

PRELIMINARY DATA ON THE GEOGRAPHICAL DISTRIBUTION OF *DROSOPHILA* SPECIES WITHIN MORPHOCLIMATIC DOMAINS OF BRAZIL

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ABSTRACT

In order to define the geographical distribution of the large and diverse Neotropical drosophilid fauna, samples are being collected from the major morphoclimatic domains of Brazil. We report here results for the genus Drosophila from collecting efforts made in the domains of Atlantic forest, Caatingas and Cerrados. Within these domains, collections were also made from areas of dunes, restingas (strand vegetation) and the pantanal of Mato Grosso. The results broaden the previously known geographical and ecological distributions of several species and species groups and include records of one species previously unknown from Brazil.

INTRODUCTION

In this paper we present data on the distribution and ecology of some *Drosophila*; these data were gathered in the course of a broad program on the systematics and evolutionary genetics of the drosophilid fauna of the Neotropics.

Among similar studies done in Brazil, the most significant are those of Dobzhansky and Pavan (1950) and Pavan (1959). These papers discussed the geographical distribution and seasonal variations of many species from a large area. Petersen (1960) did a similar study for two localities in Rio Grande do Sul, and Malogolowkin (1951) presented an annotated list for one locality in Bahia. Scattered data on the distribution of *Drosophila* species can be found in several publications (see Wheeler, 1970).

The present work is the result of a cooperative effort by two groups, one from the Departamento de Biologia da Universidade de São Paulo (Sene, Vilela, and Pereira), the other from the Museu de Zoologia da Universidade de São Paulo (MZUSP) (Val). The first group is mainly interested in the fauna of the open formations and is studying the systematics and evolutionary genetics of the *repleta* group of *Drosophila*. The main interest of the second group is the study of the Atlantic Forest drosophilid fauna.

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METHODS AND MATERIALS

The collections were made from April 1976 to June 1978, extensively sampling three major morphoclimatic domains in Brazil: cerrados, caatingas, and Atlantic Forest (Map 1 and Appendix).

Most flies were collected on orange and banana baits fermented with baker's yeast. Additional fruits such as papaya, pineapple or mangoes did not add to the collections, so the simpler baits were normally used.

Baits were set in three different ways: (1) on the ground in wet areas, such as forest; (2) in plastic bags hung from vegetation in dry areas, such as the caatingas; (3) in 1 liter cans hung from vegetation, in different environments, starting January 1978.

Most samples were brought back alive from the field in styrofoam boxes and studied while fresh in the laboratory. Some Atlantic Forest samples were sorted in the field and studied as dry specimens in the laboratory.

All of the materials are deposited in the MZUSP collections. Series of about 30 males and females per species per locality are pinned and labelled. Remaining samples are stored in vials in association with the pinned series.

Special attention was made to collect only in natural environments and far from houses. Exceptions are clearly pointed out herein and grouped together in "disturbed environments". This distinction was not made clear in many previous studies.

Most localities were surveyed once, a few twice, and three were sampled every two months during the entire sampling program (Peruibe, Boracéia, and Mogi-Guaçu). Thus, we have no data on population fluctuations due to seasonal variation from most of the localities, and detailed statistical analyses of our results are precluded. The main import of the data is whether a species is present or absent in any given sample.

RESULTS

Collecting results are presented in Tables 1 to 3. Below are presented summaries by species group.

Subgenus *Sophophora**willistoni* group

With the exception of *D. nebulosa* Sturtevant, the species of this group are more abundant in wet forests than in other areas; they were not collected under extremely dry conditions, suggesting that humidity is a limiting factor for flies of this group. These observations agree with those of Dobzhansky and Pavan (1950).

Subgroup *willistoni*. We did not identify the cryptic species of this subgroup. Although members of the subgroup are found in all environmental situations sampled, ecological affinities of the individual species are unknown. The identifiable species, *D. capricorni* Dobzhansky and Pavan and *D. fumipennis* Duda, were collected mainly in forest situations.

