

# 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

Irving Fox<sup>1</sup>

## INTRODUCTION

The last complete list of *Culicoides* (Vargas, 1949b)<sup>2</sup> included 30 Nearctic and 60 Neotropical species; but so great has been taxonomic activity during the past 5 years that many more species are known today. By the end of June 1954 a total of 198 trivial names had been used for *Culicoides* of the Western Hemisphere, of which 14 pertain to species belonging in other genera and at least 24 are synonyms. In *Leptoconops* 12 names have been used of which 3 are synonyms; and 12 names have also been proposed in *Lasiohelea*.

Recently attempts have been made to divide *Culicoides* into subgenera. The system which follows differs from two previous efforts, those of Khalaf (1954) and Vargas (1953a), in that primary emphasis for separation of the subgenera is placed on the male terminalia. It is possible in this way to retain Khalaf's name *Monoculicoides* even though he included in this subgenus the type of Vargas' *Beltranmyia*. Vargas erected *Beltranmyia* for a small group of species related to *crepuscularis* Malloch, but since the males differ from others only in having a reduced ventral root, it is deemed desirable to use the subgeneric name for a much larger group of species. It has not been possible to place in subgeneric synonymy two names which have been considered synonyms of *Culicoides*, *Synhelea* Kieffer (1925a), which was based on two species never again found, and *Cotocripus* Brèthes (1912), which was based on *caridei*, a disputed species placed in *Culicoides* by some authors and in *Dasyhelea* by others. *Caridei* is here included among those Neotropical species whose males have not been described which probably belong in either *Oecacta* or *Beltranmyia*.

## LITERATURE REVIEW

It is the general opinion today that only three of the genera of Ceratopogonidae occurring in the Western Hemisphere include members which suck mammalian blood; these are *Culicoides*, *Leptoconops*, and *Lasiohelea*. In 1915, Townsend erroneously postulated that two species of *Forcipomyia*,

<sup>1</sup> Assistant Professor of Medical Entomology, School of Medicine, University of Puerto Rico, San Juan, P.R.

<sup>2</sup> For references see Bibliography, pp. 270-85.

*utae* Knab and *townsendi* Knab, both described in 1915, were the vectors of American leishmaniasis. Edwards (1922) and Goetghebuer (1923, 1935) indicated that any records of biting by *Forcipomyia*, *Atrichopogon*, or *Dasyhelea* are very likely in error. The bloodsucking midges affect man's welfare by causing severe annoyance from their bites, to which certain individuals react very strongly (Dampf, 1936a; Hase, 1933; Jobling, 1928; Leclercq, 1950; Mandoul, 1926) and by transmitting human and animal diseases. They are the proven vectors of three human nematodes, *Acanthocheilonema perstans* (Garnham and Harper, 1944; Hopkins, 1952; Hopkins and Nicholas, 1952; Kershaw, 1950; Nicholas, 1953a, Nicholas, *et al.*, 1953; Roman, 1941; Sharp, 1927, 1928); *Acanthocheilonema streptocerca* (Chardome and Peel, 1949; Henrard and Peel, 1949; Van Den Berghe and Chardome, 1952); and *Mansonella ozzardi* (Briceño-Rossi, 1949; Buckley, 1933, 1934a, 1934b; O'Connor, 1937; Romaña and Wygodzinsky, 1950); but not of *Onchocerca volvulus* (Gibson and Ascoli, 1952). Various authors have suspected them to be vectors of fevers of undetermined origin (Huttel, *et al.*, 1953; Loughnan, 1921; Purcell, 1937; Stephens, 1923; Wanson, 1939). As regards animal diseases, they transmit equine and bovine onchocerciasis (Buckley, 1938; Moignoux, 1951; Steward, 1933, 1935; Wehr and Lucker, 1952), African horse sickness and blue tongue of sheep (Bradley, 1954; Du Toit, 1944, 1945), and a filaria of frogs (Desportes, 1941, 1942). On several occasions unidentified filariae have been found in them (Causey, 1938; Dampf, 1936a; Hoffman, 1939; Mirsa, *et al.*, 1952; Sergent, *et al.*, 1933; Vargas, 1941).

A number of workers have dealt with the morphology of the adult (Goetghebuer, 1923; Jobling, 1928; Leon, 1924; Mukerji, 1931a, 1931b; Pomerantzev, 1932; Snodgrass, 1943; Tokunaga, 1937) and of the immature stages (Anderson, 1937; Carter, *et al.*, 1920; Dove, *et al.*, 1932; Fox, 1942; Goetghebuer, 1919; Goetghebuer and Lenz, 1934; Hill, 1947; Hoffman, 1924; Jobling, 1929, 1953; Kettle and Lawson, 1952; Lawson, 1951; Mayer, 1934; Medwedewa, 1927; Painter, 1926; Parker, 1950; Patel, 1921; Patton, 1913; Rieth, 1915; Smith and Lowe, 1948; Thienemann, 1928; Thomsen, 1937; Williams, 1951a, 1951b; Wirth, 1952a, 1952c).

Flight range, seasonal incidence, and other aspects of bionomics have been treated by Atchely and Hull, 1936; Bequaert, 1924; Carpenter, 1951; Downes, 1950; Foley and Picout-Laforest, 1923; Fox, 1952b; Fox and Maldonado, 1953; Gerry, 1953; Glick, 1939; Hull, *et al.*, 1934; Kettle, 1951a, 1951b; Meyers, 1932; Nicholas, 1953b; Parker, 1949; Roberts, 1950; Sergent, 1922; Shields and Hull, 1943; and Woke, 1954.

Control measures against the immature stages include the use of dikes and pumps (Anonymous, 1938, 1941; Dove and Hall, 1934; Hull and Dove, 1935; Hull, *et al.*, 1939, 1943; Platts, *et al.*, 1943) and treatment of the soil with insecticides such as DDT, BHC, dieldrin, and others (Anonymous,

1930; Dorsey, 1947; Curran and Goulding, 1950; Fennah, 1945; Gerry, 1950; Goulding, 1950; Goulding, *et al.*, 1953; Hill and Roberts, 1947; Kettle, 1949, 1952; Labrecque and Goulding, 1954; Labrecque, *et al.*, 1951; Madden, *et al.*, 1946; Rees and Smith, 1950, 1952; Steward, 1946; Wilson, 1951). Adults in houses are controlled by DDT and other sprays (Anonymous, 1947; Bishopp, 1946; Hull and Shields, 1939; Trapido, 1947) and temporary control out-of-doors is often obtained by DDT aerosols (Brescia and Wilson, 1947; Bruce and Blakeslee, 1948; Glasgow and Collins, 1946; Travis, 1949; Wilson, *et al.*, 1949). Various repellents such as dimethyl pthalate and Indalone have been used with success (Applewhite and Cross, 1951; Applewhite and Smith, 1950; Cameron, 1946; Granett, *et al.*, 1949; Holden and Findlay, 1944; Peacock, *et al.*, 1948; Pijoan, *et al.*, 1946; Travis and Morton, 1950; Travis, *et al.*, 1946).

A number of colleagues have kindly assisted in the preparation of this work by lending specimens and supplying needed references to literature. Among them are L. C. Curtis, H. Floch, P. Freeman, J. D. Gregson, D. G. Hall, E. H. Hinman, G. P. Holland, C. E. Hopla, D. R. Iriarte, O. A. Johannsen, R. H. Jones, F. B. Lewis, B. de Meillon, A. Rudnick, W. E. Snow, L. Vargas, and W. W. Wirth, to whom particular thanks are due for his advice and helpfulness.

**KEY TO THE SUBGENERA OF *CULICOIDES* LATREILLE (MALES)**

1. Ninth tergite rounded apically, the apicolateral processes absent or small and convergent..... 2  
     Ninth tergite shaped variously, the apicolateral processes prominent and usually divergent..... 5
2. Aedeagus basally with a long curved hooklike process at the middle  
     *Macfiella*  
     Aedeagus without such a process..... 3
3. Aedeagus triangular with a definite basal marginal band and extended tip; ventral root absent..... *Hoffmania*  
     Aedeagus otherwise, if triangular usually without a basal band; ventral root present..... 4
4. Ventral root long; inner side of basistyle without prominent setae  
     *Avaritia*  
     Ventral root short; inner side of basistyle with prominent setae  
     *Culicoides*
5. Parameres fused medially to form a plate, sometimes with the tips free..... 6  
     Parameres entirely separate..... 7
6. Plate (fused parameres) usually triangular with one apical point or two small lobes; aedeagus not bifid.....*Selfia*

Plate with two apical points and aedeagus often bifid

*Monoculicoides*

7. Parameres fringed with spines or long hairs apically on one side

*Oecacta*

Parameres without such spines.....*Beltranmyia*

**KEY TO THE SUBGENERA OF *CULICOIDES* (FEMALES)**

1. Wing with second radial cell in a light spot..... 2  
 Wing with second radial cell in a dark spot or without spots..... 4
2. Size small, 1.0 to 1.5 mm., wing markings faint and macrotrichiae scanty..... *Avaritia*  
 Size large, 1.5 to 2.5 mm., wing markings distinct and macrotrichiae abundant..... 3
3. Wing with cubital fork in a light area..... *Hoffmania*  
 Wing with cubital fork in a dark area..... *Culicoides*
4. Spermathecae not apparent..... *Selfia*  
 Spermathecae apparent, single or double..... 5
5. Spermatheca single, opening to the duct wide..... *Monoculicoides*  
 Spermathecae usually double, if single the opening to the duct narrow 6
6. Fourth hind tarsal segment cordiform..... *Macfiella*  
 Fourth hind tarsal segment cylindrical..... *Oecacta*, *Beltranmyia*

**MACFIELLA, NEW SUBGENUS**

Male hypopygium with the ninth tergite more or less rounded apically, the apicolateral processes very small. Parameres separate the tips without spines. Aedeagus without a prominent arch, the apical portion long, distally truncate, basally with a long curved hooklike pointed process. Ventral root long with a prominent basal projection, dorsal root about as long as the ventral somewhat boot-shaped. Female with eyes contiguous, wing with second radial cell in a dark spot, spermathecae two, fourth tarsal segment of all the legs cordiform and wider than the fifth. Type, here designated, *Ceratopogon phlebotomus* Williston.

Only two species of this subgenus are known, *phlebotomus* (Williston) and *willistoni* Wirth and Blanton, and both are Neotropical. They are very similar as regards the hypopygium and wing but may be easily distinguished by the mesonotum, which in *willistoni* has a pattern of conspicuous dark spots, while in *phlebotomus* it is greenish gray without a distinct pattern.

**SUBGENUS *HOFFMANIA* FOX**

*Hoffmania*, Fox, 1947, 21. Ortiz, 1950, 437. Vargas, 1953a, 34. Type, by original designation, *Culicoides inamollae* Fox and Hoffman.

Male hypopygium with the ninth tergite rounded apically, the apicolateral processes small and convergent or absent. Parameres entirely separate or fused basally, the tips sometimes with fine hairs on both sides. Aedeagus more or less triangular with a basal marginal sclerotized band and distally extended to form a "peg". Ventral root absent, dorsal root more or less fingerlike. Females with the eyes contiguous; wing with the second radial cell mainly in a light spot and the cubital fork in a light area; spermathecae, two.

Only two species of this subgenus occur in the Nearctic Region, *venustus* Hoffman and *inamollae* Fox and Hoffman. The males may be distinguished by the parameres which in *venustus* are completely separated while in *inamollae* they are joined at their bases by a peculiar loop. The wing of the female of *venustus* usually has two small light spots in cell  $M_1$  beyond the light spot on vein  $M_2$  and the crossvein is in a light spot; the wing of the female of *inamollae* has only one light spot in the tip of cell  $M_1$  and there is a dark spot on the cross vein at its junction with the first radial cell.

Neotropical species (including Mexico).—*bimaculatus* Floch and Abonnenc, *coulinhoi* Barretto, *decor* Williston, *diabolicus* Hoffman, *diminutus* Barbosa, *flavivenula* Lutz, *foxi* Ortiz, *guttatus* (Coquillett), *heliconiae* Fox and Hoffman, *hylas* Macfie, *inamollae* Fox and Hoffman, *insignis* Lutz, *lutzi* Lima, *maruim* Lutz, *ocumarensis* Ortiz, *oliveri* Fox and Hoffman, *recifei* Barbosa, *rozeboomi* Barbosa, *verecundus* Macfie.

#### AVARITIA, NEW SUBGENUS

Male hypopygium with the ninth tergite usually without a median notch and the apicolateral processes absent; in one species (*chiopterus*) with the posterior margin of the ninth tergite concave and the corners prominent but not forming characteristic processes. Parameres separate or joined basally, the tips with or without hairs. Aedeagus various, sometimes triangular. Inner margin of the basistyle without setae; ventral root very long, longer than the dorsal root. Females very small, 1.0–1.5 mm., eyes contiguous; wing markings faint, macrotrichiae scanty, the second radial cell usually in a light spot, but sometimes in a dark spot; spermathecae double. Type, here designated, *Ceratopogon obsoletus* Meigen.

Only two species of this subgenus occur in the Nearctic Region, *obsoletus* (Meigen) and *chiopterus* (Meigen). The females cannot be distinguished easily, but the males may be readily separated by the terminalia; in *chiopterus* the aedeagus is more or less triangular and the ninth sternite has a very wide excavation, but in *obsoletus* the aedeagus is different in shape and the ninth sternite has a narrow deep median notch. The Neotropical *pusillus* Lutz belongs to this subgenus on the basis of the terminalia, which resemble somewhat those of *chiopterus*, however, the female is unusual in that the second radial cell of the wing is in a dark spot.

SUBGENUS *CULICOIDES* LATREILLE

*Culicoides* Latreille, 1809, 251. Type, by original designation, *Culicoides pubicularis* (Linnaeus) as *Culicoides punctata* Latreille. Vargas, 1953a, 33. Khalaf, 1954, 38.

*Haemophructus* Macfie, 1925, 349. Type, by monotypy, *Haemophructus maculipennis* Macfie.

*Prosapelma* Kieffer, 1925a, 417. Type, by original designation, *Prosapelma cinerea* Kieffer.

Male hypopygium with ninth tergite rounded, often projecting at the midline, apicolateral processes usually reduced or absent, sometimes long but weakly sclerotized. Aedeagus various, if triangular without a basal marginal band. Inner margin of the basistyle with prominent setae. Ventral root short, not longer than the dorsal root. Female large, 1.5 to 2.5 mm. long; eyes contiguous or very close together; wings with the second radial cell in a light spot and markings prominent, often with three broad transverse dark stripes, the middle one enclosing the basal portion of the cubital fork in a dark area; spermathecae double.

NEARCTIC FORMS.—*cockerellii cockerellii* (Coquillett), *c. saltonensis* Wirth, *luteovenus* Root and Hoffman, *sordidellus* (Zetterstedt), *tristriatulus* Hoffman, *yukonensis* Hoffman.

NEOTROPICAL SPECIES (INCLUDING MEXICO).—*beebei* Fox, *cova-garciai* Ortiz, *efferus* Fox, *elutus* Macfie, *luteovenus* Root and Hoffman, *yukonensis* Hoffman.

KEY TO THE NEARCTIC SPECIES OF *CULICOIDES* (MALES)

1. Apicolateral processes extending beyond the middle portion of the tergite. . . . . 2  
    Apicolateral processes not extending beyond the middle portion of the tergite. . . . . 3
2. Basistyle with a pronounced hump on the inner margin . . . . . *yukonensis*  
    Basistyle without such a hump . . . . . *tristriatulus*
3. Basal arms of aedeagus short, the distal triangular portion about twice their length. . . . . *luteovenus*  
    Basal arms long, about as long as the distal portion . . . . . *c. cockerelli, c. saltonensis*

KEY TO THE NEARCTIC SPECIES OF *CULICOIDES* (FEMALES)

1. Wing with a dark spot centrally in cell  $Cu_1$ . . . . . *yukonensis*  
    Cell  $Cu_1$  without such a dark spot . . . . . 2
2. Mesonotum with three distinct dark bands. . . . . *tristriatulus*  
    Mesonotum not as above . . . . . 3

- 3. Hind tibiae with basal light bands.....*luteovenus*  
Hind tibiae uniform brown or yellowish..... 4
- 4. Mesonotum usually uniform gray.....*c. saltonensis*  
Mesonotum with two dark spots.....*sordidellus, c. cockerellii*

SUBGENUS *SELFIA* KHALAF

*Selfia* Khalaf, 1954, 38. Type, by original designation, *Culicoides hieroglyphicus* Malloch.

Male hypopygium with ninth tergite of various shapes, apicolateral processes long and divergent. Parameres fused to form a plate usually triangular with one distal point but sometimes with two small lobes. Aedeagus consisting of two sclerotized pieces often fused apically. Ventral root prominent but often partly internal, dorsal root absent or internal. Females with spermathecae unsclerotized, not apparent; wings without spots.

NEARCTIC SPECIES.—*brookmani* Wirth, *denningi* Foote and Pratt, *hieroglyphicus* Malloch, *jamesi* Fox, *multipunctatus* Malloch, *tenuistylus* Wirth. No Neotropical species appear to have been described.

KEY TO THE NEARCTIC SPECIES OF *SELFIA* (MALES)

- 1. Plate (fused parameres) with a pair of lobes distally; aedeagus with three prongs apically..... *multipunctatus*  
Plate without such lobes, more or less triangular; aedeagus not as above..... 2
- 2. Ninth sternite with projecting processes at least three times as long as wide..... *hieroglyphicus*  
Ninth sternite without such processes..... 3
- 3. Aedeagus a pair of boomerang-shaped plates with apices widely separated..... *brookmani*  
Aedeagus not as above..... 4
- 4. Dististyle distally foot-shaped..... *jamesi*  
Dististyle distally slender..... 5
- 5. Apicolateral processes as long as or longer than the distances between their bases..... *tenuistylus*  
Apicolateral processes much shorter than the distances between their bases..... *denningi*

KEY TO THE NEARCTIC SPECIES OF *SELFIA* (FEMALES)

- 1. Mesonotum with small dark dots..... *multipunctatus*  
Mesonotum otherwise..... 2
- 2. Mesonotum with broad light spots..... *hieroglyphicus, denningi*  
Mesonotum uniform brown or with narrow light bands..... 3

3. *Mesonotum* uniform brown..... *brookmani*  
*Mesonotum* with two submedian light bands..... *jamesi*, *tenuistylus*

SUBGENUS *MONOCULICOIDES* KHALAF

*Monoculicoides* Khalaf, 1954, 39. Type, by original designation, *Ceratopogon nubeculosus* Meigen.

Male hypopygium with ninth tergite shaped variously, the apicolateral processes broad and long. Parameres fused to form a plate usually bifid distally with two apical points. Aedeagus usually deeply bifid as well. Dorsal root usually longer than the ventral root and often boot-shaped. Females very large 2.0 mm. or more, with a small round tubercle above the base of each antenna; wings with the second radial cell in a dark spot; spermatheca single, large, often irregular in shape and with opening to the duct wide.

Only two species of this subgenus definitely occur in the Nearctic Region, *variipennis* (Coquillett) and *gigas* Root and Hoffman, which is known only from the female. The two species are easily distinguished by the mesonotum which in *variipennis* has a stippling of prominent brown dots while in *gigas* it is gray with indistinct markings; the spermathecae are also different being C-shaped in the former species and ovate in the latter. No Neotropical species appear to have been described, but *variipennis* occurs in Mexico.

SUBGENUS *OECACTA* POEY

*Oecacta* Poey, 1851, 236. Type, by monotypy, *Oecacta furens* Poey. Kieffer, 1906, 55. Kieffer, 1926, 106. Khalaf, 1954, 36 (in part).

*Haematomyidium* Goeldi, 1905, 137. Type, by original designation, *Haematomyidium paraense* Goeldi.

*Psychophaena* Philippi, 1865, 628. Type, by monotypy, *Culicoides venezuelensis* Ortiz and Mirsa as *Psychophaena pictipennis* Philippi (name preoccupied).

*Diplosella* Kieffer, 1921b, 113. Type, by monotypy, *Diplosella sergenti* Kieffer.

Male hypopygium with ninth tergite quadrangular, wider basally than apically, the apicolateral processes usually long, median cleft usually present. Parameres separate, the tips with spines varying in number and size forming a fringe on one side or with long hairs on one side, often with a lobelike swelling before the tip. Aedeagus with a wide basal arch. Ventral root in almost all the species with a basal projection giving the whole a "boathook" shape, dorsal root fingerlike about as long as the ventral root. Females usually with two spermathecae and wings usually with the second



radial cell included in a dark spot, occasionally wings uniform without dark spots.

NEARCTIC SPECIES.—*baueri* Hoffman, *floridensis* Beck, *furens* (Poey), *haematopotus* Malloch, *mohave* Wirth, *pifanoi* Ortiz; *piliferus* Root and Hoffman, *salihii* Khalaf, *stellifer* (Coquillett), *stilobezzioides* Foote and Pratt, *unicolor* (Coquillett).

NEOTROPICAL SPECIES (INCLUDING MEXICO).—*baueri* Hoffman, *bambusicola* Lutz, *carpenteri* Wirth and Blanton, *dampfi* Root and Hoffman, *dasyophrus* Macfie, *furens* (Poey), *galindoi* Wirth and Blanton, *gorgasi* Wirth and Blanton, *haematopotus* Malloch, *hoffmani* Fox, *iriartei* Fox, *lanei* Ortiz, *leopoldoi* Ortiz, *limai* Barretto, *lopesi* Barretto, *magnipalpis* Wirth and Blanton, *mojingaensis* Wirth and Blanton, *paraensis* (Goeldi), *pifanoi* Ortiz, *piliferus* Root and Hoffman, *propriipennis* Macfie, *scopus* Root and Hoffman, *stigmalis* Wirth, *uniradialis* Wirth and Blanton, *venezuelensis* Ortiz and Mirsa.

KEY TO THE NEARCTIC SPECIES OF *OECACTA* (MALES)

1. Apex of aedeagus bent anteriorly; parameres with several long hairs before the tip..... *stilobezzioides*  
Aedeagus not as above; parameres with spines apically..... 2
2. Arch of aedeagus with a distinct process on each side..... 3  
Arch of aedeagus without such processes..... 5
3. Parameres with a lobelike swelling before the broadly expanded tip  
*haematopotus*  
Parameres without lobelike swellings and the tips not broadly expanded..... 4
4. Processes on arch of aedeagus very long, longer than one-half the apical portion of the aedeagus..... *salihii*  
Processes on arch of aedeagus shorter than one-half the apical portion  
*baueri*
5. Apex of aedeagus clearly divided into lobes..... 6  
Apex of aedeagus not divided, but may be striated..... 7
6. Apicolateral processes longer than the distance between them  
*furens*  
Apicolateral processes shorter than the distance between them  
*pifanoi*
7. Parameres with a lobelike swelling on stem before the tip..... 8  
Parameres slender without lobelike swellings..... 9
8. Fringing spines of parameres limited to an expanded basal portion of tip..... *stellifer*  
Fringing spines not so limited and tip not expanded..... *mohave*

9. Apex of aedeagus truncate and striated; basal projection of ventral root distinct..... *piliferus*  
 Apex of aedeagus pointed or conelike; basal projection of ventral root indefinite..... 10
10. Apicolateral processes long and prominent..... *unicolor*  
 Apicolateral processes very short..... *floridensis*

SUBGENUS *BELTRANMYIA* VARGAS

*Beltranmyia* Vargas, 1953a, 34. Type, by original designation, *Culicoides crepuscularis* Malloch.

Male hypopygium as in *Oecacta* except that the parameres do not have a fringe of spines on one side at the tip. The ventral root is usually long and slender but may be short or even absent and rarely in the shape of a "boat-hook". Females usually with two spermatacae but often with one, otherwise as in *Oecacta*.

NEARCTIC FORMS.—*alaskensis* Wirth, *arboricola* Root and Hoffman, *biguttatus* (Coquillett), *canithorax* Hoffman, *copiosus* Root and Hoffman, *crepuscularis* Malloch, *guttipennis* (Coquillett), *hinmani* Khalaf, *horneae* Foote and Pratt, *loughnani* Edwards, *melleus* (Coquillett), *monoensis* Wirth, *nanus* Root and Hoffman, *niger* Root and Hoffman, *ousairani* Khalaf, *palmerae* James, *pumilus* (Winnertz), *spinus* Root and Hoffman, *stonei* James, *travisi* Vargas, *usingeri* Wirth, *utahensis* Fox, *villosipennis villosipennis* Root and Hoffman, *v. oklahomensis* Khalaf, *weesei* Khalaf, *wirthi* Foote and Pratt.

