

Messy but worthy!

An overview of the systematics of Neotropical Tachinini (Diptera: Tachinidae)

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Since I began my studies with tachinids as an undergrad student in 2010 at the Universidade de São Paulo, my attention was instantly drawn to the large, bristly and colorful specimens of the tribe Tachinini. Under the supervision of Dr. Silvio Nihei in the Departamento de Zoologia, I chose to revise the taxonomy of a small genus of Tachinini, *Xanthozona* Townsend (Fig. 1). This was the beginning of my career in the taxonomy and systematics of Tachinidae. Although the task was initially small, I had no idea at the time of how challenging the study of Neotropical tachinids would be, especially within this tribe.

First of all, the tribe Tachinini is part of the controversial subfamily Tachininae, whose classification has been the subject of debate for many decades (Mesnil 1966, Crosskey 1973, 1976, 1980, O'Hara & Cerretti 2016). The monophyly of Tachinini was confirmed by morphological and molecular characters (Cerretti *et al.* 2014, Stireman *et al.* 2019), but the classification of the polyphyletic subfamily Tachininae and its tribes has still to be clearly defined. The classification of Tachinini, however, was subjected to considerable rearrangement during the last century. Townsend (1936) divided Tachinini into seven tribes, namely the Cuphocerini, Dejeaniini, Juriniini (also known as Epalpini), Microtropesini, Macromyini, Schineriini and Tachinini. Later, Mesnil (1966) provided some diagnostic characters for the tribe Tachinini (subtribe Tachinina in his classification) and lumped all of Townsend's tribes into it with the exception of Macromyini (now incorporated into the tribe Nemoraeni). Mesnil's concept of Tachinini has been accepted without much debate since then.

Despite some limitations of Townsend's classification there is, indeed, some degree of morphological heterogeneity among many of the taxa in the current Tachinini, especially when considering the development of palpi, antennae, head chaetotaxy, and wings. Furthermore, comparative studies of characters of the male and female terminalia of Tachinini remain very scarce, despite the significant phylogenetic signal that these character systems exhibit within the family (Herting 1957, Verbeke 1962, Thompson 1963, Tschorsnig 1985, Cantrell 1988, Cerretti *et al.* 2014).

Another layer of complexity in the taxonomy of Neotropical Tachinini is the historical legacy of splitting taxa into multiple monotypic genera, as was done also in other tribes of the family (O'Hara 2013). With a worldwide distribution, Tachinini are a large tribe, comprising 139 valid genera and a little more than 900 species (Guimarães 1971, Crosskey 1973, 1976,



Figure 1. Lateral view of a male *Xanthozona melanopyga* (Wiedemann) from São Carlos, SP, Brazil.

Herting & Dely-Draskovits 1993, O'Hara & Wood 2004, O'Hara *et al.* 2009, 2019, O'Hara & Cerretti 2016). However, 71 genera (about 51%) of the tribe are monotypic, with 67 of them endemic to the Neotropical Region. Curiously, the majority of monotypic taxa (42 genera) is concentrated in the former New World tribe Juriniini, characterized by specimens with vestigial or absent palpi. These numbers clearly reflect an over-splitting of the lineages comprising the Tachinini in the Neotropics, and this situation needs to be reassessed and revised.

In light of the challenges found in the classification of Tachininae and in the taxonomic problems of Tachinini that I found during my undergrad research and Master's degree, I decided to focus my Ph.D. project on the phylogeny and historical biogeography of the New World Tachinini. Therefore, the main objectives of my Ph.D. project are to infer the phylogeny of Tachinini with morphological characters and molecular data, focusing on New World taxa, and to reconstruct the biogeographic history of the New World lineages of Tachinini. With a phylogenetic perspective, I intend to propose an updated classification of New World Tachinini, providing diagnostic characters for the genera. Additionally, with a biogeographic reconstruction it will be possible to better understand the diversification of tachinine lineages in the New World, especially in such important biogeographic areas as the Amazon rainforest, the Atlantic Forest, the Cerrado (also known as the Brazilian savanna) and the Andean mountains.