Subgroup *bocainensis*. Species of this subgroup were more frequently collected in localities within the Atlantic Forest. Three species occur at Boracéia: *D. bocainoides* Carson, *D. bocainensis* Pavan & Cunha, and *D. parabocainensis* Carson. *Drosophila nebulosa* is one of the most abundant species in the open types of vegetation, particularly in the cerrados and caatingas.

saltans group

These flies show marked seasonal fluctuations and appear to be very sensitive to different collecting techniques (Pavan, 1959).

Subgroup *sturtevanti*. We did not identify the cryptic species of this subgroup (Magalhães, 1962; Mourão and Bicudo, 1967). Our data show that the subgroup as a whole is



Map — Localities : 1-7, Atlantic Forest ; 8,9, Forests in the interior ; 10,11, Strand vegetation ; 12, Pantanal ; 13-20, Coast ; 21,22, Rio Grande do Sul ; 23-30, Cerrados ; 31-40, Caatingas ; 41, Edge of the Chaco ; 42-45, Disturbed environments. See appendix for more details.

Table 1 — Numbers of specimens collected in forests, restingas (strand vegetation), Pantanal of Mato Grosso and disturbed environments.

	Forests									Restingas		Pantanal	Disturbed environments				
	Roracéia (1)	Serra da Bocaina (2)	Rejo do da Lapa (3)	Bugêno Lafèvre (4)	Terapópolis (5)	Santa Teresa (6)	Ferrêbo (7)	Rio Ivaó (8)	Piritiba (9)	Periba (10)	Quaritiba (11)	Miranda (12)	Irecê (13)	Correias (13)	Cabreva (14)	Rio Igastro (15)	
<i>D. millistoni</i>	4932	6537	371	113	534	963	6	11768	256	72	186	1477	-	-	7	303	
<i>D. capricorni</i>	539	6078	227	45	609	195	-	-	-	-	-	-	-	-	-	-	
<i>D. fumipennis</i>	795	35	-	-	-	33	-	-	-	-	-	-	-	-	-	-	
<i>D. subgr. bocainensis</i>	69	454	2252	204	67	44	-	-	-	-	-	-	-	-	-	-	
<i>D. nebulosa</i>	-	-	-	2	17	5	-	524	793	1	-	1351	13	-	-	30	
<i>D. neocolliptica</i>	53	-	-	-	9	1	-	1	1	1	1	1	1	1	1	1	
<i>D. neosaltans</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. prosaltans</i>	5	-	-	-	-	-	-	-	-	-	8	6	-	-	10	-	
<i>D. stultevanti</i>	35	1	-	-	21	16	2	79	12	6	46	73	-	-	2	24	
<i>D. ananassae</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
<i>D. malenkottiana</i>	-	-	-	-	-	-	-	-	2	5681	1	9	-	-	29	-	
<i>D. melanogaster</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	4	-	2	
<i>D. simulans</i>	25	35	-	2	139	95	-	264	169	2	1965	1437	1	36	86	813	
<i>D. busckii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	
<i>D. latifasciiformis</i>	-	-	1	1	1	-	-	32	43	6	3	10	1	-	3	76	
<i>D. immigrans</i>	114	41	-	1	28	-	-	68	-	1	-	-	-	81	-	5	
<i>D. ananama</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	
<i>D. anassari</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. annulimana</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. atata</i>	3	5	-	-	2	-	5	-	-	-	-	-	-	-	-	-	
<i>D. quadrum</i>	10	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. dreyfusi</i>	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. cardini</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
<i>D. cardinoides</i>	-	-	-	-	10	1	4	16	57	19	10	61	16	22	12	72	
<i>D. neocardini</i>	-	-	-	-	-	-	-	411	27	-	-	5	-	-	-	40	
<i>D. polymorpha</i>	382	78	-	-	68	13	20	2943	49	28	26	142	-	5	3	89	
<i>D. gniosolineata</i>	78	196	-	1	39	3	-	-	67	2	-	-	-	-	-	-	
<i>D. guaxamunu</i>	19	29	-	10	-	5	-	403	-	1	-	-	-	-	-	-	
<i>D. guaxani</i>	10	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. guaxaja</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. pallidipennis</i>	1	-	-	-	1	-	1	2	-	-	-	3	-	-	-	6	
<i>gr. reptata</i>	9	-	-	-	19	6	-	575	328	-	21	197	324	38	16	176	
<i>D. bandianatorum</i>	41	261	-	85	27	-	-	3	2	-	-	-	-	-	-	-	
<i>D. exocina</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
<i>gr. tripunctata</i>	739	601	17	118	181	162	25	2295	25	8	7	42	-	-	1	90	
<i>D. para</i>	-	-	-	-	-	-	-	-	-	-	-	71	-	-	-	-	
unidentified	17	44	19	12	15	4	-	117	3	-	-	18	-	4	4	1	
TOTAL	7913	14425	2888	593	1782	1536	63	19502	7514	148	2282	4893	384	541	144	1769	