NEOTROPICAL SPECIES (INCLUDING MEXICO).—*albomacula* Root and Hoffman, *arubae* Fox and Hoffman, *aureus* Ortiz, *bahiensis* Barbosa, *borinqueni* Fox and Hoffman, *briceñoi* Ortiz, *copiosus* Root and Hoffman, *crepuscularis* Malloch, *daedalus* Macfie, *dominicii* Ortiz, *eublepharus* Macfie, *fluvialis* Macfie, *guyanensis* Floch and Abonnenc, *hertigi* Wirth and Blanton, *jamaicensis* Edwards, *kintzi* Wirth and Blanton, *loughnani* Edwards, *macrostigma* Wirth and Blanton, *panamensis* Barbosa, *propinquus* Macfie, *reticulatus* Lutz, *stigmalis* Wirth, *trilineatus* Fox, *wirthomyia* Vargas.

KEY TO THE NEARCTIC SPECIES OF *BELTRANMYIA* (MALES)

1. Ventral root greatly reduced or absent..... 2  
 Ventral root various not greatly reduced or absent..... 3
2. Apex of aedeagus pointed..... *alaskensis*, *crepuscularis*  
 Apex of aedeagus truncate..... *canithorax*
3. Aedeagus consisting of the arch only..... *pumilus*  
 Apex of aedeagus expanded and otherwise modified..... 4

4. Parameres with apex flaring into several radiating points . . . . . 5  
 Parameres not so modified . . . . . 6

5. Apex of aedeagus narrow, not much wider than an apicolateral process  
*spinosus*  
 Apex of aedeagus broadly rounded, much wider than an apicolateral  
 process . . . . . *usingeri*

6. Apex of aedeagus with a conspicuous hooklike process on each side  
 distally . . . . . *melleus*  
 Aedeagus without such processes . . . . . 7

7. Apex of aedeagus with lateral lobes or with a mesal notch . . . . . 8  
 Aedeagus not as above . . . . . 9

8. Apex of aedeagus with 1 or 2 distinct lobes on each side  
*v. villosipennis, v. oklahomensis*  
 Apex of aedeagus with a mesal notch and lateral points . . . *monoensis*

9. Aedeagus deeply excavated at distal third to form distinct shoulders  
 and a narrow apex . . . . . *palmerae*  
 Aedeagus not as above . . . . . 10

10. Membrane spiculate . . . . . 11  
 Membrane bare . . . . . 14

11. Dististyles markedly bent beyond the middle; apex of aedeagus pointed;  
 ventral root short, broad, and mostly internal . . . . . *guttipennis*  
 Dististyles not markedly bent; apex of aedeagus truncate; ventral  
 root slender and external . . . . . 12

12. Ventral roots very long, longer than the dorsal roots and almost  
 meeting . . . . . *biguttatus*  
 Ventral roots shorter, about as long as the dorsal roots . . . . . 13

13. Dististyle short, about one-half as long as basistyle and distally ex-  
 panded . . . . . *copiosus*  
 Dististyle long, about as long as basistyle and distally attenuated  
*weesei*

14. Apex of aedeagus extended to a very slender point  
*arboricola, ousairani*  
 Apex of aedeagus rounded or truncate . . . . . 15

15. Parameres enlarged in middle as wide as or wider than at the base . . 16  
 Parameres slender, tapering to tip, much wider at base than in the  
 middle . . . . . 18

16. Base of parameres bent almost at right angles; ninth tergite without  
 a median notch . . . . . *loughnani*  
 Parameres not as above; ninth tergite with a notch . . . . . 17

17. Dististyle bent at base; ventral root obscure, shorter than dorsal root  
*utahensis*  
 Dististyle not as above; ventral root as long as or longer than dorsal  
 root . . . . . *niger, hinmani*

18. Apicolateral processes very wide at base, each wider than distance between them; ventral root about one-half as long as dorsal root  
*stonei*  
Apicolateral processes narrower than the distance between them; ventral root about as long or longer than dorsal root. . . . . 19
19. Apical portion of aedeagus much extended giving the whole the shape of an inverted Y. . . . . *travisi, horneae*  
Apical portion of aedeagus not greatly extended, triangular, massive, giving the whole the shape of an inverted V. . . . . 20
20. Paramere greatly enlarged and footlike at the base. . . . . *wirthi*  
Paramere not as above. . . . . *nanus*

*Nocivum* Harris, briefly described in 1862, has never been identified and so is omitted from the following key to the females of *Beltranmyia* and *Oecacta*. Also omitted are three species of Foote and Pratt which are known only from the males, *horneae*, *stilobezzioides* and *wirthi*. *Reevesi* Wirth was described only from the female, hence its subgenus cannot be definitely determined, however, it probably belongs in one of these subgenera and is included in the key. There are a number of Neotropical species whose males are undescribed which also appear to belong in these two subgenera, as follows: *acotylus* Lutz, *alahialinus* Barbosa, *alambiculorum* Macfie, *avilaensis* Ortiz and Mirsa, *bennarrochei* Ortiz and Mirsa, *cacozelus* Macfie, *caprilesi* Fox, *caridei* Brèthes, *castillae* Fox, *debilipalpis debilipalpis* Lutz, *d. equatoriensis* Barbosa, *d. glabrior* Macfie, *discrepans* Ortiz and Mirsa, *flocha-bonnenci* Ortiz, and Mirsa, *germanus* Macfie, *gibsoni* Wirth, *ginesi* Ortiz, *guadeloupensis* Floch and Abonnenc, *horticola* Lutz, *leoni* Barbosa, *lichyi* Floch and Abonnenc, *obnoxius* Fox, *pachymerus* Lutz, *pampoikilus* Macfie, *paucienfuscatus* Barbosa, *poikilonotus* Macfie, *pulchripennis* Macfie, *rangeli* Ortiz and Mirsa, *wokei* Fox.

KEY TO THE NEARCTIC SPECIES OF *BELTRANMYIA* AND *OECACTA* (FEMALES)

1. Spermatheca single. . . . . 2  
Spermathecae double. . . . . 4
2. Ring present; antennal flagellum with segments in a continuous series, segment XI not much larger than X. . . . . *reevesi*  
Ring absent; an abrupt change in shape between antennal segments X and XI, the latter much larger than the former. . . . . 3
3. Apical half of second radial cell in a light spot; third palpal segment moderate in size; mesonotum without a distinct pattern  
*canithorax*  
Apical half of second radial cell in a dark spot; third palpal segment large and swollen; mesonotum with a distinct pattern  
*crepuscularis, alaskensis*

4. Wing uniform without light or dark spots.....	5
Wing with light or dark spots.....	8
5. Spermathecae large, dark, without ring.....	6
Spermathecae smaller, light, with ring.....	7
6. Third palpal segment with pit small or indefinite.....	<i>melleus</i>
Third palpal segment with a large pit.....	<i>stonei, weesei</i>
7. Legs uniform brownish black; mesonotum shining black....	<i>monoensis</i>
Legs light yellow, sometimes with knees dark; mesonotum yellow or brown.....	<i>salihi, floridensis, pumilus</i>
8. Wing with only two distinct light spots, one on the cross vein and one just beyond the second radial cell.....	9
Wing with other light spots as well as those on the cross vein and beyond the second radial cell.....	10
9. Hind tibial comb with 5 or 6 spines.....	<i>unicolor</i>
Hind tibial comb with 4 spines.....	<i>usingeri, spinosus, biguttatus</i>
10. Basal half of cell $M_1$ with a light area or with a light spot on vein $M_2$ .....	11
Basal half of cell $M_1$ dark.....	<i>travisi, nanus, hollensis</i>
11. No light spots in the apical halves of cells $R_5$ and $M_1$ and a transverse row of light spots across the middle of the wing.....	<i>niger</i>
Wing not as above.....	12
12. Hind tibial comb with 5 or 6 spines.....	13
Hind tibial comb with 4 spines.....	17
13. Wing with circumscribed light spots straddling veins $M_1$ and $M_2$	14
Wing without such light spots.....	16
14. Light spot on cross vein small hardly extending beyond vein $M_1$	<i>villosipennis</i>
Light spot on cross vein large extending well beyond vein $M_1$ .....	15
15. Vein $Cu_2$ with a light border.....	<i>arboricola, ousairani</i>
Vein $Cu_2$ without a light border.....	<i>guttipennis, v. oklahomensis</i>
16. Cell $R_5$ with 3 light spots, the distal 2 may be connected to form a single inverted U-shaped spot; cell $M_1$ with 3 light spots	<i>stellifer</i>
Cells $R_5$ and $M_1$ with at most 2 light spots.....	<i>unicolor</i>
17. Cell $R_5$ with at least 2 light spots in addition to the one just beyond the second radial cell; mesonotal pattern consisting of many small dark dots.....	<i>furens</i>
Cell $R_5$ with 1 light spot only in addition to the one just beyond the second radial cell; mesonotum not as above.....	18
18. Distal light spot of cell $R_5$ small, near the tip of the wing	<i>haematopotus</i>
Cell $R_5$ not as above.....	19

19. Third palpal segment large and swollen, about  $1\frac{1}{2}$  times as long as the first and second together . . . . . 20  
 Third palpal segment moderate, only slightly longer than the first and second . . . . . 22
20. Cubital fork in a light area, cell  $R_5$  with a dark spot at the middle and at the tip . . . . . *loughmani*  
 Cubital fork in a dark area, cell  $R_5$  not as above . . . . . 21
21. Cell  $R_5$  clearly with a double light spot at the middle; mesonotum with a distinct pattern . . . . . *baueri*  
 Cell  $R_5$  with a faint oval spot at the middle; mesonotum without a pattern . . . . . *copiosus*
22. Last 5 segments of antennal flagellum much shorter than first 8 . . . . . *pifanoi*  
 Last 5 segments about equal to or longer than the first 8 . . . . . 23
23. Size very small, about 1.0 mm . . . . . 24  
 Size larger, about 1.3 mm . . . . . 25
24. Base of vein  $M_2$  straddled by a light spot; mesonotum with a distinct pattern . . . . . *hinmani*  
 Base of vein  $M_2$  without a spot; mesonotum without a pattern . . . . . *mohave*
25. A light spot in the middle of vein  $M_2$  . . . . . *piliferus*  
 A light area at the base of vein  $M_2$  . . . . . *utahensis, palmerae*

**CULICOIDES LATREILLE****acotylus Lutz**

*Culicoides acotylus* Lutz, 1913, 69 (♀, Salto Augusto, Rio Tapajoz, Brazil). Vargas, 1945, 43. Barbosa, 1947, 10 (♀, Brazil). Macfie, 1948, 74. Ortiz and Peña Garcia, 1948, 6 (Venezuela). Vargas, 1949b, 194. Iriarte, 1950, 391. Ortiz, 1951a, 8 (Venezuela). Ortiz and Mirsa, 1952b, 258 (♀, Venezuela).

*Culicoides acolytus* Lima, 1937, 413.

*Culicoides panamericanus* Fox, 1947, 90 (♀, Mexico).

**alahialinus Barbosa**

*Culicoides alahialinus* Barbosa, 1952, 11 (♀, Limones, Esmeralda, Ecuador).

**alambiculorum Macfie**

*Culicoides alambiculorum* Macfie, 1948, 81 (♀, El Vergel, Chiapas, Mexico).

**alaskensis Wirth**

*Culicoides alaskensis* Wirth, 1951a, 84 (♂ ♀, Valdez, Alaska). Williams, 1951a, 181 (Alaska).

*Culicoides (Monoculicoides) alaskensis* Khalaf, 1954, 40.

**albomacula Root and Hoffman**

*Culicoides albomacula* Root and Hoffman, 1937, 164 (♂ ♀, San Jacinto, D. F., Mexico). Vargas, 1945, 44 (Mexico). Macfie, 1948, 71. Vargas, 1949b, 194. Ortiz, 1950, 462.

*Culicoides albomaculatus* Johannsen, 1943, 779.

*Culicoides (Oecacta) albomacula* Khalaf, 1954, 36.

**amazonius Macfie**

See *Culicoides phlebotomus* (Williston).

**ancorus Coquillett**

*Ceratopogon ancorus* Coquillett, 1902, 87.

*Culicoides ancorus* Kieffer, 1906, 54.

REMARKS.—A species of *Dasyhelea* (Wirth, 1952a, 159).

**arboricola Root and Hoffman**

*Culicoides arboricola* Root and Hoffman, 1937, 166 (♂ ♀, Baltimore, Md.; Georgia, Mississippi, U. S. A.) Fox, 1942, 416 (pupa, Maryland, U. S. A.) Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 194. Ortiz, 1950, 462. Johannsen, 1952, 161. Khalaf, 1952b, 349 (Oklahoma, U. S. A.) Beck, 1952, 103 (Florida, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.) Foote and Pratt, 1954, 15 (♂ ♀, Florida, Georgia, Illinois, Louisiana, U. S. A.).

*Culicoides (Oecacta) arboricola* Khalaf, 1954, 37.

**arubae Fox and Hoffman**

*Culicoides arubae* Fox and Hoffman, 1944, 109 (♂ ♀, Aruba, D. W. I.). Vargas, 1945, 43. Fox, 1946a, 250. Anduze, *et al.*, 1947, 11 (Venezuela). Barbosa, 1947, 11 (♂ ♀, Venezuela; Canal Zone). Macfie, 1948, 71. Ortiz and Peña Garcia 1948, 7 (Venezuela). Ortiz, 1949, 326 (Venezuela). Floch and Abonnenc, 1949a, 71. Vargas, 1949b, 195. Iriarte, 1950, 369. Ortiz, 1950, 462. Ortiz, 1951a, 10. Ortiz and Mirsa, 1952b, 269 (♂ ♀, Venezuela)

*Culicoides* species (1) Fox, 1942, 420 (pupa, D. W. I.).

*Culicoides variipennis* Ortiz (not Coquillett), 1942, 258 (Venezuela). Iriarte, 1943, 192 (Venezuela).

**aureus Ortiz**

*Culicoides aureus* Ortiz, 1951c, 585 (♀, San Felipe, Yaracuy, Venezuela).

*Culicoides miyamotoi* Wirth and Blanton, 1953b, 231 (♂ ♀, Canal Zone).

REMARKS.—The above synonymy is given on the authority of Wirth (personal communication).

**avilaensis Ortiz and Mirsa**

*Culicoides avilaensis* Ortiz and Mirsa, 1951, 593 (♀, Los Chorros, Miranda, Venezuela).

**bahiensis Barbosa**

*Culicoides bahiensis* Barbosa, 1947, 11 (♂ ♀, Bahia, Brazil). Vargas, 1949b, 195. Ortiz, 1950, 462.

**bambusicola Lutz**

*Culicoides bambusicola* Lutz, 1913, 62 (♂, Brazil). Rieth, 1915, 417. Lima, 1937, 412. Barretto, 1944, 95 (♂, Brazil). Vargas, 1945, 43. Lane, 1947, 166 (larva, pupa, Brazil). Macfie, 1948, 71. Vargas, 1949b, 195.

*Culicoides bambusicolus* Barbosa, 1947, 12 (Brazil). Ortiz, 1950, 462. Barbosa, 1952, 11 (larva, pupa).

*Culicoides (Oecacta) bambusicola* Khalaf, 1954, 37.

**baueri Hoffman**

*Culicoides baueri* Hoffman, 1925, 297 (♀, Baltimore, Md., U. S. A.). Root and Hoffman, 1937, 163 (♂ ♀, Mexico). Johannsen, 1943, 779. James, 1943, 149 (Colorado, U. S. A.) Vargas, 1945, 44 (Mexico). Macfie, 1948, 72. Vargas, 1949b, 195. Ortiz and Mirsa, 1951, 559 (♂ ♀, Venezuela) Wirth, 1952a, 183 (♂ ♀, California, U. S. A.) Johannsen, 1952, 160. Beck, 1952, 104 (Florida, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 16 (♂ ♀, Georgia, California, Maryland, U. S. A.).

*Culicoides bahueri* Ortiz, 1950, 462. Ortiz, 1951a, 9. Ortiz, 1951b, 442 (Venezuela).

*Culicoides (Oecacta) baueri* Khalaf, 1954, 37.

**beebei Fox**

*Culicoides beebei* Fox, 1952a, 366 (♀, Rancho Grande near Maracay, Venezuela).

**bellus Coquillett**

*Ceratopogon bellus* Coquillett, 1902, 87.

*Culicoides bellus* Kieffer, 1906, 54.

REMARKS.—A species of *Alluaudomyia* (Wirth, 1952a, 195).

**benarrochei Ortiz and Mirsa**

*Culicoides benarrochei* Ortiz and Mirsa, 1952a, 127 (♀, Caraballeda, Vargas, Dpto. Federal, Venezuela).



**biguttatus Coquillett**

*Ceratopogon biguttatus* Coquillett, 1901, 604 (♀, Washington, D. C., U. S. A.). Aldrich, 1905, 108.

*Culicoides biguttatus* Kieffer, 1906, 54. Malloch, 1915b, 308 (♀, Illinois, U. S. A.). Hoffman, 1925, 283 (♀, Maryland, Massachusetts, New York, Texas, U. S. A.). Leonard, 1928, 707 (New York, U. S. A.). Metcalf, 1932, 5 (New York, U. S. A.). Metcalf and Sanderson, 1932, 59 (New York, U. S. A.). Jellison and Phillips, 1933, 26 (Montana, U. S. A.). Root and Hoffman, 1937, 170 (♂ ♀, Connecticut, U. S. A.). Thomsen, 1937, 70 (pupa, New York, U. S. A.). Curtis, 1941, 18 (Canada). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 195. Ortiz, 1950, 462. Wirth, 1951c, 318 (Virginia, U. S. A.). Johannsen, 1952, 160. Beck, 1952, 103 (Florida, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 16 (♂ ♀, Florida, Georgia, Illinois, Kansas, Maryland, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, U. S. A.).

*Culicoides (Oecacta) biguttatus* Khalaf, 1954, 38.

**bimaculatus Floch and Abonnenc**

*Culicoides bimaculatus* Floch and Abonnenc, 1942b, 3 (♀, Cayenne, French Guiana). Barbosa, 1947, 8. Vargas, 1949b, 195. Floch, 1952, 295 (French Guiana).

**borinqueni Fox and Hoffman**

*Culicoides borinqueni* Fox and Hoffman, 1944, 110 (♂ ♀, Palmas Abajo, P. R.). Vargas, 1945, 43. Barbosa, 1947, 12. Wolcott, 1948, 426. Fox 1949, 30 (♂ ♀, Puerto Rico). Vargas, 1949b, 195. Fox and Kohler, 1950, 342 (Puerto Rico). Ortiz, 1950, 462. Fox and Maldonado, 1953, 165, (Puerto Rico).

*Culicoides* species (2) Fox, 1942, 417 (pupa, Puerto Rico).

**briceñoi Ortiz**

*Culicoides briceñoi* Ortiz, 1951a, 10 (Venezuela). Ortiz, 1951b, 445 (♂, Venezuela).

**brookmani Wirth**

*Culicoides brookmani* Wirth, 1952a, 179 (♂ ♀, Arroyo Seco Ranger Station, Monterey Co., Cal., U. S. A.).

*Culicoides (Selfia) brookmani* Khalaf, 1954, 38.

**cacozelus Macfie**

*Culicoides cacozelus* Macfie, 1948, 85 (♀, El Vergel, Chiapas, Mexico) Ortiz, 1951c, 581 (♀, Venezuela).

*Culicoides cacozelus* Vargas, 1949b, 195.

**canithorax Hoffman**

*Culicoides canithorax* Hoffman, 1925, 284 (♀, Brunswick, Ga., U. S. A.). Dove, *et al.*, 1932, 508 (South Carolina, U. S. A.). Atchley and Hull, 1936, 514. Root and Hoffman, 1937, 160 (♂ ♀, Maryland, South Carolina, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 195. Dove, 1949, 869. Ortiz, 1950, 462. Johannsen, 1952, 160. Beck, 1952, 103 (Florida, U. S. A.). Foote and Pratt, 1954, 17 (♂ ♀, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, Mississippi, New Jersey, South Carolina, U. S. A.).

*Culicoides mississippiensis* Hoffman, 1926a, 158 (♀, Mississippi, U. S. A.). Hinman, 1932, 773 (Louisiana, Mississippi, U. S. A.). Root and Hoffman, 1937, 160 (♀, Louisiana, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 195. Foote and Pratt, 1954, 17. Bradley, 1954, 126.

*Culicoides (Beltranmyia) canithorax* Vargas, 1953a, 35.

*Culicoides (Monoculicoides) canithorax* Khalaf, 1954, 40.

**caprilesi Fox**

*Culicoides caprilesi* Fox, 1952a, 364 (♀, Mount Marahuaca, Venezuela).

**caridei Brèthes**

*Cotocripus caridei* Brèthes, 1912, 451 (♀, Buenos Aires, Argentina). Lutz, 1914, 81.

*Centrorhynchus setifer* Lutz, 1913, 64 (♀, Brazil).

*Culicoides setifer* Edwards, 1922, 166. Vargas, 1945, 43.

*Culicoides caridei* Lane 1945, 366 (♀, Brazil; Argentina). Barbosa, 1947, 13 (Uruguay). Macfie, 1948, 69. Vargas, 1949b, 195.

*Dasyhelea caridei* Lane and Ortiz, 1950, 460.

**castillae Fox**

*Culicoides castillae* Fox, 1946a, 251 (♀, Puerto Castilla, Honduras).

Barbosa, 1947, 7. Macfie, 1948, 73. Vargas, 1949b, 196. Ortiz, 1950, 462.

Ortiz and Mirsa, 1952a, 126.

**carpenteri Wirth and Blanton**

*Culicoides carpenteri* Wirth and Blanton, 1953a, 72 (♂ ♀, Madden Dam, C. Z.).

**chiopterus Meigen**

*Ceratopogon chiopterus* Meigen, 1830, 263 (Europe).

*Ceratolphus chiopterus* Kieffer, 1906, 60 (North America).

*Culicoides chiopterus* Root and Hoffman, 1937, 156 (♂, Maryland, U. S. A.).

Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 196. Ortiz, 1950, 462. Johannsen, 1952, 160. Kettle and Lawson, 1952, 447 (larva, pupa,

England). Downes and Kettle, 1952, 66 (♂ ♀, Scotland). Foote and Pratt, 1954, 18, ♂.

*Culicoides (Culicoides) chiopterus* Khalaf, 1954, 39.

REMARKS.—This species is widely distributed in Europe (Kieffer, 1925b, 76; Goetghebuer and Lenz, 1934, 41; Edwards, 1939, 143; Hill, 1947, 107).

### **cinctus Coquillett**

*Ceratopogon cinctus* Coquillett, 1901, 605.

*Culicoides cinctus* Kieffer, 1906, 54.

REMARKS.—A species of *Dasyhelea* (Wirth, 1952a, 150).

### **cockerellii Coquillett**

*Ceratopogon cockerellii* Coquillett, 1901, 603 (♀, Custer Co., Colo., U. S. A.).

*Ceratopogon cockerelli* Aldrich, 1905, 108.

*Culicoides cockerelli* Kieffer, 1906, 54. Hoffman, 1925, 293 (♀, Colorado, U. S. A.; Canada). Root and Hoffman, 1937, 157 (Canada). Curtis, 1941, 18 (Canada). Johannsen, 1943, 779. James, 1943, 149 (♂, Colorado, U. S. A.). Vargas, 1945, 43. Vargas, 1949b, 196.

*Culicoides cockerellii* Knowlton and Fronk, 1950, 114 (Utah, U. S. A.). Wirth, 1951a, 81 (♂ ♀, Alaska). Wirth, 1952a, 171 (♂ ♀, California, Colorado, Utah, Wyoming, U. S. A.; Alaska; Canada). Foote and Pratt, 1954, 18 (♂ ♀, Montana, Wyoming, U. S. A.).

*Culicoides (Culicoides) cockerellii* Khalaf, 1954, 39.

### **cockerellii saltonensis Wirth**

*Culicoides cockerellii saltonensis* Wirth, 1952a, 173 (♂ ♀, Seeley, Imperial Co., Calif., U. S. A.).

*Culicoides (Culicoides) c. saltonensis* Khalaf, 1954, 39.

### **cockerelli var. tristriatulus Hoffman**

See *Culicoides tristriatulus* Hoffman

### **columbianus Kieffer**

*Culicoides columbianus* Kieffer, 1917b, 304.

*Dasyhelea columbianus* Kieffer, 1919a, 64.

REMARKS.—Macfie, 1948, 69, states that this is not a *Culicoides*.

### **copiosus Root and Hoffman**

*Culicoides copiosus* Root and Hoffman, 1937, 171 (♂ ♀, San Jacinto, D.F., Mexico). Johannsen, 1943, 779. Vargas, 1945, 49 (♂, Mexico). Macfie,

1948, 69. Vargas, 1949b, 196. Ortiz, 1950, 462. Wirth, 1952a, 191 ( $\sigma^7$  ♀, California, U. S. A.).

