



On the geographic distribution of the *Drosophila willistoni* group (Diptera, Drosophilidae) – updated distribution of *alagitans* and *bocainensis* subgroups.

Zanini, Rebeca^{1,2}, **Maríndia Deprá**^{1,2}, **Vera Lúcia da Silva Valente**^{1,2}. ¹Programa de Pós-Graduação em Biologia Animal, Universidade Federal do Rio Grande do Sul (UFRGS), Avenida Bento Gonçalves, 9500 prédio 43435 CEP 91501-970, Bairro Agronomia, Porto

Alegre, RS, Brazil. ²Laboratório de *Drosophila*, Departamento de Genética, Instituto de Biociências, Universidade Federal do Rio Grande do Sul (UFRGS), Avenida Bento Gonçalves, 9500 prédio 43323 sala 210 CEP 91501-970, Bairro Agronomia, Porto Alegre, RS, Brazil. Corresponding author: rebeca.zanini@gmail.com

Introduction

Drosophila willistoni group (Diptera, Drosophilidae) is a Neotropical species group and is currently composed of 24 species distributed in three subgroups – *alagitans*, *bocainensis*, and *willistoni* (Bächli, 2015).

The *alagitans* species group was established by Patterson and Mainland (1944), which reunited *D. alagitans* and *D. capnoptera* in a species group belonging to subgenus *Drosophila* (Wheeler and Magalhães, 1962). Later, Hsu (1949) observed that the male genitalia of these species resembled the *willistoni* species group and the *alagitans* group was later transferred to subgenus *Sophophora* (Wheeler, 1949). Wheeler and Magalhães (1962) described two new species for this subgroup – *D. megalagitans* and *D. neoalagitans*.

Carson (1954) observed that three distinct specimens were designated as *D. bocainensis*; one of them was confirmed as *D. bocainensis* and the others redescribed as *D. parabocainensis* and *D. bocainoides*, establishing the *bocainensis* species complex (Carson, 1954). Salzano (1956) also reviewed the status of this species. Wheeler and Magalhães (1962) described some species belonging to this subgroup – *D. changuinolae*, *D. pseudobocainensis*, and *D. parabocainoides*. The later were allocated as *D. subinfumata* synonym (Vilela and Bächli, 1990).

Drosophila mangabeirai was inserted in *melanogaster* group (Malogolowkin, 1952); its male genitalia, however, is compatible with those of *D. willistoni* group, to which this species was later transferred (Carson *et al.*, 1957). The *bocainensis* subgroup also encompasses *Drosophila capricorni*, *D. fumipennis*, *D. nebulosa*, and *D. sucinea*.

Later, Vilela and Bächli (1990) redescribed *D. abregolineata*, *D. fumipennis*, and *D. subinfumata*. The authors also described *D. pittieri* (Bächli and Vilela, 2002). Recently, Figuero and Rafael (2013) described *D. neocapnoptera* in Ecuador. Both new reported species belong to *alagitans* subgroup.

Wheeler and Magalhães (1962) provided a distribution map of some *alagitans-bocainensis* species and asserted that the species fall into two clusters: northern distribution (*alagitans*-like forms) and Southern distribution (*bocainensis*-like forms). The geographic range of *D. nebulosa* was discussed in Ehrmann and Powell (1982).

The objective of this study was to update the current distribution map for *alagitans* and part of *bocainensis* subgroup as well as provide distribution maps for the species not included in the previously available map.

Material and Methods

We gathered all distribution records for each species of *alagitans* and *bocainensis* subgroup in literature and plotted those in maps using QGIS 2.10.1 software. All entries and respective references are available in Taxodros (taxodros.uzh.ch) (Bächli, 2015).



Figure 1. Geographic distribution of the *alagitans* and *bocainensis* subgroups. A, Subgroup *alagitans* (*D. alagitans*, *D. capnoptera*, *D. megalagitans*, *D. neoalagitans*, *D. neocapnoptera*, and *D. pittieri*). B, Subgroup *bocainensis* (*D. nebulosa* and *D. sucinea*). C, Subgroup *bocainensis* (*D. capricorni* and *D. fumipennis*).

