

Our drosophilid collection data at Observatori Fabra would support previous observations from collections at Font Gropa indicating that *D. suzukii* is well established in the Barcelona area, even though its frequency was much lower in our last collection in autumn 2014. Its establishment in this area, as well as throughout Europe and North America, raises an important concern given the negative economical consequences of its females ovipositing in commercial fresh fruits and the subsequent damage to the corresponding crops. Moreover, our data would indicate that native species might be affected by the presence of this exotic species that would postpone their autumn population maxima, when they might be subjected to different environmental conditions.

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**References:** Calabria, G., J. Máca, G. Bächli, L. Serra, and M. Pascual 2012, *J. Appl. Entomol.* 136: 139-147; Canals, J., J. Balanyà, and F. Mestres 2013, *Dros. Inf. Serv.* 96: 185-186; Cini, A., C. Ioriatti, and G. Anfora 2012, *Bull. of Insect.* 65: 149-160; de Frutos and Prevosti 1984, *Genetica* 63: 181-187; Orengo, D.J., 1994, *Correlación entre el polimorfismo cromosómico y el tamaño del cuerpo en Drosophila subobscura*. Ph.D. thesis. Universitat de Barcelona, Barcelona. 173 pp; Orengo, D.J., and A. Prevosti 1996, *Evolution* 50: 1346-1350; Pineda, L., C. Esteve, M. Pascual, and F. Mestres 2014, *Dros. Inf. Serv.* 97: 37.



### **On the geographic distribution of the *Drosophila willistoni* group (Diptera, Drosophilidae) – updated geographic distribution of the Neotropical *willistoni* subgroup.**

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### **Introduction**

*Drosophila willistoni* species group comprises 24 Neotropical species, divided into three subgroups – *alagitans*, *bocainensis*, and *willistoni* (Bächli, 2015). The *willistoni* subgroup is composed of six sibling species: *D. willistoni*, *D. equinoxialis*, *D. tropicalis*, *D. insularis*, *D. pavlovskiana*, and *D. paulistorum*. The latter is actually a species complex. *Drosophila willistoni* was described as *Drosophila pallida* (Williston, 1896). Since this nomenclature was already used, Sturtevant (1916) changed it to *D. willistoni*. Dobzhansky and Pavan (1943) found two *willistoni*-like species, one more common and slightly smaller than the other. They believed that the more common species was *D. willistoni* and nominated the larger and less frequent species as *D. paulista*. Later, the authors perceived that, in fact, *D. paulista* was a synonym of the *D. willistoni* and, since then, the smaller species was nominated *D. paulistorum* (Dobzhansky and Pavan in Burla *et al.* 1949).

A few years later, three new siblings were described: *D. equinoxialis* (Dobzhansky, 1946), *D. tropicalis* (Burla and Cunha, 1949 in Burla *et al.*, 1949) and *D. insularis* (Dobzhansky, 1957 in Dobzhansky *et al.*, 1957). Also, Townsend (1954) found that *D. tropicalis* comprises two subspecies, *tropicalis* and *cubana*. *Drosophila tropicalis tropicalis* presents a southern distribution and the northernmost register is in Rio Branco, Brazil; while *D. tropicalis cubana* is a northern form and the southernmost register is in Jamaica (Townsend, 1954).

In 1959, Dobzhansky and Spassky discovered that *D. paulistorum* was not a unique species, but a cluster of six incipient species – Amazonian, Andean-Brazilian, Centroamerican, Guianan, Orinocan and

Transitional. The denominated Guianan was posteriorly elevated to species, *D. pavlovskiana* (Kastritsis and Dobzhansky, 1967) and another incipient species denominated Interior was added to *D. paulistorum* cluster by Pérez-Salas *et al.* (1970).

Similar to *D. tropicalis*, it was discovered that *D. willistoni* and *D. equinoxialis* also represent subspecies. Ayala (1973) observed that populations of *D. willistoni* from Lima, Peru presented incipient reproductive isolation from flies collected in Colombia, Venezuela, Trinidad, and Brazil (*D. willistoni willistoni*) and were assigned as a new subspecies, *D. willistoni quechua*. Populations of *D. equinoxialis* from Hispaniola, Puerto Rico, and Costa Rica exhibited incipient reproductive isolation from flies from Panama and Continental South America. These subspecies were denominated *caribbensis* and *equinoxialis*, respectively.