Table 2 — Numbers of specimens collected in littoral formations (coast), in transitional types of vegetation (Rio Grande do Sul) and on the edge of the Chaco.

	Coast								Rio Grande do Sul		Chaco
	B. Maxaranguape (13)	Arreal do Cabo (14)	Cabo Frio (15)	Guaratuba (16)	Perúbe (17)	Barra Velha (18)	I. Sta. Catarina (19)	Tremandaí (20)	Guaritas (21)	Jaguari (22)	Bela Vista (23)
<i>gr. willistoni</i>	1	-	-	12	8	33	12	1109	26	36	480
<i>D. capricorni</i>	-	-	-	-	-	-	-	1	-	1	-
<i>D. fumipennis</i>	-	-	-	-	-	-	-	-	-	-	-
sub <i>gr. bocainensis</i>	-	-	-	-	-	-	-	-	-	-	-
<i>D. nebulosa</i>	102	3	2	-	2	-	-	4	-	1	197
<i>D. neocordata</i>	-	-	-	-	-	-	-	-	-	-	7
<i>D. prosaltans</i>	-	-	-	7	-	-	1	3	1	-	20
<i>D. sturtevantii</i>	9	-	-	71	254	64	1	3	1	1	199
<i>D. ananassae</i>	-	-	-	-	-	-	-	-	-	-	-
<i>D. kikawai</i>	-	-	-	-	-	-	-	-	-	-	8
<i>D. malexhotliana</i>	1182	11	4	9	8	-	-	-	-	-	56
<i>D. melanogaster</i>	-	-	-	-	3	-	-	-	-	-	-
<i>D. simulans</i>	362	45	3	840	33	6	23	666	32	14	2484
<i>D. busckii</i>	-	-	-	-	-	1	-	-	-	-	-
<i>D. latifasciataeformis</i>	108	2	1	1	50	9	-	-	-	-	190
<i>D. immigrans</i>	-	-	-	-	-	-	-	-	-	-	-
<i>D. ararama</i>	-	-	-	-	-	-	-	-	-	-	2
<i>gr. canalinea</i>	-	-	-	-	1	-	-	-	-	-	-
<i>D. cardini</i>	-	-	-	1	1	-	-	4	-	-	8
<i>D. cardinoides</i>	2	1	1	2	100	7	-	49	6	7	170
<i>D. neocardini</i>	-	-	-	3	-	-	1	2	-	-	-
<i>D. polymorpha</i>	-	-	-	14	23	9	-	297	9	9	121
<i>D. griseolineata</i>	-	-	-	-	-	1	-	335	-	-	-
<i>D. guaramunu</i>	-	-	-	-	-	-	-	9	-	-	2
<i>D. pallidipennis</i>	-	-	-	-	1	1	-	9	-	-	-
<i>gr. repleta</i>	41	1570	73	75	31	159	14	600	29	129	1002
<i>D. crocina</i>	-	-	-	-	2	-	-	-	-	-	-
<i>gr. tripunctata</i>	-	-	-	1	2	-	-	56	-	-	-
<i>D. para</i>	-	-	-	3	4	-	-	-	-	5	55
unidentified	-	12	1	7	-	-	-	10	5	5	402
TOTAL	1807	1644	85	1046	523	280	52	3157	108	207	5418

Table 3 — Numbers of specimens collected in localities of cerrados and caatingas.

