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A PRELIMINARY ASSESSMENT OF THRIPS INHABITING A TROPICAL MONTANE CLOUD FOREST OF CHIAPAS, MEXICO

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ABSTRACT

Approximately 6000 species of Thysanoptera have been described worldwide. They are particularly diverse in the Neotropics, living in a wide range of environments. Although many species of thrips are well known as inhabitants of cultivated plants, there are others that are abundant in other types of habitats. In the present study we conducted a survey in the "Biosphere Reserve of Volcan Tacana" with the main objective to know the native fauna of thrips. The results confirm the presence of 112 species in 52 genera and 4 families. Our survey indicates that this reserve contains a great biodiversity of Thysanoptera. A full check-list of species is provided.

Key Words: Thysanoptera, Thrips, Chiapas State, Mexico

RESUMEN

Aproximadamente 6000 especies de Thysanoptera han sido descritas en todo el mundo. Estos organismos son particularmente diversos en la región Neotropical, en donde viven en una gran variedad de ambientes. Aunque muchas especies de trips son bien conocidas por vivir sobre plantas cultivadas, existen otras que abundan en otro tipo de hábitats. En el presente trabajo llevamos a cabo un estudio de reconocimiento en "Reserva de la Biósfera del Volcán Tacaná" con el principal objetivo de conocer la fauna nativa de trips. Los resultados confirman la presencia de 112 especies en 52 géneros y 4 familias. Nuestro estudio indica que esta reserva contiene una alta diversidad de Thysanoptera. Se proporciona una lista completa de las especies.

Palabras Clave: Thysanoptera, Trips, Chiapas, Mexico

Thrips (Thysanoptera) are ubiquitous tiny insects, usually 1-2 mm in length, and generally yellow, brown, or black in color. They occupy widely different ecological niches resulting in the expression of a diverse array of lifestyles (Morse & Hoddle 2006). Approximately half of the known species feed on fungi, the others being phytophagous in flowers or on leaves, and a few are predator species (Lewis 1973, Cavalleri et al. 2010). Currently, throughout the world, there are approximately 6,000 species of thysanopterans (Buckman et al. 2013, ThripsWiki 2014), although the thrips fauna is more abundant and diverse in the tropics than in temperate regions (Mound & Marullo 1996). Compared to other orders of insects, the Mexican fauna of Thysanoptera has been poorly studied. Johansen & Mojica (2011) mentioned that the first 2 known species of thysanopteran from Mexico were *Elaphrothrips longiceps* (Bagnall, 1908) and *Docessissophothrips ampliceps* Bagnall, 1908. They both were collected in the State of Veracruz in 1857 and described as new species by Bagnall (1908). At present, there are approximately 608 thrips recorded from Mexico (Johansen & Mojica 1996, Johansen & Mojica 2003). Considering the geographic location of Mexico, with a wide array of ecosystems that include the arid areas of Northern Mexico, the temperate sub-humid central plateau, and the humid tropical regions of the Southeast, this figure seems an underestimate. There should be many species of thrips that have not yet been recorded.

Tropical montane cloud forest (TMCF) is a type of evergreen mountain forest distributed throughout the tropical belt at elevations of 1,500-3,000 m and a wide range of rainfall regimes (Hamilton et al. 1995). This type of ecosystem is characterized by a humid atmosphere due to a constant presence of clouds or mist that promotes abundant vegetation. It exhibits great natural variation in species composition and structure in short geo-

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graphic distances, because of habitat heterogeneity and topographic isolation (Williams-Linera 2002). In Mexico, TMCF is limited to a narrow strip that cover less than 1% of the Mexican territory, but they are the most diverse by unit area, contributing 12% of plant biodiversity with high levels of endemicity (Rzedowski 1993; Challenger 1998). TMCF has long been recognized as one of the most threatened types of vegetation globally (Hamilton et al. 1995; Bubb et al. 2004). One of the most important TMCFs of Mexico is the "Biosphere Reserve of Volcan Tacana" (BRVT) in the State of Chiapas, near the border with Guatemala. In this pristine place we carried out a survey with the main objective to study the fauna of thrips. We aimed to produce an inventory of Thysanoptera with some biological annotations for the main species. We consider that this work will be very helpful for further studies in this particularly region of Mexico, as this area has never been sampling for thrips.

