</i> , 1949	De Toni <i>et al.</i> (2005)
<i>D. willistoni</i> Sturtevant, 1916	De Toni <i>et al.</i> (2005)
<i>Rhinoleucophenga obesa</i> (Loew, 1872)	Malogolowkin (1946)
<i>Scaptodrosophila latifasciaeformis</i> (Duda, 1940)	Pavan (1959), Dobzhansky & Pavan (1950), Val & Marques (1996)
<i>Zaprionus indianus</i> Gupta, 1970	David <i>et al.</i> (2006)
<i>Zygothrica bilineata</i> (Williston, 1896)	Grimaldi (1990)
<i>Z. microeristes</i> Grimaldi, 1987	Grimaldi (1987)
<i>Z. prodispar</i> Duda, 1925	Grimaldi (1987)

In the state of Mato Grosso, few studies on Drosophilidae species have been conducted, and only 30 species have been recorded (Table 1). Three biomes are observed in the state: Amazon, Pantanal and Cerrado, which covers most of the state's area. Cerrado is the second Brazilian biome in size. The prevailing vegetal physiognomy is the savannah, though forest patches are observed, in which vegetation aspect and physiognomy are varied (Valente, 2006). Estimates say that the biome comes second in species richness in the world. Yet, the Cerrado is endangered by the increase in plantation and pasture areas. Nowadays the Cerrado is considered a global conservation hotspot (Myers *et al.*, 2000).

In an effort to add to the current knowledge of drosophilid distribution in the Cerrado biome, our study lists 18 records of Drosophilidae species in the Tangará da Serra region, state of Mato Grosso, west-central Brazil, new to the region.



Figure 1. South America map indicating the municipality of Tangará da Serra, state of Mato Grosso (MT), Brazil.

Material and Methods

Sample collections were carried out in the municipality of Tangará da Serra, state of Mato Grosso ($14^{\circ}04'38''S$; $57^{\circ}03'45''W$) (Figure 1), located between Parecis and Tapirapuã mountain ranges. The prevailing vegetation class is the Seasonal Semi-deciduous Forest. Nowadays, the patches of intact original vegetation are rare in the region. This area of the Cerrado biome undergoes the influence of the Amazonian biome, receiving an expressive number of animal and plant species native to the latter. Adult fly specimens were collected (i) on specially prepared banana baits (Tidon and Sene, 1988) and (ii) flying over fruit lying in the collection site, using an entomological net, whereas

larvae were collected with fruit and flowers and reared in the laboratory upon emergence of adult flies. Plant species on which individuals were collected (adult or as immature) were also recorded. As for immature individuals, the material was sent to the laboratory and stored in a controlled temperature environment ($21 \pm 1^{\circ}C$) for one month. Emerging flies were retrieved daily. Table 2

shows the dates, locations and collection approaches adopted.

The characterization of the drosophilids collected was based on external morphologic traits and male genitalia, according to Wheeler and Kambyzellis (1966).

Table 2 – Date, location, collection method, and plant species collected and used as feeding or breeding sites.

	Date	Location	Collection method / resource collected
01	March 22 nd 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Artocarpus heterophyllus</i> (Thunb.) (Moraceae) – jackfruit
02	March 22 nd 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Persea americana</i> Mill. (Lauraceae) – avocado
03	March 25 th 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Artocarpus heterophyllus</i> (Thunb.) (Moraceae) – jackfruit
04	March 31 st 2007	Forest patch near Agricultural School	Flying over fruits of <i>Bactris coccinea</i> Barb. Rodr. (Palmae) – red club palm
05	April 13 th 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Malpighia glabra</i> L. (Malpighiaceae) – acerola fruit
06	23 rd to 26 th April 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Persea americana</i> Mill. (Lauraceae) – avocado
07	23 rd to 26 th April 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Pyrus</i> sp. (Rosaceae) – common pear
08	24 th April 2007	Park in town center	Emerged from flowers of Convolvulaceae
09	13 th May 2007	Vacant lot in downtown	Emerged from flowers of Convolvulaceae
10	13 th May 2007	Park in town center	Emerged from <i>Buchenavia tomentosa</i> Eichler (Combretaceae) – mirindiba fruit
11	14 th May 2007	Garden of UNEMAT <i>Campus</i>	Flying over fruits of <i>Artocarpus heterophyllus</i> (Thunb.) (Moraceae) – jackfruit
12	18 th May 2007	Plantation near UNEMAT <i>Campus</i>	Inside flowers of <i>Cucurbita pepo</i> L. (Cucurbitaceae) – zucchini
13	18 th to 21 st May 2007	Forest patch near UNEMAT <i>Campus</i>	Collection using traps according to Tidon & Sene (1988)
14	18 th to 21 st May 2007	Pasture area near UNEMAT <i>Campus</i>	Collection using traps according to Tidon & Sene (1988)

Results and Discussion

A total of 1,187 individuals were collected. Specimens belonged to 35 species and four genera of Drosophilidae, the majority of which associated to fruit (Table 3). The only species associated to flowers were *D. denieri* and one *Drosophila* species belonging to the *bromeliae* group, not yet described — *Drosophila* sp.1 (H.J. Schmitz, personal communication). Schmitz and Hofmann (2005) state that *D. denieri* was recorded in Argentina, Uruguay, and in the Brazilian states of Rio Grande do Sul and Santa Catarina. The authors draw attention to the hypothesis that the apparently restricted distribution of *D. denieri* is due to inappropriate collection approaches. The first record of the species in the Mato Grosso section of the Cerrado biome confirms the notion.