	Cerrados								Caatingas									
	Barreiras (23)	Brasília (24)	Lagoa Santa (25)	Mogi Guaçu (26)	São Carlos (27)	Itu (28)	Campo Grande (29)	Caracol (30)	Bom Jesus (31)	Junco do Seridó (32)	S.J. de Espinheiras (33)	Milagres (34)	Cach. dos Montes (35)	Mira Serra (36)	Ibotirema (37)	Barreiras (38)	Cafarnaüm (39)	Xique-Xique (40)
<i>gr. williatoni</i>	33	36	20	1205	341	119	93	746	4	47	6	-	10	11	6	13	-	-
<i>D. capricorni</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>D. fumipennis</i>	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sub <i>gr. bocainensis</i>	-	-	1	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>D. nebulosa</i>	3330	362	29	556	50	-	71	230	52	71	123	-	7	31	114	95	5	-
<i>D. austrosaltans</i>	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-
<i>D. neocordata</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>D. prosaltans</i>	1	-	2	8	37	1	8	11	-	-	-	5	2	5	-	-	-	-
<i>D. sturtevantii</i>	1	65	97	353	463	6	23	189	1	1	-	-	7	-	-	2	-	-
<i>D. ananassae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>D. malehotliana</i>	241	4	3	9	44	3	-	8	217	1083	1508	226	36	988	21	119	2308	97
<i>D. kiklawai</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>D. melanogaster</i>	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>D. simulans</i>	598	45	53	388	314	128	2532	351	71	266	116	65	117	40	39	94	174	58
<i>D. busckii</i>	-	1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>D. latifasciaeformis</i>	331	9	11	37	406	5	4	10	9	24	29	73	6	6	2	97	18	23
<i>D. immigrans</i>	-	1	-	16	2	-	11	-	-	-	-	-	-	-	-	-	-	-
<i>D. aaxama</i>	-	-	-	-	1	-	-	2	-	-	-	-	-	1	-	-	-	-
<i>D. cardini</i>	1	-	-	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>D. cardinoides</i>	65	9	3	255	69	2	42	12	1	26	41	7	11	5	24	9	20	13
<i>D. polymorpha</i>	2	3	18	226	71	63	33	83	-	-	-	1	2	2	4	-	2	-
<i>D. gaiseolineata</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>D. guaranunu</i>	-	6	-	68	5	-	6	8	-	-	-	-	-	-	-	-	-	-
<i>D. pallidipennis</i>	-	1	-	2	-	2	-	-	-	-	-	-	-	1	-	-	-	-
<i>gr. repleta</i>	163	190	67	156	118	7	314	199	34	535	21	1304	487	176	33	15	1924	296
<i>D. bandeirantorum</i>	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>gr. tripunctata</i>	47	42	2	70	7	1	1	32	-	-	-	-	-	-	-	-	-	-
<i>D. para</i>	1	-	-	-	-	-	-	40	-	-	-	-	-	-	-	5	-	-
unidentified	4	-	1	2	3	-	5	8	-	-	-	2	-	-	1	-	-	-
TOTAL	4822	783	310	3359	1939	338	3146	1938	389	2053	1844	1682	687	1266	243	451	4452	508

more abundant in the cerrados. Specimens from Tramandai (Rio Grande do Sul) represent the first record of this subgroup from southern Brazil.