Materials and Methods

The BRVT has an area of ca. 6,378 ha (Fig. 1). The climate is temperate humid with abundant rains in summer (from May to Oct). The rainfall is ca. 4,000 mm yearly and the mean temperature is 15.3 °C (INEGI 1981). The vegetation is varied, being in the highest parts of the reserve a mixed forest of *Abies, Alnus, Buddleja, Juniperus, Pinus* and *Quercus* (Islebe et al. 1994). In lower places, the main elements of the forest are species of *Matudaea, Inga, Clethra, Liquidambar, Pithecolobium, Ilez, Podocarpus, Osmanthus,*

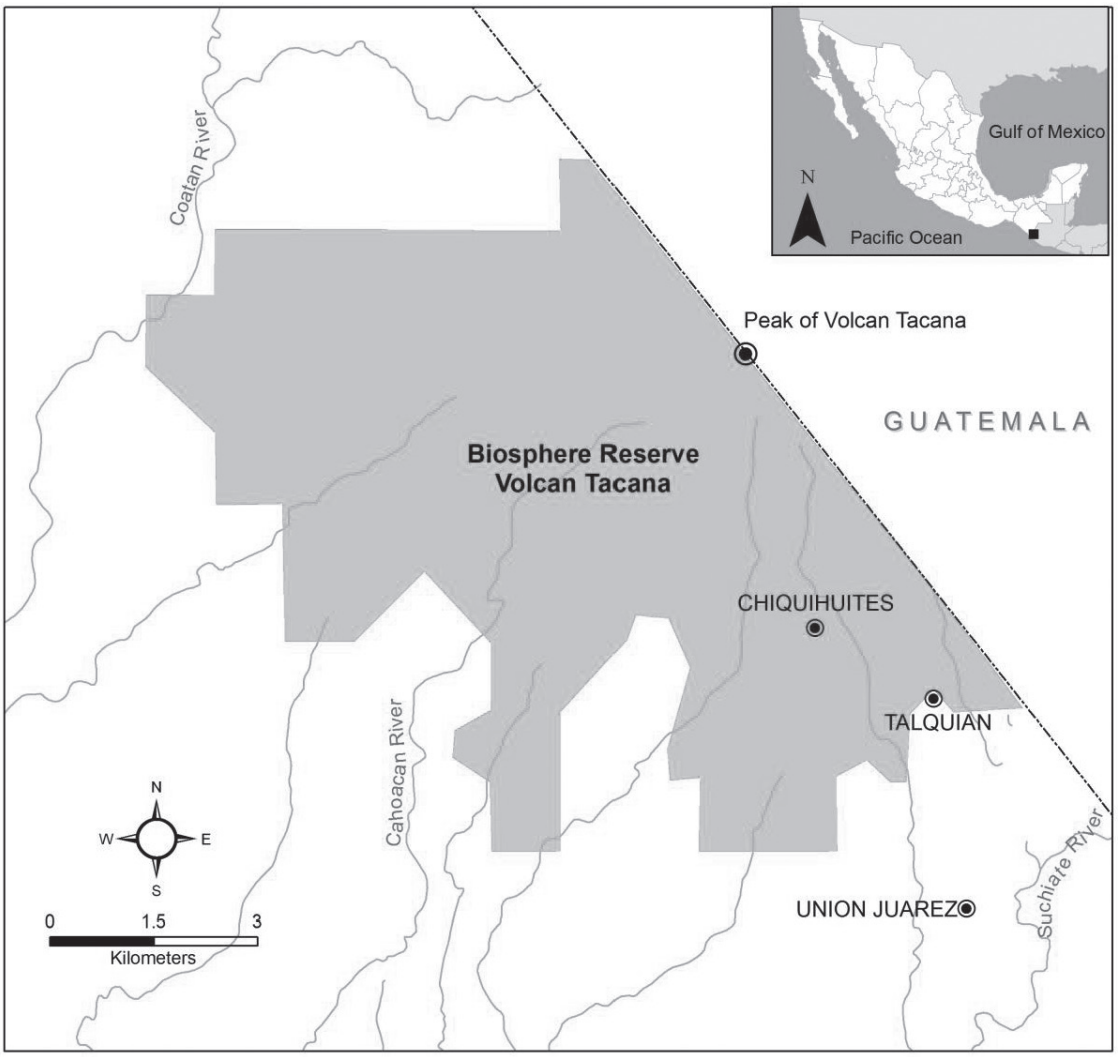


Fig 1. Map of Mexico showing the sampled area where thrips species were collected.

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Decrela and *Olmediella* (Miranda 1975). Understory vegetation comprises hundreds of species of shrubs, ferns, epiphytes, and palms (Challenger & Soberón 2008). In recent years, the reserve has been impacted in some parts by anthropogenic disturbance. Among these activities, human settlements, deforestation and agriculture (coffee) are frequent.