*Culicoides (Oecacta) copiosus* Khalaf, 1954, 37.

#### **coutinhoi Barretto**

*Culicoides coutinhoi* Barretto, 1944, 96 ( $\sigma^7$ , Mogi das Cruzes e Prainha, S. Paulo, Brazil). Barbosa, 1947, 13 (♀, Brazil). Vargas, 1949b, 196. Ortiz, 1950, 449.

*Culicoides (Culicoides) coutinhoi* Khalaf, 1954, 46.

#### **cova-garciai Ortiz**

*Culicoides cova-garciai* Ortiz, 1950, 457 ( $\sigma^7$  ♀, Caracas, Venezuela). Ortiz, 1951a, 9. Ortiz, 1951b, 444.

*Culicoides (Culicoides) cova-garciai* Khalaf, 1954, 39.

#### **crepuscularis Malloch**

*Culicoides crepuscularis* Malloch, 1915a, 303 ( $\sigma^7$  ♀, Dubois, Ill., Arizona, Michigan, U. S. A.). Hoffman, 1925, 298 (♀, Colorado, Maryland, New Mexico, Texas, U. S. A.). Jellison and Philip, 1933, 26 (Montana, U. S. A.). Root and Hoffman, 1937, 159 ( $\sigma^7$  ♀, Montana, U. S. A.; Mexico). Thomsen, 1937, 70 (pupa, New York, U. S. A.). Adams, 1940, 125 (Missouri, U. S. A.). Curtis, 1941, 18 (Canada). Fox, 1942, 415 (pupa, Maryland, U. S. A.). Johannsen, 1943, 779. James, 1943, 149 (Colorado, U. S. A.). Vargas, 1945, 44 (Mexico). Macfie, 1948, 71. Vargas, 1949b, 196. Knowlton and Fronk, 1950, 113 (Utah, U. S. A.). Ortiz, 1950, 462. Gerry, 1950, 191 (Massachusetts, U. S. A.). Knowlton and Kardos, 1951, 163 (Utah, U. S. A.). Wirth, 1951c, 318 (Virginia, U. S. A.). Wirth, 1952a, 188 ( $\sigma^7$  ♀, California, Colorado, Florida, Georgia, Kansas, Maryland, Minnesota, Montana, Nebraska, South Dakota, Texas, Utah, Virginia, Washington, Wyoming, U. S. A.; Canada). Johannsen, 1952, 160. Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Beck, 1952, 103 (Florida, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 19 ( $\sigma^7$  ♀, Alabama, Florida, Georgia, Illinois, Kansas, Maryland, Michigan, Montana, New Jersey, New York, South Dakota, Virginia, Utah, Vermont, U. S. A.). Edmunds and Keener, Jr., 1954, 82 (Nebraska, U. S. A.).

*Culicoides (Beltranomyia) crepuscularis* Vargas, 1953a, 35.

*Culicoides (Monoculicoides) crepuscularis* Khalaf, 1954, 40.

#### **daedalus Macfie**

*Culicoides daedalus* Macfie, 1948, 83 ( $\sigma^7$ , El Vergel, Chiapas, Mexico). Vargas, 1949b, 196. Ortiz, 1950, 462. Ortiz and Mirsa, 1952b, 277 ( $\sigma^7$  Venezuela).

*Culicoides* sp. Ortiz, 1951c, 583 (♀, Venezuela).

*Culicoides (Oecacta) daedalus* Khalaf, 1954, 37.

#### **dampfi Root and Hoffman**

*Culicoides dampfi* Root and Hoffman, 1937, 169 (♂ ♀, San Jacinto, D. F., Mexico). Johannsen, 1943, 779. Vargas, 1945, 44 (Mexico). Macfie, 1948, 71. Vargas, 1949b, 197. Ortiz, 1950, 462.

*Culicoides (Oecacta) dampfi* Khalaf, 1954, 36.

#### **dasyophrus Macfie**

*Culicoides dasyophrus* Macfie, 1940a, 27 (♂ ♀, New River, British Guiana). Vargas, 1945, 43. Macfie, 1948, 74. Vargas, 1949b, 197. Ortiz, 1950, 462. Carpenter, 1951, 205 (Canal Zone). Ortiz and Mirsa, 1952a, 126 (♀, Venezuela).

*Culicoides dasyophrus* Barbosa, 1947, 13 (♂, Canal Zone).

#### **debilipalpis Lutz**

*Culicoides debilipalpis* Lutz, 1913, 60 (♀, Anhemby, São Paulo, Brazil). Macfie, 1937, 7 (♀, Trinidad). Lima, 1937, 420 (♀, Brazil). Macfie, 1938, 164 (Trinidad). Macfie, 1939, 200 (♀, Brazil). Adamson, 1939, 79 (Trinidad). Floch and Abonnenc, 1942a, 9 (♀, French Guiana). Vargas, 1945, 43. Briceño-Iragorry, 1946, 398 (Venezuela). Anduze *et al.*, 1947, 11 (Venezuela). Barbosa, 1947, 14 (♀, Brazil; Barbados; St. Croix; Trinidad; Venezuela). Macfie, 1948, 86 (♀, Mexico). Briceño-Iragorry, 1949, 318 (Venezuela). Floch and Abonnenc, 1949a, 71 (Venezuela). Vargas, 1949b, 197. Iriarte, 1950, 388. Ortiz, 1951a, 10 (Venezuela). Barbosa, 1952, 12 (pupa, Argentina; Brazil).

#### **debilipalpis equatoriensis Barbosa**

*Culicoides debilipalpis equatoriensis* Barbosa, 1952, 13 (♀, Sto. Domingo, Colorados, Ecuador).

#### **debilipalpis glabrior Macfie**

*Culicoides debilipalpis* var. *glabrior* Macfie, 1940a, 27 (♀, New River, British Guiana). Vargas, 1945, 43. Barbosa, 1947, 14 (Panama). Macfie, 1948, 73. Vargas, 1949b, 197. Warmke, 1952, 474 (Brazil).

#### **decor Williston**

*Ceratopogon decor* Williston, 1896, 281 (♀, St. Vincent). Aldrich, 1905, 108. Kieffer, 1906, 50.

*Culicoides decor* Johannsen, 1943, 779. Vargas, 1945, 43. Macfie, 1948, 68. Vargas, 1949b, 197.

*Culicoides (Hoffmania) decor* Ortiz, 1950, 439.

*Culicoides (Culicoides) decor* Khalaf, 1954, 46.

### **denningi Foote and Pratt**

*Culicoides denningi* Foote and Pratt, 1954, 20 (♂ ♀, Saskatoon, Saskatchewan, Canada; Wyoming, U. S. A.).

### **diabolicus Hoffman**

*Culicoides diabolicus* Hoffman, 1925, 294 (♀, Cabima, Panama). Macfie, 1932, 487 (♀, Colombia). Lima, 1937, 417 (♀, Brazil). Adamson, 1939, 81 (Trinidad). Kumm, *et al.*, 1940, 420 (Costa Rica). Floch and Abonenc, 1942a, 2 (French Guiana). Fairchild, 1943, 572 (Panama). Johannsen, 1943, 779. Vargas, 1944, 163 (♂ ♀, Mexico). Vargas, 1945, 43. Floch, 1952, 295 (French Guiana). Macfie, 1953, 102 (Costa Rica).

*Culicoides* species Dampf, 1936a, 228 (♀, Mexico).

*Culicoides guttatus* var. *diabolicus* Macfie, 1937, 8 (♂ ♀, Trinidad).

*Culicoides filariferus* Hoffman, 1939, 172 (♀, Mexico). Gibson and Ascoli, 1952, 315. Bradley, 1954, 135. Foote and Pratt, 1954, 1.

*Culicoides guttatus (diabolicus)* Macfie, 1940a, 25 (British Guiana). Woke, 1954, 69 (Panama).

*Culicoides pseudodiabolicus* Fox, 1946a, 256 (♀, Trinidad). Vargas, 1949b, 204.

*Culicoides guttatus* Macfie, 1948, 74.

*Culicoides (Hoffmania) diabolicus* Fox, 1948, 24 (♂ ♀, Canal Zone). Ortiz, 1950, 446.

*Culicoides (Culicoides) diabolicus* Khalaf, 1954, 46.

### **diminutus Barbosa**

*Culicoides diminutus* Barbosa, 1951, 163 (new name for *wokei* Barbosa, pre-occupied). Woke, 1954, 68 (Canal Zone; Nicaragua).

*Culicoides wokei* Barbosa (not Fox), 1947, 28 (♂ ♀, Balboa, C. Z.; Mexico; Guatemala; Nicaragua). Vargas, 1949b, 208. Ortiz, 1950, 464.

### **discrepans Ortiz and Mirsa**

*Culicoides discrepans* Ortiz and Mirsa, 1951, 595 (♀, Los Chorros, Miranda, Venezuela).

### **dominicii Ortiz**

*Culicoides dominicii* Ortiz, 1951a, 7 (♂, Ocumare del Tuy, Miranda, Venezuela). Mirsa and Ortiz, 1952, 475 (♀, Venezuela).

*Culicoides (Oecacta) dominicii* Khalaf, 1954, 38.

**dovei Hall**

See *Culicoides furens* (Poey).

**efferus Fox**

*Culicoides efferus* Fox, 1952a, 365 (♀, Rio Charape, Peru).

**elutus Macfie**

*Culicoides elutus* Macfie, 1948, 75 (♀, El Carrizal, Chiapas, Mexico).  
Vargas, 1949b, 197. Wirth, 1952a, 175.

**eublepharus Macfie**

*Culicoides eublepharus* Macfie, 1948, 86 (♀, British Guiana). Vargas, 1949b,  
197. Ortiz, 1952a, 129 (♂ ♀, Venezuela). Ortiz and Mirsa, 1952a, 126

**filariferus Hoffman**

See *Culicoides diabolicus* Hoffman.

**flavivenula Lutz**

*Culicoides flavivenula* Lutz, 1937, 418 (♀, Japuhya, Angra dos Reis,  
Brazil). Floch and Abonnenc, 1942a, 3 (French Guiana). Vargas, 1945, 3.  
Barbosa, 1947, 15 (Brazil). Vargas, 1949b, 198.

*Culicoides (Hoffmania) flavivenula* Fox, 1948, 26. Ortiz, 1950, 448.

*Culicoides (Culicoides) flavivenula* Khalaf, 1954, 46.

**flochabonnenci Ortiz and Mirsa**

*Culicoides flochabonnenci* Ortiz and Mirsa, 1952b, 267 (♀, Los Chorros,  
Miranda, Venezuela).

*Culicoides lichyi* Ortiz and Mirsa (not Floch and Abonnenc) 1951, 601 (♀,  
Venezuela).

**floridensis Beck**

*Culicoides floridensis* Beck, 1951, 135 (♂ ♀, Englewood, Sarasota Co., Fla.,  
U. S. A.). Beck, 1952, 105. Foote and Pratt, 1954, 21.

**fluvialis Macfie**

*Culicoides fluvialis* Macfie, 1940a, 25 (♀, New River, British Guiana).  
Vargas, 1945, 43. Barbosa, 1947, 15. Macfie, 1948, 73. Vargas, 1949b,  
198. Ortiz, 1951a, 2 (♀, Venezuela). Ortiz and Mirsa, 1952b, 264 (♂,  
Venezuela).

**fluviatilis Lutz**

See *Lasiohelea fluviatilis* (Lutz).

**foxi Ortiz**

- Culicoides foxi* Ortiz, 1950, 461 (Venezuela). Ortiz, 1951a, 4 ( $\sigma^7$  ♀, Venezuela). Ortiz, 1951b, 444 (Venezuela). Mirsa, *et al.*, 1952, 161 (Venezuela). Fox and Maldonado, 1953, 165 (Puerto Rico).  
*Culicoides (Hoffmania) guttatus* Fox (not Coquillett), 1948, 23 (♀, in part, Venezuela).  
*Culicoides guttatus* Fox, 1949, 31 ( $\sigma^7$  ♀, Puerto Rico). Fox and Kohler, 1950, 342 (Puerto Rico).  
*Culicoides (Culicoides) foxi* Khalaf, 1954, 39.

**furens Poey**

- Oecacta furens* Poey, 1851, 236 ( $\sigma^7$  ♀, Cuba). Osten-Sacken, 1878, 23. Cockerell, 1894, 419 (Jamaica). Townsend, 1893b, 381 (Jamaica). Townsend, 1897, 17 (Mexico). Aldrich, 1905, 119. Johannsen, 1905, 102. Kieffer, 1906, 55. Pratt, 1907, 28 (Cuba; Montserrat, W. I.; Mexico). Johannsen, 1908, 267. Surcouf and González-Rincones, 1912, 307. Stephens, 1923, 368 (Cuba).  
*Ceratopogon maculithorax* Williston, 1896, 277 (♀, St. Vincent, W. I.). Aldrich, 1905, 109.  
*Culicoides maculithorax* Kieffer, 1906, 54. Johannsen, 1908, 267. Lutz, 1912, 21 (Brazil). Rieth, 1915, 417. Loughnan, 1921, 202 (Jamaica). Edwards, 1922, 164 (Jamaica). Gibson, 1923, 41 (British Honduras).  
*Culicoides furens* Lutz, 1912, 16. Lutz, 1913, 53 (♀, Brazil). Root, 1922, 396 (Puerto Rico). Root, 1924, 208 (Honduras). Bequaert, 1924, 197 (Honduras). Kieffer, 1925a, 419 (♀, Hoffman, 1925, 287 (♀, Cuba; Mexico; Trinidad; Puerto Rico; Canal Zone; Bahama Group; Florida, U. S. A.). Painter, 1926, 245 (Honduras). Wolcott, 1927, 312 (Haiti). Hall, 1932, 88 (Honduras). Meyers, 1932, 1 (Bahamas). Hinman, 1932, 775 (Louisiana, U. S. A.). Buckley, 1933, 257 (St. Vincent). Buckley, 1934a, 99 (St. Vincent). Buckley, 1934b, 1. Myers, 1935, 71 (Trinidad). Van Volkenberg, 1935, 17 (Puerto Rico). Dampf, 1936a, 232 (Mexico). Atchley and Hull, 1936, 514. Wolcott, 1936, 325 (Puerto Rico). Root and Hoffman, 1937, 162 ( $\sigma^7$  ♀, Louisiana, Texas, U. S. A.). Macfie, 1937, 10 ( $\sigma^7$  ♀, Trinidad). Lima, 1937, 414. Tokunaga, 1937, 298. Adamson, 1939, 80 (Trinidad). Wolcott, 1941, 109 (Puerto Rico). Fox, 1942, 418 (pupa, Puerto Rico). Floch and Abonnenc, 1942b, 1 (♀, French Guiana). Johannsen, 1943, 779. Fairchild, 1943, 572 (Panama). Barretto, 1944, 89 ( $\sigma^7$ , Brazil). Beatty, 1944, 144 (St. Croix). Vargas, 1945, 44. Fox, 1946a, 255 (St. John, V. I.; Dominican Republic; Trinidad). Woke, 1947, 364 (Nicaragua). Trapido, 1947, 472 (Panama). Barbosa, 1947, 15 ( $\sigma^7$ , Trinidad; St. Croix; Nicaragua; Honduras; Venezuela; Barbados; Panama; Mexico; British Honduras; Antigua; Cuba; Bahamas; Guatemala;



- Puerto Rico; Jamaica; Florida, Georgia, Maryland, Massachusetts, New Jersey, U. S. A.). Macfie, 1948, 73. Ortiz and Peña Garcia, 1948, 7 (Venezuela). Wolcott, 1948, 426 (Puerto Rico). Briceño-Iragorry, 1949, 318 (Venezuela). Ortiz, 1949, 328 (Venezuela). Dove, 1949, 869 (Florida, U. S. A.). Floch and Abonnenc, 1949a, 71. Floch and Abonnenc, 1949b, 1343 (French Guiana). Vargas, 1949b, 198. Floch and Abonnenc, 1950, 1 (Guadeloupe). Travis and Morton, 1950, 154 (Florida, U. S. A.). Fox and Kohler, 1950, 342 (Puerto Rico). Iriarte, 1950, 375. Ortiz, 1950, 462. Goulding, 1950, 102 (Florida, U. S. A.): Kohler and Fox, 1951, 113 (Puerto Rico). Ortiz, 1951a, 10 (Venezuela). Carpenter, 1951, 205 (Panama). Wirth, 1952c, 95 (larva, pupa, Florida, U. S. A.). Beck, 1952, 104 (Florida, U. S. A.). Fox, 1952b, 888. Barbosa, 1952, 13 (Ecuador). Goulding, *et al.*, 1953, 37 (Florida, U. S. A.). Fox and Maldonado, 1953, 165 (Puerto Rico). Bradley, 1954, 125. Foote and Pratt, 1954, 21 ( $\sigma^7$  ♀, Florida, Georgia, Maryland, Massachusetts, Mississippi, New Jersey, South Carolina, Texas, U. S. A.). Labrecque and Goulding, 1954, 20 (Florida, U. S. A.) Woke, 1954, 71 (Panama; Nicaragua).
- Culicoides dovei* Hall, 1932, 88 ( $\sigma^7$  ♀, Florida, Georgia, North Carolina, South Carolina, U. S. A.). Dove, *et al.*, 1942, 505 (egg, larva, pupa,  $\sigma^7$  ♀, South Carolina, U. S. A.). Hull, *et al.*, 1934, 162 (North Carolina, U. S. A.).
- Culicoides (Oecacta) furens* Khalaf, 1954, 37.

#### **galindoi Wirth and Blanton**

- Culicoides galindoi* Wirth and Blanton, 1953a, 73 ( $\sigma^7$  ♀, Mojinga Swamp, Fort Sherman, C. Z.).

#### **germanus Macfie**

- Culicoides germanus* Macfie, 1940a, 27 ( $\sigma^7$ , New River, British Guiana) Vargas, 1945, 43. Barbosa, 1947, 17. Macfie, 1948, 74.

#### **gibsoni Wirth**

- Culicoides gibsoni* Wirth, 1952b, 246 (♀, Finca San Rafael, San Pedro Yepocapa, Chimaltenango, Guatemala). Gibson and Ascoli, 1952; 317 (Guatemala).

#### **gigas Root and Hoffman**

- Culicoides gigas* Root and Hoffman, 1937, 172 (♀, Fort a la Corne, Canada). Curtis, 1941, 18 (Canada). Leech, 1943, 23 (Canada). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 198. Ortiz, 1950, 463.

#### **ginesi Ortiz**

- Culicoides ginesi* Ortiz, 1951c, 586 (♀, San Felipe, Yaracuy, Venezuela).

**gorgasi Wirth and Blanton**

*Culicoides gorgasi* Wirth and Blanton, 1953b, 232 (♂ ♀, Las Tablas, Los Santos, Panama).

**griseus Coquillett**

*Ceratopogon griseus* Coquillett, 1901, 602.

*Culicoides griseus* Kieffer, 1906, 54.

REMARKS.—A species of *Dasyhelea* (Wirth, 1952a, 155).

**guadeloupensis Floch and Abonnenc**

*Culicoides guadeloupensis* Floch and Abonnenc, 1950, 2 (♀, St. Claude, Guadeloupe). Ortiz and Mirsa, 1952a, 126.

**guttatus Coquillett**

*Ceratopogon guttatus* Coquillett, 1904, 35 (♀, São Paulo, Brazil).

*Culicoides guttatus* Kieffer, 1906, 54. Lutz, 1912, 16 (Brazil). Lutz (in part), 1913, 58 (♀, Brazil). Neiva and Penna, 1916, 96 (Brazil). Lima, 1937, 416 (♀, Brazil). Macfie, 1939, 199 (Brazil). Vargas, 1944, 164. Barretto, 1944, 91 (♂, Brazil). Vargas, 1945, 43. Barbosa, 1947, 17 (Brazil). Wolcott, 1948, 426. Lane, 1949, 115 (♂ ♀, Brazil). Vargas, 1949b, 199. Ortiz, 1950, 440. Warmke, 1952, 474 (Brazil).

*Culicoides (Culicoides) guttatus* Khalaf, 1954, 39.

REMARKS.—This species has also been reported from British Honduras (Gibson, 1923, 41); Columbia (Macfie, 1932, 448); Trinidad (Macfie, 1938, 164; Adamson, 1939, 79); British Guiana (Macfie, 1940b, 185); Nicaragua (Barbosa, 1947, 17); Venezuela (Ortiz, 1951a, 9); Canal Zone (Carpenter, 1951, 205); French Guiana (Floch, 1952, 295); Guatemala (Gibson and Ascoli, 1952, 317); and Ecuador (Barbosa, 1952, 15). All of these records, however, are questionable because authors do not agree in regard to what zoological species should be ascribed to the name. In 1949 Lane synonymized the following 9 names with *guttatus*: *insignis*, *diabolicus*, *flavivenula*, *filariferus*, *bimaculatus*, *coutinhoi*, *inamollae*, *pseudodiabolicus*, and *painteri*. Other authors, however, do not agree and have their own versions concerning synonymy. In this catalogue all these names are considered good species except *filariferus* and *pseudodiabolicus* (believed to be synonyms of *diabolicus*) and *painteri*, a synonym of *inamollae*.

**guttipennis Coquillett**

*Ceratopogon guttipennis* Coquillett, 1901, 603 (♀, Medina, Ohio, U. S. A.).

Aldrich, 1905, 109. Pratt, 1907, 23 (larva, pupa, ♀, Arizona, Maryland, Ohio, Texas, Virginia, U. S. A.).

*Ceratopogon (Culicoides) guttipennis* Lutz, 1913, 71.

*Culicoides guttipennis* Kieffer, 1906, 54. Malloch, 1915a, 299 (♀, Illinois, U. S. A.). Malloch, 1915b, 306. Kieffer, 1919b, 191. Hoffman, 1924, 88. Hoffman, 1925, 296 (♀, Arizona, Maryland, Texas, Virginia, U. S. A.). Leonard, 1928, 707 (New York, U. S. A.). Hinman, 1932, 774 (Louisiana, U. S. A.). Baker, 1935, 150 (larva, New York, U. S. A.). Root and Hoffman, 1937, 160 (♂ ♀, Connecticut, Louisiana, Maryland, U. S. A.). Fox 1942, 415 (pupa, Maryland, U. S. A.). Johannsen, 1943, 779. Fenton, 1944, 5 (Oklahoma, U. S. A.). Vargas, 1945, 43. Ortiz, 1950, 463. Wirth, 1951c, 318 (Virginia, U. S. A.). Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Johannsen, 1952, 161. Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 22 (♂ ♀, Florida, Georgia, Maryland, Missouri, Ohio, Oklahoma, Texas, Virginia, Vermont, U. S. A.).

*Culicoides guttipennis* Vargas, 1949b, 199.

*Culicoides (Oecacta) guttipennis* Khalaf, 1954, 38.

#### **guyanensis Floch and Abonnenc**

*Culicoides guyanensis* Floch and Abonnenc, 1942a, 5 (♂ ♀, Cayenne, French Guiana). Barbosa, 1947, 19 (♂, Brazil; Canal Zone; Trinidad). Macfie, 1948, 80. Vargas, 1949b, 199. Ortiz, 1950, 463. Ortiz, 1951a, 9 (Venezuela). Floch, 1952, 295 (French Guiana). Woke, 1954, 68 (Canal Zone).

*Culicoides stellifer* Macfie (not Coquillett), 1937, 12 (♀, Trinidad). Macfie, 1938, 165 (Trinidad). Adamson, 1939, 80 (Trinidad).

*Culicoides recifensis* Barbosa, 1943, 263 (♀, Brazil). Vargas, 1945, 43.

*Culicoides stubalensis* Fox, 1946a, 254 (♀, Trinidad).

#### **haematopotus Malloch**

*Culicoides haematopotus* Malloch, 1915a, 302 (♂ ♀, Urbana, Ill., U. S. A.). Malloch, 1915b, 308. Hoffman, 1925, 299 (♀, Maryland, U. S. A.). Root and Hoffman, 1937, 161 (♂ ♀, District of Columbia, Kansas, New Mexico, U. S. A.; Mexico). Thomsen, 1937, 70 (pupa, New York, U. S. A.). James, 1943, 149 (Colorado, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 44 (Mexico). Macfie, 1948, 71. Vargas, 1949b, 199. Knowlton and Fronk, 1950, 114 (Utah, U. S. A.). Ortiz, 1950, 463. Wirth, 1951c, 318 (Virginia, U. S. A.). Wirth, 1952a, 182 (♂ ♀, California, Colorado, Georgia, Louisiana, Maryland, Nevada, New Mexico, Oklahoma, Texas, U. S. A.). Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Johannsen, 1952, 160. Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 23 (♂ ♀, Florida, Georgia, Illinois, Louisiana, Michigan, New York, Ohio, Pennsylvania, Tennessee, Utah, Virginia, U. S. A.). Edmunds and Keener, Jr., 1954, 83 (Nebraska, U. S. A.).