Results and Discussion

The *alagitans* subgroup distribution is restricted to Northern South America, Central and North America, and Caribbean Islands (Figure 1A). The exception is *D. alagitans*, which is found in some localities in Mexico and in Santa Catarina State, in Southern Brazil. *D. capnoptera* has the broadest distribution in this subgroup, ranging from Mexico through Central America countries. *D. neoalagitans* occurs in Jamaica and Hispaniola islands. The remaining species only have one distribution entry – *D. pittieri* in Rancho Grande, Northern Venezuela, *D. neocapnoptera* in Baeza-Teno, Ecuador, and *D. megalagitans* in Bucaramanga, Colombia.

Regarding *bocainensis* subgroup, *D. nebulosa* seems to have the widest distribution (Figure 1B). The southernmost point of occurrence is in Grutas, Argentina, and the northernmost is in Chatham, Canada. This species is also reported in USA, Mexico, Costa Rica, El Salvador, Panama, Colombia, Venezuela, Peru, Ecuador, Chile, Brazil, Uruguay, Galapagos Islands, Antilles, Hispaniola, Cuba, and Bahamas. *D. sucinea* occurs in Northern South America, Central America, and Mexico (Figure 1B) and lives in sympatry with *D. nebulosa* in Mexico, Panama, Ecuador, and Peru.

Drosophila fumipennis distributes from Central America, through Colombia, Venezuela, and Peru to Brazil, from North to South (Figure 1C). *D. capricorni* has a similar distribution, except that it occurs in Mexico and is very uncommon in Northern and Northeast areas of Brazil (Figure 1C).

Some species have a very narrow known distribution – *D. abregolineata* was only found in the type locality, Turrialba (Costa Rica) (Figure 2A); *D. changuinola* occurs in the type locality Changuinola (Panama), in Leticia (Peru) and in Barreiro Rico (Brazil) (Figure 2B).

Drosophila mangabeirai is mostly found in Central America, but also occurs in Salvador, Brazil, and in Antilles (Figure 2A). *D. bocainensis* is also found in South and Southeast Brazil, Colombia, Ecuador, Venezuela, and Honduras (Figure 2A); *D. bocainoides* also lives in South and Southeast Brazil in a more restricted distribution.

Drosophila subinfumata presents a very discontinuous distribution, since it inhabits South and Southeast Brazil, Panama, and Costa Rica (Figure 2B). *D.*

pseudobocainensis is found in Northern South America (Colombia, Bolivia, and Venezuela) and in Central America (Costa Rica, El Salvador, and Panama) (Figure 2B), whereas *D. parabocainensis* distributes in South and Southern Brazil and Colombia (Figure 2B).