Concerning the geographic distribution of *D. willistoni* and its siblings, Spassky *et al.* (1971) compiled previously published data and also added new information. This study was updated by Dobzhansky and Powell (1975) and Ehrmann and Powell (1982). Since then, these species have been collected in several new localities. Therefore, the objective of this study was to update the distribution map of *D. willistoni* subgroup, including *D. paulistorum* species complex.

## Material and Methods

We gathered all distribution records in literature for each species and its synonyms of the *willistoni* subgroup. We searched all distribution records compiled in Taxodros and verified the data in the original material. We checked the geographic coordinates using Google Maps and plotted those in maps using QGIS 2.10.1 software. All distribution records, coordinates and respective references are available in Taxodros ([taxodros.uzh.ch](http://taxodros.uzh.ch)) (Bächli, 2015).

## Results and Discussion

The *willistoni* subgroup is almost entirely Neotropical, except for the occurrences in USA and North Mexico.

*Drosophila willistoni* has the broadest distribution of this subgroup, spanning from Florida, Mexico, and Caribbean Islands, in North America, to Argentina and Uruguay, in Southern South America (Figure 1A). This species has been reported in most of South America, except in Paraguay and Chile, while also being found in Galapagos Islands. The northernmost records for *D. willistoni* are in Hawaii and in Crater Lake, Oregon, USA.

*Drosophila tropicalis* occurs in Florida, Mexico, Caribbean Islands, Central America, North and central South America. The southernmost registered locality for this species is São José do Rio Preto, in São Paulo state, Brazil (Figure 1B). *Drosophila equinoxialis* has a geographic distribution very similar to *D. tropicalis*, living in sympatry in the major part of its territory (Figure 1B).

Two species of this subgroups have a very restricted distribution. *Drosophila insularis*, endemic of the Antilles, was found in five localities: Guadeloupe, Monkey Hill, Montserrat, Saint Kitts, and Saint Lucia (Figure 1B). *Drosophila pavlovskiana* occurrence was registered in Apoteri and Georgetown, in Guyana, and in Ocamo, Porto Ayacucho and Rancho Grande, in Venezuela (Figure 1B). *D. pavlovskiana* has not been recently collected.

Regarding *Drosophila paulistorum* cluster, we can observe an interesting aspect. When considering *D. paulistorum* occurrences, not specifying the semispecies (Figure 2A), there are much more registers, and, consequently, the living area seems to be wider than when we indicate the semispecies (Figure 2B). *Drosophila paulistorum* has a highly similar distribution to *D. willistoni*, although not occurring in Uruguay and Argentina (Figure 2A). The southernmost records of *D. paulistorum* are in Porto Alegre, Rio Grande do Sul state, Southern Brazil.

Considering the semispecies of *D. paulistorum*, Andean-Brazilian is the most widespread, occurring in several localities of Brazil, Ecuador, Peru, Colombia, and Venezuela (Figure 2B). This semispecies occurs alone in the largest part of its distribution, although it lives sympatrically with Amazonian, Orinocan or Interior along the Amazon river and the upper Orinoco.