*Culicoides (Oecacta) haematopotus* Khalaf, 1954, 37.

**heliconiae Fox and Hoffman**

*Culicoides heliconiae* Fox and Hoffman, 1944, 108 (♂ ♀, Maracay, Venezuela). Fox, 1946a, 256. Barbosa, 1947, 8. Macfie, 1948, 70. Vargas, 1949b, 199. Iriarte, 1950, 372. Ortiz, 1951a, 9.

*Culicoides* species (3) Fox, 1942, 418 (pupa, Venezuela).

*Culicoides helioconiae* Vargas, 1945, 43.

*Culicoides (Hoffmania) heliconiae* Fox, 1948, 22 (♂ ♀, Trinidad; Honduras). Ortiz, 1950, 450.

*Culicoides (Culicoides) heliconiae* Khalaf, 1954, 39.

**hertigi Wirth and Blanton**

*Culicoides hertigi* Wirth and Blanton, 1953b, 229 (♂ ♀, Río Hato, Coclé Prov., Panama).

**hieroglyphicus Malloch**

*Culicoides hieroglyphicus* Malloch, 1915a, 297 (♀, Ash Creek, Graham Mt., Ariz., U. S. A.). Hoffman, 1925, 280 (♀, Arizona, U. S. A.). Root and Hoffman, 1937, 158 (♂ ♀, Arizona, Kansas, Montana, U. S. A.). James, 1943, 148 (♂, Colorado, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 199. Ortiz, 1950, 462. Knowlton and Kardos, 1951, 163 (Utah, U. S. A.). Wirth, 1952a, 176 (♂ ♀, Arizona, California, Colorado, Kansas, Nevada, New Mexico, Oklahoma, Texas, U. S. A.). Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Foote and Pratt, 1954, 24 (♂ ♀, Arizona, Kansas, Montana, Nevada, New Mexico, Oklahoma, U. S. A.). Edmunds and Keener, Jr., 1954, 83 (Nebraska, U. S. A.).

*Culicoides (Selfia) hieroglyphicus* Khalaf, 1954, 38.

**hinmani Khalaf**

*Culicoides hinmani* Khalaf, 1952b, 353 (♂ ♀, Wichita Refuge, Okla., U. S. A.).

*Culicoides (Oecacta) hinmani* Khalaf, 1954, 37.

**hirtipes Kieffer**

*Culicoides hirtipes* Kieffer, 1917b, 305. Lima, 1937, 412. Vargas, 1945, 43. *Dasyhelea hirtipes* Kieffer, 1919a, 64. Macfie, 1948, 69. Vargas, 1949b, 199.

REMARKS.—Lane and Ortiz, 1950, 460, consider this species to be a synonym of *caridei* Brèthes, which they believe to be a *Dasyhelea*.

**hirtulus Coquillett**

See *Culicoides obsoletus* Meigen.

**hoffmani Fox**

*Culicoides hoffmani* Fox, 1946a, 251 (♀, Camuto Village, Trinidad). Barbosa, 1947, 7. Macfie, 1948, 74. Wolcott, 1948, 426. Ortiz and Peña

García, 1948, 6 (Venezuela). Fox, 1949, 29 (♂ ♀, Puerto Rico). Ortiz 1949, 328 (Venezuela). Vargas, 1949b, 199. Floch and Abonnenc, 1949a, 72. Fox and Kohler, 1950, 342 (Puerto Rico). Iriarte, 1950, 373. Ortiz, 1950, 463. Ortiz, 1951a, 10. Fox and Maldonado, 1953, 165 (Puerto Rico).

### ***hollensis* Melander and Brues**

*Ceratopogon hollensis* Melander and Brues, 1903, 13 (♀, Woods Hole, Mass., U. S. A.). Aldrich, 1905, 109. Kieffer, 1906, 50.

*Culicoides hollensis* Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 199. Foote and Pratt, 1954, 24.

### ***horneae* Foote and Pratt**

*Culicoides horneae* Foote and Pratt, 1954, 25 (♂, Batavia, N. Y., U. S. A.).

### ***horticola* Lutz**

*Culicoides horticola* Lutz, 1913, 61 (♀, Tatuhy, São Paulo, Brazil). Rieth 1915, 417. Lima, 1937, 420 (♀, Brazil). Floch and Abonnenc, 1942a, 4 (♀, French Guiana). Vargas, 1945, 43. Macfie, 1948, 74. Vargas, 1949b, 199. Ortiz, 1951a, 10 (Venezuela).

*Culicoides horticola* Barbosa, 1947, 7.

### ***hylas* Macfie**

*Culicoides hylas* Macfie, 1940a, 26 (♀, New River, British Guiana). Vargas, 1945, 43. Barbosa, 1947, 9. Macfie, 1948, 70.

### ***inamollae* Fox and Hoffman**

*Culicoides inamollae* Fox and Hoffman, 1944, 110 (♂ ♀, Mayagüez, P. R.). Vargas, 1945, 43. Fox, 1946a, 257. Barbosa, 1947, 9. Vargas, 1949b, 200. Fox and Kohler, 1950, 342 (Puerto Rico). Kohler and Fox, 1951, 113 (Puerto Rico). Fox, 1952b, 888 (Puerto Rico). Fox and Maldonado, 1953, 165 (Puerto Rico). Foote and Pratt, 1954, 25 (♂ ♀, Florida, U. S. A.; Puerto Rico).

*Culicoides oliveri* Fox and Hoffman (in part), 1944, 108 (♂, Haiti).

*Culicoides painteri* Fox, 1946a, 258 (♀, Honduras).

*Culicoides (Hoffmania) inamollae* Fox, 1948, 25 (♂ ♀, Florida, U. S. A.). Wolcott, 1948, 426.

*Culicoides (Hoffmania) painteri* Fox, 1948, 26 (♂ ♀, Honduras).

*Culicoides insignis* Ortiz and Peña Garcia (not Lutz), 1948, 6 (Venezuela).

Ortiz, 1949, 328 (Venezuela). Floch and Abonnenc, 1949a, 72 (Venezuela).

Ortiz, 1950, 441 (♂ ♀, Venezuela). Ortiz, 1951a, 9 (Venezuela).

*Culicoides guttatus* Beck (not Coquillett), 1952, 102 (Florida, U. S. A.).

*Culicoides (Culicoides) inamollae* Khalaf, 1954, 46.

**indianus Macfie**

See *Culicoides verecundus* Macfie.

**insignis Lutz**

*Culicoides insignis* Lutz, 1913, 51 (♂ ♀, pupa, Rio de Janeiro, Brazil). Lutz 1912, 21. Rieth, 1915, 417. Lima, 1937, 415 (♀, Brazil). Vargas, 1945, 43. Barbosa, 1947, 20 (♂, Brazil). Vargas, 1949b, 200. Iriarte, 1950, 389. Ortiz, 1950, 462. Barbosa, 1952, 17 (Brazil).

*Culicoides guttatus* Lutz (not Coquillett, in part), 1913, 58 (♀, Brazil).

*Culicoides (Hoffmania) insignis* Fox, 1948, 25.

*Culicoides (Culicoides) insignis* Khalaf, 1954, 39.

REMARKS.—Floch and Abonnenc, 1942b, 1, have reported this species from French Guiana and Macfie, 1948, 75, doubtfully ascribed the name to specimens from Mexico. There has been so much disagreement in regard to the identification of this species that its distribution outside of Brazil is uncertain.

**iriartei Fox**

*Culicoides iriartei* Fox, 1952a, 368 (♀, La Salina, Edo. Zulia, Venezuela).

*Culicoides vargasi* Wirth and Blanton, 1953a, 74 (♂ ♀, Las Tablas, Los Santos, Prov., Panama; Venezuela).

REMARKS.—The above synonymy is given on the authority of Wirth (personal communication).

**jamaicensis Edwards**

*Culicoides loughnani* var. *jamaicensis* Edwards, 1922, 165 (♀, Kingston, Jamaica). Hoffman, 1925, 283 (Panama). Lima, 1937, 413. Fairchild, 1943, 572 (Panama). Johannsen, 1943, 779. Vargas, 1945, 43. Macfie, 1948, 80 (Mexico). Ortiz, 1950, 463.

*Culicoides loughnani* Fox (not Edwards), 1946a, 254 (Jamaica). Ortiz and Mirsa, 1952b, 271 (♂ ♀, Venezuela).

*Culicoides loughnani* var. *jamaicensis* Barbosa, 1947, 21 (♂, Panama; Jamaica; St. Croix).

*Culicoides loughnani* var. *jamaicensis* Vargas, 1949b, 201.

*Culicoides loughnani jamaicensis* Fox, 1949, 32 (♂ ♀, Puerto Rico). Fox and Kohler, 1950, 342 (Puerto Rico). Kohler and Fox, 1951, 113 (Puerto Rico). Ortiz, 1951a, 9 (Venezuela). Ortiz, 1951b, 442 (Venezuela). Fox, 1952b, 888 (Puerto Rico). Fox and Maldonado, 1953, 165 (Puerto Rico).

**jamesi Fox**

*Culicoides jamesi* Fox, 1946b, 244 (♂ ♀, Hamilton, Mont., U. S. A.). Vargas, 1949b, 200. Ortiz, 1950, 463. Wirth, 1952a, 178 (♂ ♀, California,

Colorado, Montana, Washington, U. S. A.; Canada). Foote and Pratt, 1954, 26 (♂, Colorado, Montana, U. S. A.).

*Culicoides (Selfia) jamesi* Khalaf, 1954, 38.

#### **kintzi Wirth and Blanton**

*Culicoides kintzi* Wirth and Blanton, 1953a, 72 (♂ ♀, Mojinga Swamp, Fort Sherman, C. Z.).

#### **lanei Ortiz**

*Culicoides lanei* Ortiz, 1950, 431 (♂, Cerro Sefa (?), Panama). Ortiz, 1951c, 557 (♂, Panama).

*Culicoides (Oecacta) lanei* Khalaf, 1954, 37.

#### **leoni Barbosa**

*Culicoides leoni* Barbosa, 1952, 17 (♀, Sto. Domingo, Ecuador).

#### **leopoldoi Ortiz**

*Culicoides leopoldoi* Ortiz, 1951c, 579 (♀, Ocumare del Tuy, Miranda, Venezuela). Ortiz and Mirsa, 1951, 596 (♂, Venezuela). Ortiz and Mirsa, 1952a, 127 (♀, Venezuela; Panama).

#### **levis Coquillett**

*Ceratopogon levis* Coquillett, 1901, 604.

*Culicoides levis* Kieffer, 1906, 54.

REMARKS.—A species of *Atrichopogon* (Wirth, 1952a, 121).

#### **lichyi Floch and Abonnenc**

*Culicoides lichyi* Floch and Abonnenc, 1949a, 69 (♀, Río Borburata, Venezuela). Ortiz, 1951a, 10. Ortiz and Mirsa, 1952a, 125.

#### **limai Barretto**

*Culicoides limai* Barretto, 1944, 99 (♂, Mogí das Cruzes, São Paulo, Brazil).

Barbosa, 1947, 8. Vargas, 1949b, 201. Ortiz, 1950, 463. Ortiz and Mirsa, 1951, 597. (♂, Venezuela). Ortiz and Mirsa, 1952b, 265 (♀, Venezuela)

*Culicoides (Oecacta) limai* Khalaf, 1954, 37.

#### **lituratus Williston**

*Ceratopogon lituratus* Williston, 1896, 281.

*Culicoides lituratus* Kieffer, 1906, 54.

REMARKS.—A species of *Atrichopogon* (Macfie, 1948, 68).

**lopesi Barretto**

*Culicoides lopesi* Barretto, 1944, 102 (♂, Mogi das Cruzes, São Paulo, Brazil). Barbosa, 1947, 6. Vargas, 1949b, 201. Ortiz, 1950, 463.

*Culicoides (Oecacta) lopesi* Khalaf, 1954, 37.

**lotus Williston**

*Ceratopogon lotus* Williston, 1896, 282.

*Culicoides lotus* Kieffer, 1906, 54.

REMARKS.—A species of *Forcipomyia* (Macfie, 1948, 68).

**loughnani Edwards**

*Culicoides loughnani* Edwards, 1922, 165 (♀, Kingston, Jamaica). Hoffman, 1925, 282. Lima, 1937, 413. Johannsen, 1943, 779. Vargas, 1945, 43. Macfie, 1948, 72. Beck, 1952, 104 (Florida, U. S. A.). Foote and Pratt, 1954, 26 (♂ ♀, Florida, U. S. A.).

*Culicoides laughnani* Beatty, 1944, 144 (St. Croix).

*Culicoides longnani* Barbosa, 1947, 21.

*Culicoides loughmani* Vargas, 1949b, 201.

**loughnani var. jamaicensis Edwards**

See *Culicoides jamaicensis* Edwards.

**luteovenus Root and Hoffman**

*Culicoides luteovenus* Root and Hoffman, 1937, 156 (♂ ♀, San Jacinto, D. F., Mexico). Johannsen, 1943, 779. Vargas, 1945, 44 (Mexico). Barbosa, 1947, 21 (Canal Zone). Macfie, 1948, 76 (Mexico). Vargas, 1949b, 201. Knowlton and Fronk, 1950, 114 (Utah). Ortiz, 1950, 463. Wirth, 1952a, 175 (♂ ♀, California, Utah, Washington, U. S. A.; Mexico).

*Culicoides (Culicoides) luteovenus* Khalaf, 1954, 39.

**lutzi Lima**

*Culicoides lutzi* Lima, 1937, 419 (♀, Abaeté, Pará, Brazil). Floch and Abonnenc, 1942a, 2 (♀, French Guiana). Floch and Abonnenc, 1942b, 2 (♂, French Guiana). Vargas, 1945, 43. Barbosa, 1947, 8. Vargas, 1949b, 201. Ortiz, 1951a, 9 (Venezuela). Floch, 1952, 295 (French Guiana).

*Culicoides (Hoffmania) lutzi* Fox, 1948, 22. Ortiz, 1950, 448.

*Culicoides (Culicoides) lutzi* Khalaf, 1954, 46.

**macrostigma Wirth and Blanton**

*Culicoides macrostigma* Wirth and Blanton, 1953b, 230 (♂ ♀, Mojinga Swamp, Fort Sherman, C. Z.).



**maculithorax Williston**

See *Culicoides furens* (Poey).

**magnipalpis Wirth and Blanton**

*Culicoides magnipalpis* Wirth and Blanton, 1953a, 76 (♂ ♀, Cerro Campana, Panama).

**maruim Lutz**

*Culicoides maruim* Lutz, 1913, 48 (egg, pupa, ♀, Rio de Janeiro, Brazil; Trinidad). Rieth, 1915, 417. Lima, 1937, 412. Barbosa, 1947, 29 (♂ ♀ Brazil). Macfie, 1948, 71. Briceño-Iragorry, 1949, 318 (Venezuela). Floch and Abonnenc, 1949a, 79. Iriarte, 1950, 363. Ortiz, 1951a, 8. Barbosa, 1952, 18 (pupa, Brazil).

*Culicoides marium* Vargas, 1945, 43. Vargas, 1949b, 201.

*Culicoides (Hoffmania) maruim* Fox, 1948, 22 (♂ ♀, Brazil).

*Culicoides trinidadensis* Hoffman, 1925, 286 (♀, Trinidad). Myers, 1935, 71 (Trinidad). Macfie, 1937, 9. Lima, 1937, 416. Johannsen, 1943, 780. Vargas, 1945, 43. Fox, 1946a, 256 (Trinidad). Barbosa, 1947, 27. Macfie, 1948, 75.

*Culicoides (Hoffmania) trinidadensis* Fox, 1948, 23 (♀, Trinidad). Ortiz, 1950, 450.

*Culicoides (Culicoides) marium* Khalaf, 1954, 46.

**melleus Coquillett**

*Ceratopogon melleus* Coquillett, 1901, 604 (♀, Lake Worth, Fla., U. S. A.). Aldrich, 1905, 109.

*Culicoides melleus* Kieffer, 1906, 54. Hoffman, 1925, 278 (♀, Maryland, U. S. A.). Hoffman, 1926a, 159 (Mississippi, U. S. A.). Dove, *et al.*, 1932 508 (South Carolina, U. S. A.). Atchley and Hull, 1936, 514. Root and Hoffman, 1937, 152. Johannsen, 1943, 779. Vargas, 1945, 43. Goulding, *et al.*, 1951, 9 (Florida, U. S. A.). Johannsen, 1952, 159. Beck, 1952, 104 (Florida, U. S. A.). Wirth, 1952c, 94 (larva, pupa, Florida, U. S. A.). Bradley, 1954, 126. Foote and Pratt, 1954, 27 (♂ ♀, Florida, Georgia, Maryland, Massachusetts, Mississippi, New York, U. S. A.).

*Culicoides meleus* Vargas, 1949b, 201.

**mississippiensis Hoffman**

See *Culicoides canithorax* Hoffman.

**minutissimus Zetterstedt**

See *Culicoides pumilus* Winnertz.

**miyamotoi Wirth and Blanton**

See *Culicoides aureus* Ortiz.

**mohave Wirth**

*Culicoides mohave* Wirth, 1952a, 187 (♂ ♀, Vidal, San Bernardino Co., Calif.; Arizona, U. S. A.).

*Culicoides (Oecacta) mohave* Khalaf, 1954, 37.

**mojingaensis Wirth and Blanton**

*Culicoides mojingaensis* Wirth and Blanton, 1953b, 232 (♂ ♀, Mojinga Swamp, Fort Sherman, C. Z.).

**monoensis Wirth**

*Culicoides monoensis* Wirth, 1952a, 193 (♂ ♀, Huntoon Creek, Mono Co., Calif., U. S. A.).

*Culicoides (Oecacta) monoensis* Khalaf, 1954, 38.

**multipunctatus Malloch**

*Culicoides multipunctatus* Malloch, 1915a, 296 (♀, Urbana, Ill., U. S. A.). Hoffman, 1925, 280. Root and Hoffman, 1937, 152. Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 202. Khalaf, 1952b, 349 (♂ ♀, Oklahoma, U. S. A.). Johannsen, 1952, 159. Foote and Pratt, 1954, 28 (♂ ♀, Oklahoma, Texas, U. S. A.).

*Culicoides (Selfia) multipunctatus* Khalaf, 1954, 38.

**mutabilis Coquillett**

*Ceratopogon mutabilis* Coquillett, 1901, 602.

*Culicoides mutabilis* Kieffer, 1906, 54.

REMARKS.—A species of *Dasyhelea* (Wirth, 1952a, 157).

**nanus Root and Hoffman**

*Culicoides nanus*, Root and Hoffman, 1937, 165 (♂ ♀, Gwynn's Falls Park, Baltimore, Md., U. S. A.). Fox, 1942, 417 (pupa, Maryland, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 202. Ortiz, 1950, 463. Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Foote and Pratt, 1954, 28 (♂ ♀, Georgia, South Carolina, U. S. A.).

*Culicoides (Oecacta) nanus* Khalaf, 1954, 37.

**niger Root and Hoffman**

*Culicoides niger* Root and Hoffman, 1937, 168 (♂ ♀, Bay Shore near Baltimore, Md., U. S. A.). Fox, 1942, 417 (pupa, Maryland, U. S. A.).

Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 202. Ortiz, 1950, 463. Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Foote and Pratt, 1954, 28 (♂ ♀, Florida, Virginia, U. S. A.).

*Culicoides (Oecacta) niger* Khalaf, 1954, 37.

### **nocivum Harris**

*Simulium nocivum* Harris, 1862, 602 (Massachusetts, U. S. A.).

*Ceratopogon nocivum* Osten Sacken, 1878, 14. Aldrich, 1905, 109.

*Culicoides nocivum* Johannsen, 1943, 779. Vargas, 1945, 43. Vargas, 1949b, 202. Foote and Pratt, 1954, 29.

### **obnoxius Fox**

*Culicoides obnoxius* Fox, 1952a, 365 (♀, Mount Marahuaca, Venezuela).

### **obsoletus Meigen**

*Ceratopogon obsoletus* Meigen, 1818, 76 (Europe).

*Culicoides obsoletus* Edwards, 1926, 405 (♀, England; North America).

Jobling, 1928, 211. Twinn, 1931, 248 (Canada). Goetghebuer and Lenz, 1934, 45 (Europe). Mayer, 1934, 205 (larva, pupa). Root and Hoffman, 1937, 155 (♂ ♀, Kansas, Montana, New York, Tennessee, U. S. A.; Canada). Hearle, 1938, 29 (Canada). Edwards, 1939, 143 (♂ ♀, England). Curtis, 1941, 18 (Canada). James, 1943, 148 (Colorado, U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Hill, 1947, 97 (egg, larva, pupa, England). Hill and Roberts, 1947, 160. Jenkins, 1948, 153 (Alaska). Vargas, 1949b, 202. Ortiz, 1950, 463. Wirth, 1951a, 77 (♀, Alaska). Wirth, 1951c, 318 (Virginia, U. S. A.). Williams, 1951a, 181 (Alaska). Wirth, 1952a, 169 (♂ ♀, California, Colorado, Indiana, Maryland, Massachusetts, Missouri, Montana, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Washington, U. S. A.; Alaska; Canada). Beck, 1952, 103 (Florida, U. S. A.). Kettle and Lawson, 1952, 447 (larva, pupa, England). Johannsen, 1952, 160. Downes and Kettle, 1952, 61 (♂ ♀, Scotland). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Gerry, 1953, 142 (Massachusetts, U. S. A.). Bradley, 1954, 129. Foote and Pratt, 1954, 30 (♂ ♀, Georgia, Illinois, Indiana, Maryland, Massachusetts, Missouri, Montana, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, U. S. A.; Alaska).

*Ceratopogon hirtulus* Coquillett, 1900, 396 (♀, Alaska). Aldrich, 1905, 110. Kieffer, 1906, 50.

*Culicoides hirtulus* Root and Hoffman, 1937, 173. Johannsen, 1943, 779.

*Ceratopogon sanguisuga* Coquillett, 1901, 64 (♀, Maryland, U. S. A.).

Pratt, 1907, 26 (Maryland, U. S. A.; Canada). Leonard, 1928, 707 (New York, U. S. A.).

*Culicoides sanguisugus* Malloch, 1951a, 301 (♂ ♀, Illinois, U. S. A.). Malloch, 1915b, 307. Cole and Lovett, 1921, 213 (Oregon, U. S. A.). Hoffman, 1925, 281 (♀, District of Columbia, Maine, Maryland, New Hampshire, New York, Pennsylvania, South Carolina, U. S. A.; Canada). Gerry, 1950, 191 (Massachusetts, U. S. A.).

*Culicoides biguttatus* Jenkins (not Coquillett), 1948, 154.

*Culicoides (Culicoides) obsoletus* Khalaf, 1954, 39.

REMARKS.—In addition to being widely distributed in Europe and North America, this species occurs in Japan (Tokunaga, 1940, 143).

### **ocumarensis Ortiz**

*Culicoides ocumarensis* Ortiz, 1950, 455 (♂ ♀, Ocumare del Tuy, Miranda, Venezuela). Ortiz, 1951a, 9. Ortiz, 1951b, 442.

*Culicoides (Culicoides) ocumarensis* Khalaf, 1954, 46.

### **oliveri Fox and Hoffman**

*Culicoides oliveri* Fox and Hoffman (in part), 1944, 108 (♀, Mariani, Haiti).

Vargas, 1945, 43. Fox, 1946a, 250 (♀, Haiti). Barbosa, 1947, 9. Macfie, 1948, 70. Vargas, 1949b, 203. Ortiz, 1950, 449.

*Culicoides (Hoffmania) oliveri* Fox, 1948, 23.

*Culicoides (Culicoides) oliveri* Khalaf, 1954, 46.

### **ortizi Fox**

See *Culicoides venezuelensis* Ortiz and Mirsa.

### **ousairani Khalaf**

*Culicoides ousairani* Khalaf, 1952b, 354 (♂ ♀, Wichita Refuge, Okla., U. S. A.).

*Culicoides (Oecacta) ousairani* Khalaf, 1954, 37.

### **pachymerus Lutz**

*Culicoides pachymerus* Lutz, 1914, 83 (♀, Amazonas, Brazil). Bequaert, 1926, 203 (Brazil). Lima, 1937, 421. Barbosa, 1947, 22. Macfie, 1948, 69.

Vargas, 1949b, 203.

*Culicoides pachymerus* Vargas, 1945, 43.