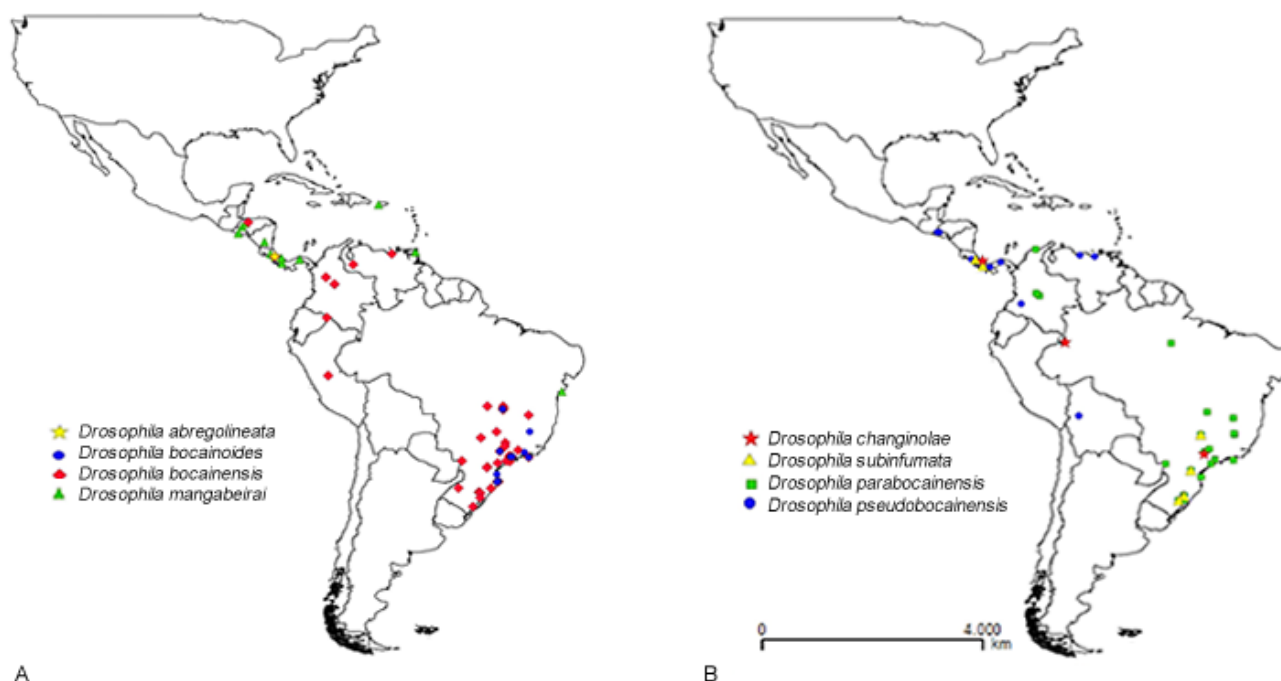


Figure 2. Geographic distribution of the *bocainensis* subgroup. A, *D. abregolineata*, *D. bocainensis*, *D. bocainoides*, and *D. mangabeirai*. B, *D. changinolae*, *D. parabocainensis*, *D. pseudobocainensis*, and *D. subinfumata*.

Central America, Colombia, Venezuela, Ecuador, and Southeast Brazil are the areas where most of the species of *willistoni* group lives in sympatry. The most widespread species are *D. nebulosa*, *D. capricorni*, and *D. fumipennis*. Some species, especially belonging to *alagitans* subgroup, have a few or sometimes a single occurrence, which leads us to wonder if there is a lack of studies, the species are misidentified/ unidentified, or these taxa have a very narrow or endemic distribution.

Acknowledgments: We thank CNPq, CAPES and FAPERGS for the scholarships and grants.

References: Bächli, G., 2015, Taxodros - The database on taxonomy of Drosophilidae. [Online]; Bächli, G., and C.R. Vilela 2002, Bulletin de la Société Entomologique Suisse 75: 223-243; Carson, H.L., 1954, Evolution 8: 148-165; Carson, H.L., M.L. Wheeler, and W. B. Heed 1957, Univ. Texas Publ. 5721: 115-122; Ehrmann, L., and J.R. Powell 1982, The *Drosophila willistoni* species group. In: *The Genetics and Biology of Drosophila*, vol. 3b. (Ashburner, M., H.L. Carson, and J.N. Thompson, Jr., eds.). New York: Academic Press Inc, 193-220; Figuero, M.L., and V. Rafael 2013, Iheringia 103: 246-254; Hsu, T.C., 1949, Univ. Texas Publ. :80-142; Malogolowkin, C., 1951, Revis. Bras. Biol. 11 (4): 431-434; Patterson, J.T., and G.B. Mainland 1944, Univ. Texas Publ. 4445: 9-101; Salzano, F.M., 1956, O problema das espécies crípticas: estudos no sub-grupo *bocainensis* (*Drosophila*). PhD thesis. Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; Vilela, C.R., and G. Bächli 1990, Bulletin de la Société Entomologique Suisse 63: 1-332; Wheeler, M.R., and L.E. Magalhães 1962, Univ. Texas Publ. 6205: 155-171; Wheeler, M.R., 1949, Univ. Texas Publ. 4920: 157-1920.