

An updated catalogue of biting midges of the genus *Culicoides* Latreille, 1809 (Diptera, Ceratopogonidae) of Mexico and their known distribution by state

Alejandro Mendez-Andrade¹, Sergio Ibáñez-Bernal¹

¹ Instituto de Ecología, A.C. Red Ambiente y Sustentabilidad. Carretera antigua a Coatepec 351, Col. El Haya, Xalapa, Veracruz, C.P. 91073, Mexico
 Corresponding author: Sergio Ibáñez-Bernal (sergio.ibanez@inecol.mx)

Abstract

An updated catalogue of *Culicoides* of Mexico is presented. It includes 86 species with their regional distribution and corresponding record references, known immature stages and associated pathogens. In addition, a taxonomic key for subgenera and species groups for Mexico is presented and an index of species by state is included.

Key words: Biting midges, Culicoidini, distribution, hematophagy, species list

Table of contents

| | |
|--------------------------------------------------------------------------|----|
| Introduction | 4 |
| Genus <i>Culicoides</i> Latreille, 1809 | 7 |
| Subgenus <i>Amossovia</i> Glukhova, 1989 | 7 |
| <i>Culicoides (Amossovia) cochisensis</i> Wirth & Blanton, 1967 | 7 |
| <i>Culicoides (Amossovia) oklahomensis</i> Khalaf, 1952 | 7 |
| <i>Culicoides (Amossovia) ousairani</i> Khalaf, 1952 | 7 |
| Subgenus <i>Anilomyia</i> Vargas, 1960 | 7 |
| <i>Culicoides (Anilomyia) hayesi</i> Matta, 1967 | 8 |
| <i>Culicoides (Anilomyia) nigrigenus</i> Wirth & Blanton, 1956 | 8 |
| <i>Culicoides (Anilomyia) pseudodecor</i> Spinelli & Huerta, 2015 | 8 |
| Subgenus <i>Avaritia</i> Fox, 1955 | 8 |
| <i>Culicoides (Avaritia) boydi</i> Wirth & Mullens, 1992 | 8 |
| <i>Culicoides (Avaritia) pusilloides</i> Wirth & Blanton, 1955 | 9 |
| <i>Culicoides (Avaritia) pusillus</i> Lutz, 1913 | 9 |
| Subgenus <i>Beltranmyia</i> Vargas, 1953 | 9 |
| <i>Culicoides (Beltranmyia) crepuscularis</i> Malloch, 1915 | 9 |
| Subgenus <i>Culicoides</i> Latreille, 1809 | 10 |
| <i>Culicoides (Culicoides) elutus</i> Macfie, 1948 | 10 |
| <i>Culicoides (Culicoides) fortinensis</i> Spinelli & Huerta, 2015 | 10 |
| <i>Culicoides (Culicoides) luteovenus</i> Root & Hoffman, 1937 | 10 |
| <i>Culicoides (Culicoides) neopulicaris</i> Wirth, 1955 | 11 |
| <i>Culicoides (Culicoides) rulfoi</i> Spinelli & Huerta, 2015 | 11 |



Academic editor: Art Borkent
 Received: 1 March 2023
 Accepted: 15 May 2023
 Published: 14 June 2023

ZooBank: <https://zoobank.org/21D43252-42C9-4845-82B1-7FCC58568126>

Citation: Mendez-Andrade A, Ibáñez-Bernal S (2023) An updated catalogue of biting midges of the genus *Culicoides* Latreille, 1809 (Diptera, Ceratopogonidae) of Mexico and their known distribution by state. ZooKeys 1167: 1–47. <https://doi.org/10.3897/zookeys.1167.102858>

Copyright: © Alejandro Mendez-Andrade & Sergio Ibáñez-Bernal.
 This is an open access article distributed under terms of the Creative Commons Attribution License ([Attribution 4.0 International – CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).

| | |
|-------------------------------------------------------------------------------|----|
| Subgenus <i>Diphaomyia</i> Vargas, 1960 | 11 |
| <i>Culicoides (Diphaomyia) baueri</i> Hoffman, 1925 | 11 |
| <i>Culicoides (Diphaomyia) blantoni</i> Vargas & Wirth, 1955 | 11 |
| <i>Culicoides (Diphaomyia) haematopotus</i> Malloch, 1915 | 12 |
| <i>Culicoides (Diphaomyia) iriartei</i> Fox, 1952 | 12 |
| Subgenus <i>Drymodesmyia</i> Vargas, 1960 | 12 |
| <i>Culicoides (Drymodesmyia) arizonensis</i> Wirth & Hubert, 1960 | 12 |
| <i>Culicoides (Drymodesmyia) bakeri</i> Vargas, 1954 | 13 |
| <i>Culicoides (Drymodesmyia) butleri</i> Wirth & Hubert, 1960 | 13 |
| <i>Culicoides (Drymodesmyia) cacticola</i> Wirth & Hubert, 1960 | 13 |
| <i>Culicoides (Drymodesmyia) copiosus</i> Root & Hoffman, 1937 | 13 |
| <i>Culicoides (Drymodesmyia) insolatus</i> Wirth & Hubert, 1960 | 14 |
| <i>Culicoides (Drymodesmyia) jamaicensis</i> Edwards, 1922 | 14 |
| <i>Culicoides (Drymodesmyia) loughnani</i> Edwards, 1922 | 14 |
| <i>Culicoides (Drymodesmyia) panamensis</i> Barbosa, 1947 | 15 |
| <i>Culicoides (Drymodesmyia) poikilonotus</i> Macfie, 1948 | 15 |
| <i>Culicoides (Drymodesmyia) ryckmani</i> Wirth & Hubert, 1960 | 15 |
| <i>Culicoides (Drymodesmyia) sitiens</i> Wirth & Hubert, 1960 | 15 |
| <i>Culicoides (Drymodesmyia) torridus</i> Wirth & Hubert, 1960 | 16 |
| <i>Culicoides (Drymodesmyia) wirthomyia</i> Vargas, 1953 | 16 |
| Subgenus <i>Glaphiromyia</i> Vargas, 1960 | 16 |
| <i>Culicoides (Glaphiromyia) dampfi</i> Root & Hoffman, 1937 | 16 |
| <i>Culicoides (Glaphiromyia) parascopus</i> Wirth & Blanton, 1978 | 17 |
| <i>Culicoides (Glaphiromyia) scopus</i> Root & Hoffman, 1937 | 17 |
| Subgenus <i>Haematomyidium</i> Goeldi, 1905 | 17 |
| <i>Culicoides (Haematomyidium) debilipalpis</i> Lutz, 1913 | 17 |
| <i>Culicoides (Haematomyidium) eadsi</i> Wirth & Blanton, 1971 | 18 |
| <i>Culicoides (Haematomyidium) ginesi</i> Ortiz, 1951 | 18 |
| <i>Culicoides (Haematomyidium) kettlei</i> Breidenbaugh & Mullens, 1999 | 18 |
| <i>Culicoides (Haematomyidium) paraensis</i> (Goeldi, 1905) | 18 |
| Subgenus <i>Hoffmania</i> Fox, 1948 | 19 |
| <i>Culicoides (Hoffmania) diabolicus</i> Hoffman, 1925 | 19 |
| <i>Culicoides (Hoffmania) filariferus</i> Hoffman, 1939 | 19 |
| <i>Culicoides (Hoffmania) foxi</i> Ortiz, 1950 | 19 |
| <i>Culicoides (Hoffmania) hylas</i> Macfie, 1940 | 20 |
| <i>Culicoides (Hoffmania) insignis</i> Lutz, 1913 | 20 |
| <i>Culicoides (Hoffmania) ocumarensis</i> Ortiz, 1950 | 20 |
| <i>Culicoides (Hoffmania) palpalis</i> Macfie, 1948 | 21 |
| <i>Culicoides (Hoffmania) pseudodiabolicus</i> Fox, 1946 | 21 |
| <i>Culicoides (Hoffmania) verecundus</i> Macfie, 1948 | 21 |
| Subgenus <i>Macfiella</i> Fox, 1955 | 21 |
| <i>Culicoides (Macfiella) phlebotomus</i> (Williston, 1896) | 21 |
| <i>Culicoides (Macfiella) willistoni</i> Wirth & Blanton, 1953 | 22 |
| Subgenus <i>Mataemyia</i> Vargas, 1960 | 22 |
| <i>Culicoides (Mataemyia) dicrourus</i> Wirth & Blanton, 1955 | 22 |
| Subgenus <i>Monoculicoides</i> Khalaf, 1954 | 22 |
| <i>Culicoides (Monoculicoides) occidentalis</i> Wirth & Jones, 1957 | 23 |
| <i>Culicoides (Monoculicoides) sonorensis</i> Wirth & Jones, 1957 | 23 |
| <i>Culicoides (Monoculicoides) variipennis</i> (Coquillett, 1901) | 23 |

| | |
|------------------------------------------------------------------------------|----|
| Subgenus <i>Oecacta</i> Poey, 1853..... | 24 |
| <i>Culicoides (Oecacta) barbosai</i> Wirth & Blanton, 1956..... | 24 |
| <i>Culicoides (Oecacta) cancer</i> Hogue & Wirth, 1968..... | 24 |
| <i>Culicoides (Oecacta) furens</i> Poey, 1853..... | 24 |
| Subgenus <i>Selfia</i> Khalaf, 1954..... | 25 |
| <i>Culicoides (Selfia) hieroglyphicus</i> Malloch, 1915..... | 25 |
| <i>Culicoides (Selfia) multipunctatus</i> Malloch, 1915..... | 25 |
| Subgenus unplaced, <i>acotylus</i> species group..... | 25 |
| <i>Culicoides acotylus</i> Lutz, 1913..... | 25 |
| Subgenus unplaced, <i>daedalus</i> species group..... | 26 |
| <i>Culicoides crescentis</i> Wirth & Blanton, 1959..... | 26 |
| <i>Culicoides daedalus</i> Macfie, 1948..... | 26 |
| <i>Culicoides pampoikilus</i> Macfie, 1948..... | 26 |
| Subgenus unplaced, <i>eublepharus</i> species group..... | 27 |
| <i>Culicoides eublepharus</i> Macfie, 1948..... | 27 |
| <i>Culicoides propriipennis</i> Macfie, 1948..... | 27 |
| <i>Culicoides rangeli</i> Ortiz & Mirsa, 1952..... | 27 |
| Subgenus unplaced, <i>fluvialis</i> species group..... | 28 |
| <i>Culicoides castillae</i> Fox, 1946..... | 28 |
| <i>Culicoides leopoldoi</i> Ortiz, 1951..... | 28 |
| Subgenus unplaced, <i>leoni</i> species group..... | 28 |
| <i>Culicoides gabaldoni</i> Ortiz, 1954..... | 28 |
| <i>Culicoides glabellus</i> Wirth & Blanton, 1959..... | 28 |
| <i>Culicoides leoni</i> Barbosa, 1952..... | 29 |
| Subgenus unplaced, <i>limai</i> species group..... | 29 |
| <i>Culicoides luglani</i> Jones & Wirth, 1958..... | 29 |
| Subgenus unplaced, <i>mohave</i> species group..... | 29 |
| <i>Culicoides bajensis</i> Wirth & Moraes, 1979..... | 29 |
| <i>Culicoides hoguei</i> Wirth & Moraes, 1979..... | 30 |
| <i>Culicoides mohave</i> Wirth, 1952..... | 30 |
| <i>Culicoides woodruffi</i> Spinelli & Huerta, 2015..... | 30 |
| Subgenus unplaced, <i>reticulatus</i> species group..... | 30 |
| <i>Culicoides lanei</i> Ortiz, 1950..... | 30 |
| Subgenus unplaced, <i>stigmalis</i> species group..... | 31 |
| <i>Culicoides stigmalis</i> Wirth, 1952..... | 31 |
| Subgenus unplaced, <i>stonei</i> species group..... | 31 |
| <i>Culicoides melleus</i> (Coquillett, 1901)..... | 31 |
| <i>Culicoides weneri</i> Wirth & Blanton, 1971..... | 31 |
| Species of <i>Culicoides</i> unplaced to subgenus or species group..... | 31 |
| <i>Culicoides albomaculus</i> Root & Hoffman, 1937..... | 31 |
| <i>Culicoides arubae</i> Fox & Hoffman, 1944..... | 32 |
| <i>Culicoides neghmei</i> Vargas, 1955..... | 32 |
| <i>Culicoides propinquus</i> Macfie, 1948..... | 32 |
| Keys to the subgenera and species groups of <i>Culicoides</i> of Mexico..... | 32 |
| Species list by state..... | 34 |
| Conclusions..... | 35 |
| Acknowledgments..... | 37 |
| Additional information..... | 37 |
| References..... | 37 |

Introduction

Species of the genus *Culicoides* Latreille, 1809 are tiny hematophagous dipterans, between 1 to 3 millimeters of length, and are known as “jejenes”, “polvorines”, “purrujas”, or “chaquistes” in Spanish, and as “biting midges”, “no-see-ums”, or “punkies” in English (Ibáñez-Bernal et al. 1996; Spinelli et al. 2005). This genus is the most diverse in the family Ceratopogonidae and is composed of 1,368 known extant species, classified into 33 subgenera, 38 species groups, and the remainder as miscellaneous (Borkent and Dominiak 2020; Borkent et al. 2022; Chatterjee et al. 2022; Labuschagne et al. 2023; Sarkar et al. 2023). Except for the regions of New Zealand and Antarctica, biting midges are distributed throughout the world and their populations occur in wetland, forest, agricultural, rural, and peri-urban areas, from sea level to 4,200 m of altitude (Wirth and Blanton 1959; Harrup et al. 2015).

Biting midges are a global concern because they cause direct and indirect damage to humans, domestic animals, and wildlife. Some species are vectors of pathogens, including viruses, bacteria, protozoa, and filariae (Vargas 1969; Borkent 2004) that infect different vertebrates, mainly birds and ruminant mammals, and produce important diseases such as Oropouche fever, Bluetongue disease, African horse sickness, Epizootic hemorrhagic disease, Schmallenberg disease (Mellor et al. 2000; Sick et al. 2019), as well as avian malaria by different species of *Haemoproteus* Kruse, 1890, *Leucocytozoon* Berestneff, 1904, *Hepaticystis* Levaditi & Schoen, 1932, and *Trypanosoma* Gruby, 1843 (Valkiunas 2005). In addition, their high densities and often-irritating bites cause skin lesions, secondary infections, and allergies (Blanton and Wirth 1979; Ibáñez-Bernal et al. 2020) and can generate important economic losses in sectors related to recreation and tourism, forestry, and agriculture (Wirth and Blanton 1974; Borkent and Spinelli 2007).