### **painteri Fox**

See *Culicoides inamollae* Fox.

**palmerae James**

*Culicoides palmerae* James, 1943, 151 (♂ ♀, Ft. Collins, Colo., U. S. A.). Vargas, 1945, 43. Vargas, 1949b, 203. Knowlton and Fronk, 1950, 114. (Utah, U. S. A.). Wirth, 1952a, 191 (♂ ♀, California, Utah, U. S. A.). Foote and Pratt, 1954, 30 (♂ ♀, Colorado, Montana, Nevada, New Mexico, Wyoming, U. S. A.). Edmunds and Keener, Jr., 1954, 83 (Nebraska, U. S. A.).

*Culicoides (Oecacta) palmerae* Khalaf, 1954, 38.

**palpalis Macfie**

See *Culicoides verecundus* Macfie.

**pampoikilus Macfie**

*Culicoides pampoikilus* Macfie, 1948, 79 (♀, El Vergel, Chiapas, Mexico). Vargas, 1949b, 203.

**panamensis Barbosa**

*Culicoides panamensis* Barbosa, 1947, 22 (♂ ♀, Barro Colorado, C. Z.). Vargas, 1949b, 203. Ortiz, 1950, 463.

**panamericanus Fox**

See *Culicoides acotyhus* Lutz.

**paraensis Goeldi**

*Haematomyidium paraense* Goeldi, 1905, 137 (♀, Pará, Brazil). Kieffer 1906, 66.

*Culicoides paraensis* Lutz, 1913, 55 (♀, Brazil). Rieth, 1915, 23. Neiva and Penna, 1916, 96 (Brazil). Wille, 1925, 415 (Brazil). Lutz and Núñez Tovar, 1928, 13 (♀, Venezuela). Macfie, 1932, 486 (♀, Trinidad). Dunn, 1934, 178 (Panama). Buckley, 1934a, 99 (St. Vincent). Lima, 1937, 414. Macfie, 1938, 164 (Grenada). Macfie, 1939, 200 (Brazil). Martorell, 1939, 210 (Venezuela). Ortiz, 1942, 258 (Venezuela). Floch and Abonnenc, 1942a, 4 (♀, French Guiana). Johannsen, 1943, 779. Fairchild, 1943, 572 (Panama). Iriarte, 1943, 192 (Venezuela). Barretto, 1944, 92 (♂, Brazil). Ortiz, 1944, 248 (Venezuela). Vargas, 1945, 43. Fox, 1946a, 250. Briceño-Iragorry, 1946, 398 (Venezuela). Anduze, *et al.*, 1947, 11 (Venezuela). Barbosa, 1947, 23 (Brazil; Panama; Peru; Venezuela). Macfie, 1948, 72. Ortiz and Peña Garcia, 1948, 7 (Venezuela). Briceño-Iragorry, 1949, 318 (Venezuela). Ortiz, 1949, 326. Vargas, 1949b, 203. Floch and Abonnenc, 1949a, 71. Floch and Abonnenc, 1949b, 1343 (French Guiana). Romaña and Wygodzinsky, 1950, 31 (Argentina). Iriarte, 1950, 363. Ortiz, 1950, 464. Ortiz, 1951a, 10. Ortiz, 1951c, 574

(♂ ♀, Venezuela). Barbosa, 1952, 19 (Argentina; Bolivia; Brazil). Gibson and Ascoli, 1952, 317 (Guatemala). Floch, 1952, 295 (French Guiana). Mirsa, *et al.*, 1952, 161 (Venezuela). Tucker, 1952, 349 (Barbados). Macfie, 1953, 102 (Costa Rica). Woke, 1954, 71 (Panama).

*Culicoides undecimpunctatus* Kieffer, 1917b, 307 (♀, Argentina). Lima, 1937, 414. Macfie, 1948, 72.

*Culicoides (Oecacta) paraensis* Khalaf, 1954, 37.

### **paucienfuscatus** Barbosa

*Culicoides paucienfuscatus* Barbosa, 1947, 23 (♀, Manaus, Amazonas, Brazil; Panama). Vargas, 1949b, 203.

### **phlebotomus** Williston

*Ceratopogon phlebotomus* Williston, 1896, 281 (♀, St. Vincent Island, B. W. I.). Aldrich, 1905, 109.

*Culicoides phlebotomus* Kieffer, 1906, 55. Lutz, 1912, 16. Lutz, 1913, 70. Wolcott, 1923, 210 (Puerto Rico). Wolcott, 1924, 169. Root, 1924, 208 (Honduras). Hoffman, 1925, 285 (♀, Puerto Rico). Painter, 1926, 258 (Honduras). Ciferri, 1929, 520 (Dominican Republic). Wolcott, 1936, 325 (Puerto Rico). Root and Hoffman, 1937, 151. Lima, 1937, 414. Fox, 1942, 419 (pupa, Virgin Islands). Johannsen, 1943, 779. Vargas, 1945, 43. Fox, 1946a, 252 (St. Croix). Barbosa, 1947, 24 (Trinidad). Macfie, 1948, 72. Wolcott, 1948, 426. Vargas, 1949b, 204. Fox and Kohler, 1950, 342 (Puerto Rico). Iriarte, 1952, 526 (Venezuela). Wirth and Blanton, 1953c, 114 (♂ ♀, Puerto Rico, Mexico; Honduras; Nicaragua; Panama; Venezuela; Brazil). Ortiz and Mirsa, 1952b, 275 (♂ ♀, Venezuela). Fox and Maldonado, 1953, 165 (Puerto Rico). Woke, 1954, 71 (Nicaragua).

*Culicoides amazonius* Macfie, 1935a, 52 (♂ ♀, Brazil). Macfie, 1937, 7 (Trinidad; Tobago). Adamson, 1939, 79 (Trinidad). Floch and Abonenc, 1942a, 3 (♀, French Guiana). Floch, 1952, 295 (French Guiana).

*Culicoides amazonicus* Vargas, 1945, 43. Barbosa, 1947, 11 (Brazil). Ortiz, 1950, 462.

*Culicoides (Oecacta) amazonius* Khalaf, 1954, 36.

### **pictipennis** Phillipi

See *Culicoides venezuelensis* Ortiz and Mirsa.

### **pifanoi** Ortiz

*Culicoides pifanoi* Ortiz, 1951c, 588 (♂ ♀, San Felipe, Yaracuy, Venezuela). Mirsa, *et al.*, 1952, 160 (Venezuela).

*Culicoides tricoloratus* Wirth and Blanton, 1953b, 233 (♂ ♀, Panama; Florida, U. S. A.).

REMARKS.—The above synonymy is given on the authority of Wirth (personal communication).

**piliferus Root and Hoffman**

*Culicoides piliferus* Root and Hoffman, 1937, 163 (♂ ♀, Baltimore, Md., U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 44 (♀, Mexico). Vargas, 1949b, 204. Wirth, 1952a, 186. Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 31 (♂ ♀, Georgia, New York, Vermont, Virginia, U. S. A.).

*Culicoides (Oecacta) piliferus* Khalaf, 1954, 36.

**poikilonotus Macfie**

*Culicoides poikilonotus* Macfie, 1948, 82 (♀, El Vergel, Chiapas, Mexico).

**polystictus Kieffer**

*Culicoides polystictus* Kieffer, 1921a, 181. (♀, Paraguay). Macfie, 1948, 69. *Culicoides polystictus* Barbosa, 1947, 25. Vargas, 1949b, 204.

REMARKS.—The status of this species is uncertain because of its incomplete original description.

**propinquus Macfie**

*Culicoides propinquus* Macfie, 1948, 81 (♂, San Cristobal, Chiapas, Mexico). Vargas, 1949b, 204. Ortiz, 1950, 464.

*Culicoides (Oecacta) propinquus* Khalaf, 1954, 38.

**proprïipennis Macfie**

*Culicoides proprïipennis* Macfie, 1948, 84 (♀, San Cristobal, Chiapas, Mexico). Ortiz and Mirsa, 1952b, 262 (♂, Venezuela).

*Culicoides proprïipennis* Vargas, 1949b, 204.

**pseudodiabolicus Fox**

See *Culicoides diabolicus* Hoffman.

**pulchripennis Macfie**

*Culicoides pulchripennis* Macfie, 1939, 200 (♀, Nova Teutonia, Brazil). Vargas, 1945, 43. Barbosa, 1947, 7. Macfie, 1948, 73. Vargas, 1949b, 204. Ortiz and Mirsa, 1952a, 125.

**pulicaris Linnaeus**

REMARKS.—The report of this European species in Cuba by Stephens, 1923, 368, was undoubtedly based on a misidentification.

**pumilus Winnertz**

*Ceratopogon pumilus* Winnertz, 1852, 46 (Europe).

*Culicoides pumilus* Edwards, 1939, 142 (♂, England). Vargas, 1945, 43 (New World).

*Ceratopogon minutissimus* Zetterstedt, 1855, 4860 (Scandinavia).

*Culicoides minutissimus* Edwards, 1926, 405 (♀, England). Johannsen, 1943, 779 (Greenland).

*Culicoides (Oecacta) pumilus* Khalaf, 1954, 36.

REMARKS.—This species is widely distributed in Europe (Goetghebuer and Lenz, 1934, 44; Kieffer, 1925b, 77).

**pusillus Lutz**

*Culicoides pusillus* Lutz, 1913, 52 (♀, Manguinhos, Brazil). Rieth, 1915, 417. Lima, 1937, 412. Macfie, 1938, 165 (♂ ♀, Trinidad). Adamson, 1939, 81 (Trinidad). Floch and Abonnenc, 1942b, 2 (♂ ♀, French Guiana). Vargas, 1945, 43. Barbosa, 1947, 25 (Panama; Jamaica). Macfie, 1948, 79 (Mexico). Vargas, 1949b, 205. Fox and Kohler, 1950, 342 (Puerto Rico). Ortiz, 1950, 464. Ortiz, 1951a, 8. Ortiz, 1951b, 442 (Venezuela). Ortiz and Mirsa, 1951, 603 (♂ ♀, Venezuela). Fox, 1952b, 888 (Puerto Rico). Mirsa, *et al.*, 1952, 161 (Venezuela). Fox and Maldonado, 1953, 165. (Puerto Rico).

**pygmaeus Williston**

*Ceratopogon pygmaeus* Williston, 1896, 278.

*Culicoides pygmaeus* Kieffer 1906, 55.

REMARKS.—A species of *Dasyhelea* (Macfie, 1948, 68).

**rangeli Ortiz and Mirsa**

*Culicoides rangeli* Ortiz and Mirsa, 1952a, 126 (♀, Los Chorros, Miranda, Venezuela).

**recifei Barbosa**

*Culicoides recifei* Barbosa, 1947, 25 (♂ ♀, Recife, Pernambuco, Brazil). Vargas, 1949b, 205. Barbosa, 1952, 20.

*Culicoides insignis* Barbosa (not Lutz), 1944, 259 (♂ ♀, Brazil).

*Culicoides (Culicoides) recifi* Khalaf, 1954, 46.

**recifensis Barbosa**

See *Culicoides guyanensis* Floch and Abonnenc.

**reevesi Wirth**

*Culicoides reevesi* Wirth, 1952a, 193 (♀, Bakersfield, Kern Co., Calif., U. S. A.).



**reticulatus Lutz**

*Culicoides reticulatus* Lutz, 1913, 49 (larva, ♀, Rio de Janeiro, Brazil).  
Lutz, 1912, 21. Rieth, 1915, 417. Lima, 1937, 413. Barbosa, 1943, 261  
(♂ ♀, Brazil). Vargas, 1945, 43. Barbosa, 1947, 25 (Brazil). Macfie,  
1948, 73. Vargas, 1949b, 205. Ortiz, 1950, 464.

**riethi Kieffer**

*Culicoides riethi* Kieffer, 1914, 237 (Europe). Root and Hoffman 1937, 159  
(♀, Arizona, U. S. A.). Vargas, 1945, 43. Foote and Pratt, 1954, 12.

REMARKS.—Root and Hoffman were unable to decide whether they had an  
aberration of *variipennis* or whether *riethi* really occurs in the United  
States, hence the occurrence of the latter in the Western Hemisphere is  
doubtful.

**rozeboomi Barbosa**

*Culicoides rozeboomi* Barbosa, 1947, 26 (♂ ♀, Trinidad; Peru; Panama).  
Vargas, 1949b, 206. Ortiz, 1950, 452. Carpenter, 1951, 205 (Panama).  
Woke, 1954, 68 (Canal Zone).

*Culicoides (Culicoides) rozeboomi* Khalaf, 1954, 46.

**salih Khalaf**

*Culicoides salih* Khalaf, 1952b, 351 (♂ ♀, Wichita Refuge, Okla., U. S. A.)  
*Culicoides (Oecacta) salih* Khalaf, 1954, 37.

**sanctae-marthae Kieffer**

*Culicoides sanctae-marthae* Kieffer, 1917b, 306.

*Dasyhelea sanctae-marthae* Kieffer, 1919a, 64.

REMARKS.—Macfie, 1948, 69, stated that this species is not a *Culicoides*.

**sanguisuga Coquillett**

See *Culicoides obsoletus* Meigen.

**scopus Root and Hoffman**

*Culicoides scopus* Root and Hoffman, 1937, 170 (♂ ♀, San Jacinto, D. F.,  
Mexico). Johannsen, 1943, 780. Vargas, 1945, 43. Macfie, 1948, 71.  
Vargas, 1949b, 206. Ortiz, 1950, 464.

*Culicoides (Oecacta) scopus* Khalaf, 1954, 36.

**setifer Lutz**

See *Culicoides caridei* (Brèthes).

**simulans Root and Hoffman**

See *Culicoides travisi* Vargas.

**sordidellus Zetterstedt**

*Ceratopogon sordidellus* Zetterstedt, 1838, 820 (♀, Greenland). Staeger 1844, 355. Osten Sacken, 1878, 23. Aldrich, 1905, 110.

*Ceratophorus sordidellus* Kieffer, 1906, 61.

*Ceratopogon (Culicoides?) sordidellus* Goetghebuer 1935, 310.

*Johannsoniella sordidella* Brumpt, 1936, 1454 (Greenland).

*Culicoides sordidellus* Edwards, 1938, 545 (♀, Greenland). Johannsen, 1943, 780. Vargas, 1945, 43. Vargas, 1949b, 207.

**spinus Root and Hoffman**

*Culicoides spinus* Root and Hoffman, 1937, 172 (♂, Baltimore, Md., U. S. A.). Johannsen, 1943, 780. Vargas, 1945, 43. Vargas, 1949b, 207. Ortiz, 1950, 464. Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Khalaf, 1953, 46 (♂ ♀, Oklahoma, U. S. A.). Foote and Pratt, 1954, 32 (♂ ♀, New York, Virginia, U. S. A.).

*Culicoides (Oecacta) spinus* Khalaf, 1954, 38.

**stellifer Coquillett**

*Ceratopogon stellifer* Coquillett, 1901, 603 (♀, Washington, D. C., U. S. A.). Howard, 1904, 92 (Texas, U. S. A.). Aldrich, 1905, 110. Pratt, 1907, 26 (♀, Arizona, District of Columbia, Mississippi, New Mexico, Tennessee, Virginia, U. S. A.).

*Ceratopogon (Culicoides) stellifer* Lutz, 1913, 71.

*Culicoides stellifer* Kieffer, 1906, 55. Malloch, 1915a, 300 (♂ ♀, Illinois, Michigan, U. S. A.). Malloch, 1915b, 307. Hoffman, 1925, 295 (♀, District of Columbia, New Mexico, U. S. A.). Hoffman, 1926a, 159 (New York, U. S. A.). Leonard, 1928, 707 (New York, U. S. A.). Root and Hoffman, 1937, 162 (♂ ♀, Connecticut, Kansas, Maryland, Mississippi, Virginia, U. S. A.). Fox, 1942, 419 (pupa, Maryland, U. S. A.). James, 1943, 148 (Colorado, U. S. A.). Johannsen, 1943, 780. Vargas, 1945, 43. Barbosa, 1947, 26 (Colorado, Florida, Georgia, Kentucky, Maryland, Mississippi, New Mexico, Ohio, Oklahoma, South Carolina, Tennessee, Virginia, U. S. A.). Vargas, 1949b, 207. Knowlton and Fronk, 1950, 114 (Utah, U. S. A.). Ortiz, 1950, 464. Knowlton and Kardos, 1951, 163 (Utah, U. S. A.). Wirth, 1951c, 318 (Virginia, U. S. A.). Ortiz, 1951c, 576 (♀, Florida, Louisiana, U. S. A.). Wirth, 1952a, 184 (♂, California, Delaware, District of Columbia, Florida, Georgia, Maryland, New Mexico, Oklahoma, South Carolina, Tennessee, Utah, Virginia, U. S. A.). Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 32 (♂ ♀, Alabama, Delaware, Florida, Georgia, Illinois, Maryland, Ohio, Pennsylvania, Utah,

Virginia, U. S. A.). Edmunds and Keener, Jr., 1954, 83 (Nebraska, U. S. A.).

*Culicoides (Oecacta) stellifer* Khalaf, 1954, 37.

REMARKS.—Several authors have mentioned this species as occurring in Venezuela (Iriarte, 1943, 192; Ortiz, 1944, 251; Anduze, *et al.*, 1947, 11; Floch and Abonnenc, 1949a, 71; Iriarte, 1950, 363; and Ortiz, 1951a, 10) but these records appear to be based on misidentifications.

### **stigmalis Wirth**

*Culicoides stigmalis* Wirth, 1952b, 245 (♀, Finca San Rafael, San Pedro Yepocapa, Chimaltenango, Guatemala). Gibson and Ascoli, 1952, 317 (Guatemala). Vargas, 1953b, 229 (♂, Mexico; Panama).

### **stilobezzioides Foote and Pratt**

*Culicoides stilobezzioides* Foote and Pratt, 1954, 33 (♂, Ithaca, N. Y.).

### **stonei James**

*Culicoides stonei* James, 1943, 149 (♂ ♀, Ft. Collins, Colo., U. S. A.). Vargas, 1945, 43. Vargas, 1949b, 207. Foote and Pratt, 1954, 33 (♀, Colorado, U. S. A.).

*Culicoides (Oecacta) stonei* Khalaf, 1954, 38.

### **stubalensis Fox**

See *Culicoides guyanensis* Floch and Abonnenc.

### **stylifer Lutz**

See *Lasiohelea stylifer* (Lutz).

### **tenuistylus Wirth**

*Culicoides tenuistylus* Wirth, 1952a, 178 (♂ ♀, Wheeler's Springs, Ventura Co., Calif., U. S. A.).

*Culicoides (Selfia) tenuistylus* Khalaf, 1954, 38.

### **transiens Walker**

*Ceratopogon transiens* Walker, 1848, 25 (♀, St. Martin's Falls, Albany River, Hudson's Bay). Osten Sacken, 1878, 23. Aldrich, 1905, 110. Kieffer, 1906, 52. Smith, 1900, 628. (New Jersey, U. S. A.).

*Culicoides transiens* Johannsen, 1943, 780. Vargas, 1949b, 207.

REMARKS.—A species of *Atrichopogon* according to Paul Freeman who studied the types in the British Museum (personal communication).

**travisi Vargas**

*Culicoides travisi* Vargas, 1949a, 233 (new name for *simulans* R.&H., preoccupied by Vimmer, 1932). Ortiz, 1950, 464. Wirth, 1951c, 318, (Virginia, U. S. A.). Beck, 1952, 104 (Florida, U. S. A.). Johannsen, 1952, 160. Snow and Pickard, 1953, 28 (Georgia, Tennessee, U. S. A.). Foote and Pratt, 1954, 33 (♂ ♀, Florida, Georgia, Maryland, New York, Ohio, Pennsylvania, Virginia, U. S. A.).

*Culicoides simulans* Root and Hoffman, 1937, 167 (♂ ♀, Baltimore, Md., U. S. A.). Johannsen, 1943, 779. Vargas, 1945, 43. Khalaf, 1952b, 349 (Oklahoma, U. S. A.).

*Culicoides (Oecacta) travisi* Khalaf, 1954, 37.

**tricoloratus Wirth and Blanton**

See *Culicoides pifanoi* Ortiz.

**trilineatus Fox**

*Culicoides trilineatus* Fox, 1946a, 250 (♀, Red Hook, St. Thomas, V. I.) Barbosa, 1947, 6. Macfie, 1948, 72. Wolcott, 1948, 426. Fox, 1949, 30. (♂ ♀, Puerto Rico). Fox and Kohler, 1950, 352 (Puerto Rico).

*Culicoides trilineatus* Vargas, 1949b, 207.

**trinidadensis Hoffman**

See *Culicoides maruim* Lutz.

**tristriatulus Hoffman**

*Culicoides cockerelli* var. *tristriatulus* Hoffman, 1925, 294 (♀, Eureka, Calif., U. S. A.). Root and Hoffman, 1937, 157. Johannsen, 1943, 779. Vargas, 1949b, 196. Ortiz, 1950, 462.

*Culicoides tristriatulus* Jenkins, 1948, 154 (Alaska). Travis, 1949, 455 (Alaska). Applewhite and Smith, 1950, 353 (Alaska). Applewhite and Cross, 1951, 21 (Alaska). Williams, 1951a, 173 (Alaska). Williams, 1951b, 430 (egg, larva, pupa, Alaska). Wirth, 1951a, 78 (♂ ♀, Alaska). Wirth, 1952a, 173 (♂ ♀, California, U. S. A.).

*Culicoides sordidellus* Jenkins (not Zetterstedt), 1948, 154 (Alaska).

*Culicoides (Culicoides) tristriatulus* Khalaf, 1954, 39.

REMARKS.—Vargas, 1945, 48, described what he believed to be the male of this species but Wirth, 1952a, 175, stated that Vargas was dealing with another species possibly *elutus* Macfie.

**undecimpunctatus Kieffer**

See *Culicoides paraensis* (Goeldi).

**unicolor Coquillett**

*Ceratopogon unicolor* Coquillett, 1905, 65 (♀, Eureka, Calif., U. S. A.).

Kieffer, 1906, 51. Pratt, 1907, 26 (California, U. S. A.).

*Culicoides unicolor* Hoffman, 1925, 279 (♀, California, U. S. A.). Root and Hoffman, 1937, 152. Curtis, 1941, 18 (Canada). Johannsen, 1943, 780. Vargas, 1945, 43. Vargas, 1949b, 208. Wirth, 1951a, 85 (♂ ♀, Alaska). Williams, 1951a, 181 (Alaska). Wirth, 1952a, 185 (♂ ♀, California, Montana, Oregon, U. S. A.; Canada; Alaska).

*Culicoides (Oecacta) unicolor* Khalaf, 1954, 36.

**uniradialis Wirth and Blanton**

*Culicoides uniradialis* Wirth and Blanton, 1953a, 70 (♂ ♀, Mojinga Swamp, Fort Sherman, C. Z.)

**usingeri Wirth**

*Culicoides usingeri* Wirth, 1952a, 192 (♂ ♀, Hat Creek Ranger Station, Shasta, Co., Calif., U. S. A.).

*Culicoides (Oecacta) usingeri* Khalaf, 1954, 38.

**utahensis Fox**

*Culicoides utahensis* Fox, 1946b, 246 (♂, Logan, Utah, U. S. A.). Vargas, 1949b, 208. Knowlton and Fronk, 1950, 113 (Utah, U. S. A.). Ortiz, 1950, 464. Wirth, 1952a, 189 (♂ ♀, California, Idaho, Montana, Utah, U. S. A.).

*Culicoides (Oecacta) utahensis* Khalaf, 1954, 38.

**vargasi Wirth and Blanton**

See *Culicoides iriartei* Fox.

**variipennis Coquillett**

*Ceratopogon variipennis* Coquillett, 1901, 602 (♀, Richmond, Va., New Jersey, U. S. A.; Mexico). Smith, 1900, 628 (New Jersey, U. S. A.). Aldrich, 1905, 110. Pratt, 1907, 26 (New Jersey, New Mexico, Virginia, U. S. A.).