Drosophila prosaltans Duda is more abundant in the cerrados, similar to the pattern shown by the *sturtevanti* subgroup. *Drosophila neocordata* Magalhães and *austrosaltans* Spassky were collected from the neighboring localities of Bela Vista and Caracol in southern Mato Grosso do Sul. *Drosophila neocordata* was previously known only from the type locality, Montes Claros (Minas Gerais). *Drosophila austrosaltans* was previously known from the type locality, Pirassununga (São Paulo) and from Carolina and Imperatriz (Maranhão). *Drosophila neoliptica* Pavan and Magalhães, and *D. neosaltans* Pavan and Magalhães, were collected by us only at Atlantic Forest localities.

melanogaster group

This group is not Neotropical. All five species represented in the collections are introduced.

Drosophila melanogaster Meigen, *D. kikkawai* Burla, and *D. ananassae* Doleschall are rare in natural environments. We collected them only in open types of vegetation.

Drosophila malerkotliana Parshad and Paika was not known from South America previous to our collecting program (Sene and Val, 1977; Val and Sene, 1980). It is probably a recently introduced species, which we found in large numbers, widely distributed in areas of open vegetation. The species was not collected in most localities surveyed in the Atlantic Forest, but was collected in very small numbers in the forest not far from the Ivai River (Paraná). It was abundant at Piritiba (Bahia), which is an enclave of forest in the caatingas, and we did not collect it in southern Brazil.

Drosophila simulans Sturtevant is one of the most widespread species in our collections, found in all sorts of environments. It is usually more abundant in open formations than in forests (Perondini et al., 1979).

Subgenus *Scaptodrosophila*

Drosophila latifasciaeformis Duda is a widely distributed species, found in all types of vegetation, but absent from southern Brazil. Dobzhansky and Pavan (1950, identified as *D. mirim*), considered it as "probably a native species which nevertheless thrives in the company of introduced scavengers". In our opinion it is an introduced species.

Subgenus *Dorsilopha*

Drosophila busckii Coquillet is an introduced species, rarely found in natural environments, and limited to open formations and disturbed areas.

Subgenus *Drosophila*

Drosophila immigrans Sturtevant is the only introduced species in this subgenus. It was collected in association with man (Correias, Rio de Janeiro) and in forests and cerrados. It was not collected in caatingas or dunes, suggesting a limitation by semi-arid conditions.

annulimana group

D. ararama was collected at few localities in cerrados and caatingas, on the edge of the Chaco and in strand vegetation. *D. arassari* and *D. annulimana* were only collected within the Atlantic Forest.

calloptera group

D. atrata and *D. quadrum* were collected only within the Atlantic Forest.

dreyfusi group

D. dreyfusi was identified only from Boracéia (São Paulo), within the Atlantic Forest.

cardini group

Although Heed & Russell (1971) mention *D. cardini* from Brazil, it has not been reported from the country by previous investigators (Pavan & Dobzhansky 1950, Pavan 1959, Wheeler 1970).

We collected it from Bahia to Rio Grande do Sul in areas of open vegetation. *Drosophila cardinoides* Dobzhansky and Pavan is a widespread species. It was not collected in the Atlantic Forest, suggesting a preference for open types of vegetation. *Drosophila neocardini* Streisinger was collected in low numbers in a few localities, and we did not collect it in cerrados or caatingas. It was previously unknown from southern Brazil, but we collected it in Tramandaí (Rio Grande do Sul) and in the island of Santa Catarina (Santa Catarina). *Drosophila polymorpha* Dobzhansky and Pavan was collected from all but the driest environments.

guarani group

Drosophila griseolineata Duda and *D. guaramunu* Dobzhansky and Pavan were collected together in several localities in eastern Brazil; in western Brazilian localities only *D. guaramunu* was found. Our data for *D. guaramunu* agree with those of Dobzhansky and Pavan (1950) in that we did not collect the species in the caatingas. *Drosophila griseolineata* was collected in an enclave of forest in the caatingas at Piritiba (Bahia). *Drosophila guarani* Dobzhansky and Pavan and *D. guaraja* King were found only in localities within the Atlantic Forest.