In several regions of the world, the transmission of pathogens by different species of *Culicoides* directly affects human health and has a detrimental effect on the farming industry and wildlife conservation programs. Mansonellosis, caused by *Mansonella* filariae, affects regions in America and Africa, and Oropouche fever, caused by a virus of the same name affects Central and South American countries, both considered neglected diseases which are the most relevant human diseases in which a *Culicoides* species is involved as vector (Linley et al. 1983; Borkent 2004; Mediannikov and Ranque 2018; Romero-Alvarez and Escobar 2018). However, pathogens of veterinary importance, such as Bluetongue virus, Epizootic hemorrhagic virus, Schmallenberg virus, and avian haemosporidians, cause significant economic losses at local and regional levels in farm industry (Mills et al. 2017; Alkhamis et al. 2020; Marzal and García-Longoria 2020), mainly because of high animal mortality and morbidity, transport bans, trade restrictions, prevention and control costs, and management and conservation efforts directed at wildlife (Sick et al. 2019; Marzal and García-Longoria 2020).

Despite the important sanitary and economic damages caused by different species of *Culicoides*, in Mexico, they have been scarcely studied as compared with other hematophagous Diptera; given their global relevance, at present, the study of the genus in the country can be considered neglected. The current

knowledge of Mexican species corresponds to the taxonomic description (Root and Hoffman 1937; Hoffman 1939; Vargas 1944, 1953a, 1953b, 1954, 1955, 1960, 1972; Macfie 1948; Vargas and Wirth 1955; Spinelli and Huerta 2015) and distribution records (Wirth and Jones 1957; Wirth and Hubert 1960; Wirth and Blanton 1978; Wirth and Moraes 1979; Huerta 1996; Huerta et al. 2012, 2020, 2022), progressively compiled in different lists and catalogues.

The first list of species from Mexico was elaborated by Vargas (1945) and included 14 species without a subgeneric classification. A decade later, the known richness was increased to 31 species by Fox (1955) in his catalog of hematophagous ceratopogonids of America and, later, to 50 species by Wirth (1974) in the "Catalog of the Diptera of America south of the United States", both of which already present a subgeneric classification of the genus. Ibáñez-Bernal et al. (1996) updated the richness of the family Ceratopogonidae in Mexico and specifically for the genus *Culicoides*, reporting 71 species, 13 subgenera, and eight endemic species; however, the identity of the species was not mentioned. The most recent catalog that most completely incorporated the known *Culicoides* fauna of Mexico, and its regional distribution was presented by Borkent and Spinelli (2000), in which they reported 69 species (eight endemic), 14 subgenera, and eight species groups. More recently, catalogues of the family Ceratopogonidae have corresponded to the Nearctic (Borkent and Grogan 2009) and Neotropical fauna (Borkent and Spinelli 2007), the two biogeographic regions that collide in Mexico (Griffiths 1980; Halffter 2003; Morrone 2005), but do not include all species known from Mexico. Particularly for the Neotropical Region, 49 species, 12 subgenera and 7 species groups have been reported, and for the Nearctic Region, 38 species, 10 subgenera and 3 species groups, respectively; neither of the two catalogues included the known endemic species of the country which were unknown at the time.

Mexico's biogeographic regions are important for *Culicoides* species distribution. The Nearctic and Neotropical Regions possess different habitats, with arid xerophyte vegetation and temperate forests in the north, and tropical forests in the south (Griffiths 1980). *Culicoides* species can be restricted to one region or occur in both. The "Mexican Transition Zone" is a vital area with various ecosystems and serving as a bridge between the two regions (Halffter 2003). It allows for the exchange of flora and fauna, and both regions share some biotic elements due to historical and ecological processes, but also there are conditions that promote endemism.

In recent years, the emergence and re-emergence of diseases caused by pathogens transmitted by different *Culicoides* species, such as the Schmallenberg virus and Bluetongue virus (Sick et al. 2019), has increased the interest of researchers and institutions and the need for their study worldwide. Vector species of *Culicoides* have already been reported in Mexico (Dampf 1936; Borkent and Spinelli 2007); however, their role as vectors in the country is uncertain. Mexico hosts an important vertebrate faunal diversity, the four North American migratory bird routes, and the largest migration of birds of prey in the world (Rappole et al. 1998) making it an important region where pathogens can be dispersed and maintained by biting midges, increasing the risk of emergence or re-emergence of zoonoses or wildlife diseases.

Vector-borne diseases are increasing their distribution and incidence, acquiring a more preponderant role in the maintenance of human welfare. Under this framework and with the scarce attention that historically has been given to the study of *Culicoides* in Mexico, it is evident and necessary to update the known information of the genus in the country. This work presents an update catalogue of the *Culicoides* of Mexico. It includes 86 species of 15 subgenera, ten species groups and four species not included in any group or subgenus (Table 1). It is arranged by subgenus and species, followed by the author(s) and the year of publication of the original description, their synonymies, and references. Subgenera and species groups are presented alphabetically, but species are classified according to the most recent proposal of Borkent and Dominiak (2020) and the assignment to the *limai* group of *C. luglani* by Phillips (2022). For each species the original reference, type locality, and their regional distribution by state, with the corresponding record reference are also presented. In addition, a key for subgenera and species groups and an index of species by state are presented.

Table 1. Number of species of *Culicoides* by subgenus and species group in Mexico.

| Subgenus/species group | Number of species |
|--------------------------------------------------------------------|-------------------|
| Subgenus <i>Amossovia</i> | 3 |
| Subgenus <i>Anilomyia</i> | 3 |
| Subgenus <i>Avaritia</i> | 3 |
| Subgenus <i>Beltranmyia</i> | 1 |
| Subgenus <i>Culicoides</i> | 5 |
| Subgenus <i>Diphaomyia</i> | 4 |
| Subgenus <i>Drymodesmyia</i> | 14 |
| Subgenus <i>Glaphiromyia</i> | 3 |
| Subgenus <i>Haematomyidium</i> | 5 |
| Subgenus <i>Hoffmania</i> | 9 |
| Subgenus <i>Macfiella</i> | 2 |
| Subgenus <i>Mataemyia</i> | 1 |
| Subgenus <i>Monoculicoides</i> | 3 |
| Subgenus <i>Oecacta</i> | 3 |
| Subgenus <i>Selfia</i> | 2 |
| Subgenus unplaced, <i>acotylus</i> species group | 1 |
| Subgenus unplaced, <i>daedalus</i> species group | 3 |
| Subgenus unplaced, <i>eublepharus</i> species group | 3 |
| Subgenus unplaced, <i>fluvialis</i> species group | 2 |
| Subgenus unplaced, <i>leoni</i> species group | 3 |
| Subgenus unplaced, <i>limai</i> species group | 1 |
| Subgenus unplaced, <i>mohave</i> species group | 4 |
| Subgenus unplaced, <i>reticulatus</i> species group | 1 |
| Subgenus unplaced, <i>stigmalis</i> species group | 1 |
| Subgenus unplaced, <i>stonei</i> species group | 2 |
| Species of <i>Culicoides</i> unplaced to subgenus or species group | 4 |
| Total | 86 |

Genus *Culicoides* Latreille, 1809

Subgenus *Amossovia* Glukhova, 1989

Amossovia Glukhova, 1989: 226 (as subgenus of *Culicoides*). Type species: *Culicoides dendrophilus* Amosova, by original designation.

Culicoides (Amossovia) cochisensis Wirth & Blanton, 1967

Culicoides cochisensis Wirth & Blanton, 1967: 216. Type locality: United States, Arizona, Santa Cruz, Sycamore Canyon. Additional references: Wirth (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California Sur (Wirth and Blanton 1967).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Murphree and Mullen 1991).

Associated pathogens. Unknown.

Culicoides (Amossovia) oklahomensis Khalaf, 1952

Culicoides oklahomensis Khalaf, 1952: 355 (as subspecies of *villosipennis* Root and Hoffman). Type locality: United States, Oklahoma, Wichita Refuge. Additional references: Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California, Sonora (Wirth and Blanton 1967).

General distribution. Nearctic. USA, Mexico. Neotropical. Guatemala (Borkent and Grogan 2009).

Immature stages. Larva (Murphree and Mullen 1991), pupa (Lamberson et al. 1992).

Associated pathogens. Unknown.

Culicoides (Amossovia) ousairani Khalaf, 1952

Culicoides ousairani Khalaf, 1952: 354. Type locality: United States, Oklahoma, Wichita Refuge. Additional references: Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Nuevo León (Wirth and Blanton 1967).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Murphree and Mullen 1991), pupa (Lamberson et al. 1992).

Associated pathogens. Unknown.

Subgenus *Anilomyia* Vargas, 1960

Anilomyia Vargas, 1960: 37 (as subgenus of *Culicoides*). Type species: *Culicoides covagarciai* Ortiz, by original designation.

***Culicoides (Anilomyia) hayesi* Matta, 1967**

Culicoides hayesi Matta, 1967: 75. Type locality: Honduras, Distrito Central, La Tigra. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Tamaulipas (Wirth and Blanton 1970).

General distribution. Neotropical. Mexico, Honduras (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Matta 1967).

Associated pathogens. Unknown.

***Culicoides (Anilomyia) nigrigenus* Wirth & Blanton, 1956**

Culicoides nigrigenus Wirth & Blanton, 1956b: 222. Type locality: Panama, Boca del Toro, Almirante. Additional references: Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Veracruz (Wirth and Blanton 1970), Hidalgo (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Guatemala, Belize, El Salvador, Nicaragua, Panama, Colombia, Trinidad and Tobago, Argentina (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Anilomyia) pseudodecor* Spinelli & Huerta, 2015**

Culicoides pseudodecor Spinelli & Huerta, 2015: 818. Type locality: Mexico, Morelos, El Salto Falls.

Distribution in Mexico. Morelos, Veracruz (Spinelli and Huerta 2015).

General distribution. Endemic. Mexico. (Spinelli and Huerta 2015).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Avaritia* Fox, 1955

Avaritia Fox, 1955: 218 (as subgenus of *Culicoides*). Type species: *Ceratopogon obsoletus* Meigen, by original designation.

***Culicoides (Avaritia) boydi* Wirth & Mullens, 1992**

Culicoides boydi Wirth & Mullens, 1992: 1006. Type locality: United States, California Riverside County, Deep Canyon, Santa Rosa Mountains. Additional references: Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Mullens 1992).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Egg, larva, pupa (Breidenbaugh and Mullens 1999b).

Associated pathogens. Bluetongue virus (Wirth and Mullens 1992).

***Culicoides (Avaritia) pusilloides* Wirth & Blanton, 1955**

Culicoides pusilloides Wirth & Blanton, 1955a: 104. Type locality: Panama, Boca del Toro Province, Almirante. Additional references: Wirth and Blanton (1959, 1974), Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Guatemala, Belize, Panama (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Avaritia) pusillus* Lutz, 1913**

Culicoides pusillus Lutz, 1913: 52. Type locality: Brazil, Rio de Janeiro, Manguinhos. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959, 1974), Wirth (1965, 1974), Aitken et al. (1975), Blanton and Wirth (1979), Wirth et al. (1985), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Chiapas (Macfie 1948), Tabasco, Veracruz (Huerta et al. 2012), Oaxaca (Huerta et al. 2020).

General distribution. Nearctic. USA. Neotropical. Mexico, Central and South America (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Bluetongue virus (Mo et al. 1994).

Subgenus *Beltranmyia* Vargas, 1953

Beltranmyia Vargas, 1953: 34 (as subgenus of *Culicoides*). Type species: *Culicoides crepuscularis* Malloch, by original designation.

***Culicoides (Beltranmyia) crepuscularis* Malloch, 1915**

Culicoides crepuscularis Malloch, 1915: 303. Type locality: United States, Illinois, Du Bois. Additional references: Fox (1955), Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Mexico City (Root and Hoffman 1937; Vargas 1945; formerly Distrito Federal), Morelos, Sonora, Veracruz (Wirth et al. 1988), Coahuila (Huerta et al. 2012).

General distribution. Nearctic. Canada, USA, Mexico. Neotropical. Mexico, El Salvador, Honduras, Costa Rica (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Jamnback 1965).

Associated pathogens. *Chandlerella quiscali* (Robinson 1971), *Eufilaria longicaudata* (Hibler 1963), *Haemoproteus danilewskyi* (Fallis and Bennett 1960), *H. fringillae* (Fallis and Bennet 1961), *H. velans* (Borkent 2004).

Subgenus *Culicoides* Latreille, 1809

Silvicola Mirzaeva & Isaev, 1990: 98 (as subgenus of *Culicoides*). Type species: *Culicoides grisescens* Edwards, by original designation.

***Culicoides (Culicoides) elutus* Macfie, 1948**

Culicoides elutus Macfie, 1948: 75. Type locality: Mexico, Chiapas, El Carrizal. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Oaxaca (Vargas 1945, as var. *cockerelli* Coquillett 1901), Chiapas (Macfie 1948).

General distribution. Neotropical. Mexico, Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Culicoides) fortinensis* Spinelli & Huerta, 2015**

Culicoides fortinensis Spinelli & Huerta, 2015: 812. Type locality: Mexico, Veracruz, Fortín de la Flores.

Distribution in Mexico. Veracruz (Spinelli and Huerta 2015).

General distribution. Endemic. Mexico (Spinelli and Huerta 2015).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Culicoides) luteovenus* Root & Hoffman, 1937**

Culicoides luteovenus Root & Hoffman, 1937: 156. Type locality: Mexico, Mexico City, San Jacinto. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1965, 1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Mexico City (Root and Hoffman 1937), Oaxaca (Vargas 1945), Chiapas (Macfie 1948), Veracruz (Huerta et al. 2012).

General distribution. Nearctic. USA. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Wirth 1952).

Associated pathogens. Unknown.

***Culicoides (Culicoides) neopulicaris* Wirth, 1955**

Culicoides neopulicaris Wirth, 1955: 355. Type locality: United States, Texas, Kerrville. Additional references: Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009), Huerta et al. (2012).

Distribution in Mexico. San Luis Potosí, Guerrero (Wirth 1955), Chiapas, Morelos, Veracruz (Wirth and Blanton 1969), Hidalgo, Estado de México, Yucatán (Huerta et al. 2012), Oaxaca (Huerta et al. 2020).

General distribution. Nearctic. USA. Neotropical. Mexico, Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica (Borkent and Spinelli 2007).

Immature stages. Pupa (Jones 1961).

Associated pathogens. Unknown.

***Culicoides (Culicoides) rulfoi* Spinelli & Huerta, 2015**

Culicoides rulfoi Spinelli & Huerta, 2015: 816. Type locality: Mexico, Michoacán, Puerto Garnica.

Distribution in Mexico: Michoacán (Spinelli and Huerta 2015).

General distribution. Endemic. Mexico (Spinelli and Huerta 2015).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Diphaomyia* Vargas, 1960

Diphaomyia Vargas, 1960: 40 (as subgenus of *Culicoides*). Type species: *Culicoides baueri* Hoffman, by original designation.