*Culicoides variipennis* Kieffer, 1906, 55. Hoffman, 1924, 67 (Maryland, U. S. A.). Hoffman, 1925 (♂ ♀ Maryland, New York, U. S. A.). Leonard, 1928, 707 (New York, U. S. A.). Stanford, 1931, 99 (Utah, U. S. A.). Whitehead, 1934, 264 (Oklahoma, U. S. A.). Root and Hoffman, 1937, 158 (♂ ♀, Arizona, California, Kansas, Mississippi, New Jersey, Texas, U. S. A.; Mexico). Thomsen, 1937, 70 (pupa, New York, U. S. A.). Curtis, 1941, 18 (Canada). Fox, 1942, 414 (pupa, Maryland, U. S. A.). Johannsen, 1943, 780. James, 1943, 148 (Colorado, U. S. A.). Var-

gas, 1945, 45 (Mexico). Macfie, 1948, 71. Vargas, 1949b, 208. Knowlton and Fronk, 1950, 113 (Utah, U. S. A.). Ortiz, 1950, 464. Knowlton and Kardos, 1951, 163 (Utah, U. S. A.). Wirth, 1952a, 180 (♂ ♀, Arizona, California, Colorado, Georgia, Illinois, Indiana, Maryland, Mississippi, Montana, Nevada, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Texas, Washington, U. S. A.). Khalaf, 1952b, 349 (Oklahoma, U. S. A.). Johannsen, 1952, 160. Ortiz and Mirsa, 1952a, 125 (♀, Louisiana, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 34 (♂ ♀, Arizona, Arkansas, Colorado, Georgia, Illinois, Indiana, Kansas, Maryland, Mississippi, Nebraska, New Jersey, Ohio, Texas, Virginia, U. S. A.) Edmunds and Keener, Jr., 1954, 83 (Nebraska, U. S. A.).

*Culicoides variipennis* Malloch, 1915a, 297 (pupa, ♂ ♀, Arizona, Illinois, U. S. A.). Adams, 1940, 125 (Missouri, U. S. A.).

*Culicoides (Monoculicoides) variipennis* Khalaf, 1954, 40.

REMARKS.—This species has been mentioned several times as occurring in Venezuela (Ortiz, 1942, 258; Iriarte, 1943, 192; Anduze, *et al.*, 1947, 11; Iriarte, 1950, 363; Ortiz, 1951a, 10). Ortiz and Mirsa, 1952a, 125, indicate that the record is due to a misidentification. See *Culicoides arubae* Fox and Hoffman.

#### **venezuelensis Ortiz and Mirsa**

*Culicoides venezuelensis* Ortiz and Mirsa, 1950, 137 (♂ ♀, Los Chorros, Caracas, Venezuela).

*Psychophaena pictipennis* Phillipi, 1865, 628 (♀, Chile; name preoccupied by Staeger, 1839). Kieffer, 1906, 65.

*Psychophaena (Culicoides) pictipennis* Lutz, 1913, 71.

*Culicoides pictipennis* Ingram and Macfie, 1931, 155. Vargas, 1945, 43. Barbosa, 1947, 24. Macfie, 1948, 80.

*Culicoides ortizi* Fox, 1952a, 366 (♀, Venezuela).

#### **venustus Hoffman**

*Culicoides venustus* Hoffman, 1925, 290 (♀, Baltimore, Md., U. S. A.). Hoffman, 1926a, 159 (New York, U. S. A.). Leonard, 1928, 707 (New York, U. S. A.). Root and Hoffman, 1937, 155 (♂ ♀, Connecticut, U. S. A.). Thomsen, 1937, 70 (larva, pupa, New York, U. S. A.). Johannsen, 1943, 780. Vargas, 1945, 43. Vargas, 1949b, 208. Beck, 1952, 102 (Florida, U. S. A.). Snow and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 35 (♂ ♀, Alabama, Delaware, Florida, Georgia, Maryland, Mississippi, North Carolina, Ohio, Pennsylvania, Vermont, Virginia, U. S. A.).

*Culicoides (Hoffmania) venustus* Fox, 1948, 28 (♂ ♀). Ortiz, 1950, 446.  
Johannsen, 1952, 160.

*Culicoides (Culicoides) venustus* Khalaf, 1954, 39.

#### **verecundus Macfie**

*Culicoides verecundus* Macfie, 1948, 76 (♂ ♀, El Vergel, Chiapas, Mexico).

Vargas, 1949b, 208. Ortiz and Mirsa, 1952b, 259 (♂ ♀, Venezuela).

*Culicoides indianus* Macfie, 1940a, 25 (British Guiana; not *indianus* Macfie, 1932, 488).

*Culicoides palpalis* Macfie, 1948, 78 (♀, Mexico).

*Culicoides (Hoffmania) verecundus* Ortiz, 1950, 453.

*Culicoides (Culicoides) verecundus* Khalaf, 1954, 46.

#### **villosipennis Root and Hoffman**

*Culicoides villosipennis* Root and Hoffman, 1937, 165 (♂ ♀, Sparrow's Point near Baltimore, Md., U. S. A.). Fox, 1942, 416 (pupa, Maryland, U. S. A.). Johannsen, 1943, 780. Vargas, 1945, 43. Vargas, 1949b, 208. Wirth, 1951c, 318 (Virginia, U. S. A.). Beck, 1952, 103 (Florida, U. S. A.). Johannsen, 1952, 161. Stone and Pickard, 1953, 28 (Tennessee, U. S. A.). Foote and Pratt, 1954, 36 (♂ ♀, Georgia, Louisiana, Oklahoma, Texas, Virginia, U. S. A.).

*Culicoides (Oecacta) villosipennis* Khalaf, 1954, 37.

#### **villosipennis oklahomensis Khalaf**

*Culicoides villosipennis oklahomensis* Khalaf, 1952b, 355 (♂, Wichita Refuge, Oklahoma, U. S. A.).

*Culicoides (Oecacta) v. oklahomensis* Khalaf, 1954, 37.

#### **villosipes Kieffer**

*Culicoides villosipes* Kieffer, 1917b, 305.

*Dasyhelea villosipes* Kieffer, 1919, 64.

REMARKS.—Macfie, 1948, 69, stated that this species is not a *Culicoides*.

#### **weesei Khalaf**

*Culicoides weesei* Khalaf, 1952a, 65 (♂, Wichita Refuge, Okla., U. S. A.).

Khalaf, 1952b, 351 (♀, Oklahoma, U. S. A.).

*Culicoides (Oecacta) weesei* Khalaf, 1954, 38.

#### **willistoni Wirth and Blanton**

*Culicoides willistoni* Wirth and Blanton, 1953c, 116 (♂ ♀, Río Hato, Panama).

**wirthi Foote and Pratt**

*Culicoides wirthi* Foote and Pratt, 1954, 36 (♂, Helena, Mont., U. S. A.).

**wirthomyia Vargas**

*Culicoides wirthomyia* Vargas, 1953b, 227 (♂, Iguala, Guerrero, Mexico).

**wokei Barbosa**

See *Culicoides diminutus* Barbosa.

**wokei Fox**

*Culicoides wokei* Fox, 1947, 91 (♀, West Bank, Balboa, C. Z.). Macfie, 1948, 73. Vargas, 1949b, 208. Woke, 1954, 68 (Canal Zone).

**yukonensis Hoffman**

*Culicoides yukonensis* Hoffman, 1925, 291 (♀, Yukon Territory, Canada). Root and Hoffman, 1937, 152. Curtis, 1941, 18 (Canada). Johannsen, 1943, 780. Vargas, 1945, 45 (Mexico). Jenkins, 1948, 153 (Alaska). Travis, 1949, 455 (Alaska). Vargas, 1949b, 208. Wirth, 1951a, 81 (♂ ♀, Alaska). Williams, 1951a, 181 (Alaska).

*Culicoides (Culicoides) yukonensis* Khalaf, 1954, 39.

**LEPTOCONOPS SKUSE**

This genus has recently been defined by Wirth (1952a, 110) who recognizes three Nearctic subgenera, *Leptoconops* Skuse (1889, 288), *Holoconops* Kieffer (1918, 135), and *Styloconops* Kieffer (1921b, 107), the subgeneric characters applying only to the females. Ortiz (1952b) has listed the 9 species which occur in the Western Hemisphere giving the subgenera to which they belong and a key to most of the Neotropical species. The males of only 4 of the 9 species have been described.

**KEY TO THE NEARCTIC SPECIES OF LEPTOCONOPS (FEMALES)**

1. Antenna with 13 segments (*Holoconops*)..... 2
  - Antenna with 14 segments..... 4
2. Small species, wing 0.8–0.9 mm..... 3
  - Larger species, wing 1.0–1.5 mm..... *kertészii*
3. Mesonotum black contrasting with yellowish legs and abdomen
  - bequaerti*
  - Not as above, uniform reddish-brown..... *catowbae*
4. Claws with a stout basal tooth; basitarsi with 15–20 short dark spines (*Styloconops*)..... *freeborni*
  - Claws simple; basitarsi without such spines but with slender setae (*Leptoconops*)..... 5



5. Fourth palpal segment half as long as third..... *floridensis*  
 Fourth palpal segment as long as third..... *torrens*

### **bequaerti (Kieffer)**

*Holoconops bequaerti* Kieffer, 1925a, 405 (♀, Puerto Castilla, Honduras).  
*Leptoconops (Holoconops) hondurensis* Hoffman, 1926b, 135, (♂ ♀, Honduras; Cuba).

*Holoconops hondurensis* Macfie, 1937, 2 (♀, Trinidad). Adamson, 1939, 81 (Trinidad).

*Holoconops bequaerti* Johannsen, 1943, 776.

*Leptoconops (Holoconops) bequaerti* Wirth, 1951b, 281 (Florida, Mississippi, U. S. A.; Dominican Republic; Jamaica; Venezuela). Ortiz, 1952b, 164 (Venezuela).

*Leptoconops bequaerti* Woke, 1954, 71 (Nicaragua). Mayer, 1934, 256 (pupa).

### **brasiliensis (Lutz)**

*Tersesthes brasiliensis* Lutz, 1913, 66 (♀, Rio Tocantins, Brazil).

*Protersesthes brasiliensis* Kieffer, 1921b, 107.

*Leptoconops braziliensis* Carter, 1921, 13 (♀, Brazil).

*Leptoconops brasiliensis* Lane, 1945, 358 (♀, Brazil).

*Leptoconops (Leptoconops) brasiliensis* Ortiz, 1952b, 168.

### **carteri Hoffman**

See *Leptoconops torrens* (Townsend).

### **catawbae (Boesel)**

*Holoconops catawbae* Boesel, 1948, 69 (♀, Lakeside, Ohio, U. S. A.). Johannsen, 1952, 156.

*Leptoconops (Holoconops) catawbae* Wirth, 1951b, 282 (♀, Michigan, U. S. A.).

### **floridensis Wirth**

*Leptoconops (Leptoconops) floridensis* Wirth, 1951b, 282 (♀, Santa Rosa Island, Escambia Co., Fla., U. S. A.). Ortiz, 1952b, 168.

### **freeborni Wirth**

*Leptoconops (Styloconops) freeborni* Wirth, 1952a, 115 (♂ ♀, Hueneme, Ventura Co., Calif., U. S. A.).

### **hondurensis Hoffman**

See *Leptoconops bequaerti* (Kieffer).

**kertészi Kieffer**

*Leptoconops kertészi* Kieffer, 1908, 576 (♀, Cairo, Egypt). Freeborn and Zimmerman, 1934, 261 (♂, California, U. S. A.). Knowlton and Fronk, 1950, 113 (Utah, U. S. A.). Knowlton and Kardos, 1951, 163 (Utah, U. S. A.).

*Leptoconops (Holoconops) kertészi* var. *americanus* Carter, 1921, 22 (♀, Utah, U. S. A.). Rees and Smith, 1950, 9 (Utah, U. S. A.).

*Leptoconops kertészi* var. *americanus* Knowlton, 1949, 93 (Utah, U. S. A.). Rees and Smith, 1952, 49 (Utah, U. S. A.).

*Holoconops kertészi* Smith and Lowe, 1948, 157 (egg, larva, pupa, ♂ ♀, California, U. S. A.). Boesel, 1948, 70.

*Holoconops kertészi* var. *americanus* Johannsen, 1943, 776.

*Leptoconops (Holoconops) kertészi* Wirth, 1952a, 113 (♂ ♀, California, Colorado, Montana, Nebraska, New Mexico, Utah, Wyoming, U. S. A.).

**kertészi var. americanus Carter**

See *Leptoconops kertészi* Kieffer.

**petrocchiae Shannon and Del Ponte**

*Leptoconops petrocchiae* Shannon and Del Ponte, 1927, 734 (♀, Río Tapia (La Posta), Tucumán, Argentina).

*Leptoconops (Leptoconops) petrocchiae* Ortiz, 1952b, 168.

**torrens (Townsend)**

*Tersesthes torrens* Townsend, 1893a, 369 (♀, Continental Divide, N. Mex., U. S. A.). Johannsen, 1905, 96. Kieffer, 1906, 47. Pratt, 1907, 28 (Arizona, Florida, New Mexico, Utah, U. S. A.; Cuba). Kieffer, 1921b, 107. Stephens, 1923, 368 (Cuba).

*Leptoconops torrens* Aldrich, 1905, 107. Kieffer, 1908, 557. Kieffer, 1917a, 190 (New Mexico, U. S. A.). Carter, 1921, 15 (♂ ♀, New Mexico, U. S. A.). Freeborn and Zimmerman, 1934, 258 (♂, California, New Mexico, Texas, U. S. A.). Johannsen, 1943, 776 (California, Colorado, New Mexico, U. S. A.). Smith and Lowe, 1948, (larva, California, U. S. A.). Boesel, 1948, 70.

*Leptoconops carteri* Hoffman, 1926b, 133 (♀, California, U. S. A.).

*Leptoconops (Leptoconops) torrens* Wirth, 1952a, 110 (♂ ♀, Arizona, California, Texas, U. S. A.). Ortiz, 1952b, 168 (♀, California, U. S. A.).

**venezuelensis Ortiz**

*Leptoconops (Leptoconops) venezuelensis* Ortiz, 1952b, 165 (♀, San Carlos de Río Negro, Terr. Federal Amazonas, Venezuela).

**LASIOHELEA KIEFFER 1921b**

Goetghebuer and Lenz (1934, 6) considered *Lasiohelea* to be a synonym of *Forcipomyia* but recent authors (Macfie, 1940b, 15; Tokunaga, 1940, 101; Johannsen, 1943, 770) maintain the two separate. No Nearctic species have been reported but Johannsen (1943, 777) cites an undescribed species from Georgia, U. S. A. Only two of the species listed below are known to suck mammalian blood, *fluviatilis* (Lutz) and *styliifer* (Lutz).

**aeronautica Macfie**

*Forcipomyia (Lasiohelea) aeronautica* Macfie, 1935b, 265 (♀, Tumatumari, British Guiana).

**bromelicola (Lutz)**

*Ceratopogon bromelicola* Lutz, 1914, 84 (♂ ♀, Ilha do Governador, Rio de Janeiro, Brazil).

*Apelma bromicola* Saunders, 1925, 263 (larva, pupa, ♂ ♀, Brazil).

*Lasiohelea bromelicola* Lane, 1945, 360 (♂ ♀, Brazil).

**cretea Boesel**

*Lasiohelea cretea* Boesel, 1937, 46 (♀, Cretaceous amber, Canada).

**danaisi Floch and Abonnenc**

*Lasiohelea danaisi* Floch and Abonnenc, 1949a, 73 (♀, Rancho Grande, Aragua, Venezuela).

**fluviatilis (Lutz)**

*Johannseniella fluviatilis* Lutz, 1914, 82 (♀, Rio Negro, Massaraby, Brazil).

*Culicoides fluviatilis* Dunn, 1934, 178 (Panama). Fairchild, 1943, 572 (Panama).

*Serromyia fluviatilis* Fox, 1946a, 249.

*Lasiohelea fluviatilis* Lane, 1945, 363. Barbosa, 1947, 15. Vargas, 1949b, 198.

**globosa Boesel**

*Lasiohelea globosa* Boesel, 1937, 47 (♀, Cretaceous amber, Canada).

**intrepida Macfie**

*Forcipomyia (Lasiohelea) intrepida* Macfie, 1936, 228 (♀, Iquitos, Peru).

**louriei Macfie**

*Lasiohelea louriei* Macfie, 1935a, 49 (♀, Tutoia, Piaui, Brazil).

**nana Macfie**

*Lasiohelea nana* Macfie, 1939, 171 (♀, Nova Teutonia, Brazil). Macfie, 1944, 297 (♂, Trinidad).

**opilionivora Lane**

*Lasiohelea opilionivora* Lane, 1947, 159 (♀, Juquiá, S. Paulo, Brazil).

**shannoni Ingram and Macfie**

*Lasiohelea shannoni* Ingram and Macfie, 1931, 171 (♀, L. Correntoso, Chile).

**stylifer (Lutz)**

*Centrorhynchus stylifer* Lutz, 1913, 63 (♀, Lassance, Minas, Brazil).

*Lasiohelea stylifer* Edwards, 1922, 166. Dunn, 1934, 178 (Panama). Macfie, 1939, 171 (Brazil). Macfie, 1940b, 181 (British Guiana). Fairchild, 1943, 572 (Panama). Macfie, 1944, 298 (Trinidad). Lane, 1945, 362 (♀, Brazil).

Lane, 1947, 161 (larva, pupa, Brazil). Ortiz, 1952c, 242 (♀, Venezuela).  
*Culicoides stylifer* Vargas, 1945, 43. Vargas, 1949b, 207.

**GEOGRAPHIC INDEX**

ALASKA.—*Culicoides alaskensis*, *obsoletus*, *cockerellii*, *tristriatulus*, *unicolor*, *yukonensis*.

ANTIGUA.—*Culicoides furens*.

ARGENTINA.—*Culicoides caridei*, *debilipalpis*, *paraensis*, *Leptoconops petrocchia*.

ARUBA.—*Culicoides arubae*.

BAHAMA.—*Culicoides furens*.

BARBADOS.—*Culicoides furens*, *debilipalpis*, *paraensis*.

BOLIVIA.—*Culicoides paraensis*.

BRAZIL.—*Culicoides acotylus*, *bahiensis*, *bambusicola*, *caridei*, *coutinhoi*, *debilipalpis*, *debilipalpis glabrior*, *diabolicus*, *flavivenula*, *furens*, *guttatus*, *guyanensis*, *horticola*, *insignis*, *limai*, *lopesi*, *lutzi*, *maruim*, *pachymerus*, *paraensis*, *paucienfuscatus*, *phlebotomus*, *pulchripennis*, *pusillus*, *recifei*, *reticulatus*. *Leptoconops brasiliensis*. *Lasiohelea bromelicola*, *fluviatilis*, *louriei*, *nana*, *opilionivora*, *stylifer*.

BRITISH GUIANA.—*Culicoides dasyophrus*, *debilipalpis glabrior*, *diabolicus*, *eublepharus*, *fluvialis*, *germanus*, *hylas*, *verecundus*. *Lasiohelea aeronautica*, *stylifer*.

BRITISH HONDURAS.—*Culicoides furens*.

CANADA.—*Culicoides biguttatus*, *cockerellii*, *crepuscularis*, *denningi*, *gigas*, *jamesi*, *obsoletus*, *unicolor*, *variipennis*, *yukonensis*. *Lasiohelea cretea*, *globosa*.

- CHILE.—*Culicoides venezuelensis*. *Lasiohelea shannoni*.
- COLOMBIA. *Culicoides diabolicus*, *furens*, *phlebotomus*.
- COSTA RICA.—*Culicoides diabolicus*, *paraensis*, *phlebotomus*.
- CUBA.—*Culicoides furens*. *Leptoconops bequaerti*, *torrens*.
- DOMINICAN REPUBLIC.—*Culicoides furens*, *phlebotomus*. *Leptoconops bequaerti*.
- ECUADOR.—*Culicoides alahialinus*, *caridei*, *debilipalpis equatoriensis*, *furens*, *leoni*.
- FRENCH GUIANA.—*Culicoides bimaculatus*, *debilipalpis*, *diabolicus*, *flavi-venula*, *furens*, *guyanensis*, *horticola*, *lutzi*, *paraensis*, *phlebotomus*, *pusillus*.
- GREENLAND.—*Culicoides pumilus*, *sordidellus*.
- GRENADA.—*Culicoides paraensis*.
- GUADALOUPE.—*Culicoides furens*, *guadeloupensis*.
- GUATEMALA.—*Culicoides diminutus*, *furens*, *gibsoni*, *paraensis*, *stigmatis*.
- HAITI.—*Culicoides furens*, *inamollae*, *oliveri*.
- HONDURAS.—*Culicoides castillae*, *furens*, *heliconiae*, *inamollae*, *phlebotomus*. *Leptoconops bequaerti*.
- JAMAICA. *Culicoides furens*, *jamaicensis*, *loughnani*, *pusillus*. *Leptoconops bequaerti*.
- MEXICO.—*Culicoides acotylus*; *alambicorum*, *albomacula*, *baueri*, *cacozelus*, *copiosus*, *crepuscularis*, *daedalus*, *dampfi*, *debilipalpis*, *diabolicus*, *diminutus*, *elutus*, *furens*, *haematopotus*, *jamaicensis*, *luteovenus*, *pampoikilus*, *phlebotomus*, *piliferus*, *poikilonotus*, *propinquus*, *propriipennis*, *pusillus*, *scopus*, *stigmatis*, *variipennis*, *verecundus*, *wirthomyia*, *yukonensis*.
- NICARAGUA.—*Culicoides diminutus*, *furens*, *phlebotomus*. *Leptoconops bequaerti*.
- PANAMA (INCLUDING CANAL ZONE).—*Culicoides arubae*, *aureus*, *carpenteri*, *dasyophrus*, *debilipalpis glabrior*, *diabolicus*, *diminutus*, *furens*, *galindoi*, *gorgasi*, *guyanensis*, *hertigi*, *iriartei*, *jamaicensis*, *kintzi*, *lanei*, *leopoldoi*, *luteovenus*, *macrostigma*, *magnipalpis*, *mojingaensis*, *panamensis*, *paraensis*, *paucienfuscatus*, *phlebotomus*, *pifanoi*, *pusillus*, *rozeboomi*, *stigmatis*, *uniradialis*, *willistoni*, *wokei*. *Lasiohelea fluviatilis*, *stylifer*.
- PARAGUAY.—*Culicoides polystictus*.
- PERU.—*Culicoides efferus*, *paraensis*, *rozeboomi*. *Lasiohelea intrepida*.
- PUERTO RICO. *Culicoides borinqueni*, *foxi*, *furens*, *hoffmani*, *inamollae*, *jamaicensis*, *phlebotomus*, *pusillus*, *trilineatus*.
- ST. CROIX.—*Culicoides furens*, *jamaicensis*, *loughnani*, *phlebotomus*.
- ST. JOHN.—*Culicoides furens*.
- ST. THOMAS.—*Culicoides trilineatus*.
- ST. VINCENT.—*Culicoides decor*, *furens*, *paraensis*, *phlebotomus*.
- TOBAGO.—*Culicoides phlebotomus*.
- TRINIDAD.—*Culicoides debilipalpis*, *diabolicus*, *furens*, *guyanensis*, *heli-*

*coniae*, *hoffmani*, *maruim*, *paraensis*, *phlebotomus*, *pusillus*, *rozeboomi*, *trinidadensis*. *Leptoconops bequaerti*. *Lasiohelea nana*, *stylifer*.

UNITED STATES.—*Culicoides arboricola*, *baueri*, *biguttatus*, *brookmani*, *canithorax*, *chiopterus*, *cockerellii*, *c. saltonensis*, *copiosus*, *crepuscularis*, *denningi*, *floridensis*, *furens*, *guttipennis*, *haematopotus*, *hieroglyphicus*, *hinmani*, *hollensis*, *horneae*, *inamollae*, *jamesi*, *loughnani*, *luteovenus*, *melleus*, *mohave*, *monoensis*, *multipunctatus*, *nanus*, *niger*, *nocivum*, *obsoletus*, *ousairani*, *palmerae*, *pifanoi*, *piliferus*, *reevesi*, *salihii*, *spinosus*, *stellifer*, *stilobezzioides*, *stonei*, *tenuistylus*, *travisi*, *tristriatulus*, *unicolor*, *usingeri*, *utahensis*, *variipennis*, *venustus*, *villosipennis*, *v. oklahomensis*, *weesei*, *wirthi*. *Leptoconops bequaerti*, *catawbae*, *floridensis*, *freeborni*, *kertészi*, *torrens*. (See below).

URUGUAY.—*Culicoides caridei*.

VENEZUELA.—*Culicoides acotylus*, *arubae*, *aureus*, *avilaensis*, *baueri*, *bebei*, *benarrochei*, *briceñoi*, *cacozelus*, *caprilesi*, *cova-garciai*, *daedalus*, *dasyophrus*, *debilipalpis*, *discrepans*, *dominicii*, *eublepharus*, *flochabonnenci*, *fluvialis*, *foxi*, *furens*, *ginesi*, *guyanensis*, *heliconiae*, *hoffmani*, *horticola*, *inamollae*, *iriartei*, *jamaicensis*, *leopoldoi*, *lichyi*, *limai*, *lutzi*, *maruim*, *obnoxius*, *ocumarensis*, *paraensis*, *phlebotomus*, *pifanoi*, *propriipennis*, *pusillus*, *rangeli*, *venezuelensis*, *verecundus*. *Leptoconops bequaerti*, *venezuelensis*. *Lasiohelea danaisi*, *stylifer*.