We performed 2 samplings of thrips at BRVT: one sampling in 2011 and another in 2012. On each occasion we took an area of approximately 4 km^2 located between Chiquihutes (N 15° 05' 67" W 92° 06' 49"; 2,085 m asl) and Talquián (N 15° 05' 14" W 92° 05' 55"; 2,021 m asl), where we fixed 10 sampling points. In each point we carried out a random sample of thrips collected from flowers, leaves and branches of the understory vegetation. Specimens were placed in 70% ethanol and taken to El Colegio de la Frontera Sur (ECOSUR), in Tapachula, Chiapas. At the laboratory, more than 3,500 thrips were mounted on slides (Mound & Kibby 1998; Palmer et al. 1989) using either Canada balsam or Hoyer's medium. Before the mounting process, specimens were soaked in 5% NaOH and the internal contents were removed. Thrips species were identified, when possible, using the taxonomic keys in Mound & Marullo (1996), Moritz et al. (2004) and Johansen (1975, 1981ab, 1982, 1983). Voucher specimens are located in the reference collection of INECOL.

Results

All species in the checklist presented below are based on our sampling because this area has never been studied for Thysanoptera. Two suborders were recognized: Terebrantia and Tubulifera. Both of these major groups were well represented in this National Park of Chiapas. An asterisk (*) beside the name, indicates that the species is presumably not-native to Central America. A total of 112 species in 4 families were collected.

Heterothripidae

The 4 genera and 70 species recognized in this family are all from the New World. These species are mostly flower-feeding, 65 of them being placed in *Heterothrips*, but 3 Brazilian species of the genus *Alaucothrips* are ectoparasitic on an homopteran species. Most Heterothripidae were collected on Malpighiaceae plants at BRVT.

Heterothrips Hood, 1908

H. mexicanus Watson, 1924

Aeolothripidae

Most of the 190 species in this family of about 23 genera are found in temperate areas of the North and South Hemispheres, although most of the genera are from tropical countries. The tropical species, in genera such as *Franklinothrips* and *Stomatothrips*, are mainly obligate predators of other arthropods, whereas most of the temperate area species in the genus *Aeolothrips* are flower-living facultative predators. Species such as *Aeolothrips romanruizi* and *Franklinothrips orizabensis* were collected on flowers of shrubs, while *Erythrothrips durango* and *Stomatothrips* sp. were collected from grass tussocks.

Aeolothrips Haliday, 1836

A. romanruizi Ruiz-De la Cruz et al. 2013

Erythrothrips Moulton, 1911

E. durango Watson, 1924

Franklinothrips Back, 1912

F. orizabensis Johansen, 1974

Stomatothrips Hood, 1912

S. brunneus Crawford J. C, 1940

S. flavus Hood, 1912

S. septennarius Hood, 1925

Thripidae

Approximately 2,000 species in 290 genera are placed in this family. Most of them are phytophagous on higher plants, with a few species on ferns and bryophytes (Mound 1989, Mound et al. 1994). A few species are obligate predators (e.g. *Scolothrips sexmaculatus*). Four subfamilies within the Thripidae are currently recognized worldwide, and each of these is represented in Chiapas. Some of these species were collected on *Poaceae,* i.e., *Arorathrips*, *Bregmatothrips*, *Caliothrips*, *Dinurothrips* and *Plesiothrips*. Other species were found on flowers of trees as *Psectrothrips* and *Retanathrips* while numerous species of *Frankliniella* were captured on herbaceous flowers. *Caliothrips nanus* and *Salpingothrips minimus* were abundant in flowers of Leguminoseae plants.

Ameranathrips Mound & Marullo, 1996

A. herediae Mound & Marullo, 1996

Arorathrips Bhatti, 1990

A. fulvus (Moulton, 1936)

A. mexicanus (Crawford, 1909)

Baileyothrips Kono & O'Neill, 1964

B. limbatus (Hood, 1935)

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Bravothrips Johansen, 1986
B. kraussi (Crawford J. C., 1948)
B. mexicanus (Priesner, 1933)

Bregmatothrips Hood, 1912
B. venustus Hood, 1912

Caliothrips Daniel, 1904
C. insularis (Hood, 1928)
C. nanus (Hood, 1928)

Cercyothrips Morgan, 1925
C. striatus Morgan, 1925

Chaetanaphothrips Priesner, 1926
C. orchidii (Moulton, 1907)

Charassothrips Hood, 1954
C. incomparabilis (Johansen, 1983)