***Culicoides (Diphaomyia) baueri* Hoffman, 1925**

Culicoides baueri Hoffman, 1925: 297. Type locality: United States, Maryland, Baltimore. Additional references: Root and Hoffman (1937), Vargas (1945), Fox (1955), Vargas and Wirth (1955), Forattini (1957), Wirth (1965, 1974), Wirth et al. (1985), Borkent and Wirth (1997), Borkent and Grogan (2009).

Distribution in Mexico. Puebla (Huerta et al. 2012), Oaxaca (Huerta et al. 2020).

General distribution. Nearctic. USA. Neotropical. Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Murphree and Mullen 1991).

Associated pathogens. *Haemoproteus mansonii* (as *H. meleagridis*, Atkinson et al. 1983).

***Culicoides (Diphaomyia) blantoni* Vargas & Wirth, 1955**

Culicoides blantoni Vargas & Wirth, 1955: 33. Type locality: Mexico, Tamaulipas, Ciudad Mante. Additional references: Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Guerrero, Puebla, San Luis Potosí, Tamaulipas (Vargas and Wirth 1955), Morelos, Sinaloa (Wirth 1974), Veracruz (Huerta et al. 2012), Tabasco (Huerta et al. 2022).

General distribution. Nearctic. USA. Neotropical. Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Diphaomyia) haematopotus* Malloch, 1915**

Culicoides haematopotus Malloch, 1915: 302. Type locality: United States, Illinois. Additional references: Vargas (1949), Fox (1955), Wirth (1965, 1974), Atchley and Wirth (1979), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Mexico City (Root and Hoffman 1937), Guerrero (Vargas 1945), Chiapas (Macfie 1948), Baja California (Atchley and Wirth 1979), Puebla, Veracruz (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico, Belize, Guatemala, Honduras (Borkent and Grogan 2009).

Immature stages. Larva (Jamnback 1965), pupa (Thomsen, 1937).

Associated pathogens. *Chandlerella quiscali* (Robinson 1971), *Chandlerella striatospicula*, *Eufilaria longicaudata* (Hibler 1963), *Haemaphysalis mansonii* (as *H. meleagridis*, Atkinson et al. 1988), Bluetongue virus (Becker et al. 2010).

***Culicoides (Diphaomyia) iriartei* Fox, 1952**

Culicoides iriartei Fox, 1952: 368. Type locality: Venezuela, Zulia, La Salina. Additional references: Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides vargasi Wirth & Blanton, 1953: 74, syn. Type locality: Panama.

Distribution in Mexico. Chiapas, Veracruz (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Guatemala, Belize, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad and Tobago, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Drymodesmyia* Vargas, 1960

Drymodesmyia Vargas, 1960: 40 (as subgenus of *Culicoides*). Type species: *Culicoides copiosus* Root and Hoffman, by original designation.

***Culicoides (Drymodesmyia) arizonensis* Wirth & Hubert, 1960**

Culicoides arizonensis Wirth & Hubert, 1960: 655. Type locality: United States, Arizona, Maricopa. Additional references: Wirth (1965, 1974), Wirth et al.

(1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) bakeri* Vargas, 1954**

Culicoides bakeri Vargas, 1954: 27. Type locality: Mexico, Mexico City (formerly Distrito Federal), Chapultepec. Additional references: Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000).

Distribution in Mexico. Mexico City (Vargas 1954).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) butleri* Wirth & Hubert, 1960**

Culicoides butleri Wirth & Hubert, 1960: 650. Type locality: United States, Arizona, Baboquivari, Brown Canyon. Additional references: Wirth et al. (1985, 1988), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Nuevo León (Wirth et al. 1988).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) cacticola* Wirth & Hubert, 1960**

Culicoides cacticola Wirth & Hubert, 1960: 653. Type locality: United States, California, Los Angeles, San Dimas Canyon. Additional references: Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California Sur, Sonora (Monarch 2022).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Murphree and Mullen 1991), egg, pupa (Breidenbaugh and Mullens 1999b).

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) copiosus* Root & Hoffman, 1937**

Culicoides copiosus Root & Hoffman, 1937: 171. Type locality: Mexico, Mexico City (formerly Distrito Federal), San Jacinto. Additional references: Vargas (1945), Fox (1955), Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Mexico City (Root and Hoffman 1937), Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) insolatus* Wirth & Hubert, 1960**

Culicoides insolatus Wirth & Hubert, 1960: 654. Type locality: Mexico, Baja California, San Felipe. Additional references: Wirth (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) jamaicensis* Edwards, 1922**

Culicoides jamaicensis Edwards, 1922: 165 (as var. *loughnani* Edwards). Type locality: Jamaica, Kingston. Additional references: Fox (1955), Wirth and Blanton (1959, 1974), Wirth and Hubert (1960), Wirth (1965, 1974), Aitken et al. (1975), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009), Huerta et al. (2020).

Distribution in Mexico. Chiapas (as var. *loughnani* Macfie 1948), Veracruz (Wirth and Hubert 1960), Yucatán (Borkent and Spinelli 2007), Guerrero, Estado de México, Jalisco, Oaxaca (Huerta et al. 2012), Tabasco (Huerta et al. 2022).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) loughnani* Edwards, 1922**

Culicoides loughnani Edwards, 1922: 165. Type locality: Jamaica, Kingston. Additional references: Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Yucatán (Borkent and Spinelli 2007).

General distribution. Nearctic. USA. Neotropical. Mexico, Bahamas, Cuba, Jamaica. Australian. Australia (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) panamensis* Barbosa, 1947**

Culicoides panamensis Barbosa, 1947: 22. Type locality: Panama, Barro Colorado. Additional references: Fox (1955), Wirth (1955, 1974), Forattini (1957), Wirth and Blanton (1959, 1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides alambicolorum Macfie, 1948: 81, syn. Type locality: Mexico, Chiapas.

Distribution in Mexico. Chiapas (Macfie 1948), Nayarit, Veracruz (Borkent and Spinelli 2000), Baja California, Estado de México, Morelos (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Costa Rica, Jamaica (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) poikilonotus* Macfie, 1948**

Culicoides poikilonotus Macfie, 1948: 82. Type locality: Mexico, Chiapas, El Verjel. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides cacozelus Macfie, 1948: 85, syn. Type locality: Mexico, Chiapas.

Culicoides hertigi Wirth & Blanton, 1953: 229, syn. Type locality: Panama.

Distribution in Mexico. Chiapas (Macfie 1948), Veracruz (Huerta et al. 2012), Tabasco (Huerta et al. 2022).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Venezuela, Trinidad and Tobago, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) ryckmani* Wirth & Hubert, 1960**

Culicoides ryckmani Wirth & Hubert, 1960: 656. Type locality: United States, California, Los Angeles, San Dimas Canyon. Additional references: Wirth (1965, 1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) sitiens* Wirth & Hubert, 1960**

Culicoides sitiens Wirth & Hubert, 1960: 652. Type locality: United States, California, Los Angeles, San Dimas Canyon. Additional references: Atchley

(1967), Wirth (1965, 1974), Wirth et al. (1985), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) torridus* Wirth & Hubert, 1960**

Culicoides torridus Wirth & Hubert, 1960: 654. Type locality: Mexico, Baja California, San Felipe. Additional references: Wirth (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Hubert 1960).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Drymodesmyia) wirthomyia* Vargas, 1953**

Culicoides wirthomyia Vargas, 1953: 227. Type locality: Mexico, Guerrero, Iguala. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Guerrero (Vargas 1953b).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Glaphiromyia* Vargas, 1960

Glaphiromyia Vargas, 1960: 41 (as subgenus of *Culicoides*). Type species: *Culicoides scopus* Root and Hoffman, by original designation.

***Culicoides (Glaphiromyia) dampfi* Root & Hoffman, 1937**

Culicoides dampfi Root & Hoffman, 1937: 169. Type locality: Mexico, Mexico City (formerly Distrito Federal), San Jacinto. Additional references: Fox (1955), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000).

Distribution in Mexico. Mexico City (Root and Hoffman 1937).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Glaphiromyia) parascopus* Wirth & Blanton, 1978**

Culicoides parascopus Wirth & Blanton, 1978: 238. Type locality: Mexico, Michoacán, Puerto Garnica. Additional references: Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Michoacán (Wirth and Blanton 1978).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Glaphiromyia) scopus* Root & Hoffman, 1937**

Culicoides scopus Root & Hoffman, 1937: 170. Type locality: Mexico, Mexico City (formerly Distrito Federal), San Jacinto. Additional references: Vargas (1945), Fox (1955), Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Mexico City (Root and Hoffman 1937).

General distribution. Neotropical. Mexico, Costa Rica, Panama (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Haematomyidium* Goeldi, 1905

Haematomyidium Goeldi, 1905: 137. Type species: *Haematomyidium paraensis* Goeldi, by original designation.

***Culicoides (Haematomyidium) debilipalpis* Lutz, 1913**

Culicoides debilipalpis Lutz, 1913: 60. Type locality: Brazil, São Paulo, Serra da Bocaina. Additional references: Macfie (1948), Fox (1955), Forattini (1957), Wirth (1965, 1974), Wirth et al. (1985), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Culicoides khalafi Beck, 1957: 104, syn. Type locality: United States, Florida.

Culicoides ichesi Ronderos & Spinelli, 1995: 77, syn. Type locality: Argentina, Misiones.

Distribution in Mexico. Veracruz, Yucatán (Huerta et al. 2012), Oaxaca (Huerta et al. 2020).

General distribution. Nearctic. USA. Neotropical. Mexico, Central and South America (Borkent and Grogan 2009).

Immature stages. Larva (Ronderos et al. 2010), pupa (Forattini 1957).

Associated pathogens. Bluetongue virus (Mullen et al. 1985).

***Culicoides (Haematomyidium) eadsi* Wirth & Blanton, 1971**

Culicoides eadsi Wirth & Blanton, 1971a: 37. Type locality: United States, Texas, Cameron County. Additional references: Wirth (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Nayarit, San Luis Potosí, Sonora, Yucatán (Wirth and Blanton 1971a).

General distribution. Nearctic. USA. Neotropical. Mexico, Cuba, Guatemala (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Haematomyidium) ginesi* Ortiz, 1951**

Culicoides ginesi Ortiz, 1951: 586. Type locality. Venezuela, San Felipe, Yaracuy. Additional references: Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Oaxaca (Huerta et al. 2020).

General distribution. Neotropical. Mexico, El Salvador, Honduras, Nicaragua Costa Rica, Panama, Colombia, Venezuela, Trinidad and Tobago, Brazil, Argentina (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Haematomyidium) kettlei* Breidenbaugh & Mullens, 1999**

Culicoides kettlei Breidenbaugh & Mullens, 1999a: 150. Type locality: United States, California, Riverside County. Additional references: Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Breidenbaugh and Mullens 1999a).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Egg, larva, pupa (Breidenbaugh and Mullens 1999a).

Associated pathogens. Unknown.

***Culicoides (Haematomyidium) paraensis* (Goeldi, 1905)**

Culicoides paraensis (Goeldi, 1905): 137 (as *Haematomyidium paraense*). Type locality: Brazil, Pará. Additional references: Wirth (1965, 1974), Wirth and Blanton (1974), Blanton and Wirth (1979), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009), Huerta et al. (2022). *Culicoides undecimpunctatus* Kieffer, 1917: 307, syn. Type locality: Argentina, San Pablo.

Distribution in Mexico. Quintana Roo, San Luis Potosí (Blanton and Wirth 1979), Tabasco, Veracruz (Wirth and Felipe-Bauer 1989), Chiapas (Huerta et al. 2012).

General distribution. Nearctic. USA. Neotropical. Mexico, Central and South America (Borkent and Spinelli 2007).

Immature stages. Larva (Murphree and Mullen 1991), pupa (Lamberson et al. 1992).

Associated pathogens. Oropouche virus (Pinheiro et al. 1981).

Subgenus *Hoffmania* Fox, 1948

Hoffmania Fox, 1948: 21 (as subgenus of *Culicoides*). Type species: *Culicoides inamollae* Fox and Hoffman (= *Culicoides insignis* Lutz), by original designation.

***Culicoides (Hoffmania) diabolicus* Hoffman, 1925**

Culicoides diabolicus Hoffman, 1925: 294. Type locality: Panama, Cabima. Additional references: Vargas (1945), Fox (1955), Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas, Veracruz (Vargas 1944), Oaxaca (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Venezuela, Ecuador (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. *Filaria* sp. (Dampf 1936).

***Culicoides (Hoffmania) filariferus* Hoffman, 1939**

Culicoides filariferus Hoffman, 1939: 172. Type locality: Mexico, Chiapas, El Vergel. Additional references: Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Hoffman 1939), Veracruz (Borkent and Spinelli 2000).

General distribution. Neotropical. Mexico, Central America, Trinidad and Tobago, Ecuador, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Hoffmania) foxi* Ortiz, 1950**

Culicoides foxi Ortiz, 1950c: 461. Type locality: Puerto Rico, Campo Tortugero. Additional references: Forattini (1957), Wirth (1974), Wirth and Blanton (1974), Aitken et al. (1975), Huerta (1996), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Huerta et al. (2012, 2020).

Distribution in Mexico. Veracruz (Wirth and Blanton 1974), Guerrero, Oaxaca (Spinelli et al. 1993), Chiapas (Borkent and Spinelli 2007), Tabasco (Huerta et al. 2022).

General distribution. Neotropical. Mexico, Puerto Rico, Central and South America (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. *Leishmania braziliensis* (Rebêlo et al. 2016).

***Culicoides (Hoffmania) hylas* Macfie, 1940**

Culicoides hylas Macfie, 1940: 26. Type locality: Guyana, New River. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Huerta et al. (2012).

Distribution in Mexico. Veracruz (Wirth and Blanton 1968), Oaxaca (Huerta et al. 2020).

General distribution. Neotropical. Mexico, Central America, Venezuela, Colombia, Ecuador, Peru, Brazil (Borkent and Spinelli 2007).

Immature stages. Pupa (Forattini 1957).

Associated pathogens. Unknown.

***Culicoides (Hoffmania) insignis* Lutz, 1913**

Culicoides insignis Lutz, 1913: 51. Type locality: Brazil, Rio de Janeiro. Additional references: Wirth and Blanton (1956c, 1959, 1974), Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009), Huerta et al. (2022).

Culicoides inamollae Fox & Hoffman, 1944: 110, syn. Type locality: Puerto Rico.

Culicoides painteri Fox, 1946: 257, syn. Type locality: Honduras.

Distribution in Mexico. Chiapas (Macfie 1948), Tamaulipas (Wirth and Blanton 1956c), Yucatán (Blanton and Wirth 1979), Tabasco, Veracruz (Huerta et al. 2012), Oaxaca (Huerta et al. 2020).