#### GEOGRAPHIC INDEX OF THE UNITED STATES

ALABAMA.—*Culicoides crepuscularis*, *stellifer*, *venustus*.

ARIZONA.—*Culicoides crepuscularis*, *guttipennis*, *hieroglyphicus*, *mohave*, *stellifer*, *variipennis*. *Leptoconops torrens*.

ARKANSAS.—*Culicoides variipennis*.

CALIFORNIA.—*Culicoides baueri*, *brookmani*, *cockerellii*, *c. saltonensis*, *copiosus*, *crepuscularis*, *haematopotus*, *hieroglyphicus*, *jamesi*, *luteovenus*, *mohave*, *monoensis*, *obsoletus*, *palmerae*, *reevesi*, *stellifer*, *tenuistylus*, *tristriatulus*, *unicolor*, *usingeri*, *utahensis*, *variipennis*. *Leptoconops freeborni*, *kertészi*, *torrens*.

COLORADO.—*Culicoides baueri*, *cockerellii*, *crepuscularis*, *haematopotus*, *hieroglyphicus*, *jamesi*, *obsoletus*, *palmerae*, *stellifer*, *stonei*, *variipennis*. *Leptoconops kertészi*, *torrens*.

CONNECTICUT.—*Culicoides biguttatus*, *guttipennis*, *stellifer*, *venustus*.

DELAWARE.—*Culicoides canithorax*, *stellifer*, *venustus*.

DISTRICT OF COLUMBIA.—*Culicoides biguttatus*, *haematopotus*, *obsoletus*, *stellifer*.

FLORIDA.—*Culicoides arboricola*, *baueri*, *biguttatus*, *canithorax*, *crepuscularis*, *floridensis*, *furens*, *guttipennis*, *haematopotus*, *inamollae*, *loughnani*, *melleus*, *nanus*, *niger*, *obsoletus*, *pifanoi*, *piliferus*, *spinosus*, *stellifer*, *travisi*, *venustus*, *villosipennis*. *Leptoconops bequaerti*, *floridensis*, *torrens*.

- GEORGIA.—*Culicoides arboricola*, *baueri*, *biguttatus*, *canithorax*, *crepuscularis*, *furens*, *guttipennis*, *haematopotus*, *melleus*, *nanus*, *obsoletus*, *piliferus*, *stellifer*, *travisi*, *variipennis*, *venustus*, *villosipennis*..
- IDAHO.—*Culicoides utahensis*.
- ILLINOIS.—*Culicoides arboricola*, *biguttatus*, *crepuscularis*, *guttipennis*, *haematopotus*, *multipunctatus*, *obsoletus*, *stellifer*, *variipennis*.
- INDIANA.—*Culicoides obsoletus*, *variipennis*.
- KANSAS.—*Culicoides biguttatus*, *crepuscularis*, *haematopotus*, *hieroglyphicus*, *obsoletus*, *stellifer*, *variipennis*.
- KENTUCKY.—*Culicoides stellifer*.
- LOUISIANA.—*Culicoides arboricola*, *canithorax*, *furens*, *guttipennis*, *haematopotus*, *stellifer*, *variipennis*, *villosipennis*.
- MAINE.—*Culicoides canithorax*, *obsoletus*.
- MARYLAND.—*Culicoides arboricola*, *baueri*, *biguttatus*, *canithorax*, *chiop-terus*, *crepuscularis*, *furens*, *guttipennis*, *haematopotus*, *melleus*, *nanus*, *niger*, *obsoletus*, *piliferus*, *spinosus*, *stellifer*, *travisi*, *variipennis*, *venustus*, *villosipennis*.
- MASSACHUSETTS.—*Culicoides biguttatus*, *canithorax*, *crepuscularis*, *furens*, *hollensis*, *melleus*, *nocivum*, *obsoletus*.
- MICHIGAN.—*Culicoides crepuscularis*, *haematopotus*, *stellifer*. *Leptoconops catawbae*.
- MINNESOTA.—*Culicoides crepuscularis*.
- MISSISSIPPI.—*Culicoides arboricola*, *canithorax*, *furens*, *guttipennis*, *melleus*, *stellifer*, *variipennis*, *venustus*. *Leptoconops bequaerti*.
- MISSOURI.—*Culicoides crepuscularis*, *guttipennis*, *obsoletus*, *variipennis*.
- MONTANA.—*Culicoides biguttatus*, *cockerellii*, *crepuscularis*, *hieroglyphicus*, *jamesi*, *obsoletus*, *palmerae*, *unicolor*, *utahensis*, *variipennis*, *wirthi*. *Leptoconops kertészi*.
- NEBRASKA.—*Culicoides crepuscularis*, *haematopotus*, *hieroglyphicus*, *palmerae*, *stellifer*, *variipennis*. *Leptoconops kertészi*.
- NEVADA.—*Culicoides haematopotus*, *hieroglyphicus*, *palmerae*, *variipennis*.
- NEW HAMPSHIRE.—*Culicoides obsoletus*.
- NEW JERSEY.—*Culicoides biguttatus*, *canithorax*, *crepuscularis*, *furens*, *obsoletus*, *variipennis*.
- NEW MEXICO.—*Culicoides crepuscularis*, *haematopotus*, *hieroglyphicus*, *palmerae*, *stellifer*, *variipennis*. *Leptoconops kertészi*, *torrens*.
- NEW YORK.—*Culicoides biguttatus*, *crepuscularis*, *guttipennis*, *haematopotus*, *horneae*, *melleus*, *obsoletus*, *piliferus*, *spinosus*, *stellifer*, *stilobezzioides*, *travisi*, *variipennis*, *venustus*.
- NORTH CAROLINA.—*Culicoides furens*, *venustus*.
- OHIO.—*Culicoides biguttatus*, *haematopotus*, *guttipennis*, *obsoletus*, *stellifer*, *travisi*, *variipennis*, *venustus*. *Leptoconops catawbae*.

OKLAHOMA.—*Culicoides arboricola*, *crepuscularis*, *guttipennis*, *haematopotus*, *hieroglyphicus*, *hinmani*, *multipunctatus*, *nanus*, *obsoletus*, *ousairani*, *salihi*, *spinosus*, *stellifer*, *travisi*, *variipennis*, *villosipennis*, *v. oklahomensis*, *weesei*.

OREGON.—*Culicoides obsoletus*, *unicolor*, *variipennis*.

PENNSYLVANIA.—*Culicoides biguttatus*, *haematopotus*, *obsoletus*, *stellifer*, *travisi*, *venustus*.

SOUTH CAROLINA.—*Culicoides canithorax*, *furens*, *melleus*, *nanus*, *obsoletus*, *stellifer*.

SOUTH DAKOTA.—*Culicoides crepuscularis*.

TENNESSEE.—*Culicoides arboricola*, *baueri*, *biguttatus*, *crepuscularis*, *guttipennis*, *haematopotus*, *obsoletus*, *piliferus*, *stellifer*, *travisi*, *variipennis*, *venustus*, *villosipennis*.

TEXAS.—*Culicoides biguttatus*, *crepuscularis*, *furens*, *guttipennis*, *haematopotus*, *hieroglyphicus*, *multipunctatus*, *stellifer*, *variipennis*, *villosipennis*. *Leptoconops torrens*.

UTAH.—*Culicoides cockerellii*, *crepuscularis*, *haematopotus*, *hieroglyphicus*, *luteovenus*, *palmerae*, *stellifer*, *utahensis*, *variipennis*. *Leptoconops kertészii*, *torrens*.

VERMONT.—*Culicoides biguttatus*, *crepuscularis*, *guttipennis*, *obsoletus*, *piliferus*, *venustus*.

VIRGINIA.—*Culicoides arboricola*, *biguttatus*, *crepuscularis*, *guttipennis*, *haematopotus*, *niger*, *obsoletus*, *piliferus*, *spinosus*, *stellifer*, *travisi*, *variipennis*, *venustus*, *villosipennis*.

WASHINGTON.—*Culicoides crepuscularis*, *jamesi*, *luteovenus*, *obsoletus*, *variipennis*.

WYOMING.—*Culicoides crepuscularis*, *cockerellii*, *denningsi*, *palmerae*. *Leptoconops kertészii*.

#### SUMMARY

This catalogue dealing with the bloodsucking Ceratopogonidae of the Western Hemisphere includes 198 subspecific and specific names in *Culicoides*, 12 in *Leptoconops* and 12 in *Lasiohelea*, together with most of the literature references to them which had appeared up to June 1954. A subgeneric system in *Culicoides* based particularly on the male genitalia is proposed and eight subgenera are described or redescribed: *Macfiella* (new subgenus), *Hoffmania*, Fox, *Avaritia* (new subgenus), *Culicoides* Latreille, *Selfia* Khalaf, *Monoculicoides* Khalaf, *Oecacta* Poey, and *Beltranmyia* Vargas. The species are placed in the appropriate subgenera, as far as possible, and a key is given to the males and females of the Nearctic forms. The Geographic Index lists the species reported from the geographic units of the Western Hemisphere as well as each of the states of the United States.



A brief review of the literature on biology, control, and medical importance is also included.

### RESUMEN

Este catálogo trata de los ceratopogónidos hematófagos del hemisferio occidental e incluye 198 nombres específicos y subespecíficos del género *Culicoides*, 12 del género *Leptoconops* y 12 del género *Lasiohelea*. Incluye además casi todas las referencias de la literatura que han sido publicadas hasta Junio, 1954. Se ofrece un sistema de clasificación subgenérico en los *Culicoides* basado particularmente en los órganos genitales del macho. Hay descripciones de ocho subgéneros de los cuales dos son nuevos: *Macfiella* (subgénero nuevo), *Hoffmania* Fox, *Avaritia* (subgénero nuevo), *Culicoides* Latreille, *Selfia* Khalaf, *Monoculicoides* Khalaf, *Oecacta* Poey y *Beltranmyia* Vargas. Las especies están colocadas en los subgéneros apropiados hasta donde es posible y se da una clave de los machos y las hembras de las formas Neárticas. El índice geográfico incluye las especies informadas de las unidades geográficas del hemisferio occidental así como las de cada estado de los Estados Unidos de América. Se incluye también un breve repaso sobre la biología, el control y la importancia médica de los ceretopogónidos hematófagos.

### BIBLIOGRAPHY

- Adams, C. F., A preliminary list of the Chironomidae (midges) of Missouri, *Proc. Mo. Acad. Sci.* 5 124-7, 1940.
- Adamson, A. M., Observations on biting sandflies (Ceratopogonidae) in Trinidad, British West Indies, *Trop. Agr.* (Trinidad) 16 79-81, 1939.
- Aldrich, J. M., A catalogue of North American Diptera (or two-winged flies), *Smithsn. Inst. Misc. Collect.* 46 107-9, 119, 1905.
- Anderson, F. S., Ueber die Metamorphose der Ceratopogoniden und Chironomiden Nordost Grönlands, *Meddelelser om Grönland* 116 1-95, 1937.
- Anduze, P. J., Pifano, C. F., and Vogelsang, E. G., Nomina de los Artropods vulnerantes conocidos actualmente en Venezuela, *Bol. Ent. Venez.* 6 1-16, 1947.
- Anonymous, Control of the sand fly, *Sci.* 71 xii, 1930.
- , "Sandflies" and "Punkies", U.S. Dept. Agr., Bur. Ent. and Plant Quar. Mimeo. Circ. E-441, 3 p., 1938.
- , Insects in relation to national defense, U.S. Dept. Agr., Bur. Ent. and Plant Quar. Circ. 8 27-30, 1941.
- , DDT for control of household pests, U.S. Dept. Agr., Bur. Ent. and Plant Quar. and U.S. Pub. Health Serv., Washington, D. C., 15 p., 1947.
- Applewhite, K. H., and Cross, H. F., Further studies of repellents in Alaska, *J. Econ. Ent.* 44 19-22, 1951.
- Applewhite, K. H., and Smith, C. N., Field tests with mosquito and sand fly repellents in Alaska, *J. Econ. Ent.* 43 353-7, 1950.
- Atehley, F. O., and Hull, J. B., Oviposition by *Culicoides* breeding in salt marshes, *J. Parasitol.* 22 514, 1936.

- Baker, F. C., The effect of photoperiodism on resting treehole mosquito larvae, *Canad. Ent.* 67 149-53, 1935.
- Barbosa, F. A. S., Descrição de "*Culicoides recifensis*" n. sp. e do macho de "*Culicoides reticulatus*" Lutz (Diptera, Chironomidae), *Rev. Brasil. Biol.* 3 261-4, 1943.
- , "*Culicoides insignis*" Lutz, com a descrição do hipopégio (Diptera: Chironomidae), *Rev. Brasil. Biol.* 4 259-61, 1944.
- , *Culicoides* (Diptera: Heleidae) da Região Neotrópica, *An. Soc. Biol. Pernambuco* 7 3-30, 1947.
- , A change of specific name in the genus *Culicoides* (Diptera, Heleidae), *Proc. Ent. Soc. Wash.* 53 163, 1951.
- , Novos subsídios para o conhecimento dos *Culicoides* Neotrópicos (Diptera: Heleidae), Imprensa Industrial Recife-Pernambuco, 21 p., 1952.
- Barretto, M. P., Sobre o gênero *Culicoides* Latreille, 1809, com a descrição de três novas espécies (Diptera: Ceratopogonidae), *An. Fac. Med. Univ. São Paulo* 20 89-105, 1944.
- Beatty, H. A., The insects of St. Croix, V.I., *J. Agr. Univ. P. R.* 28 114-72, 1944.
- Beck, E. C., A new *Culicoides* from Florida (Diptera, Ceratopogonidae), *Fla. Ent.* 34, 135-6, 1951.
- , Notes on the distribution of *Culicoides* in Florida (Diptera, Ceratopogonidae), *Fla. Ent.* 35 101-7, 1952.
- Bequaert, J. C., Report of an entomological trip to the Truxillo division, Honduras to investigate the sand-fly problem, *Ann. Rep. Med. Dep. United Fruit Co.* 13 193-206, 1924.
- , Chironomidae in Medical report of the Hamilton Rice seventh expedition to the Amazon, in conjunction with the Department of Tropical Medicine of Harvard University, 1924-1925, *Contrib. Harvard Inst. Trop. Biol. Med.* 4 203, 1926.
- , Notes on the Arthropoda of medical importance in Guatemala, *Carnegie Inst. Wash. Pub.* 499 223-8, 1938.
- Bishopp, F. C., Present position of DDT in the control of insects of medical importance, *Amer. J. Pub. Health* 36 593-606, 1946.
- Boesel, M. W., Order Diptera Fam. Chironomidae in insects and arachnids from Canadian amber; *Univ. Toronto Studies, Geol. Ser.* 40 44-55, 1937.
- , *Holoconops* in the western Lake Erie Region (Diptera: Heleidae), *Ohio J. Sci.* 48 69-72, 1948.
- Bradley, G. H., Studies on *Culicoides*, *Pub. Health Rep.* 69 123-9, 1954.
- Brescia, F., and Wilson, I. B., Aerosol generator as used for sand fly control, *J. Econ. Ent.* 40 316-9, 1947.
- Brêthes, J., Descripción de un nuevo género y especie nueva de Chironomidae, *An. Mus. Hist. Nat. Buenos Aires* 22 451-3, 1912.
- Briceño-Iragorry, L., Nota acerca de *Culicoides* (Diptera: Ceratopogonidae), *Bol. Lab. Clín. "Luis Razetti"* 14 397-9, 1946.
- , Breve nota sobre *Culicoides*, *Bol. Lab. Clín. "Luis Razetti"* 15 318-9, 1949.
- Briceño Rossi, A. L., Primeros casos de filariasis a *Mansonella ozzardi* constatados en Venezuela, *Rev. San. Assist. Social* 14 671-4, 1949.
- Bruce, W. G., and Blakeslee, E. B., Control of salt-marsh sandflies and mosquitoes with DDT insecticides, *Mosquito News* 8 26-7, 1948.
- Brumpt, E., Précis de parasitologie. 5th. ed., vol. II, Paris, pp. 1083-2139, 1936.
- Buckley, J. J. C., A note on the development of *Filaria ozzardi* in *Culicoides furens* Poey, *J. Helminthol.* 11 257-8, 1933.

- , On the development in *Culicoides furens* Poey of *Filaria (Mansonella) ozzardi* Manson 1897, *J. Helminthol.* **12** 99–118, 1934a.
- , Development of *Filaria ozzardi* in *Culicoides furens*, *Trans. Roy. Soc. Trop. Med. and Hyg.* **28** 1, 1934b.
- , On *Culicoides* as a vector of *Onchocerca gibsoni* (Cleland and Johnston, 1910), *J. Helminthol.* **16** 121–58, 1938.
- Cameron, E., Report on midge repellents in Control of midges; An interim report of a subcommittee of the Scientific Advisory Committee, Department of Health for Scotland, H. M. S. O. Edinburg, Scotland, p. 4–8, 1946.
- Carpenter, S. J., Studies of *Culicoides* in the Panama Canal Zone (Diptera, Heleidae), *Mosquito News* **2** 202–8, 1951.
- Carter, H. F., A revision of the genus *Leptoconops*, Skuse, *Bul. Ent. Res.* **12** 1–28, 1921.
- Carter, H. F., Ingram, A., and Macfie, J. W. S., Observations on the Ceratopogonine midges of the Gold Coast with descriptions of new species, Parts I–II, *Ann. Trop. Med. and Parasitol.* **14** 187–274, 1920.
- Causey, O. R., *Culicoides* of Siam with descriptions of new species, *Amer. J. Hyg.* **27** 399–416, 1938.
- Chardome, M., and Peel, E., La répartition des filaires dans la région de Coquilhatville et la transmission de *Dipetalonema streptocerca* par *Culicoides grahami*, *Ann. Soc. Belge Méd. Trop.* **29** 99–119, 1949.
- Ciferri, R., Sur un *Grubyella* parasite de simuliés, *Grubyella ochoterenai* n. sp., *Ann. de Parasitol. Humaine et Compar.* **7** 511–23, 1929.
- Cockerell, T. D. A., A supplementary note to Mr. Johnson's list of Jamaican Diptera, *Proc. Acad. Nat. Sci. Phila.* **46** 419–20, 1894.
- Cole, F. R., and Lovett, A. L., An annotated list of the Diptera (flies) of Oregon, *Proc. Calif. Acad. Sci.* **11** 197–344, 1921.
- Coquillett, D. W., Papers from the Harriman Alaska Expedition, Diptera, *Proc. Wash. Acad. Sci.* **2** 389–464, 1900.
- , New Diptera in the U.S. National Museum, *Proc. U.S. Natl. Mus.* **23** 593–618, 1901.
- , New Diptera from North America, *Proc. U.S. Natl. Mus.* **25** 83–126, 1902.
- , A new *Ceratopogon* from Brazil, *J. N. Y. Ent. Soc.* **12** 35–6, 1904.
- , New Nematoceros Diptera from North America, *J. N. Y. Ent. Soc.* **13** 56–69, 1905.
- Curran, R. F., and Goulding, Jr., R. L., The problems and methods involved in sampling salt-marsh sandfly populations, Florida Anti-Mosquito Assoc. *Ann. Mtg.* **21** 113–17, 1950.
- Curtis, L. C., A preliminary list of the species of *Culicoides* in Western Canada (Diptera: Ceratopogonidae) *Proc. Ent. Soc. Brit. Columbia* **37** 18–9, 1941.
- Dampf, A., Los ceratopogónidos o jejenes (Insecta, Diptera, Fam. Ceratopogonidae) como transmisores de filarias, *Medicina, México* **16** 227–33, 1936a.
- , Les cératopogonidés, agents transmetteurs de filaires, *Bul. Mens., Off. Internat. Hyg. Pub.* **28** 1955–60, 1936b.
- , Ceratopogonidae in the transmission of a form of *Filaria*, which causes onchocerciasis in some parts of Mexico, *Mil. Surg.* **78** 282, 1936c.
- Desportes, C., Nouvelles recherches sur la morphologie et sur l'évolution d' *Icosiella neglecta* (Diesing 1851) filaire commune de la grenouille verte, *Ann. de Parasitol. Humaine et Compar.* **18** 46–66, 1941.
- , *Forcipomyia velez* Winn. et *Sycorax silacea* Curtis vecteurs d' *Icosiella neglecta*

- (Diesing) filaire commune de la grenouille verte, *Ann. de Parasitol. Humaine et Compar.* **19** 53-68, 1942.
- Dorsey, C. K., Population and control studies of the Palau gnat on Peleliu, Western Caroline Islands, *J. Econ. Ent.* **40** 805-14, 1947.
- Dove, W. E., John B. Hull, 1906-1949. *J. Econ. Ent.* **42** 869, 1949.
- Dove, W. E., and Hall, D. G., Dikes and automatic tide gates in control of sand flies and salt marsh mosquitoes, *J. Parasitol.* **20** 337-8, 1934.
- Dove, W. E., Hall, D. G., and Hull, J. B., The salt marsh sand fly problem, *Ann. Ent. Soc. Amer.* **25** 505-27, 1932.
- Downes, J. A., The habits and life cycle of *Culicoides nubeculosus* Meigen, *Nature* (London) **166** 510, 1950.
- Downes, J. A., and Kettle, D. S., Descriptions of three species of *Culicoides* Latreille (Diptera: Ceratopogonidae) new to science together with notes on and a revised key to the British species of the *pulicaris* and *obsoletus* groups, *Proc. Roy. Ent. Soc. London* **21** 61-78, 1952.
- Dunn, L. H., Entomological investigations in the Chiriqui Region of Panama, *Psyche* **41** 166-83, 1934.
- Du Toit, R. M., The transmission of blue-tongue and horse-sickness by *Culicoides*, *Onderstepoort J. Vet. Sci. and Anim. Indus.* **19** 7-16, 1944.
- , Transmission of horse-sickness and blue-tongue in South Africa, *Farming in So. Africa* **19** 421-3, 1945.
- Edmunds, L. R., and Keener, Jr., G. G., Observations on the biting habits of *Culicoides crepuscularis* Malloch in Western Nebraska, with notes on other species collected in light traps (Diptera, Heleidae), *Mosquito News* **14** 82-3, 1954.
- Edwards, F. W., On some Malayan and other species of *Culicoides*, with a note on the genus *Lasiohelea*, *Bul. Ent. Res.* **13** 161-7, 1922.
- , On the British biting midges (Diptera, Ceratopogonidae), *Trans. Ent. Soc. London* **74** 389-426, 1926.
- , *Culicoides sordidellus* Zett, *Ann. and Mag. Nat. Hist.* **1** (Ser. 11) 545, 1938.
- , Ceratopogonidae in Edwards, Oldroyd and Smart, British blood-sucking flies, British Museum (Nat. Hist.) London, 156 pp., 1939.
- Fairchild, G. B., An annotated list of the bloodsucking insects, ticks and mites known from Panama, *Amer. J. Trop. Med.* **23** 569-91, 1943.
- Fennah, R. G., Preliminary tests with DDT against insect pests of foodcrops in the Lesser Antilles, *Trop. Agr. (Trinidad)* **22** 222-6, 1945.
- Fenton, F. A., The insect pest record for Oklahoma, 1942 and 1943, *Proc. Okla. Acad. Sci.* **24** 1-5, 1944.
- Floch, H., Rapport pendant l'année 1951, *Arch. Inst. Pasteur de la Guyane et du Ter. de L'Inni. Pub.* **262** 1-310, 1952.
- Floch, H., and Abonnenc, E., Cératopogonidés hématophages de la Guyane Française, *Inst. Pasteur de la Guyane et du Ter. de L'Inni. Pub.* **37** 1-10, 1942a.
- , Cératopogonidés hématophages de la Guyane Française, II. *Inst. Pasteur de la Guyane et du Ter. de L'Inni. Pub.* **49** 1-5, 1942b.
- , Cératopogonidés nouveaux du Venezuela, *Bol. Ent. Venez.* **8** 69-75, 1949a.
- , *Mansonella ozzardi* et *Culicoides furens* dans les départements français du continent américain, *Compt. Rend. Soc. Biol.* **143** 1343, 1949b.
- , Les *Culicoides* de la Guadeloupe, Description de *Culicoides guadeloupensis* n. sp. *Inst. Pasteur de la Guyane et du Ter. de L'Inni. Pub.* **203** 1-5, 1950.
- Foley, H., and Picout-Laforest, A., Quelques observations sur la répartition et la biologie d'*Holococonops mediterraneus* (Ceratopogonines) dans les régions sahariennes, *Arch. Inst. Pasteur d'Algérie* **1** 684-7, 1923.