Dinurothrips Hood, 1913
D. vezenyii Bagnall, 1919

Enneothrips Hood, 1935
E. flaviceps Hood, 1955

Echinothrips Moulton, 1911
E. mexicanus Moulton, 1911

Frankliniella Karny, 1910
F. annulipes Hood, 1915
F. borinquen Hood, 1942
F. bruneri Watson, 1926
F. brunnea Priesner, 1932
F. cephalica (Crawford, DL, 1910)
F. chamulae Johansen, 1981
F. curiosa Priesner, 1932
F. desmodii Mound & Marullo, 1996
F. difficilis Hood, 1925
F. distinguenda Bagnall, 1919
F. floydandrei Sakimura & O'Neill, 1979
F. fulvipennis Moulton, 1933
F. gardeniae Moulton, 1948
F. gossypiana Hood, 1936
F. insularis Franklin, 1908
F. invasor Sakimura, 1972
F. lichenicola Johansen & Mojica, 1989
F. melanommata Williams, 1913
F. minuta (Moulton, 1907)
F. occidentalis (Pergande, 1985)
F. parvula Hood, 1925
F. pulchella Hood, 1935
F. rostrata Priesner, 1932
F. simplex Priesner, 1924
F. standleyana Hood, 1935
F. vargasi Retana & Mound, 1995
F. williamsi Hood, 1915
F. xanthomelaena Hood, 1937

Guerothrips Goldarazena & Infante, 2013
G. moundi Goldarazena & Infante, 2013

Heliothrips Haliday, 1836
H. haemorrhoidalis (Bouche, 1833)

Hydatothrips Karny, 1913
H. sternalis (Hood, 1935)

Leucothrips Reuter, 1904
L. furcatus /*theobromae*

Microcephalothrips Bagnall, 1926
M. abdominalis (Crawford D. L., 1910)

Neohydatothrips John, 1929
N. gracilipes (Hood, 1924)
N. inversus (Hood, 1928)
N. rapoporti Johansen, 1983
N. ruginosus (Hood, 1954)
N. signifer (Priesner, 1932)

Plesiothrips Hood, 1915
P. tricolor cfr. Johansen, 1976
Psectrothrips Hood, 1937
P. longiceps (Hood, 1954)

Pseudothrips Hinds, 1902
P. inequalis (Beach, 1896)

Retanathrips Mound & Nickel, 2009
R. funnestus (Hood, 1915)

Rhamphothrips Karny, 1930
R. pandens Sakimura, 1983

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Salpingothrips Hood, 1935
S. minimus Hood, 1935

Scirtothrips Shull, 1909
**S. citri* (Moulton, 1909)

Selenothrips Karny, 1911
S. rubrocinctus (Giard, 1901)

Thrips Linnaeus, 1758
**T. palmi* Karny, 1925
**T. tabaci* Lindeman, 1888
**T. simplex* (Morison, 1930)

Trichromothrips Priesner, 1930
**T. xanthius* cfr (Williams, 1917).

PHLAEOTHRIPIDAE

This is the only family of Tubulifera and includes at least 3,550 species in about 460 genera (ThripsWiki 2014). They live mainly in the warmer parts of the world. Two subfamilies are recognized, and both are well represented in the BRVT. The smaller of the 2 subfamilies (Idolothripinae) includes at least 700 species in about 80 genera, mainly in tropical countries. All of these species feed by imbibing whole fungal spores, as is evident from their gut contents. The larger species collected in the BRVT, such as, species in the genera *Elaphrothrips*, *Diceratothrips*, *Nesothrips* and *Pseudocryptothrips*, were particularly common on dead leaves or broken branches, but many smaller species were captured in leaf litter. The Phlaeothripinae includes more than 2,800 species in 370 genera, although 50% of these genera remain monotypic (ThripsWiki 2014). Species of some genera were collected in flowers (*Haplothrips* sp.) and galls (*Gynaikothrips* spp.). A few species collected from the leaves of trees including *Aleurodothrips*, *Neurothrips, Karnyothrips* and *Leptothrips*, are probably predators of micro arthropods.

Adraneothrips Hood, 1925
A. alajuela Mound & Marullo, 1996
A. alternatus Hood, 1925
A. decorus Hood, 1938
A. diligens Hood, 1935
A. desocellatus (Priesner, 1933)
A. fuscicollis Hood, 1925
A. uniformis Hood, 1925

Aleurodothrips Franklin, 1909
A. fasciapennis (Franklin, 1908)

Androthrips Karny, 1911
A. ramachandrai Karny, 1926

Apterygothrips Priesner, 1933
A. sp.