General distribution. Nearctic. USA. Neotropical. Mexico, Central and South America (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Forattini 1957).

Associated pathogens. Bluetongue virus (Tanya et al. 1992).

***Culicoides (Hoffmania) ocumarensis* Ortiz, 1950**

Culicoides ocumarensis Ortiz, 1950b: 455. Type locality: Venezuela, Miranda, Ocumare del Tuy. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Spinelli (2000, 2007), Huerta et al. (2020).

Distribution in Mexico. Oaxaca, Tabasco (Spinelli et al. 1993).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Hoffmania) palpalis* Macfie, 1948**

Culicoides palpalis Macfie, 1948: 78. Type locality: Mexico, Chiapas, San Cristobal. Additional references: Wirth and Blanton (1968), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Macfie 1948).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador Honduras, Nicaragua, Costa Rica, Panama, Colombia, Peru, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Hoffmania) pseudodiabolicus* Fox, 1946**

Culicoides pseudodiabolicus Fox, 1946: 256. Type locality: Trinidad and Tobago, Cumuto Village. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Veracruz (Wirth 1974), Oaxaca (Huerta et al. 2020).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador Honduras, Nicaragua, Costa Rica, Panama, Colombia, Peru, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides (Hoffmania) verecundus* Macfie, 1948**

Culicoides verecundus Macfie, 1948: 76. Type locality: Mexico, Chiapas, El Vergel. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959, 1968), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Macfie 1948).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Macfiella* Fox, 1955

Macfiella Fox, 1955: 217 (as subgenus of *Culicoides*). Type species: *Ceratopogon phlebotomus* Williston, by original designation.

***Culicoides (Macfiella) phlebotomus* (Williston, 1896)**

Culicoides phlebotomus (Williston, 1896): 281 (as *Ceratopogon*). Type locality: St. Vincent. Additional references: Forattini (1957), Wirth (1974), Wirth and

Blanton (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides amazonius Macfie, 1935: 52, syn. Type locality: Brazil, Pará.

Distribution in Mexico. Oaxaca (Wirth and Blanton 1953), Guerrero (Vargas 1954), Sinaloa (Wirth et al. 1988), Campeche, Quintana Roo, Yucatán (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Central America, Colombia, Ecuador, Venezuela, Jamaica, Brazil (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Painter 1927).

Associated pathogens. *Mansonella ozzardi* (Nathan 1981).

***Culicoides (Macfiella) willistoni* Wirth & Blanton, 1953**

Culicoides willistoni Wirth & Blanton, 1953: 116. Type locality: Panama, Coclé, Rio Hato. Additional references: Wirth (1974), Wirth et al (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Sonora (Wirth et al. 1988).

General distribution. Neotropical. Mexico, Honduras, Panama (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus *Mataemyia* Vargas, 1960

Mataemyia Vargas, 1960: 43 (as subgenus of *Culicoides*). Type species: *Culicoides mojingaensis* Wirth and Blanton, by original designation.

***Culicoides (Mataemyia) dicrourus* Wirth & Blanton, 1955**

Culicoides dicrourus Wirth & Blanton, 1955b: 123. Type locality: Panama, Canal Zone, Loma Borracho. Additional references: Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Tabasco (Huerta et al. 2022).

General distribution. Neotropical. Mexico, Costa Rica, Panama, Colombia, Ecuador (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Wirth and Soria 1981).

Associated pathogens. Unknown.

Subgenus *Monoculicoides* Khalaf, 1954

Monoculicoides Khalaf, 1954: 39 (as subgenus of *Culicoides*). Type species: *Ceratopogon nubeculosus* Meigen, by original designation.

Stigmoculicoides Isaev, 1988: 15 (as subgenus of *Culicoides*). Type species: *Culicoides stigma* (Meigen), by original designation.

***Culicoides (Monoculicoides) occidentalis* Wirth & Jones, 1957**

Culicoides occidentalis Wirth & Jones, 1957: 21 (as subspecies of *variipennis*).

Type locality: United States, California, Lake County. Additional references: Wirth and Jones (1957), Wirth (1965, 1974), Wirth et al. (1985), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California, Puebla (Borkent and Spinelli 2000), Baja California Sur (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Larva (as *variipennis*) (Murphree and Mullen 1991), pupa (Shults and Borkent 2018).

Associated pathogens. Unknown.

***Culicoides (Monoculicoides) sonorensis* Wirth & Jones, 1957**

Culicoides sonorensis Wirth & Jones, 1957: 18 (as subspecies of *variipennis*).

Type locality: United States, Arizona, Cochise County. Additional references: Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Grogan (2009).

Culicoides variipennis albertensis Wirth & Jones, 1957: 17, syn. Type locality: Canada.

Culicoides variipennis australis Wirth & Jones, 1957: 15, syn. Type locality: United States, Louisiana.

Distribution in Mexico. Estado de Mexico, Guerrero, Mexico City, Nuevo León, Nuevo León, Puebla, Sonora (Wirth and Jones 1957), Coahuila, Durango, Nayarit, San Luis Potosí (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico (Borkent and Grogan 2009).

Immature stages. Egg (as *variipennis*) (Jones 1957), larva (as *variipennis*) (Wirth 1952), pupa (Borkent 2012; Shults et al. 2016, redescription).

Associated pathogens. Bluetongue virus (Price and Hardy 1954), African horse-sickness virus (Mellor et al. 1975), Epizootic hemorrhagic disease virus (Foster et al. 1977) and Vesicular stomatitis virus (Drolet et al. 2005).

***Culicoides (Monoculicoides) variipennis* (Coquillett, 1901)**

Culicoides variipennis (Coquillett, 1901): 602 (as *Ceratopogon*). Type locality: United States, Virginia, Richmond. Additional references: Vargas (1945), Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Spinelli (2000), Borkent and Grogan (2009), Huerta et al. (2012).

Distribution in Mexico. Mexico City (Hoffman 1925), Estado de México (Holbrook et al. 2000).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Jones 1955), pupa (Malloch 1915; Shults and Borkent 2018, redescription).

Associated pathogens. Bluetongue virus (Price and Hardy 1954).

Subgenus *Oecacta* Poey, 1853

Oecacta Poey, 1853: 238. Type species: *Oecacta furens* Poey, by monotypy.

***Culicoides (Oecacta) barbosai* Wirth & Blanton, 1956**

Culicoides barbosai Wirth & Blanton, 1956a: 161. Type locality: Panama, Canal Zone, Mojinga Swamp. Additional references: Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Quintana Roo (Blanton and Wirth 1979).

General distribution. Nearctic. USA. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador (Borkent and Grogan 2009).

Immature stages. Egg (Linley and Davies 1971), larva (Murphree and Mullen 1991), pupa (Blanton and Wirth 1979).

Associated pathogens. *Manzonella ozzardi* (Lowrie and Raccurt 1984), *Leishmania mexicana* (Ríos-Tostado et al. 2021).

***Culicoides (Oecacta) cancer* Hogue & Wirth, 1968**

Culicoides cancer Hogue & Wirth, 1968: 2. Type locality: Costa Rica, Puntarenas, Golfo de Nicoya, Boca de Barranca. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Sinaloa (Wirth et al. 1988).

General distribution. Neotropical. Mexico, El Salvador, Costa Rica (Borkent and Spinelli 2007).

Immature stages. Larva, pupa (Hogue and Wirth 1968).

Associated pathogens. Unknown.

***Culicoides (Oeacta) furens* Poey, 1853**

Culicoides furens (Poey, 1853): 236. Type locality: Cuba. Additional references: Hoffman (1925), Fox (1955), Forattini (1957), Wirth and Blanton (1959, 1974), Wirth (1965, 1974), Blanton and Wirth (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009). *Ceratopogon maculithorax* (Williston, 1896): 277, syn. Type locality: St. Vincent. *Culicoides dovei* Hall, 1932: 88, syn. Type locality: United States, Georgia. *Culicoides birabeni* Cavalieri, 1966: 59, syn. Type locality: Venezuela.

Distribution in Mexico. Veracruz (Townsend 1897), Tabasco (Hoffman 1925), Campeche (Barbosa 1947), Sinaloa (Vargas 1945), Guerrero, Sonora, Tamaulipas, Yucatán (Wirth and Blanton 1974), Baja California, Hidalgo, Nayarit (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico, Central America, Caribbean islands, Colombia, Venezuela, Ecuador, Brazil (Borkent and Grogan 2009).

Immature stages. Larva, pupa (Painter 1927).

Associated pathogens. *Manzonella ozzardi* (Buckley 1934), *Tetrapetalonema marmosetae* (Lowrie et al. 1978), *Leishmania mexicana* (Ríos-Tostado et al. 2021).

Subgenus *Selfia* Khalaf, 1954

Selfia Khalaf, 1954: 38 (as subgenus of *Culicoides*). Type species: *Culicoides hieroglyphicus* Malloch, by original designation.

***Culicoides (Selfia) hieroglyphicus* Malloch, 1915**

Culicoides hieroglyphicus Malloch, 1915: 297. Type locality: United States, Arizona, Graham Mountains, Ash Creek. Additional references: Atchley (1967), Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California, Sonora (Atchley 1970), Durango (Wirth et al. 1988).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Larva (Atchley 1970), pupa (Jones 1961).

Associated pathogens. Unknown.

***Culicoides (Selfia) multipunctatus* Malloch, 1915**

Culicoides multipunctatus Malloch, 1915: 296. Type locality: United States, Illinois, Urbana. Additional references: Wirth (1965), Wirth et al. (1985), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Tamaulipas (Atchley 1970), Morelos (Wirth et al. 1988).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Pupa (Jones 1961).

Associated pathogens. Unknown.

Subgenus unplaced, *acotylus* species group

***Culicoides acotylus* Lutz, 1913**

Culicoides acotylus Lutz, 1913: 69. Type locality: Brazil, Mato Grosso, Rio Tapajós. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides panamericanus Fox, 1947: 90, syn. Type locality: Mexico, Mexico City (formerly Distrito Federal).

Distribution in Mexico. Mexico City (Fox, 1947, as *panamericanus*).

General distribution. Neotropical. Mexico, Honduras, Panama, Venezuela, Trinidad and Tobago, Surinam, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *daedalus* species group

***Culicoides crescentis* Wirth & Blanton, 1959**

Culicoides crescentis Wirth & Blanton, 1959: 317. Type locality: Panama, Canal Zone, Mojinga Swamp. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Wirth and Blanton 1959).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Argentina (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides daedalus* Macfie, 1948**

Culicoides daedalus Macfie, 1948: 83. Type locality: Mexico, Chiapas, El Vergel. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1965, 1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Chiapas (Macfie 1948), Veracruz (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides pampoikilus* Macfie, 1948**

Culicoides pampoikilus Macfie, 1948: 79. Type locality: Mexico, Chiapas, El Vergel. Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Atchley (1967), Wirth (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).
Culicoides dominicii Ortiz, 1951: 7, syn. Type locality: Venezuela.

Distribution in Mexico. Chiapas (Macfie 1948), Oaxaca (Vargas 1945; Vargas 1954), Veracruz (Huerta et al. 2012).

General distribution. Nearctic. USA. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *eublepharus* species group

***Culicoides eublepharus* Macfie, 1948**

Culicoides eublepharus Macfie, 1948: 86. Type locality: Guyana. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Spinelli (2000, 2007). *Culicoides transferrans* Ortiz, 1953: 801, syn. Type locality: Venezuela.

Distribution in Mexico. Chiapas (Wirth et al. 1988).

General distribution. Neotropical. Mexico, Costa Rica, Panama, Colombia, Ecuador, Venezuela, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides propriipennis* Macfie, 1948**

Culicoides propriipennis Macfie, 1948: 84. Mexico, Chiapas, San Cristóbal de las Casas: Additional references: Fox (1955), Forattini (1957), Wirth and Blanton (1959), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Chiapas (Macfie 1948).

General distribution. Neotropical. Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Venezuela, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides rangeli* Ortiz & Mirsa, 1952**

Culicoides rangeli Ortiz & Mirsa, 1952: 126. Type locality. Venezuela, Miranda, Los Chorro. Additional references: Forattini (1957), Wirth and Blanton (1959), Wirth (1974, as *donajii*), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides donajii Vargas, 1954: 28, syn. Type locality: Mexico, Oaxaca.

Culicoides patupalpis Wirth & Blanton, 1959: 421, syn. Type locality: Panama.

Distribution in Mexico. Oaxaca (Vargas 1954, as *donajii*).

General distribution. Neotropical. Mexico, Central America, Colombia, Ecuador, Bolivia, Venezuela, Trinidad and Tobago, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *fluvialis* species group

***Culicoides castillae* Fox, 1946**

Culicoides castillae Fox, 1946: 251. Type locality: Honduras, Puerto Castilla. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Culicoides gibsoni Wirth, 1952: 246, syn. Type locality: Guatemala.

Culicoides flochabonnenci Ortiz & Mirsa, 1952: 267, syn. Type locality: Venezuela.

Distribution in Mexico. Michoacán (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Venezuela, Trinidad and Tobago (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides leopoldoi* Ortiz, 1951**

Culicoides leopoldoi Ortiz, 1951: 579. Type locality: Venezuela, Ocumare del Tuy. Additional references: Vargas (1954), Forattini (1957), Wirth and Blanton (1959), Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Oaxaca (Huerta et al. 2012), Tabasco (Huerta et al. 2022).

General distribution. Neotropical. Mexico, Central America, Colombia, Ecuador, Venezuela, Trinidad and Tobago, Bolivia, Argentina (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *leoni* species group

***Culicoides gabaldoni* Ortiz, 1954**

Culicoides gabaldoni Ortiz, 1954: 221. Type locality: Venezuela, Yaracuy, San Felipe. Additional references: Wirth (1974), Wirth and Blanton (1974), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Huerta et al. (2022).

Distribution in Mexico. Tabasco (Wirth et al. 1988), Oaxaca, Veracruz (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Central and South America (Borkent and Spinelli 2007).

Immature stages described. Unknown.

Pathogens associated. Unknown.

***Culicoides glabellus* Wirth & Blanton, 1956**

Culicoides glabellus Wirth & Blanton, 1956d: 47. Type locality: Panama, Boca del Toro, Almirante. Additional references: Wirth (1974), Wirth et al. (1988),

Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Huerta et al. (2022).

Distribution in Mexico. Oaxaca (Huerta et al. 2020).