pallidipennis group

Drosophila pallidipennis Dobzhansky and Pavan was collected in low numbers from all types of environments (except restinga).

repleta group

For the purposes of this paper we did not identify the species of this group. The entire group is mainly found in open formations, associated with cacti.

tripunctata group

Most species of this group were not identified to the species level. This is one of the largest Neotropical groups of *Drosophila* (Frota-Pessoa, 1954) very abundant in forest situations. Small numbers of specimens were collected in cerrados and dunes, but none in caatingas. *Drosophila bandeiratorum* Dobzhansky and Pavan has a distribution pattern similar to that of *D. immigrans*. It was abundant in forests, absent in caatingas and dunes. All collections were from natural environments and never associated with man. We collected *D. crocina* Patterson and Mainland only at Peruibe (São Paulo) and Piritiba (Bahia), although it was frequently found in the collections of Dobzhansky and Pavan (1950) and Pavan (1959) in other localities in Brasil.

Ungrouped species

Drosophila para Pavan and Burla was previously known from the type locality Belém (Pará) and from Ferreira Gomes (Amapá) (Pavan, 1959). We collected the species in low numbers in cerrados, on the edges of the caatingas and of the Chaco, in the Pantanal, and on the coast of São Paulo.

DISCUSSION

The main purpose of this work is to provide a preliminary overview of the *Drosophila* fauna in the different Brazilian morphoclimatic domains (Ab'Saber, 1977). Analysis of the *Drosophila* fauna of the Amazonian Forest and Araucaria Forest domains is not included in this study because of time constraints, although dried samples are available for study from these domains. The present study extensively sampled for the first time the caatingas domain (Figure 1).

The conclusions that follow are general; more detailed conclusions will be possible when the individual species of the *willistoni*, *tripunctata*, and *repleta* group are identified.

Entire groups, such as the *tripunctata* and *guarani* groups, as well as some individual species, such as *D. immigrans*, do not occur in the caatingas. Our data, on this aspect, agree with those of Dobzhansky and Pavan (1950) and Pavan (1959) who observed that the caatingas of Bahia had the lowest species diversity among the seven Brazilian regions studied.

An impressive new datum is the large numbers of the recently introduced *D. malerkotliana* in the caatingas as well as in some of other habitat types sampled.

This study presents the first data for the *Drosophila* fauna of the Brazilian coast, based on systematic surveys. The *Drosophila* fauna of the dunes and wave cut benches is a depauperate fauna, as is that of the caatingas. Members of the *tripunctata* group were collected at southern localities in the coast (states of São Paulo and Rio Grande do Sul). *Drosophila neocardini* and *sturtevanti*, previously unknown from southern Brasil, are now known from the dunes of Santa Catarina and Rio Grande do Sul. Diversification along the coast it to be expected, as the litoral formations do not constitute a proper continuous domain.

The Pantanal of Mato Grosso and the edge of the Chaco are represented by one sample each. As these are highly complex areas, more samples are necessary before any conclusion can be drawn concerning these domains.

Pavan's (1959) data on the cerrados and Atlantic Forest *Drosophila* faunae are confirmed by our larger and more extensive samples from these domains.