Diceratotothrips Bagnall, 1908
D. bicornis Bagnall, 1908

Elaphrothrips Buffa, 1909
E. affinis (Bagnall, 1908)
E. grandis Bagnall, 1910
E. laevicollis (Bagnall, 1910)
E. longiceps (Bagnall, 1908)
E. neoleonensis Johansen, 1979

Ethirothrips Karny, 1925
E. obscurus (Schmutz, 1913)

Gastrothrips Hood, 1912
G. anolis Morgan 1925

Gomphiothrips Moulton, 1933
G. mercedes Mound & Marullo, 1996

Gynaikothrips Zimmermann, 1900
G. uzeli (Zimmermann, 1900)

Haplothrips Amyot & Serville, 1843
H. gowdeyi (Franklin, 1908)
H. graminis (Hood, 1912)
H. saidi (Retana-Salazar & Soto Rodriguez, 2007)

Hoplandrothrips Hood, 1912
H. jennei (Jones, 1912)
H. longirostris Hood, 1954
H. xanthopoides Bagnall, 1917

Holothrips Karny, 1911
H. sp.

Karnyothrips Watson, 1923
K. flavipes (Jones), 1912
K. melaleucus (Bagnall, 1911)
K. merrilli (Watson, 1920)
K. texensis (Hood, 1940)

Leptothrips Hood, 1909
L. sp.

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Liothrips Uzel, 1895

L. sp.

Nesothrips Kirkaldi, 1907

N. lativentris (Karny, 1913)

Neurothrips Hood, 1924

N. punanus Stannard, 1957

Orthothrips

O. boneti Stannard 1955

Pseudocryptothrips Priesner, 1919

P. gradatus (Hood, 1925)

Tylothrips Hood, 1937

T. osbomi (Hinds, 1902)

Xeroleptothrips Johansen, 1982

X. tehuacanensis Johansen, 1982

Torvothrips Johansen, 1980

T. pennetrans Johansen, 1980

Discussion

To conserve and make a rational use of natural resources, it is a prerequisite to have a great deal of knowledge about the organisms inhabiting a region. Mexico is considered as a megadiverse country because it harbors one of the richest biological diversities on Earth. Paradoxically, some groups of organisms, such as Thysanoptera, have been poorly studied in this country (Llorente-Bousquets & Ocegueda 2008). In the case of Chiapas, one of the Mexican states with the most biological richness (González-Espinosa et al. 2005), only 65 thrips species have been formally reported (León-Cortés et al. 2005). Undoubtedly, this amount that represents 1.1% of the thrips species in the world, denotes the lack of faunistic studies in this vast area of Southern Mexico.

The species of Thysanoptera reported here are clearly a preliminary assessment of the real fauna that dwells in the "Biosphere Reserve of Volcan Tacana". As the first work of its type in this area, it is hoped to be used as a platform for further studies on thrips. Although a very small area of the reserve (0.06%) has been sampled, we have found a great diversity of Thysanoptera comprising 112 species. This vast biodiversity could be explained if we consider that Chiapas is part of the Neotropical region, where thrips' diversity is especially rich.

More than 95% of Terebrantia and 35% of Tubulifera are associated with plants (Mound & Marullo 1996; Mound 2005). As we were aware about the inaccuracies reported in the literature when referring to host plant association of thrips (Mound 2013), we did not aim to produce an inventory of thrips and their host-plant associations. It is customary for workers on thrips to record as a host, any plant from which the thrips were collected. However, in the case of phytophagous thrips, a host plant is more than a casual finding place, it is rather the place (plant) where a certain species of thrips is able to feed and breed (Mound 2013). For this reason we were only focused on the thrips species inhabiting the BRVT regardless of the plants from which they were collected.

Apparently most species recorded in the present study are widespread throughout Central America, as they have also been reported in other countries (Mound & Marullo 1996; Goldarazena et al. 2012). The genus *Frankliniella* was the most representative at the BRVT with 28 species. This is not surprisingly, considering that this genus is supposed to have originated in the Neotropics (Mound & Marullo 1996). Finally, some of the species of thrips inhabiting the BRVT can also be found in some cultivated areas of the Soconusco Region of Chiapas. For instance, on economically important crops, such as, coffee, soybean, cacao and mango, numerous species have been collected of the genera *Frankliniella*, *Thrips*, *Caliothrips*, *Heliothrips*, *Scirtothrips*, *Aeolothrips*, *Karnyothrips*, *Guerothrips*, among others (Infante et al. in preparation; Rocha et al. 2012; Goldarazena & Infante 2013). In this sense, faunistic studies can be of substantial value in understanding the ecology of thrips species and eventually useful in pest control planning.

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