General distribution. Neotropical. Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Trinidad and Tobago, Venezuela, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides leoni* Barbosa, 1952**

Culicoides leoni Barbosa, 1952: 17. Type locality: Ecuador, Santo Domingo. Additional references: Forattini (1957), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Veracruz (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Ecuador (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *limai* species group

***Culicoides luglani* Jones & Wirth, 1958**

Culicoides luglani Jones & Wirth, 1958: 89. Type locality: United States, Texas, Kerr County. Additional references: Wirth (1965, 1974), Atchley (1967), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California, Sonora, Tamaulipas (Wirth 1974).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *mohave* species group

***Culicoides bajensis* Wirth & Moraes, 1979**

Culicoides bajensis Wirth & Moraes, 1979: 291. Type locality: Mexico, Baja California Sur, Penjamo. Additional references: Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California Sur, Sonora (Wirth and Moraes 1979).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides hoguei* Wirth & Moraes, 1979**

Culicoides hoguei Wirth & Moraes, 1979: 293. Type locality: United States, California, Orange County, Seal Beach Weapons Station. Additional references: Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth and Moraes 1979).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides mohave* Wirth, 1952**

Culicoides mohave Wirth, 1952: 187. Type locality: United States, California, San Bernardino County, Vidal. Additional references: Wirth (1965, 1974), Wirth and Moraes (1979), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth 1952).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides woodruffi* Spinelli & Huerta, 2015**

Culicoides woodruffi Spinelli & Huerta, 2015: 821. Type locality: Mexico, Morelos.

Distribution in Mexico. Morelos (Spinelli and Huerta 2015).

General distribution. Endemic. Mexico (Spinelli and Huerta 2015).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *reticulatus* species group

***Culicoides lanei* Ortiz, 1950**

Culicoides lanei Ortiz, 1950a: 431. Type locality: Panama, Cerro Zefa. Additional references: Wirth (1974), Aitken et al. (1975), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Veracruz (Wirth et al. 1988).

General distribution. Neotropical. Mexico, Honduras, Costa Rica, Panama, Venezuela, Trinidad, Brazil (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *stigmalis* species group

***Culicoides stigmalis* Wirth, 1952**

Culicoides stigmalis Wirth, 1952: 245. Type locality: Guatemala, Chimaltenango, San Pedro Yepocapa. Additional references: Wirth (1974), Wirth et al. (1988), Borkent and Spinelli (2000, 2007).

Distribution in Mexico. Oaxaca (Vargas 1953b), Veracruz (Huerta et al. 2012).

General distribution. Neotropical. Mexico, Guatemala, Costa Rica, Panama (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

Subgenus unplaced, *stonei* species group

***Culicoides melleus* (Coquillett, 1901)**

Culicoides melleus (Coquillett, 1901): 604 (as *Ceratopogon*). Type locality: United States, Florida, Lake Worth. Additional references: Wirth (1965, 1974), Wirth et al. (1985), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Baja California (Wirth et al. 1988).

General distribution. Nearctic. Canada, USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides wernerii* Wirth & Blanton, 1971**

Culicoides wernerii Wirth & Blanton, 1971b: 463. Type locality: United States, Arizona, Quitobaquito, Pima County. Additional references: Wirth et al. (1985), Borkent and Spinelli (2000), Borkent and Grogan (2009).

Distribution in Mexico. Sonora (Wirth and Blanton 1971b).

General distribution. Nearctic. USA, Mexico (Borkent and Grogan 2009).

Immature stages. Unknown.

Associated pathogens. Unknown.

Species of *Culicoides* unplaced to subgenus or species group

***Culicoides albomaculus* Root & Hoffman, 1937**

Culicoides albomaculus Root & Hoffman, 1937 (as *albumacula*): 164. Type locality: Mexico, Mexico City, San Jacinto. Additional references: Vargas (1945, 1949), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000).

Distribution in Mexico. Mexico City (Root and Hoffman 1937).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides arubae* Fox & Hoffman, 1944**

Culicoides arubae Fox & Hoffman, 1944: 109. Type locality: Aruba. Additional references: Forattini (1957), Wirth (1965, 1974), Wirth and Blanton (1974), Wirth et al. (1985, 1988), Borkent and Wirth (1997), Borkent and Spinelli (2000, 2007), Borkent and Grogan (2009).

Distribution in Mexico. Tamaulipas (Vargas 1954), Campeche, Guerrero (Wirth et al. 1988), Veracruz, Yucatán (Huerta et al. 2012).

General distribution. Nearctic. USA, Mexico. Neotropical. Mexico, Aruba, Grenada, Colombia, Venezuela (Borkent and Spinelli 2007).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides neghmei* Vargas, 1955**

Culicoides neghmei Vargas, 1955: 673. Type locality: Mexico, Puebla, Atlixco. Additional references: Wirth (1974), Borkent and Wirth (1997), Borkent and Spinelli (2000).

Distribution in Mexico. Puebla (Vargas 1955).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

***Culicoides propinquus* Macfie, 1948**

Culicoides propinquus Macfie, 1948: 81. Type locality: Mexico, Chiapas, San Cristobal. Additional references: Vargas (1949), Fox (1955), Forattini (1957), Wirth (1974), Wirth et al. (1988), Borkent and Wirth (1997), Borkent and Spinelli (2000).

Distribution in Mexico. Chiapas (Macfie 1948).

General distribution. Endemic. Mexico (Borkent and Spinelli 2000).

Immature stages. Unknown.

Associated pathogens. Unknown.

Keys to the subgenera and species groups of *Culicoides* of Mexico

- 1 One spermatheca **2**
- Two or three spermathecae **6**
- 2 Spermatheca irregular or U-shaped; pigmentation of wing mostly white with isolated black spots; male parameres fused ***Monoculicoides***
- Spermatheca oval or pyriform; pigmentation of wing variable; male parameres separate **3**

- 3 Wing with abundant macrotrichia; flagellomeres 10–12 with coeloconica sensilla **4**
- Wing with sparse microtrichia limited to the distal part; flagellomeres 10–12 without coeloconica sensilla **5**
- 4 Wing cells m_1 , m_2 and distal part of r_3 with small white spots; the two post-stigmatic spots separate; flagellomere 13 without coeloconica sensilla **eublepharus species group**
- Wing cells m_1 , m_2 and distal part of r_3 with large white spots, nearly filling the cells; the two post-stigmatic spots fused; flagellomere 13 with coeloconica sensilla **Beltranmyia**
- 5 Small species, wing length < .8 mm; cell m_2 and distal part of anal cell with two white spots **leoni species group**
- Large species, wing length > .8 mm; cell m_2 and distal part of anal cell with one white spot **fluvialis species group**
- 6 Legs with tarsomere 4 cordiform, wider than long **Macfiella**
- Legs with tarsomere 4 cylindrical **7**
- 7 Wing unspotted **8**
- Wings with black or light spots, evident or diffuse, variable pattern **9**
- 8 Three unsclerotized or slightly sclerotized spermathecae **Selfia**
- Two sclerotized spermathecae **stonei species group**
- 9 Wing pigmentation diffuse, cell r_2 partially or completely included on black spot **10**
- Wing pigmentation conspicuous, with multiple white or black spots, variable pattern **11**
- 10 Small species, wing length < .85 mm; wing with cell r_2 small, with a conspicuous black spot encompassing the apical portion of r_1 and basal portion of r_2 ; distal portion of r_2 pale **Avaritia**
- Large species, wing length > .85 mm; wing with cell r_2 very large, about three times as long as broad, completely dark **stigmalis species group**
- 11 Wing with second radial cell completely or partially included in a white spot **12**
- Wing with second radial cell completely included in a black spot **14**
- 12 Wings with predominant, extensive, interconnected black spots; cell m_4 with a white spot at the base of the Cu- M_4 bifurcation and another white spot in front of it of variable size **Hoffmania**
- Wings with predominant, extensive, interconnected white spots; cell m_4 with a dark spot at base of the Cu- M_4 bifurcation **13**
- 13 Tibial comb with 6 spines **Culicoides s. str.**
- Tibial comb with 4 spines **Anilomyia**
- 14 Vein r-m dark **15**
- Vein r-m pale **16**
- 15 Flagellomeres 9–13 with coeloconica sensilla **Glaphiromyia**
- Flagellomeres 9–13 without coeloconica sensilla **acotylus species group**
- 16 Vein M_2 without a white spot straddling the middle portion **17**
- Vein M_2 with a white spot straddling the middle portion **19**
- 17 Vein M_1 and M_2 dark; cell m_2 with one spot **Haematomyidium and mohave species group**
- Vein M_1 and M_2 on white bands; cell m_2 with more than one spot **18**

- 18 Cell m_1 with one white spot distal to the medial bifurcation **Mataemyia**
 – Cell m_1 with two white spots distal to the medial bifurcation
 **reticulatus species group**
 19 Scutum without a pattern of numerous black punctiform dots, variable
 pattern **20**
 – Scutum with a pattern of numerous black punctiform dots..... **Oecacta**
 20 Anal cell with three white spots arranged in a triangular pattern ... **Amossovia**
 – Anal cell with one or two white spots **21**
 21 Flagellomeres 9–13 with coeloconica sensilla **22**
 – Flagellomeres 9–13 without coeloconica sensilla **Diphaomyia**
 22 Vein M_1 without a white spot straddling the middle portion; cell r_3 with
 distal white spot large, nearly filling de cell **limai species group**
 – Vein M_1 with a white spot straddling the middle portion; cell r_3 with distal
 white spot small **Drymodesmyia and daedalus species group**

Species list by state

Aguascalientes: without records.

Baja California: *Culicoides arizonensis*, *C. boydi*, *C. copiosus*, *C. furens*,
C. haematopotus, *C. hieroglyphicus*, *C. hoguei*, *C. insolatus*, *C. kettlei*, *C.*
luglani, *C. melleus*, *C. mohave*, *C. occidentalis*, *C. panamensis*, *C. ryckmani*, *C.*
sitiens, *C. torridus*.

Baja California Sur: *Culicoides bajensis*, *C. cacticola*, *C. cochisensis*, *C.*
occidentalis, *C. oklahomensis*.

Campeche: *Culicoides arubae*, *C. furens*, *C. phlebotomus*.

Chiapas: *Culicoides crescentis*, *C. daedalus*, *C. diabolicus*, *C. elutus*, *C.*
eublepharus, *C. filariferus*, *C. foxi*, *C. haematopotus*, *C. insignis*, *C. iriartei*,
C. jamaicensis, *C. luteovenus*, *C. neopulicaris*, *C. palpalis*, *C. pampoikilus*, *C.*
panamensis, *C. paraensis*, *C. poikilonotus*, *C. propinquuos*, *C. propriipennis*, *C.*
pusilloides, *C. pusillus*, *C. verecundus*.

Chihuahua: without records.

Coahuila: *Culicoides crepuscularis*, *C. sonorensis*.

Colima: without records.

Mexico City: *Culicoides acotylus*, *C. albomaculus*, *C. bakeri*, *C. copiosus*,
C. crepuscularis, *C. dampfi*, *C. haematopotus*, *C. luteovenus*, *C. scopus*, *C.*
sonorensis, *C. variipennis*.

Durango: *Culicoides hieroglyphicus*, *C. sonorensis*.

Guanajuato: without records.

Guerrero: *Culicoides arubae*, *C. blantoni*, *C. foxi*, *C. furens*, *C. haematopotus*,
C. jamaicensis, *C. neopulicaris*, *C. phlebotomus*, *C. scopus*, *C. sonorensis*,
C. variipennis, *C. wirthomyia*.

Hidalgo: *Culicoides furens*, *C. neopulicaris*, *C. nigrigenus*.

Jalisco: *Culicoides jamaicensis*.

Estado de México: *Culicoides jamaicensis*, *C. neopulicaris*, *C. panamensis*,
C. sonorensis, *C. variipennis*.

Michoacán: *Culicoides castillae*, *C. parascopus*, *C. rulfoi*.

Morelos: *Culicoides blantoni*, *C. crepuscularis*, *C. multipunctatus*, *C. neopulicaris*,
C. panamensis, *C. pseudodecor*, *C. woodruffi*.

Nayarit: *Culicoides eadsi*, *C. furens*, *C. panamensis*, *C. sonorensis*.

Nuevo León: *Culicoides butleri*, *C. ousairani*, *C. sonorensis*, *C. variipennis*.

Oaxaca: *Culicoides baueri*, *C. debilipalpis*, *C. diabolicus*, *C. elutus*, *C. foxi*, *C. gabaldoni*, *C. ginesi*, *C. glabellus*, *C. hylas*, *C. insignis*, *C. jamaicensis*, *C. leopoldoi*, *C. luteovenus*, *C. neopulicaris*, *C. ocumarensis*, *C. pampoikilus*, *C. phlebotomus*, *C. pseudodiabolicus*, *C. pusillus*, *C. rangeli*, *C. stigmalis*, *C. variipennis*.

Puebla: *Culicoides baueri*, *C. blantoni*, *C. haematopotus*, *C. neghmei*, *C. occidentalis*, *C. sonorensis*.

Querétaro: without records.

Quintana Roo: *Culicoides barbosai*, *C. paraensis*, *C. phlebotomus*.

San Luis Potosí: *Culicoides blantoni*, *C. eadsi*, *C. neopulicaris*, *C. paraensis*, *C. sonorensis*.

Sinaloa: *Culicoides blantoni*, *C. cancer*, *C. furens*, *C. phlebotomus*.

Sonora: *Culicoides bajensis*, *C. cacticola*, *C. crepuscularis*, *C. eadsi*, *C. furens*, *C. hieroglyphicus*, *C. luglani*, *C. oklahomensis*, *C. sonorensis*, *C. wernerii*, *C. willistoni*.

Tabasco: *Culicoides blantoni*, *C. foxi*, *C. furens*, *C. gabaldoni*, *C. insignis*, *C. leopoldoi*, *C. ocumarensis*, *C. paraensis*, *C. poikilonotus*, *C. pusillus*.

Tamaulipas: *Culicoides arubae*, *C. blantoni*, *C. furens*, *C. hayesi*, *C. insignis*, *C. luglani*, *C. multipunctatus*.

Tlaxcala: without records.

Veracruz: *Culicoides arubae*, *C. blantoni*, *C. crepuscularis*, *C. daedalus*, *C. debilipalpis*, *C. diabolicus*, *C. filariferus*, *C. fortinensis*, *C. foxi*, *C. furens*, *C. gabaldoni*, *C. haematopotus*, *C. hylas*, *C. iriartei*, *C. jamaicensis*, *C. lanei*, *C. leoni*, *C. luteovenus*, *C. neopulicaris*, *C. nigrigenus*, *C. pampoikilus*, *C. panamensis*, *C. paraensis*, *C. poikilonotus*, *C. pseudodecor*, *C. pseudodiabolicus*, *C. pusillus*, *C. stigmalis*.

Yucatán: *Culicoides arubae*, *C. eadsi*, *C. furens*, *C. insignis*, *C. jamaicensis*, *C. loughnani*, *C. neopulicaris*, *C. phlebotomus*.

Zacatecas: without records.