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REFERENCES

- Ab'Saber, A.N., 1977. Os domínios morfoclimáticos na América do Sul. Primeira aproximação geomorfológica (Inst. Geogr. Univ. S. Paulo) 52: 22 pp.
- Brade, A.C., 1956. A flora do Parque Nacional do Itatiaia. *Bol. Pq. Nac. Itatiaia* 5: 92 pp., pls.
- Dobzhansky, T. & C. Pavan, 1950. Local and seasonal variation in relative frequencies of species of *Drosophila* in Brazil. *J. Anim. Ecol.* 19: 1-14.
- Frota-Pessoa, O., 1954. Revision of the *tripunctata* group of *Drosophila* with description of fifteen new species (Drosophilidae, Diptera). *Arq. Mus. Paranaensis, Curitiba* 10: 253-304.
- Heed, W.B. & J.S. Russell, 1971. Phylogeny and population structure in island and Continental species of the *cardini* group of *Drosophila* studied by inversion analysis. *Univ. Texas Publ.* 7103:91-130.
- Magalhães, L.E., 1962. Notes on the taxonomy, morphology and distribution of the *saltans* group of *Drosophila*, with description of four new species. *Univ. Texas Publ.*, 6205: 135-154.
- Malogolowkin, C., 1951. Drosofilídeos colhidos na Bahia, com descrição de uma espécie nova (Diptera). *Revta brasil. Biol.*, 11: 431-434.
- Mourão, C.A. & H.E.M. C. Bicudo, 1967. Duas novas espécies de *Drosophila* do grupo "saltans" (Drosophilidae, Diptera). *Papéis Avulsos Zool.*, S. Paulo 20 (12): 123-134.
- Pavan, C., 1959. Relações entre Populações Naturais de *Drosophila* e o meio ambiente. *Bol. Fac. Filos., Ciênc. e Letras Univ. S. Paulo* (221), *Biol. Geral* 11: 1-81.
- Perondini, A. L. P., F. M. Sene & L. Mori, 1979. The pattern and polymorphism of some *D. simulans* Esterase in Brazil. *Egyptian Journal of Genetic and Cytology* 8: 263-268.
- Petersen, J.A., 1960. Studies on the ecology of the genus *Drosophila*. 1. Collections in two different life zones and seasonal variations in Rio Grande do Sul, Brazil. *Revta. brasil. Biol.*, 20 (1): 3-16.
- Sene, F.M. & F.C. Val, 1977. Ocorrência de *D. malkotiana* Parshad & Paika 1963 na América do Sul. *Cienc. e Cultura* 29 (7), supl.: 716.
- Val, F.C. & F.M. Sene, 1980. A newly introduced species in Brazil (Diptera, Drosophilidae). *Papéis Avulsos Zool.* 33 (19): 293-298.
- Vanzolini, P.E., 1977. A new species of *Colobodactylus*, with notes on the distribution of a group of stranded microteiid lizards (Sauria, Teiidae). *Papéis Avulsos Zool.* 31 (3): 19-47.
- Wheeler, M.R., 1970. A Catalogue of the diptera of the Americas South of the United States. Family Drosophilidae 79. Museu de Zoologia, Universidade de São Paulo: 1-65.

Appendix

Annotated list of localities. Numbers refer to localities as plotted on map (Figure 1).

Atlantic Forest

1. Boracéia — Estação Biológica de Boracéia, Salesópolis, São Paulo (45°50'W, 23°40'S). The station is located on the ridge (about 800 m) of the Serra do Mar.
2. Fazenda do Veado, Serra da Bocaina, São Paulo (45°25'W, 22°46'S).
3. Brejo da Lapa, Minas Gerais (45°17'W, 22°23'S). This locality is on the NW flank of the Itatiaia massif (see Vanzolini, 1977). The forest at the site (about 2100 m) differs from strict Atlantic Forest vegetation (Brade, 1956).
4. Eugênio Lefèvre, São Paulo (46°25'W, 22°47'S). This locality is on the Serra da Mantiqueira.
5. Teresópolis, Rio de Janeiro (43°01'W), 22°65'S). Collections were made next to the Serra dos Órgãos National Park.
6. Santa Teresa, Espírito Santo (40°37'W, 19°56'S). Collections were made next to the Nova Lombardia National Park.
7. Perube, São Paulo (46°55'W, 24°14'S). Collections were made on a spur of the Serra do Mar close to the coast.

Forests in the interior

8. Rio Ivaí, Paraná (52°22'W, 23°37'S).
9. Piritiba, Bahia (40°45'W, 11°47'S). An enclave of forest within the caatingas.