Table 3. Species collected in the region of Tangará da Serra, state of Mato Grosso, Brazil. Numbers indicate collections mentioned in Table 2.

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total
Drosophila															
<i>atrata</i> group															
<i>D. calloptera</i> Schiner, 1868*	-	1	-	5	-	-	-	-	-	-	-	-	-	-	6
<i>bromeliae</i> group															
<i>Drosophila</i> sp.1	-	-	-	-	-	-	-	8	-	-	-	-	-	-	8
<i>canalineae</i> group															
<i>D. canalinea</i> Patterson & Mainland, 1944*	1	-	-	-	-	-	-	-	-	-	-	-	1	-	2
<i>cardini</i> group															
<i>D. cardini</i> Sturtevant, 1916*	1	3	3	-	-	-	-	-	-	1	-	-	55	78	141
<i>D. cardinoides</i> Dobzhansky & Pavan, 1943*	-	-	-	-	-	-	-	-	-	52	-	-	-	-	52
<i>D. polymorpha</i> Dobzhansky & Pavan, 1943	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2
<i>melanogaster</i> group															
<i>D. ananassae</i> Doleschall, 1858*	1	-	1	-	-	-	-	-	-	1	3	-	-	-	6
<i>D. kikkawai</i> Burla, 1954*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
<i>D. malerkotiana</i> Parshad & Paika, 1964	23	-	-	-	1	1	1	-	-	12	-	-	83	11	132
<i>D. melanogaster</i> Meigen, 1830*	-	-	-	-	-	-	-	-	-	-	2	-	-	4	6
<i>D. simulans</i> Sturtevant, 1919	-	-	-	-	5	-	-	-	-	-	-	-	2	5	12
<i>repleta</i> group															
<i>D. hydei</i> Sturtevant, 1921*	37	-	1	-	-	-	-	-	-	-	-	-	-	7	45
<i>D. mercatorum</i> Patterson & Wheeler, 1942*	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
<i>D. moju</i> Pavan, 1950*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<i>D. paranaensis</i> (Barros, 1950)	-	-	-	-	-	-	-	-	-	-	-	-	4	1	5
<i>D. zottii</i> Vilela, 1983*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>saltans</i> group															
<i>D. prosaltans</i> Duda, 1927*	-	-	1	-	-	-	-	-	-	-	1	-	9	2	13
<i>D. sturtevanti</i> Duda, 1927	-	-	1	-	-	-	-	-	-	-	3	-	25	3	32
<i>Drosophila</i> sp.2	-	-	-	-	-	-	-	-	-	-	2	-	2	-	4
<i>tripunctata</i> group															
<i>D. cuaso</i> Bächli, Vilela & Ratcov, 2000*	-	-	-	-	-	-	-	-	-	25	-	-	-	-	25
<i>D. mediopunctata</i> Dobzhansky & Pavan, 1943*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
<i>D. mediotriata</i> Duda, 1925	-	-	-	3	-	-	-	-	-	18	-	-	2	2	25
<i>D. neoguarumunu</i> Frydenberg, 1956*	-	-	-	1	-	-	-	-	-	-	-	-	1	-	2
<i>D. paramediotriata</i> Townsend & Wheeler, 1955*	-	7	1	-	-	-	-	-	-	-	-	-	-	-	8
<i>D. trapeza</i> Heed & Wheeler, 1957*	-	-	3	-	-	-	-	-	-	-	-	-	2	-	5
<i>willistoni</i> group															
<i>D. nebulosa</i> Sturtevant, 1916	-	-	-	-	2	-	2	-	-	48	-	-	2	1	55
<i>willistoni</i> subgroup	4	-	-	-	-	-	-	-	-	7	-	-	4	1	16
<i>Drosophila</i> sp.3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
not grouped															
<i>D. denieri</i> Blanchard, 1938*	-	-	-	-	-	-	-	-	1	-	-	24	-	-	25
<i>Drosophila</i> sp.4 [†]	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
Rhinoleucophenga															
<i>R. obesa</i> (Loew, 1872)	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Rhinoleucophenga</i> sp.1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Rhinoleucophenga</i> sp.2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Scaptodrosophila															
<i>latifasciaeformis</i> group															
<i>S. latifasciaeformis</i> (Duda, 1940)	116	8	36	-	2	4	1	-	-	-	5	-	27	168	367
Zaprionus															
<i>vittiger</i> group															
<i>Z. indianus</i> Gupta, 1970	-	-	1	-	14	-	-	-	-	33	1	-	23	105	177
Total	183	20	49	10	24	6	5	8	1	198	17	24	248	394	1187

species with first record in the state of Mato Grosso

[†]same *Drosophila* sp.4 mentioned in Gottschalk *et al.* (in press*)