Conclusions

Expanding and updating the knowledge of insect vectors is essential for the creation, implementation, and improvement of surveillance and population control programs. The number of *Culicoides* species present in Mexico represents 6% of the known species worldwide, 57% of the Nearctic species and 29% of the Neotropical species. In addition, 11 species are endemic. These endemic species have adapted and diversified according to the topography, soil, and altitudinal gradients of the country and are concentrated in some states such as Mexico City, Michoacán, Veracruz, and Chiapas where more *Culicoides* endemics are known in areas 2,000 meters above sea level. However, the alteration of natural ecosystems by human activities and the scarcity of updated data makes the actual distribution of endemic *Culicoides* species uncertain. Therefore, it is essential to understand the processes that originate and sustain diversity in these areas, which are subject to rapid changes in climate and habitats. Mexico City is a special case, as it harbors more endemic *Culicoides* species, but it is also an area with strong anthropogenic and demographic pressure, which generates uncertainty about the current distribution of these species. This is especially important in sites such as Chapultepec and San Jacinto.

The Nearctic Region includes North America, covering arid and temperate zones in northern Mexico, such as Baja California, Chihuahua, and Nuevo León, as well as the central region of Mexico, which includes Mexico City and Puebla. On the other hand, the Neotropical Region extends through the tropical and subtropical zones of southern Mexico, and a large part of the coastal region of the Pacific and Gulf of Mexico.

The distribution of *Culicoides* species in Mexico is classified into four main categories: Nearctic, Neotropical, broad distribution in the New World, and endemic. Of the species present in the country, 50% are distributed in the Nearctic Region, 77% in the Neotropical Region, 27% in both regions, and 13% are endemic. A wide variety of species distribution can be observed. For example, the subgenera *C. (Amossovia)* and *C. (Monoculicoides)* are predominant in the Nearctic Region, while *C. (Drimodesmyia)* has a significant presence in both the Neotropical and Nearctic Regions.

On the other hand, the subgenera *C. (Anilomyia)*, *C. (Avaritia)*, *C. (Culicoides)* and *C. (Diphaomyia)* have a predominant distribution in the Neotropical Region. Although *C. (Hoffmania)* is also common in this Region, the presence of *C. insignis* has been recorded in the Nearctic and represents an important health risk. In addition, *C. (Glaphiromyia)* is a subgenus mainly endemic to Mexico, which makes it of special interest from a biogeographical perspective since species of this subgenus have been described in the transition zone of central Mexico.

Of Mexico's 32 states, *Culicoides* species have been recorded in only 25. Veracruz and Chiapas had the highest richness of biting midges. The subgenus *Drymodesmyia* is the best represented in the country with 14 species recorded, followed by the subgenus *Hoffmania*, represented by nine species. It should be noted that most of the records made in the country are the result of collection events more than half a century old and few records have been made in recent years; in addition, there are species that have not been collected since they were recorded; thus, the occurrence and distribution of several species should be reevaluated.

In general, the immature stages of *Culicoides* species are largely unknown and represent an important potential area of study. The immature stages of 30% of species present in Mexico are known. The egg stage is known for 5.8% of the species, while both larval and pupal stages for 27%. On the other hand, 15 species (17.4%) have been associated with different pathogens and therefore represent a potential risk as vectors in the country. Of these, eight species were associated with viruses, among which *C. sonorensis*, *C. insignis* and *C. paraensis* stand out for their greatest impact on human and animal health. The presence of these species in the country poses a greater health risk; therefore, it is vital to increase surveillance efforts to prevent possible disease outbreaks, especially in regions of high susceptibility, such as those with high livestock production. In addition, six species were associated with the transmission of nematodes and six species with protozoa, particularly Haemosporida.

The dichotomous keys presented in this work are the first to specifically focus on the *Culicoides* fauna of Mexico. Previously, it was necessary to consult several studies to identify the species present in the country. However, since the current subgeneric classification of *Culicoides* species could include inconsistencies and is in urgent need of revision, it is likely that these keys should help update the knowledge of the genus in the country.

Lastly, it is important to note that due to the physiographic, climatic, and topographic characteristics of the country, the great variety of ecosystems with conditions like those of other neotropical countries, as well as the lack of systematic and faunistic studies that address the spatial and temporal changes of the group, it can be inferred that the species richness of *Culicoides* in the country is far from being elucidated.

Acknowledgments

The first author was awarded a scholarship from the Mexican Council of Science and Technology (contract no. 848840) for a research project entitled “Patrones de distribución espacial y temporal de Ceratopogonidae hematófagos (Insecta: Diptera) y su implicación como vectores de hemosporidios de acuerdo con la modificación antropogénica del medio en la parte central de Veracruz, México”, that was supported by the Instituto de Ecología, Asociación Civil through the last author (Project INECOL-10816). We appreciate the commentaries of Art Borkent and two anonymous revisors to improve the manuscript.

Additional information

Conflict of interest

No conflict of interest was declared.

Ethical statement

No ethical statement was reported.

Funding

Mexican Council of Science and Technology contract no. 848840, and Instituto de Ecología A.C.-Project INECOL-10816.

Author contributions

Both collaborated in the writing of the manuscript.

Author ORCIDs

Alejandro Mendez-Andrade  <https://orcid.org/0000-0003-4074-5704>

Sergio Ibáñez-Bernal  <https://orcid.org/0000-0002-3182-6134>

Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

References

- Aitken THG, Wirth WW, Williams RW, Davies JB, Tikasingh ES (1975) A review of the blood-sucking midges of Trinidad and Tobago, West Indies (Diptera: Ceratopogonidae). *Journal of Entomology* 44: 101–144. <https://doi.org/10.1111/j.1365-3113.1975.tb00007.x>
- Alkhamis MA, Aguilar-Vega C, Fountain-Jones NM, Lin K, Perez AM, Sánchez-Vizcaíno JM (2020) Global emergence and evolutionary dynamics of Bluetongue Virus. *Scientific Reports* 10(1): 21677. <https://doi.org/10.1038/s41598-020-78673-9>

- Atchley WR (1967) The *Culicoides* of New Mexico (Diptera: Ceratopogonidae). The University of Kansas Science Bulletin 46: 937–1022. <https://doi.org/10.5962/bhl.part.20082>
- Atchley WR (1970) A biosystematic study of the subgenus *Selfia* of *Culicoides* (Diptera: Ceratopogonidae). The University of Kansas Science Bulletin 49: 181–336.
- Atchley WR, Wirth WW (1979) A review of the *Culicoides haematopotus* group in North America (Diptera: Ceratopogonidae). Journal of the Kansas Entomological Society 52: 524–545.
- Atkinson CT (1988) Epizootiology of *Haemoproteus meleagridis* Protozoa: Haemosporea in Florida: potential vectors and prevalence in naturally infected *Culicoides* (Diptera: Ceratopogonidae). Journal of Medical Entomology 25(1): 39–44. <https://doi.org/10.1093/jmedent/25.1.39>
- Atkinson CT, Greiner EC, Forrester DJ (1983) Experimental vectors of *Haemoproteus meleagridis* Levine from wild turkeys in Florida. Journal of Wildlife Diseases 19(4): 366–368. <https://doi.org/10.7589/0090-3558-19.4.366>
- Barbosa FS (1947) *Culicoides* (Diptera: Heleidae) da regio neotropica. Anais da Sociedade de Biologia de Pernambuco 7: 3–30.
- Barbosa FAS (1952) Novos subsidios para o conhecimento dos *Culicoides* neotropicos (Diptera: Heleidae). Thesis, Universidade do Recife, Recife, Brasil.
- Beck EC (1957) Two new species of *Culicoides* from Florida (Diptera: Heleidae). The Florida Entomologist 40(3): 103–105. <https://doi.org/10.2307/3492509>
- Becker ME, Reeves WK, Dejean SK, Emery MP, Ostlund EN, Foil LD (2010) Detection of bluetongue virus RNA in field-collected *Culicoides* spp. (Diptera: Ceratopogonidae) following the discovery of bluetongue virus serotype 1 in white-tailed deer and cattle in Louisiana. Journal of Medical Entomology 47(2): 269–273. <https://doi.org/10.1603/ME09211>
- Blanton FS, Wirth WW (1979) The sand flies (*Culicoides*) of Florida (Diptera: Ceratopogonidae). In: Arthropods of Florida and Neighboring Land Areas, Vol. 10, 204 pp.
- Borkent A (2004) The biting midges, the Ceratopogonidae (Diptera). In: Marquardt WC (Ed.) Biology of disease vectors. San Diego, EUA, 113–126.
- Borkent A (2012) The pupae of Culicomorpha—Morphology and a new phylogenetic tree. Zootaxa 3396(1): 1–98. <https://doi.org/10.11646/zootaxa.3398.1>
- Borkent A, Dominiak P (2020) Catalog of the biting midges of the world (Diptera: Ceratopogonidae). Zootaxa 4787(1): 1–377. <https://doi.org/10.11646/zootaxa.4787.1.1>
- Borkent A, Grogan Jr W (2009) Catalog of the new world biting midges north of Mexico (Diptera: Ceratopogonidae). Zootaxa 2273(1): 1–48. <https://doi.org/10.11646/zootaxa.2273.1.1>
- Borkent A, Spinelli GR (2000) Catalog of the new world biting midges south of the United States of America (Diptera: Ceratopogonidae). Contributions on Entomology International 4: 1–107.
- Borkent A, Spinelli GR (2007) Neotropical Ceratopogonidae (Diptera, Insecta). In: Adis J, Arias JR, Rueda-Delgado G, Wantzen KM (Eds) Aquatic Biodiversity in Latin America (ABLA). Pensoft Publishers, Sofia-Moscow, 1–198.
- Borkent A, Wirth WW (1997) World species of biting midges (Diptera: Ceratopogonidae). Bulletin of the American Museum of Natural History 233: 1–257.
- Borkent A, Dominiak P, Díaz F (2022) An update and errata for the catalog of the biting midges of the world (Diptera: Ceratopogonidae). Zootaxa 5120(1): 53–64. <https://doi.org/10.11646/zootaxa.5120.1.3>

- Breidenbaugh M, Mullens B (1999a) Two new western Nearctic *Culicoides* Latreille (Diptera: Ceratopogonidae) described from all stages. *Proceedings of the Entomological Society of Washington* 101: 149–163.
- Breidenbaugh M, Mullens B (1999b) Descriptions of immature stages of six *Culicoides* Latreille spp. (Diptera: Ceratopogoniidae) from desert mountain ranges in southern California, with notes on life histories and rearing technique. *Proceedings of the Entomological Society of Washington* 101: 839–867.
- Buckley JJC (1934) On the development, in *Culicoides furens* Poey, of filaria (= *Mansonella*) ozzardi Manson, 1897. *Journal of Helminthology* 12(2): 99–118. <https://doi.org/10.1017/S0022149X00003229>
- Cavaliere F (1966) Notas sobre Ceratopogonidae (Diptera, Nematocera) V. Descripción de una nueva especie de Venezuela: *Culicoides (Oecacta) birabeni* sp. n. *Physis (Rio de Janeiro, Brazil)* 26: 59–63.
- Chatterjee S, Pal GS, Hazra N (2022) Descriptions of two new species of *Culicoides* Latreille from Sundarbans, India with an adult key to the *ornatus* species group of the Oriental Region (Diptera, Ceratopogonidae). *Evolutionary Systematics* 6(1): 89–102. <https://doi.org/10.3897/evolsyst.6.84170>
- Coquillett DW (1901) New Diptera in the U.S. National Museum. *Proceedings of the United States National Museum* 23(1225): 593–618. <https://doi.org/10.5479/si.00963801.23-1225.593>
- Dampf A (1936) Ceratopogonidae in the transmission of a form of filaria, which causes Onchocerciasis in some parts of Mexico. *Military Surgeon* 78: 282.
- Drolet BS, Campbell CL, Stuart MA, Wilson WC (2005) Vector competence of *Culicoides sonorensis* (Diptera: Ceratopogonidae) for Vesicular stomatitis virus. *Journal of Medical Entomology* 42(3): 409–418. <https://doi.org/10.1093/jmedent/42.3.409>
- Edwards FW (1922) On some Malayan and other species of *Culicoides*, with a note on the genus *Lasiohelea*. *Bulletin of Entomological Research* 13(2): 161–167. <https://doi.org/10.1017/S0007485300028030>
- Fallis A, Bennett G (1960) Description of *Haemoproteus canachites* n. sp. (Sporozoa: Haemoproteidae) and sporogony in *Culicoides* (Diptera: Ceratopogonidae). *Canadian Journal of Zoology* 38(3): 455–464. <https://doi.org/10.1139/z60-049>
- Fallis AM, Bennett GF (1961) Sporogony of *Lleucocytozoon* and *Haemoproteus* in simuliids and ceratopogonids and a revised classification of the Haemosporidiida. *Canadian Journal of Zoology* 39(3): 215–228. <https://doi.org/10.1139/z61-026>
- Forattini OP (1957) *Culicoides* da regio Neotropical (Diptera, Ceratopogonidae). *Arquivos da Faculdade de Higiene e Saude Publica da Universidade de Sao Paulo* 11(2): 159–526. <https://doi.org/10.11606/issn.2358-792X.v11i2p161-526>
- Foster NM, Breckon RD, Luedke AJ, Jones RH, Metcalf HE (1977) Transmission of two strains of Epizootic hemorrhagic disease virus in deer by *Culicoides variipennis*. *Journal of Wildlife Diseases* 13(1): 9–16. <https://doi.org/10.7589/0090-3558-13.1.9>
- Fox I (1946) A review of the species of biting midges or *Culicoides* from the Caribbean Region (Diptera: Ceratopogonidae). *Annals of the Entomological Society of America* 39(2): 248–258. <https://doi.org/10.1093/aesa/39.2.248>
- Fox I (1947) Two new Central American biting midges or *Culicoides* (Diptera: Ceratopogonidae). *Kuba* 3: 90–91.
- Fox I (1952) Six new Neotropical species of *Culicoides* (Diptera: Ceratopogonidae). *Annals of the Entomological Society of America* 45(3): 364–368. <https://doi.org/10.1093/aesa/45.3.364>