Restinga (Strand Vegetation)

10. Peruibe, São Paulo (46°55'W, 24°14'S).
11. Guaratuba, São Paulo (45°53'W, 23°50'S).

Pantanal

12. Miranda, Mato Grosso do Sul (56°46'W, 20°05'S). Area seasonally flooded of the pantanal.

Coast

13. Barra do Maxaranguape, Rio Grande do Norte (35°16'W, 05°32'S).
14. Arraial do Cabo, Rio de Janeiro (42°02'W, 22°58'S). This area is an "island" of caatingas vegetation conditioned by the very dry climate determined by a cold oceanic resurgence. Collection made at a height of about 200 m, on a hill by the sea.
15. Cabo Frio, Rio de Janeiro (42°02'W, 22°56'S).
16. Guaratuba, São Paulo (45°53'W, 23°50'S). Collection on a spur of the "Serra do Mar", on the wave cut bench.
17. Peruibe, São Paulo (46°55'W, 24°14'S).
18. Barra Velha, Santa Catarina (48°42'W, 26°37'S).
19. Ilha de Santa Catarina, Santa Catarina (48°30'W, 27°42'S). Collection made at "Morro das Pedras" on the east side of the island.
20. Tramandaí, Rio Grande do Sul (50°13'W, 29°55'S).

Rio Grande do Sul

Localities in the State of Rio Grande do Sul, in transitional types of vegetation

21. Guaritas, Rio Grande do Sul (53°20'W, 30°45'S).
22. Jaguarí, Rio Grande do Sul (54°42'W, 29°30'S).

Cerrados

23. Barreiras, Bahia (45°15'W, 12°06'S).
24. Brasília, Distrito Federal (47°47'W, 15°47'S).
25. Lagoa Santa, Minas Gerais (43°55'W, 19°38'S).
26. Mogi-Guaçu, São Paulo (47°11'W, 22°17'S).
27. São Carlos, São Paulo (47°53'W, 22°03'S).
28. Itu, São Paulo (47°20'W, 23°21'S).
29. Campo Grande, Mato Grosso do Sul (54°34'W, 20°41'S).
30. Caracol, Mato Grosso do Sul (56°47'W, 22°13'S).

Caatingas

31. Bom Jesus, Rio Grande do Norte (35°37'W, 05°58'S).
32. Junco do Seridó, Paraíba (36°43'W, 07°00'S).
33. São José de Espinharas, Paraíba (37°17'W, 06°56'S).
34. Milagres, Bahia (39°53'W, 12°51'S).
35. Cachoeira dos Monteiros, Bahia (41°38'W, 12°25'S).
36. Mira Serra, Bahia (40°53'W, 11°47'S).
37. Ibotirama, Bahia (43°07'W, 12°18'S).
38. Barreiras, Bahia (45°05'W, 12°07'S).
39. Cafarnaum, Bahia (41°20'W, 11°30'S).
40. Xique-Xique, Bahia (42°40'W, 10°42'S).

Edge of the Chaco

41. Bela Vista, Mato Grosso do Sul (56°32'W, 22°05'S). Collection made close to the Apa River, in a complex area of transitional vegetation.

Disturbed environments

All but one of the collections in disturbed environments were made far from houses.

42. Irecê, Bahia (41°47'W, 11°20'S). Collection within an *Opuntia ficus-indica* (Linnaeus) Miller, 1768, plantation in the caatingas.

43. Correias, Rio de Janeiro (41°24'W, 19°56'S). Collection in Fazenda Bonfim, close to houses, within a plantation.

44. Cabreuva, São Paulo (47°10'W, 23°15'S). Pastureland, with large granite boulders, sparse trees and two species of cacti.

45. Rio Ligeiro, Paraná (52°31'W, 23°37'S). Close to the road between Maringá and Cianorte, on the steep banks of a river amidst pastures and a corn field; the vegetation was dense and very rich one species of a large tree cactus (*Cereus* sp.).