The lack of collections in the region also explains why *D. calloptera* and *D. moju*, which distribute in the Amazon and in the Atlantic Forest (Val *et al.*, 1981; De Toni *et al.*, 2007; Gottschalk *et al.*, in press), had not been recorded in the Cerrado before. In turn, *D. cuaso* distribution was confined to the Atlantic Forest, and the present record being the first outside that biome (Bächli *et al.*, 2000).

The other species presenting novel records in the state of Mato Grosso are: *D. canalinea*, *D. cardini*, *D. cardinoides*, *D. hydei*, *D. mediopunctata*, *D. mercatorum*, *D. neoguaramunu*, *D. paramediotriata*, *D. prosaltans*, *D. trapeza* and *D. zottii*. However, these species had previously been described in other Cerrado regions (Sene *et al.*, 1980; Martins, 2001; De Toni *et al.*, 2007). For the first time in the state the following species of the *melanogaster* groups were recorded: *D. ananassae*, *D. kikkawai*, and *D. melanogaster*. These species are cosmopolitan, exotic to the Neotropical region, and are very common in open areas of all South American continent (Ferreira and Tidon, 2005; Gottschalk *et al.*, in press).

In spite of the efforts by Brazilian researchers to obtain representative samples of Drosophilidae in the country's territory as a whole, the biogeographic and ecological studies conducted have failed to cover an expressive extension of the territory, leaving several areas totally unexplored or poorly sampled. Considering the current stage of degradation of most biomes, a considerable body of evidence on species distribution might now be irremediably lost, let alone the fact that the extent of endemism areas that have vanished is unknown.

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Screening for transposable elements in South America invasive species *Zaprionus indianus* and *Drosophila malerkotliana*.

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Transposable elements (TEs) have usually been studied focusing on distribution, structure, activity and evolution. Such analyses primarily aim at understanding the impact of TEs in the genetic dynamics and evolution of the host genomes. A kind of impact analysis that has not been enough explored is to look at genomic dynamics of TEs under stressful conditions, like environment invasion and colonization. According to the “wake-up” hypothesis (Vieira *et al.*, 1999), there is a tendency of mobilization intensification in colonizing populations resulting in an increasing of copy number. An example is given by the comparison between *D. melanogaster* and *D. simulans*, two cosmopolitan sibling species. *D. melanogaster* has dispersed around the world some centuries before *D. simulans* (Capy and Gilbert, 2004) and among 34 transposable elements analyzed, *D. melanogaster* appears to have higher insertion site numbers than *D. simulans* for 29 TEs when populations of America, Asia, Europe, Australia and Africa, the last one being the native place of both species, are compared (Vieira *et al.*, 1999).

Besides *D. melanogaster* and *D. simulans*, numerous other Drosophilidae were able to invade new habitats and had recently colonized the Brazilian territory mainly by antropic activity; among them, *Zaprionus indianus* (from Africa) and *D. malerkotliana* (from Asia). *Zaprionus indianus* was first collected in 1998, in a fig culture at Valinhos city, Sao Paulo (Vilela, 1999), and now it can be collected in several regions of Brazil (Vilela, 1999; Castro and Valente, 2001; Kato *et al.*, 2004), Uruguay (Gõni *et al.*, 2002), and southern North America (van der Linde *et al.*, 2006). *D. malerkotliana* has invaded South America in the 1970's decade (Val and Sene, 1980) and nowadays it is frequently collected in southern Brazil. The recent invasion of a continent by a species provides a useful tool for studying the dynamics of TEs during colonizing stress, because we can monitor populations since the first steps of introduction. To do that, it is necessary to accumulate information about distribution, history, and dynamics of its transposable elements. The goal of this study was then to make an initial search for transposable elements in *Z. indianus* and *D. malerkotliana* genomes to guide further studies on these invasive species.

Seven retrotransposons were searched (*copia*, *mdg-1*, *412*, *gypsy*, *297*, *micropia*, and *roo/B104*), two non-LTR retrotransposons (*jockey* and *doc*), and one transposon (*bari-1*) in a Brazilian population of *Z. indianus* (Mirassol, SP) and *D. malerkotliana* (Onda Verde, SP) by the Dot blotting method. The probes were prepared by two different methods: (1) PCR reactions were performed in 25 µl using approximately 50 ng of each TE plasmid, 0.4 µM of each specific primer