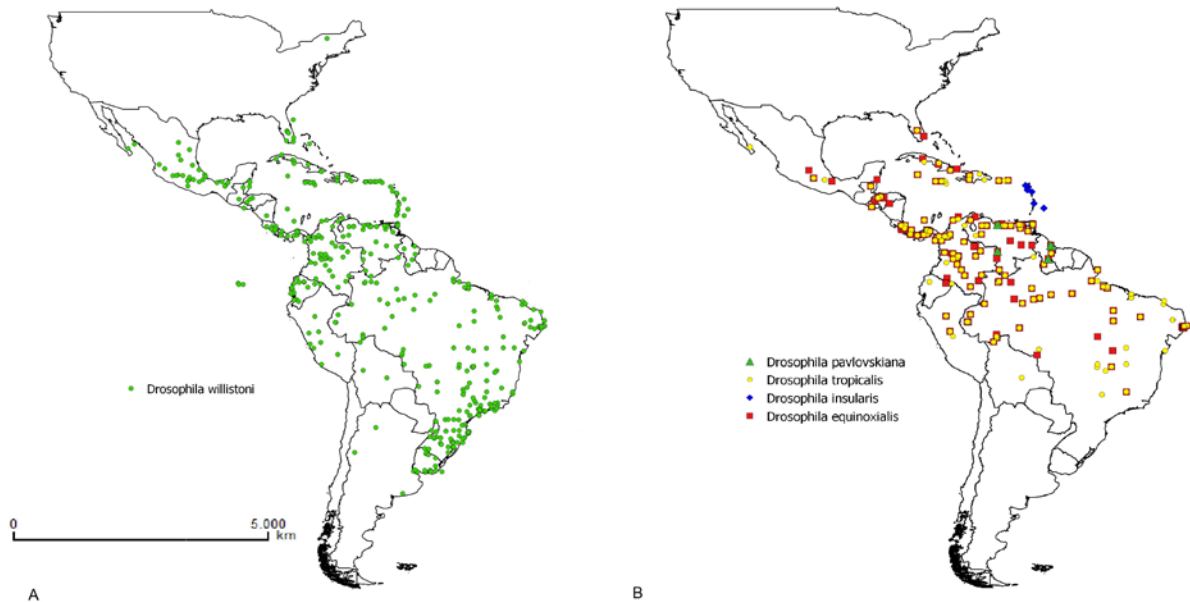


Figure 1. Geographic distribution of the *willistoni* subgroup. A. Distribution of *Drosophila willistoni*. C. Distribution of *Drosophila tropicalis*, *Drosophila equinoxialis*, *Drosophila insularis* and *Drosophila pavlovskiana*.

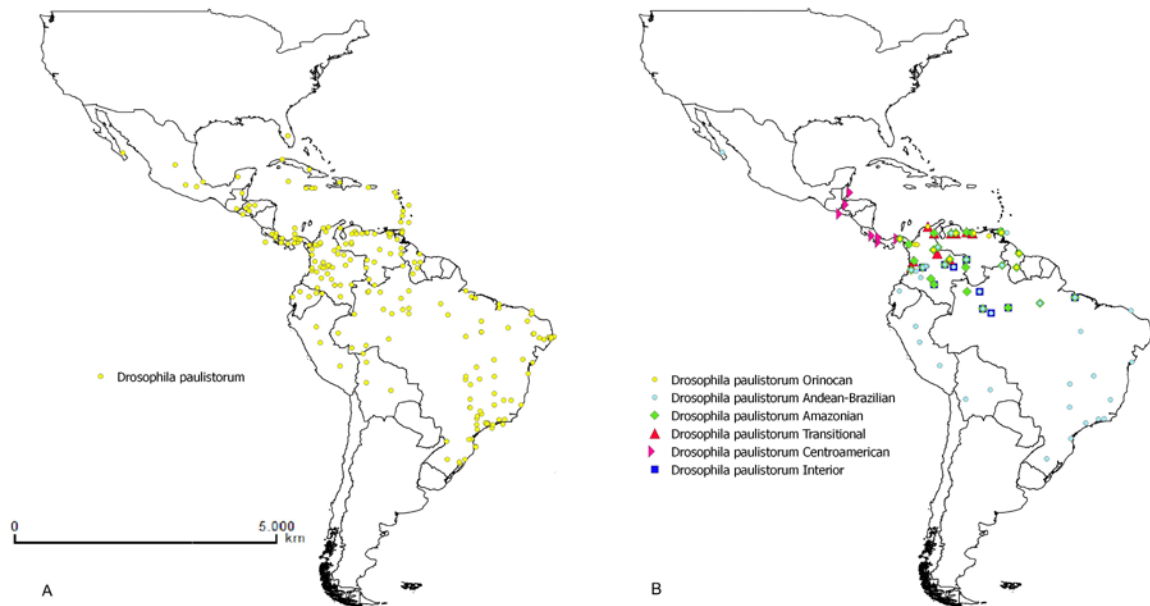


Figure 2. Geographic distribution of the *willistoni* subgroup. A. Distribution of *Drosophila paulistorum*. B. Distribution of *Drosophila paulistorum* semispecies Amazonian, Andean-Brazilian, Centroamerican, Interior, Orinocan, and Transitional.