- Fox I (1955) A catalogue of the bloodsucking midges of the Americas (*Culicoides*, *Leptoconops* and *Lasiohelea*) with keys to the subgenera and Nearctic species, a geographic index and bibliography. The Journal of Agriculture of the University of Puerto Rico 39: 214–285. <https://doi.org/10.46429/jaupr.v39i4.12674>
- Fox I, Hoffman WA (1944) New Neotropical biting sand flies of the genus *Culicoides* (Diptera: Ceratopogonidae). The Puerto Rico Journal of Public Health and Tropical Medicine 20: 108–111.
- Glukhova VM (1989) Blood-sucking midges of the genera *Culicoides* and *Forcipomyia* (Ceratopogonidae). Fauna of the USSR 139, Vol. 3(5a): 408. [In Russian]
- Goeldi E (1905) Os mosquitos no Pará. Reunião de quatro trabalhos sobre os mosquitos indígenas, principalmente as especies que molestan o homem. Memórias do Museu Goeldi (Museu Paraense) de Historia Natural e Ethnographie 4: 1–154. <https://doi.org/10.5962/bhl.title.98904>
- Griffiths GCD (1980) Preface. In: Griffiths GCD, Stone A (Eds) Flies of the Nearctic Region, Volume 1, Part 1. Schweizerbart'sche Verlagsbuchandlung, Stuttgart.
- Halffter G (2003) Biogeografía de la entomofauna de montaña de México y América Central. In: Morrone JJ, Llorente-Bousquets JE (Eds) Una perspectiva latinoamericana de la biogeografía UNAM, Mexico, 87–97.
- Hall DG (1932) A new biting *Culicoides* from saltmarshes in the southeastern states. Proceedings of the Entomological Society of Washington 34: 88–89.
- Harrup LE, Bellis GA, Balenghien T, Garros C (2015) *Culicoides* Latreille (Diptera: Ceratopogonidae) taxonomy: Current challenges and future directions. Infection, Genetics and Evolution 30: 249–266. <https://doi.org/10.1016/j.meegid.2014.12.018>
- Hibler CP (1963) Onchocercidae (Nematoda: Filarioidea) of the American Magpie, *Pica pica hudsonia* (Sabine), in northern Colorado. PhD thesis. Colorado State University, Colorado, 189 pp. <https://doi.org/10.2307/3276126>
- Hoffman WA (1939) *Culicoides filariferus*, new species. Intermediate host of an unidentified filaria from southwestern Mexico. The Puerto Rico Journal of Public Health and Tropical Medicine 15: 172–176.
- Hoffman WA (1925) A review of the species of *Culicoides* of North and Central America and the West Indies. American Journal of Epidemiology 5(3): 274–301. <https://doi.org/10.1093/oxfordjournals.aje.a119665>
- Hogue CL, Wirth WW (1968) A new Central American sand fly breeding in crab holes (Diptera, Ceratopogonidae). Los Angeles County Museum. Contributions in Science 152: 1–7. <https://doi.org/10.5962/p.241140>
- Holbrook FR, Tabachnick WJ, Schmidtman ET, McKinnon CN, Bobian RJ, Grogan WL (2000) Sympatry in the *Culicoides variipennis* complex (Diptera: Ceratopogonidae): a taxonomic reassessment. Journal of Medical Entomology 37(1): 65–76. <https://doi.org/10.1603/0022-2585-37.1.65>
- Huerta H (1996) Los ceratopogonidos colectados por Alfonso Dampf en Chiapas, México (Diptera: Ceratopogonidae). Thesis, Universidad Nacional Autónoma de México, México. [Retrieved from] <https://repositorio.unam.mx/contenidos/338773>
- Huerta H, Castrejón AR, Grogan W, Ibáñez-Bernal S (2012) New records of biting midges of the genus *Culicoides* Latreille from Mexico (Diptera: Ceratopogonidae). Insecta Mundi, 1–20. <https://doi.org/10.21829/azm.2020.3612280>
- Huerta H, Benítez-Alva JI, Concha-Suarez J, Ibáñez-Piñón CR, Manrique-Saide P (2020) New records of genus *Culicoides* Latreille from Oaxaca, Mexico (Diptera: Ceratopogonidae). Acta Zoológica Mexicana (N.S.) 36(1): 1–27. <https://doi.org/10.21829/azm.2020.3612280>

- Huerta H, Rodríguez-Martínez LM, Benitez-Alva JI, Dzul-Manzanilla F, Manrique-Saide P (2022) New records of biting midges (Diptera: Ceratopogonidae) from Tabasco, Mexico. *Revista Mexicana de Biodiversidad* 93(0): 933605. <https://doi.org/10.22201/ib.20078706e.2022.93.3605>
- Ibáñez-Bernal S, Wirth W, Huerta-Jiménez H (1996) Ceratopogonidae (Diptera). In: Llorente-Bousquets JE, García-Aldrete AN, González-Soriano E (Eds) *Biodiversidad, taxonomía y biogeografía de artrópodos de México: Hacia una síntesis de su conocimiento*. Mexico, DF, 567–577.
- Ibáñez-Bernal S, Rivera-García KD, Abella-Medrano CA (2020) Introduction to the taxonomy and general biology of Diptera (Insecta) involved in the transmission of avian haemosporida. In: Santiago-Alarcon D, Marzal A (Eds) *Avian Malaria and Related Parasites in the Tropics: Ecology, Evolution and Systematics*. Springer International Publishing, Cham, 137–184. https://doi.org/10.1007/978-3-030-51633-8_5
- Isaev VA (1988) Isolation and recognition of some subgenera of the biting midges of the genus *Culicoides* (Ceratopogonidae) with a description of a new subgenus *Stigmoculicoides*. In: *Insects - potential carriers of infectious diseases: Morphology, systematics and ecology of the dipterans*. Collected scientific works of the Ivanovo State Medical Institute, Ivanovo, 14–39. [in Russian]
- Jamnback H (1965) The *Culicoides* of New York State (Diptera: Ceratopogonidae). New York State Museum and Science Service Bulletin Number 399, [viii +] 154 pp.
- Jones RH (1955) The *Culicoides* of Wisconsin. PhD Thesis, University of Wisconsin, USA, [vi +] 204 pp. [+ 3 tables.]
- Jones RH (1957) The laboratory colonization of *Culicoides variipennis* (Coq.)1. *Journal of Economic Entomology* 50(1): 107–108. <https://doi.org/10.1093/jee/50.1.107>
- Jones RH (1961) Descriptions of pupae of thirteen North American Species of *Culicoides* (Diptera: Ceratopogonidae). *Annals of the Entomological Society of America* 54(5): 729–746. <https://doi.org/10.1093/aesa/54.5.729>
- Khalaf KT (1952) The *Culicoides* of the Wichita Refuge, Oklahoma. Taxonomy and seasonal incidence (Diptera, Heleidae). *Annals of the Entomological Society of America* 45(2): 348–358. <https://doi.org/10.1093/aesa/45.2.348>
- Khalaf KT (1954) The speciation of the genus *Culicoides* (Diptera, Heleidae). *Annals of the Entomological Society of America* 47(1): 34–51. <https://doi.org/10.1093/aesa/47.1.34>
- Kieffer JJ (1917) Chironomides d'Amérique conservés au Musée National Hongrois de Budapest. *Annales Historico-Naturales Musei Nationalis Hungarici* 15: 292–364.
- Labuschagne K, Meiswinkel R, Liebenberg D, Van Zyl C, Van Schalkwyk A, Scholtz C (2023) Description of *Culicoides truuskae* sp. n. (Diptera: Ceratopogonidae) from southern Africa. *The Onderstepoort Journal of Veterinary Research* 90(1): e1–e14. <https://doi.org/10.4102/ojvr.v90i1.2072>
- Lamberson C, Pappas CD, Pappa LG (1992) Pupal taxonomy of the tree-hole *Culicoides* (Diptera: Ceratopogonidae) in eastern North America. *Annals of the Entomological Society of America* 85(2): 111–120. <https://doi.org/10.1093/aesa/85.2.111>
- Linley JR, Davies JB (1971) Sandflies and tourism in Florida and the Bahamas and Caribbean area. *Journal of Economic Entomology* 64(1): 264–278. <https://doi.org/10.1093/jee/64.1.264>
- Linley JR, Hoch AL, Pinheiro FP (1983) Biting midges (Diptera: Ceratopogonidae) and human health. *Journal of Medical Entomology* 20(4): 347–364. <https://doi.org/10.1093/jmedent/20.4.347>

- Lowrie RC, Raccurt CP (1984) Assessment of *Culicoides barbosai* as a vector of *Mansonella ozzardi* in Haiti. *The American Journal of Tropical Medicine and Hygiene* 33(6): 1275–1277. <https://doi.org/10.4269/ajtmh.1984.33.1275>
- Lowrie RC, Eberhard ML, Orihel TC (1978) Development of *Tetrapetalonema marmosetae* to the infective stage in *Culicoides hollensis* and *C. furens*. *The Journal of Parasitology* 64(6): 1003–1007. <https://doi.org/10.2307/3279711>
- Lutz A (1913) Contribuição para o estudo das Ceratopogoninas hematofagas do Brazil. *Memorias do Instituto Oswaldo Cruz* 5(1): 45–73. <https://doi.org/10.1590/S0074-02761913000100005>
- Macfie JWS (1935) Ceratopogonidae (Dipt.) from the river Amazon. *Stylops* 4: 49–56. <https://doi.org/10.1111/j.1365-3113.1935.tb00555.x>
- Macfie JWS (1940) A report on a collection of Ceratopogonidae (Diptera) from British Guiana. *Entomologist's Monthly Magazine* 76: 23–32.
- Macfie JWS (1948) Some species of *Culicoides* (Diptera, Ceratopogonidae) from the state of Chiapas, Mexico. *Annals of Tropical Medicine and Parasitology* 42(1): 67–87. <https://doi.org/10.1080/00034983.1948.11685349>
- Malloch JR (1915) The Chironomidae, or midges, of Illinois, with particular reference to the species occurring in the Illinois River. *Bulletin of the Illinois State Laboratory of Natural History* 10(1–8): 275–543. <https://doi.org/10.21900/j.inhs.v10.376>
- Marzal A, Garcia-Longoria L (2020) The role of malaria parasites in invasion biology. In: Santiago-Alarcon D, Marzal A (Eds) *Avian Malaria and Related Parasites in the Tropics: Ecology, Evolution and Systematics*. Springer International Publishing, Cham, 487–512. https://doi.org/10.1007/978-3-030-51633-8_15
- Matta JF (1967) A new species of *Culicoides* (Diptera: Ceratopogonidae) from Honduras. *The Florida Entomologist* 50(1): 75–77. <https://doi.org/10.2307/3493213>
- Mediannikov O, Ranque S (2018) Mansonellosis, the most neglected human filariasis. *New Microbes and New Infections* 26: S19–S22. <https://doi.org/10.1016/j.nmni.2018.08.016>
- Mellor PS, Boorman J, Jennings M (1975) The multiplication of African horse-sickness virus in two species of *Culicoides* (Diptera, Ceratopogonidae). *Archives of Virology* 47(4): 351–356. <https://doi.org/10.1007/BF01347976>
- Mellor PS, Boorman J, Baylis M (2000) *Culicoides* biting midges: Their role as arbovirus vectors. *Annual Review of Entomology* 45(1): 307–340. <https://doi.org/10.1146/annurev.ento.45.1.307>
- Mills MK, Michel K, Pfannenstiel RS, Ruder MG, Veronesi E, Nayduch D (2017) *Culicoides*–virus interactions: Infection barriers and possible factors underlying vector competence. *Current Opinion in Insect Science* 22: 7–15. <https://doi.org/10.1016/j.cois.2017.05.003>
- Mo CL, Thompson LH, Homan EJ, Oviedo MT, Greiner EC, González J, Sáenz MR (1994) Bluetongue virus isolations from vectors and ruminants in Central America and the Caribbean. Interamerican Bluetongue Team. *American Journal of Veterinary Research* 55: 211–215.
- Monarch (2022) Monarch Collections Search Results Table. <https://monarch.calacademy.org/collections/list.php?usethe=1andtaxa=672146> [Last accessed 09 March 2022]
- Morrone JJ (2005) Hacia una síntesis biogeográfica de México. *Revista Mexicana de Biodiversidad* 76(002): 207–252. <https://doi.org/10.22201/ib.20078706e.2005.002.303>
- Mullen GR, Jones RH, Braverman Y, Nusbaum KE (1985) Laboratory infections of *Culicoides debilipalpis* and *C. stellifer* (Diptera: Ceratopogonidae) with Bluetongue virus. *Progress in Clinical and Biological Research* 178: 239–243.

- Murphree C, Mullen G (1991) Comparative larval morphology of the genus *Culicoides* Latreille (Diptera: Ceratopogonidae) in North America with a key to species. *Bulletin of the Society of Vector Ecologists* 16: 269–399.
- Nathan MB (1981) Transmission of the human filarial parasite *Mansonella ozzardi* by *Culicoides phlebotomus* (Williston) (Diptera: Ceratopogonidae) in coastal north Trinidad. *Bulletin of Entomological Research* 71(1): 97–106. <https://doi.org/10.1017/S0007485300051063>
- Ortiz I (1950a) Estudios en *Culicoides* II. Diptera, Ceratopogonidae. *Culicoides lanei* n. sp. de Panama. *Revista de Sanidad y Asistencia Social* 15: 431–433.
- Ortiz I (1950b) Estudios en *Culicoides* IV. Revisión de las especies americanas del sub-género *Hoffmania* Fox 1948, con la descripción de dos nuevas especies. *Revista de Sanidad y Asistencia Social* 15: 437–460.
- Ortiz I (1950c) Estudios en *Culicoides* V. Informes sobre una nueva especie y lista de los machos cuyas genitalias son conocidas. *Revista de Sanidad y Asistencia Social* 15: 461–446.
- Ortiz I (1951) Estudios en *Culicoides* (Diptera, Ceratopogonidae). IX. Sobre los caracteres diferenciales entre *Culicoides paraensis* (Goeldi, 1905), *C. stellifer* (Coquillett, 1901), y *C. lanei* (Ortiz, 1950). Descripción de cuatro nuevas especies con la redescipción de algunas otras poco conocidas. *Revista de Sanidad y Asistencia Social* 16: 573–591.
- Ortiz I (1953) Nueva contribución al conocimiento de los caracteres morfológicos externos de las hembras americanas del género *Culicoides* LTR. (Diptera, Ceratopogonidae) con una espermateca. Descripción de dos nuevas especies de Venezuela: *Culicoides transferrans* (*C. oublepharus* [sic] Ortiz, 1952) y *Culicoides mirsae*. *Revista de Sanidad y Asistencia Social* 18: 797–806.
- Ortiz I (1954) Sobre dos nuevos dípteros hematófagos del género *Culicoides* (Nematocera, Ceratopogonidae). *Archivos Venezolanos de Patología Tropical y Parasitología Médica* 2: 221–226.
- Ortiz I, Mirsa M (1952) Sobre las especies americanas del género “*Culicoides*” Latr., (Diptera, Ceratopogonidae) con una espermateca. *Acta Científica Venezolana* 2: 125–128.
- Painter RH (1927) The biology, immature stages, and control of the sandflies (biting Ceratopogoninae) at Puerto Castilla, Honduras. 1926 Annual Report of the Medical Department of the United Fruit Company 15: 245–262.
- Phillips R (2022) *Culicoides* Latreille and *Leptoconops* Skuse biting midges of the southwestern United States with emphasis on the Canyonlands of southeastern Utah (Diptera: Ceratopogonidae). *Insecta Mundi* 0907: 1–214.
- Pinheiro FP, Hoch AL, Gomes ML, Roberts DR (1981) Oropouche virus. IV. Laboratory transmission by *Culicoides paraensis*. *The American Journal of Tropical Medicine and Hygiene* 30(1): 172–176. <https://doi.org/10.4269/ajtmh.1981.30.172>
- Poey F (1853) Memorias sobre la historia natural de la Isla de Cuba, acompañadas de sumarios latinos y extractos en frances. *Barcina. Habana* 1(part 4): 201–280.
- Price DA, Hardy WT (1954) Isolation of the Bluetongue virus from Texas sheep-*Culicoides* shown to be a vector. *Journal of the American Veterinary Medical Association* 124: 255–258.
- Rappole JH, Winker K, Powell GVN (1998) Migratory bird habitat use in Southern Mexico: Mist nets versus point counts. *Journal of Field Ornithology* 69: 635–643.
- Rebêlo JMM, Rodrigues BL, Bandeira M da CA, Moraes JLP, Fonteles RS, Pereira SRF (2016) Detection of *Leishmania amazonensis* and *Leishmania braziliensis* in