Figures 2-3. Itatiaia National Park in the Atlantic Forest (state of Rio de Janeiro, Brazil). **2.** Author at an overlook in the park after collecting many tachinids and before heading back to São Paulo. **3.** Female of a probable new species of *Rhachoepalpus* Townsend collected in the rupestrian grasslands of the park. Photo taken by Thalles P. L. Pereira.

To sample genetic data, I traveled with Dr. Silvio Nihei and my colleagues at the Laboratório de Sistemática e Biogeografia de Insecta to several field sites in Brazil to collect fresh specimens. One amazing site where we collected a great diversity of species of Tachinini was the Itatiaia National Park in the state of Rio de Janeiro (Figs. 2, 3). The park covers a large area of native Atlantic Forest with rupestrian grasslands at elevations above 2,400 m. One of the highest peaks in Brazil, known as Pico das Agulhas Negras, has an elevation of 2,790 m and is the main attraction for visitors, but the surrounding area is inhabited by many endemic species of flora and fauna. Another interesting and curiously unexplored site for tachinids is the Cantareira State Park on the northern edge of metropolitan São Paulo (Fig. 4). Despite being so close to the large city, the insect fauna of the park is not well known. We collected some species there described by Charles Townsend, who had lived in the nearby city of Itaquaquecetuba, the type locality of many of his species (Hansen & Toma 2004).

Figure 4. View looking over Cantareira State Park, with the city of São Paulo, Brazil, in the background. Photo taken by Lucas D. de Campos.



To obtain morphological and biogeographical data of species, I visited eight Brazilian collections dispersed throughout the country¹. I also had the opportunity to visit the Smithsonian National Museum of Natural History (Washington, D.C., USA) for six months, from late 2018 to early 2019, to study the type material of Tachinini (including many Townsend's types). While in North America I was also able to visit the collections of the American Museum of Natural History (New York, USA) and the Canadian National Collection of Insects (Ottawa, Canada).

My first phylogenetic analyses based on morphology included 115 characters for 192 taxa of Tachinini, covering about 79% of the genera of the tribe. Preliminary results indicate that Tachinini are a monophyletic group, with lineages of the Old World being the first divergences of the tribe. The old Juriniini were also reconstructed as monophyletic and nested within Tachinini, including other genera with vestigial palpi formerly classified in Cuphocerini. Several monotypic taxa share many morphological characters of the male terminalia with other broader genera, such as *Epalpus* Rondani, *Jurinia* Robineau-Desvoidy and *Trichophora* Macquart, which might result in new synonyms. Analyses with molecular data and the reconstruction of historical biogeography of this tribe are still in progress.

As part of my study, I hope to provide morphological diagnoses of the main generic groups of the New World Tachinini, and to compare the tribe with other related tribes of the subfamily. I am also willing to collaborate with other researchers interested in the taxonomy, host associations and phylogenetics of Tachinidae, especially in the Neotropical Region.

¹ The collections visited were:

CEIOC, Coleção Entomológica do Instituto Oswaldo Cruz, Instituto Oswaldo Cruz, Rio de Janeiro
DZUP, Museu de Entomologia Pe. Jesus Santiago Moure, Universidade Federal do Paraná, Curitiba
INPA, Instituto Nacional de Pesquisas da Amazônia, Manaus
MNRJ, Museu Nacional, Universidade Federal do Rio Janeiro, Rio de Janeiro
MZSP, Museu de Zoologia da Universidade de São Paulo, São Paulo
MZUFBA, Museu de Zoologia da Universidade Federal da Bahia, Universidade Federal da Bahia, Salvador
UFMG, Coleção Entomológica do Centro de Coleções Taxonômicas da Universidade Federal de Minas Gerais, Universidade Federal de Minas Gerais, Belo Horizonte
VOBC, private collection of Vitor Becker, Camacan, Bahia.

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