*Drosophila paulistorum* Centroamerican has been found in Tical (Colombia), Lancetilla (Honduras), San Salvador (El Salvador), Turrialba (Costa Rica) and Boquete, Almirante and the Central area of Panama (Figure 2B). In central Panama, *D. paulistorum* Orinocan occurs together with Amazonian and Orinocan (Figure 2B).

The Transitional semispecies presence was reported in Chocó Condoto, Santa Marta and Valle, in Colombia and in Perija, Vigía, Barinas, Sarare, Rancho Grande and Guatopo, in Venezuela (Figure 2B). It occurs together with Orinocan in Santa Marta and with Andean-Brazilian and Amazonian in Northern Venezuela (Figure 2B).

The Amazonian semispecies spans from Panama and Trinidad to Colombia, Venezuela, Guyana, and Northern Brazil (Figure 2B). It lives in sympatry with Andean-Brazilian, Interior, Orinocan, and Transitional in several localities (Figure 2B).

The Orinocan semispecies occurs in Panama, Trinidad, Colombia, Venezuela, and Guyana, mainly in the Caribbean coast (Figure 2B). The Interior semispecies distributes in Colombia, Venezuela, and Northern Brazil. These semispecies had never been found together (Spassky *et al.*, 1971).

Most of the species of the *willistoni* subgroup live in sympatry in Colombia, Venezuela, Ecuador, Bolivia, and Northern Brazil, while we can observe a large empty patch in central Brazil, Paraguay, and Argentina (Figures 1A-B, 2A-B). This species also has not been reported in Chile, which might be explained by the presence of a great barrier: the Andes chain. This observation raises some questions: Is it possible that none of this species really lives in this area? This could be an artifact because of a lack of studies in these specific areas or the species are not properly identified?

It has been reported that the species identification in this subgroup is difficult, due to the morphological similarity among them. Although many authors have published ecological studies with *D. willistoni* subgroup, only a few studies presented the identification at specific level. Many attempts to identify these species have been made, using different approaches, such as morphological studies, allozymatic assays, crossing tests, and chromosomal analysis (Burla *et al.*, 1949; Malogolowkin, 1952; Spassky, 1957; Dobzhansky and Spassky, 1959; Pasteur, 1970; Ayala *et al.*, 1970; Richmond, 1972; Ayala and Powell, 1972; Garcia *et al.*, 2006, and review of the main results in Ehrmann and Powell, 1982, and in Cordeiro and Winge, 1995). Recently, Zanini *et al.* (2015) has shown that it is possible to identify all species of the *willistoni* subgroup and even *D. paulistorum* incipient species based on morphological characters of the male genitalia, so this study could be helpful in further research.

The most reasonable explanation for those empty spaces is, in fact, a combination of not enough studies encompassing those areas and the misidentification or lack of identification of the *willistoni* subgroup members. Further studies and a more accurate identification of these species are necessary in order to improve its distribution records.