- Culicoides* (Diptera, Ceratopogonidae) in an endemic area of cutaneous leishmaniasis in the Brazilian Amazonia. *Journal of Vector Ecology* 41: 303–308. <https://doi.org/10.1111/jvec.12227>
- Ríos-Tostado JJ, Castillo-Ureta H, Torres-Montoya EH, Torres-Avenidaño JI, Olimón-Andalón V, Romero-Higareda CE, Silva-Hidalgo G, Zazueta-Moreno JM (2021) Molecular detection of *Leishmania* (L.) *mexicana* (Kinetoplastida: Trypanostomatidae) DNA in *Culicoides furens* (Diptera: Ceratopogonidae) from an area with autochthonous canine leishmaniasis in northwestern Mexico. *Acta Parasitologica* 66(3): 1055–1058. <https://doi.org/10.1007/s11686-021-00335-1>
- Robinson EJ (1971) *Culicoides crepuscularis* (Malloch) (Diptera: Ceratopogonidae) as a host for *Chandlerella quisquali* (Von Linstow, 1904) comb. n. (Filarioidea: Onchocercidae). *The Journal of Parasitology* 57(4): 772–776. <https://doi.org/10.2307/3277795>
- Romero-Alvarez D, Escobar LE (2018) Oropouche fever, an emergent disease from the Americas. *Microbes and Infection* 20(3): 135–146. <https://doi.org/10.1016/j.micinf.2017.11.013>
- Ronderos MM, Spinelli GR (1995) Redescrición de *Culicoides lahillei* y descripción de *Culicoides ichesi*, n. sp. de la Argentina, Paraguay y Uruguay (Diptera: Ceratopogonidae). *Neotrópica* 41: 77–81.
- Ronderos MM, Cazorla CG, Spinelli GR (2010) The immature stages of the biting midge *Culicoides debilipalpis* Lutz (Diptera: Ceratopogonidae). *Zootaxa* 2716(1): 42–52. <https://doi.org/10.11646/zootaxa.2716.1.3>
- Root F, Hoffman WA (1937) The North American species of *Culicoides*. *American Journal of Epidemiology* 25(1): 150–176. <https://doi.org/10.1093/oxfordjournals.aje.a118291>
- Sarkar A, Banerjee P, Sinha SK, Mazumdar A (2023) A taxonomic revision of the Indian species of the 'Aterinervis' group of *Culicoides* Latreille subgenus *Hoffmania* Fox (Diptera: Ceratopogonidae). *Zootaxa* 5258(4): 405–428. <https://doi.org/10.11646/zootaxa.5258.4.3>
- Shults P, Borkent A (2018) Pupae of the Nearctic species of *Culicoides* Latreille subgenus *Monoculicoides* Khalaf (Diptera: Ceratopogonidae). *Zootaxa* 4504(4): 451–472. <https://doi.org/10.11646/zootaxa.4504.4.1>
- Shults P, Borkent A, Gold R (2016) The pupa of *Culicoides sonorensis* Wirth & Jones (Diptera: Ceratopogonidae)—first detailed description of this stage of the Bluetongue virus vector. *Annals of the Entomological Society of America* 109(2): 280–318. <https://doi.org/10.1093/aesa/sav119>
- Sick F, Beer M, Kampen H, Wernike K (2019) *Culicoides* biting midges—Underestimated vectors for arboviruses of public health and veterinary importance. *Viruses* 11(4): 376. <https://doi.org/10.3390/v11040376>
- Spinelli GR, Huerta H (2015) Four new species of Mesoamerican biting midges of the genus *Culicoides* (Diptera: Ceratopogonidae). *Acta Entomologica Musei Nationalis Pragae* 55: 811–824.
- Spinelli GR, Greiner EC, Wirth WW (1993) The Neotropical bloodsucking midges of the *Culicoides guttatus* group of the subgenus *Hoffmania* (Diptera: Ceratopogonidae). *Contributions of the American Entomological Institute* 27: 1–91.
- Spinelli GR, Ronderos MM, Díaz F, Marino PI (2005) The bloodsucking biting midges of Argentina (Diptera: Ceratopogonidae). *Memorias do Instituto Oswaldo Cruz* 100(2): 137–150. <https://doi.org/10.1590/S0074-02762005000200006>

- Tanya VN, Greiner EC, Gibbs EP (1992) Evaluation of *Culicoides insignis* (Diptera: Ceratopogonidae) as a vector of Bluetongue virus. *Veterinary Microbiology* 32(1): 1–14. [https://doi.org/10.1016/0378-1135\(92\)90002-B](https://doi.org/10.1016/0378-1135(92)90002-B)
- Thomsen LC (1937) Aquatic Diptera. Part V. Ceratopogonidae. *Cornell Agricultural Experiment Station Memoirs* 210: 57–80.
- Townsend CHT (1897) IV. –Contributions from the New Mexico biological station. –No. 2. On a collection of Diptera from the lowlands of the Rio Nautla, in the State of Vera Cruz. I. *Annals & Magazine of Natural History* 19(109): 16–34. <https://doi.org/10.1080/00222939708680504>
- Valkiunas G (2005) Avian malaria parasites and other haemosporidia. CRC press, Boca Raton, Florida, 946 pp. <https://doi.org/10.1201/9780203643792>
- Vargas L (1944) *Culicoides diabolicus* en México: Caracteres del macho. *Revista del Instituto de Salubridad y Enfermedades Tropicales* 5: 163–169.
- Vargas L (1945) Nota sobre Ceratopogonidos y *Culicoides*. *Revista del Instituto de Salubridad y Enfermedades Tropicales* 6: 41–49.
- Vargas L (1949) Lista de *Culicoides* del mundo. (Diptera, Heleidae). *Revista de la Sociedad Mexicana de Historia Natural* 10: 191–218.
- Vargas L (1953a) *Beltranmyia* n. subg. de *Culicoides* (Insecta: Heleidae). *Revista del Instituto de Salubridad y Enfermedades Tropicales* 13: 33–36.
- Vargas L (1953b) *Culicoides wirthomyia* n. sp., and *Culicoides stigmalis* Wirth, 1952, (Insecta, Diptera). *Revista del Instituto de Salubridad y Enfermedades Tropicales* 13: 227–233.
- Vargas L (1954) Dos nuevas especies de *Culicoides* mexicanos. *Revista del Instituto de Salubridad y Enfermedades Tropicales* 14: 25–32.
- Vargas L (1955) *Culicoides neghmei* n. sp. *Boletín del Laboratorio de la Clínica. Luis Razetti* 43: 673–676.
- Vargas L (1960) The subgenera of *Culicoides* of the Americas (Diptera, Ceratopogonidae). *Revista de Biología Tropical* 8: 35–47.
- Vargas L (1969) Los *Culicoides* como transmisores de enfermedades. *Gaceta Médica* 99: 782–787.
- Vargas L (1972) Los subgéneros de *Culicoides* (Diptera: Ceratopogonidae). *Revista de Investigación en Salud Pública* 32: 116–129.
- Vargas L, Wirth WW (1955) *Culicoides blantoni* n. sp. (Diptera, Heleidae). *Revista Del Instituto De Salubridad Y Enfermedades Tropicales* 15: 33–38.
- Williston SW (1896) On the Diptera of St. Vincent (West Indies). *Transactions of the Entomological Society of London* 1896: 253–446. [pls. 8–14] <https://doi.org/10.1111/j.1365-2311.1896.tb00965.x>
- Wirth WW (1952) The Heleidae of California. *University of California Publications in Entomology* 9: 95–266.
- Wirth WW (1955) Three new species of *Culicoides* from Texas (Diptera: Heleidae). *Journal of the Washington Academy of Sciences* 45: 355–359.
- Wirth WW (1965) Family Ceratopogonidae. In: Stone A, Sabrosky CW, Wirth WW, Foote RH, Coulson JR (Eds) *A Catalog of the Diptera of America north of Mexico*. United States Department of Agriculture, Agricultural Research Service, 121–142.
- Wirth WW (1974) Family Ceratopogonidae. In: Papavero N (Ed.) *A catalogue of the Diptera of the Americas south of the United States* 14: 1–89.
- Wirth WW, Blanton FS (1953) Studies in Panama *Culicoides* (Diptera, Heleidae). III. A new species related to *phlebotomus* (Williston). *Entomological News* 64: 113–120.

- Wirth WW, Blanton FS (1955a) Studies in Panama *Culicoides* (Diptera, Heleidae) IV. Descriptions of three new species. Bulletin of the Brooklyn Entomological Society 50: 100–106.
- Wirth WW, Blanton FS (1955b) Studies in Panama *Culicoides* (Diptera, Heleidae) V. Descriptions of three new species of the subgenus *Oecacta* Poey. Bulletin of the Brooklyn Entomological Society 50: 121–127.
- Wirth WW, Blanton FS (1956a) A new species of salt-marsh sand fly from Florida, the Bahamas, Panama and Ecuador: Its distribution and taxonomic differentiation from *Culicoides furens* (Poey) (Diptera, Heleidae). The Florida Entomologist 39(4): 157–162. <https://doi.org/10.2307/3492592>
- Wirth WW, Blanton FS (1956b) Studies in Panama *Culicoides* VII. The species of the *pulicaris* and *cova-garciai* groups (Diptera, Heleidae). Proceedings of the Entomological Society of Washington 58: 211–227.
- Wirth WW, Blanton FS (1956c) Studies in Panama *Culicoides* VIII. The Neotropical species of the *guttatus* group of the subgenus *Hoffmania* (Diptera, Heleidae). Proceedings of the Entomological Society of Washington 58: 305–326.
- Wirth WW, Blanton FS (1956d) Studies in Panama *Culicoides* (Diptera, Heleidae). IX. Two new species related to *leoni* Barbosa and *reevesi* Wirth. Bulletin of the Brooklyn Entomological Society 51: 45–52.
- Wirth WW, Blanton FS (1959) Biting midges of the genus *Culicoides* from Panama (Diptera: Heleidae). Proceedings of the United States National Museum 109(3415): 237–482. <https://doi.org/10.5479/si.00963801.109-3415.237>
- Wirth WW, Blanton FS (1967) The north american *Culicoides* of the *Guttipennis* group (Diptera: Ceratopogonidae). The Florida Entomologist 50(3): 207–232. <https://doi.org/10.2307/3493303>
- Wirth WW, Blanton FS (1968) A revision of the Neotropical biting midges of the *Hylas* group of *Culicoides* (Diptera, Ceratopogonidae). The Florida Entomologist 51(4): 201–215. <https://doi.org/10.2307/3493420>
- Wirth WW, Blanton FS (1969) North america *Culicoides* of the *Pulicaris* group (Diptera: Ceratopogonidae). The Florida Entomologist: 207–243. <https://doi.org/10.2307/3493875>
- Wirth WW, Blanton FS (1970) A review of the *Culicoides nigrigenus* group, with two new species (Diptera: Ceratopogonidae). Entomological News 81: 141–151.
- Wirth WW, Blanton FS (1971a) New Neotropical sandflies of the *Culicoides debilipalpis* group (Diptera: Ceratopogonidae). Proceedings of the Entomological Society of Washington 73: 34–43.
- Wirth WW, Blanton FS (1971b) New western *Culicoides* of the *stonei* group. Journal of the Kansas Entomological Society 44: 459–467.
- Wirth WW, Blanton FS (1974) The West Indian sandflies of the genus *Culicoides* (Diptera: Ceratopogonidae). Agricultural Research Service, US Department of Agriculture, Technical Bulletin 1474, 98 pp.
- Wirth WW, Blanton FS (1978) Two new species of Neotropical *Culicoides* (Diptera: Ceratopogonidae). The Pan-Pacific Entomologist 54: 236–240.
- Wirth WW, Felipe-Bauer ML (1989) The Neotropical biting midges related to *Culicoides paraensis* (Diptera: Ceratopogonidae). Memorias do Instituto Oswaldo Cruz 84(suppl 4): 551–565. <https://doi.org/10.1590/S0074-02761989000800096>
- Wirth WW, Hubert AA (1960) Ceratopogonidae (Diptera) reared from cacti, with a review of the *Copiosus* group of *Culicoides*. Annals of the Entomological Society of America 53(5): 639–658. <https://doi.org/10.1093/aesa/53.5.639>

- Wirth WW, Jones RH (1957) The North American subspecies of *Culicoides variipennis* (Diptera, Heleidae). US Department of Agriculture Technical Bulletin 1170, 35 pp.
- Wirth WW, Moraes APA (1979) New records and new species of biting midges from salt marshes in California and Mexico (Diptera: Ceratopogonidae). *The Pan-Pacific Entomologist* 55: 287–298.
- Wirth WW, Mullens BA (1992) *Culicoides boydi* (Diptera: Ceratopogonidae): a potential vector of Hemorrhagic disease viruses to desert bighorn sheep in southern California. *Journal of Medical Entomology* 29(6): 1006–1010. <https://doi.org/10.1093/jmedent/29.6.1006>
- Wirth WW, Soria SJ (1981) Two *Culicoides* biting midges reared from inflorescences of *Calathea* in Brazil and Colombia, and a key to the species of the discrepans group (Diptera: Ceratopogonidae). *Revista Theobroma* 11: 107–117.
- Wirth WW, Dyce AL, Peterson BV (1985) An atlas of wing photographs, with a summary of the numerical characters of the Nearctic species of *Culicoides* (Diptera: Ceratopogonidae). *Contributions of the American Entomological Institute* 22: 1–46.
- Wirth WW, Dyce AL, Spinelli GR (1988) An atlas of wing photographs, with a summary of the numerical characters of the Neotropical species of *Culicoides* (Diptera: Ceratopogonidae). *Contributions of the American Entomological Institute* 25: 1–72.