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References: Ayala, F.J., 1973, *The Pan Pacific Entomologist* 49(3): 273-280; Ayala, F.J., and J.R. Powell 1972, *Proc. Nat. Acad. Sci.* 69(5): 1094-1096; Ayala, F.J., C.A. Mourão, S. Pérez-Salas, R. Richmond, and Th. Dobzhansky 1970, *Proc. Nat. Acad. Sci.* 67(1): 225-232; Bachli, G., 2015, *Taxodros - The database on taxonomy of Drosophilidae*. [Online]; Burla, H., A.B. DaCunha, A.R. Cordeiro, Th. Dobzhansky, C. Malogolowkin, and C. Pavan 1949, *Evolution* 3: 300-314; Cordeiro, A.R., and H. Winge 1995, Levels of evolutionary divergence of *Drosophila willistoni* sibling species. *In: Genetics of natural populations of Theodosius Dobzhansky.* (Levine, L. ed.). New York: Columbia University Press, 241-261; Dobzhansky, Th., and C. Pavan 1943, *Boletim da Faculdade de Filosofia, Ciências E Letras* 36(4): 10-12; Dobzhansky, Th., and J.R. Powell 1975, The *willistoni* group of sibling species of *Drosophila*. *In: Handbook of Genetics.* (King, R.C., ed.). New York: Plenum Press, 589-622; Dobzhansky, Th., and B. Spassky 1959, *Proceedings of the National Academy of Sciences of United States of America* 45: 419-428; Dobzhansky, Th., 1946, *Ecology* 27(3): 205-211; Dobzhansky, Th., L. Ehrman, and O. Pavlovsky 1957, *University of Texas Publications* 5721: 39-47; 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; Kastritsis, C.D., and Th. Dobzhansky 1967, *The American Midland Naturalist* 78(1): 244-248; Malogolowkin, C., 1952, *Revista Brasileira de Biologia* 12(1): 79-96; Pasteur, G., 1970, *Evolution* 24: 156-168; Pérez-Salas, S., R.C. Richmond, O.A. Pavlovsky, C.D. Kastritsis, L. Ehrman, and Th. Dobzhansky 1970, *Evolution* 24: 519-527; Richmond, R., 1972, *Genetics* 70: 80-112; Spassky, B., 1957, *University of Texas Publications* 5721: 48-61; Spassky, B., R.C. Richmond, S. Pérez-Salas, O. Pavlovsky, C.A. Mourão, A.S. Hunter, H. Hoentgsberg, Th. Dobzhansky, and F.J. Ayala 1971, *Evolution* 25: 129-143; Sturtevant, A.H., 1916, *Annals of the Entomological Society of America* 9(4): 323-343; Townsend, J.I., 1954,

The American Naturalist 842 (88): 339-351; Williston, S.W., 1896, Transactions of the Entomological Society of London 18(3): 403-417; Zanini, R., M. Deprá, and V.L.S. Valente 2015, Revista Brasileira de Entomologia 59 (4) *in press*.



### Chromosomal translocation at the terminal end of 2L in *Drosophila malerkotliana*.

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All sorts of structural changes like deletions, duplications, inversions, and translocations in the polytene chromosomes of *Drosophila* can be clearly observed and are reported time to time in its different species. Paracentric inversions are very common in *Drosophila* and occur at a high frequency in a number of species of this genus. However, chromosomal translocations are very rarely reported as they confer deleterious effect. *Drosophila malerkotliana* belongs to the *bipectinata* species complex of the *ananassae* subgroup of the *melanogaster* species group (Bock, 1971). Chromosomal polymorphism in this species has substantially been investigated (Bock, 1971; Jha and Rahman, 1972; Naseerulla and Hegde, 1993). These workers have reported the occurrence of paracentric inversions in the different autosomal chromosomes of this species. As far as we know, any case of translocation has not been reported in *D. malerkotliana* so far.



Fig.1.A

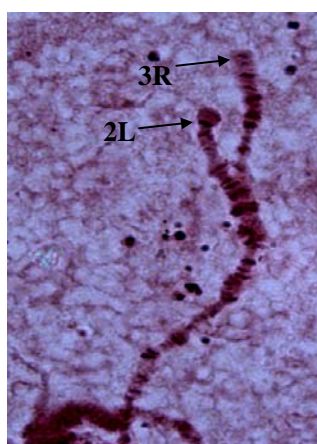


Fig.1. B



Fig.1. C

In this note, we are describing the presence of a chromosomal translocation in the left arm of second chromosome (2L) of *D. malerkotliana* in a isofemale line collected from Bilaspur (Madhya Pradesh, India) in July 2015. Perusal of banding pattern clearly reveals that a part of terminal end of 3R is attached with 2L resulting into the forked appearance of approximately 20% part of terminal end of 2L. Figure 1A shows the normal chromosome arms, whereas Figures 1B and 1C depict the translocation in 2L (translocation heterozygote). In fact, the forked appearance at the tip of 2L is due to pairing between a normal chromosome arm of 2L and a 2L chromosome arm with translocated terminal portion of 3R.

References: Bock, I.R., 1971, Chromosoma 34: 206-209; Jha, A.P., and S.M.Z. Rahman 1972, Chromosoma 37: 445-454; Naseerulla, M.K., and S.N. Hegde 1993, Dros. Inf. Serv. 72: 158-159.

Figure 1. A (top), B and C (bottom).