- Footte, R. H., and Pratt, H. D., The *Culicoides* of the eastern United States (Diptera: Heleidae), *Pub. Health Monog.* **18** (Pub. Health Serv. Pub. 296) 1-56, 1954.
- Fox, I., The respiratory trumpet and anal segment of the pupae of some species of *Culicoides* (Diptera: Ceratopogonidae), *P. R. J. Pub. Health and Trop. Med.* **17** 412-25, 1942.
- , A review of the species of biting midges or *Culicoides* from the Caribbean Region (Diptera: Ceratopogonidae), *Ann. Ent. Soc. Amer.* **39** 248-58, 1946a.
- , Two new biting midges or *Culicoides* from western United States (Diptera: Ceratopogonidae), *Proc. Ent. Soc. Wash.* **48** 244-6, 1946b.
- , Two new Central American biting midges or *Culicoides* (Diptera: Ceratopogonidae), *Kuba* **3** 90-1, 1947.
- , *Hoffmania*, a new subgenus in *Culicoides* (Diptera: Ceratopogonidae), *Proc. Biol. Soc. Wash.* **6** 21-8, 1948.
- , Notes on Puerto Rican biting midges or *Culicoides* (Diptera: Ceratopogonidae), *Bul. Brooklyn Ent. Soc.* **44** 29-34, 1949.
- , Six new Neotropical species of *Culicoides* (Diptera: Ceratopogonidae), *Ann. Ent. Soc. Amer.* **45** 364-8, 1952a.
- , Light trap studies on *Culicoides* in Puerto Rico, *J. Econ. Ent.* **45** 888-9, 1952b.
- Fox, I., and Hoffman, W. A., New Neotropical biting sandflies of the genus *Culicoides* (Diptera: Ceratopogonidae), *P. R. J. Pub. Health and Trop. Med.* **20** 108-11, 1944.
- Fox, I., and Kohler, C. E., Distribution and relative abundance of the species of biting midges or *Culicoides* in eastern Puerto Rico as shown by light traps, *P. R. J. Pub. Health and Trop. Med.* **25** 342-9, 1950.
- Fox, I., and Maldonado Capriles, J., Light trap studies on mosquitoes and *Culicoides* in western Puerto Rico, *Mosquito News* **13** 165-6, 1953.
- Freeborn, S. B., and Zimmerman, E. C., The males of *Leptoconops torrens* Tns. and *L. kerteszi* Kieff, *Bul. Ent. Res.* **25** 257-62, 1934.
- Garnham, P. C. C., and Harper, J. O., The control of rural malaria by pyrethrum dusting, *East African Med. J.* **21** 310-20, 1944.
- Gerry, B. I., Salt marsh fly control as an adjunct to mosquito control in Massachusetts, *Proc. N. J. Mosquito Exterm. Assoc.* **37** 189, 191-3, 1950.
- , Ecological data essential to effective and economical control of littoral mosquitoes and nuisance flies, *Mosquito News* **13** 141-4, 1953.
- Gibson, C. C. G., Malaria and mosquitoes in Belize, British Honduras, *J. Roy. Army Med. Corps.* **11** 38-43, 1923.
- Gibson, C. L., and Ascoli, W. F., The relation of *Culicoides* (Diptera: Heleidae) to the transmission of *Onchocerca volvulus*, *J. Parasitol.* **38** 315-20, 1952.
- Glasgow, R. D., and Collins, D. L., The thermal aerosol fog generator for large scale applications of DDT and other insecticides *J. Econ. Ent.* **39** 227-35, 1946.
- Glick, P. A., The distribution of insects, spiders and mites in the air. U.S. Dept. Agric. Tech. Bul. 673 1-150, 1939.
- Goeldi, E., Os mosquitos Pará, *Mem. Mus. Goeldi* **4** 1-154, 1905.
- Goetghebuer, M., Métamorphoses et moeurs du *Culicoides pulicaris* Linné, *Ann. Soc. Ent. Belg.* **59** 25-30, 1919.
- , Cératopogonines de Belgique parasites accidentals de l'homme, *Bul. Soc. Ent. Belg.* **5** 34, 1923.
- , Note à propos des Ceratopogonidae, *Bul. et Ann. Soc. Ent. Belg.* **75** 309-11, 1935.
- Goetghebuer, M., and Lenz, F., Heleidae (Ceratopogonidae) in Lindner, Die Fliegen der palaearktischen Region, Lief. 77 and 78, Stuttgart, 133 p., 1934.
- Goulding, R. L., Jr., A report on the investigations conducted by the cooperative

- sand fly research unit in South Florida, *Ann. Mig. Fla. Anti-Mosquito Assoc.* **21** 102-12, 1950.
- Goulding, R. L., Jr., Curran, R. F., and Labrecque, G. C., Field tests of insecticides for the control of the salt marsh sand fly, *Culicoides furens* Poey, Julius Hyman Co. (mimeographed), Denver, 10 p., 1951.
- , Insecticides for control of salt-marsh sand flies in Florida, *J. Econ. Ent.* **46** 37-43, 1953.
- Granett, P., Haynes, H. L., Connola, D. P., Bowery, T. G., and Barber, G. W., Two butoxypropylene glycol compounds as fly repellents for livestock, *J. Econ. Ent.* **42** 281-6, 1949.
- Hall, D. G., A new biting *Culicoides* from saltmarshes in the southeastern states, *Proc. Ent. Soc. Wash.* **34** 88-9, 1932.
- Hall, D. G., Hull, J. B., and Dove, W. E., New methods in sand fly studies (Diptera: Chironomidae), *Ent. News.* **44** 29-32, 1933.
- Harris, T. W., A treatise on some of the insects injurious to vegetation. C. L. Flint Ed. Boston, 640 p., 1862.
- Hase, A. Ueber heftige blasige Hautreaktionen nach *Culicoides* Stichen, *Ztschr. f. Parasitenk.* **6** 119-28, 1933.
- Hearle, E., Insects and allied parasites injurious to livestock and poultry in Canada. *Canada Dept. Agr. Pub.* **604** 1-108, 1938.
- Henrad, C., and Peel, E., *Culicoides grahami* Austen: vecteur de *Dipetalonema streptocerca* et non de *Acanthocheilonema perstans*, *Ann. Soc. Belge Méd. Trop.* **29** 127-43, 1949.
- Hill, M. A., The life-cycle and habits of *Culicoides impunctatus* Goetghebuer and *Culicoides obsoletus* Meigen, together with some observations on the life-cycle of *Culicoides odibilis* Austen, *Culicoides pallidicornis* Kieffer, *Culicoides cubitalis* Edwards and *Culicoides chiopterus* Meigen, *Ann. Trop. Med. and Parasitol.* **41** 55-115, 1947.
- Hill, M. A., and Roberts, E. W., An investigation into the effects of 'Gammexane' on the larvae, pupae and adults of *Culicoides impunctatus* Goetghebuer and on the adults of *Culicoides obsoletus* Meigen, *Ann. Trop. Med. and Parasitol.* **41** 143-63, 1947.
- Hinman, E. H., Notes on Louisiana *Culicoides* (Diptera: Ceratopogoninae), *Amer. J. Hyg.* **15** 773-6, 1932.
- Hoffman, W. A., Systematic and biological studies on the biting gnats of the sub-family Ceratopogoninae, diss. for the degree of Doctor of Science in Hygiene, Johns Hopkins Univ., 109 p. (typewritten), 1924.
- , A review of the species of *Culicoides* of North and Central America and the West Indies, *Amer. J. Hyg.* **5** 274-301, 1925.
- , Notes on Ceratopogoninae (Diptera), *Proc. Ent. Soc. Wash.* **28** 156-9, 1926a.
- , Two new species of American *Leptoconops*, *Bul. Ent. Res.* **17** 133-6, 1926b.
- , *Culicoides filariferus*, new species. *P. R. J. Pub. Health and Trop. Med.* **15** 172-4, 1939.
- Holden, J. R., and Findlay, G. M., Pyrethrum as a tsetse fly repellent: human experiments, *Trans. Roy. Soc. Trop. Med. and Hyg.* **38** 199-204, 1944.
- Hopkins, C. A., Notes on the biology of certain *Culicoides* studied in the British Cameroons, West Africa together with observations on their possible role as vectors of *Acanthocheilonema perstans*, *Ann. Trop. Med. and Parasitol.* **46** 165-72, 1952.
- Hopkins, C. A., and Nicholas, W. L., *Culicoides austeni*, the vector of *Acanthocheilonema perstans*, *Ann. Trop. Med. and Parasitol.* **46** 276-83, 1952.

- Howard, L. O., Effect of the bite of a midge on a human being, U.S. Dept. Agric. Div. Ent. Bul. 44, 92, 1904.
- Hull, J. B., and Dove, W. E., Sand fly control in mangrove marshes, *Proc. Helminthol. Soc. Wash.* 2 69, 1935.
- Hull, J. B., and Shields, S. E., Pyrethrum and oils for protection against salt-marsh sand flies (*Culicoides*), *J. Econ. Ent.* 32 93-4, 1939.
- Hull, J. B., and Platts, N. G., Experimental diking for control of sand fly and mosquito breeding in Florida salt-water marshes, *J. Econ. Ent.* 32 309-12, 1939.
- Hull, J. B., Dove, W. E., and Prince, F. M., Seasonal incidence and concentrations of sand fly larvae, *Culicoides dovei* Hall, in salt marshes (Ceratopogonidae: Diptera), *J. Parasitol.* 20 162-72, 1934.
- Hull, J. B., Shields, S. E., and Platts, N. G., Diking as a measure for sand fly control in salt marshes, *J. Econ. Ent.* 36 405-9, 1943.
- Huttel, W., Huttel, N., and Verdier, P., A propos de deux *Culicoides* nouveaux du Gabon (Diptera, Heleidae), *Ann. Parasitol. Humaine et Compar.* 28 98-107, 1953.
- Ingram, A., and Macfie, J. W. S., Ceratopogonidae in Edwards, Ingram and Macfie, Diptera of Patagonia and South Chile, Pt. 2, Fasc. 4., British Museum (Nat. Hist.), London, pp. 155-232, 1931.
- Iriarte, D. R., Contribución a la fauna venezolana, *Bol. Lab. Clin. "Luis Razetti"* 4 189-203, 1943.
- , Contribución al estudio de las ceratopogóninas hematófagas señaladas en Venezuela, Primera Parte, *Bol. Lab. Clin. "Luis Razetti"* 15 344-413, 1950.
- , Nueva especie de Ceratopogónido para el país. *Culicoides phlebotomus* Will, *Bol. Lab. Clin. "Luis Razetti"* 16 526-8, 1952.
- James, M. T., The genus *Culicoides* in Northern Colorado (Diptera, Ceratopogonidae), *Pan-Pacific Ent.* 19 148-53, 1943.
- Jellison, W. L., and Philip, C. B., Faunae of nests of the magpie and crow in western Montana, *Canad. Ent.* 65 26-31, 1933.
- Jenkins, D. W., Ecological observations on the blackflies and punkies of central Alaska, *Mosquito News* 8 148-54, 1948.
- Jobling, B., The structure of the head and mouth parts of *Culicoides pulicaris* L. (Diptera, Nematocera), *Bul. Ent. Res.* 13 211-36, 1928.
- , Some blood-sucking midges of the genus *Culicoides* from north London, *Trans. Roy. Soc. Trop. Med. Hyg.* 22 304, 1929.
- , On the blood-sucking midge *Culicoides vexans* Stager, including the description of its eggs and the first stage larva, *Parasitol.* 43 148-59, 1953.
- Johannsen, O. A., Aquatic nematoceros Diptera II. Bul. N. Y. State Mus. 86, 76-352, 1905.
- , New North American Chironomidae, Bul. N. Y. State Mus. 124, 264-85, 1908.
- , A generic synopsis of the Ceratopogonidae (Heleidae) of the Americas, a bibliography and a list of the North American species, *Ann. Ent. Soc. Amer.* 36 763-91, 1943.
- , Family Heleidae (= Ceratopogonidae) in Guide to the insects of Connecticut, Diptera, or true flies, Conn. State Geol. and Nat. Hist. Survey Bul. 80 149-76, 1952.
- Kershaw, W. E., Studies on the epidemiology of filariasis in West Africa, with special reference to the British Cameroons and the Niger delta. I: Methods of survey for infections with *Loa loa* and *Acanthocheilonema perstans*, *Ann. Trop. Med. and Parasitol.* 44 361-78, 1950.
- Kettle, D. S., An attempt to control *Culicoides impunctatus* Goetghebuer in Scotland by barrier spraying, *Ann. Trop. Med. and Parasitol.* 43 284-96, 1949.

- , Some factors affecting the population density and flight range of insects, *Proc. Roy. Ent. Soc. London Ser. A* **26** 59-63, 1951a.
- , The spatial distribution of *Culicoides impunctatus* Goet. under woodland and moorland conditions and its flight through woodland, *Bul. Ent. Res.* **42** 239-91, 1951b.
- , Midge (*Culicoides*) control in Scotland, *Trans. Ninth Internat. Cong. Ent.* **1** 935-8, 1952.
- Kettle, D. S., and Lawson, J. W. H., The early stages of British biting midges *Culicoides* Latreille (Diptera: Ceratopogonidae) and allied genera, *Bul. Ent. Res.* **43** 421-67, 1952.
- Khalaf, K., The male of *Culicoides weesei* Khalaf (Heleidae, Diptera), *J. Kans. Ent. Soc.* **25** 65, 1952a.
- , The *Culicoides* of the Wichita Refuge, Oklahoma. Taxonomy and seasonal incidence (Diptera, Heleidae), *Ann. Ent. Soc. Amer.* **45** 348-58, 1952b.
- , *Culicoides spinosus* in Oklahoma (Diptera: Heleidae), *Pan-Pacific Ent.* **39** 46-7, 1953.
- , The speciation of the genus *Culicoides* (Diptera, Heleidae), *Ann. Ent. Soc. Amer.* **47** 34-51, 1954.
- Kieffer, J. J., Diptera, Fam. Chironomidae in Wytzman, *Genera Insectorum Fasc.* **42**, 78p., 1906.
- , Description d'une espèce nouvelle de Chironomides d'Egypte, *Ann. Mus. Nat. Hungarici* **6** 576-7, 1908.
- , Zwölf neue *Culicoiden* Arten, *Arch. f. Hydrobiol. u. Planktonkunde. Sup. Bd.* **2** 231-41, 1914.
- , Chironomides d'Australie conservés au Musée National Hongrois de Budapest, *Ann. Mus. Nat. Hungarici* **15** 175-228, 1917a.
- , Chironomides d'Amerique conservés au Musée National Hongrois de Budapest, *Ann. Mus. Nat. Hungarici* **15** 292-364, 1917b.
- , Chironomides d'Afrique et d'Asie, *Ann. Mus. Nat. Hungarici* **16** 31-136, 1918.
- , Chironomides d'Europe conservés au Musée National Hongrois de Budapest, *Ann. Mus. Nat. Hungarici* **17** 1-160, 1919a.
- , Observations sur les Chironomides (Dipt.) décrits par J. R. Malloch *Bul. Soc. Ent. France*, p. 191-4, 1919b.
- , Description de quelques Chironomides exotiques, *Ann. Soc. Sci. Bruxelles* **40** 181-6, 1921a.
- , Sur quelques Diptères piqueurs de la tribu des Ceratopogoninae, *Arch. Inst. Pasteur l'Afrique du Nord* **1** 107-16, 1921b.
- , Nouveaux genres et nouvelles espèces de Chironomides piqueurs, *Arch. Inst. Pasteur d'Algerie* **3** 405-30, 1925a.
- , Diptères (Nématocères piqueurs): Chironomidae Ceratopogoninae, *Faune de France* **11** 138, 1925b.
- , Ceratopogoninae, Clé de détermination des genres, *Arch. Inst. Pasteur d'Algérie* **4** 96-107, 1926.
- Knab, F., New Ceratopogoninae from Peru, *Insector Inscitiae Menstruus* **3** 110-1, 1915.
- Knowlton, G. F., Biting midge in Utah, *J. Kans. Ent. Soc.* **22** 93, 1949.
- Knowlton, G. F., and Fronk, L. E., Some locality records of Utah Heleidae, *J. Kans. Ent. Soc.* **23** 113-4, 1950.
- Knowlton, G. F., and Kardos, E. H., Utah Heleidae, *J. Kans. Ent. Soc.* **24** 163, 1951.
- Kohler, C. E., and Fox, I., The relative attractiveness of New Jersey light traps



- painted (a) green and (b) yellow to Puerto Rican *Culicoides*, *J. Econ. Ent.* 44 112-3, 1951.
- Kumm, H. W., Komp, W. H. W., and Ruiz, H., The mosquitoes of Costa Rica, *Amer. J. Trop. Med.* 20 385-422, 1940.
- Labrecque, G. C., and Goulding, R. L., Tests with granulated BHC and dieldrin for controlling sand fly larvae, *Mosquito News* 14 20-2, 1954.
- Labrecque, G. C., Curran, R. F., and Keller, J., Field tests of insecticides for the control of sand flies, *Ann. Mig. Amer. Assoc. Econ. Ent.* 63 37, 1951.
- Lane, J., Redescrção de Ceratopogonídeos Neotrópicos, (Diptera: Ceratopogonidae), *Rev. de Ent.* 16 357-72, 1945.
- , A biologia e taxonomia de algumas espécies dos grupos *Forcipomyia* e *Culicoides* (Diptera, Ceratopogonidae) (Heleidae), *Arq. Fac. Hig. e Saude Pub. Univ. São Paulo* 1 159-70, 1947.
- , Sinonimias en *Culicoides guttatus* (Coquillett, 1904), *Bol. Ent. Venez.* 8 115-7, 1949.
- Lane, J., and Ortiz, I., I. Sinonimia en *Culicoides* (Diptera: Ceratopogonidae), *Rev. San. Assist. Social* 15 460, 1950.
- Latreille, P. A., *Genera Crustaceorum et Insectorum*, etc. 4 251, 1809.
- Lawson, J. W. H., The anatomy and morphology of the early stages of *Culicoides nubeculosus* Meigen (Diptera: Ceratopogonidae = Heleidae), *Trans. Roy. Ent. Soc. London* 102 511-74, 1951.
- Leclerq, M., Les piqûres d'insectes suceurs de sang en Belgique. I-Moustiques, Cératopogons, Simulies (Diptères Nématocères), *Rev. Med. Liège* 5 62-9, 1950.
- Leech, H. B., *Culicoides gigas* R. & H. at Vernon, B. C. (Diptera: Ceratopogonidae), *Proc. Ent. Soc. Brit. Columbia* 40 23, 1943.
- Leon, N., L'armature buccale et la pompe salivaire des *Culicoides pulicaris*, *Bul. Sect. Sci. Acad. Română Bucharest.* 9 17-22, 1924.
- Leonard, M. D., Ceratopogonidae in A list of the insects of New York with a list of the spiders and certain other allied groups, Cornell Univ. Agric. Exp. Sta. Mem. 101, 707, 1928.
- Lima, A. da C., Chave das especies de *Culicoides* da região neotropica (Diptera: Ceratopogonidae), *Mem. Inst. Oswaldo Cruz* 32 411-22, 1937.
- Loughnan, W. F. M., Unclassified fevers in Jamaica, *J. Trop. Med. and Hyg.* (London) 24 201-4, 1921.
- Lutz, A. Contribuição para o estudo das "Ceratopogoninas" hematofagas encontradas no Brazil, *Mem. Inst. Oswaldo Cruz* 4 1-33, 1912.
- , Contribuição para o estudo das Ceratopogoninas hematofagas do Brazil, *Mem. Inst. Oswaldo Cruz* 5 45-73, 1913.
- , Contribuição para o conhecimento das Ceratopogoninas do Brazil, *Mem. Inst. Oswaldo Cruz* 6 81-99, 1914.
- , *Culicoides flaviverrula* Lutz n. sp. in Lima, Chave das especies de *Culicoides* da região neotropica (Diptera: Ceratopogonidae), *Mem. Inst. Oswaldo Cruz* 32 418, 1937.
- Lutz, A., and Nuñez Tovar, M., Contribución para el estudio de los dípteros hematofagos de Venezuela in Lutz, *Estudios de Zoología y parasitología Venezolanas*, Río de Janeiro, 133 pp., 1928.
- Macfie, J. W. S., A new blood-sucking midge from Singapore, *Bul. Ent. Res.* 15 349-51, 1925.
- , Some new or little known Ceratopogonidae, *Ann. and Mag. Nat. Hist.* 9 485-99, 1932.
- , Ceratopogonidae (Dipt.) from the River Amazon, *Stylops* 4 49-56, 1935a.

- , A new ceratopogonid (Dipt.) from British Guiana, *Stylops* 4 265, 1935b.
- , Four species of Ceratopogonidae (Diptera) from the wings of insects, *Proc. Roy. Ent. Soc. London Ser. B.* 5 227-30, 1936.
- , Ceratopogonidae from Trinidad, *Ann. and Mag. Nat. Hist.* 20 1-18, 1937.
- , Notes on Ceratopogonidae (Diptera), *Proc. Roy. Ent. Soc. London Ser. B.* 7 157-66, 1938.
- , A report on a collection of Ceratopogonidae (Diptera), *Rev. de Ent.* 10 137-219, 1939.
- , A report on a collection of Ceratopogonidae (Diptera) from British Guiana, *Ent. Monthly Mag.* 76 23-32, 1940a.
- , Ceratopogonidae (Diptera) from British Guiana and Trinidad, Part. 1., *Proc. Roy. Ent. Soc. London Ser. B.* 9 179-86, 1940b.
- , The genera of Ceratopogonidae, *Ann. Trop. Med. and Parasitol.* 34 13-30, 1940c.
- , Ceratopogonidae collected in Trinidad from cacao flowers, *Bul. Ent. Res.* 35 297-300, 1944.
- , Some species of *Culicoides* (Diptera, Ceratopogonidae) from the State of Chiapas, Mexico, *Ann. Trop. Med. and Parasitol.* 42 67-87, 1948.
- , Ceratopogonidae from Costa Rica (Diptera), *Beitr. z. Ent. (Deut. Ent. Inst.)* 3 95-105, 1953.
- Madden, A. H., Lindquist, A. W., Longcoy, O. M., and Knipling, E. F., Control of adult sandflies by airplane spraying with DDT, *Fla. Ent.* 29 5-10, 1946.
- Malloch, J. R., The Chironomidae or midges of Illinois, with particular reference to the species occurring in the Illinois River, *Bul. Ill. State Lab. Nat. Hist.* 10, 275-543, 1915a.
- , Some additional records of Chironomidae for Illinois and notes on other Illinois Diptera, *Bul. Ill. State Lab. Nat. Hist.* 11, 305-63, 1915b.
- Mandoul, A. H., Présence à Bordeaux de *Culicoides perpingens*, *Ann. Parasitol. Humaine et Compar.* 4 319-22.
- Martorell, L. F., Insects observed in the State of Aragua, Venezuela, South America, *J. Agr. Univ. P. R.* 23 177-232, 1939.
- Mayer, K., Die Metamorphose der Ceratopogonidae (Dipt.), *Arch. f. Naturgesch.* 3 205-88, 1934.
- Medwedewa, N. B., Über die Morphologie und Biologie von *Culicoides nubeculosus* Mg. *Mitt. Inst. f. Heimatskunde Univ. Saratow* 2 1-18, 1927.
- Meigen, J. W., *Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*, 1 1-259, 1818.
- , *Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*, 6 1-401, 1830.
- Melander, A. L., and Brues, C. T., Guests and parasites of the burrowing bee *Halictus*, *Biol. Bul.* 5 13-4, 1903.
- Metcalf, C. L., Black flies and other biting flies of the Adirondacks, *N. Y. State Mus. Bul.* 289 5-58, 1932.
- Metcalf, C. L., and Sanderson, W. E., Control of biting flies in the Adirondacks, *N. Y. State Mus. Bul.* 289 59-72, 1932.
- Meyers, J. G., Report on the sandfly (*Culicoides*) investigations in the Bahamas, Bahamas Govt. Publ., 18 p., 1932.
- , The sand fly pest (*Culicoides*), *Trop. Agr.* (Trinidad) 12 71-3, 1935.
- Mirsa, A., Mirsa, M., and Ortiz, I., Primer hallazgo de formas evolutivas de microfilarias en el tórax de *Culicoides* (*C. pifanoi* Ortiz, 1951) en Venezuela, *Rev. San. Asist. Social* 17 159-62, 1952.

- Mirsa, M., and Ortiz, I., Estudios en *Culicoides* (Diptera, ceratopogonidae) X—Sobre la hembra de *Culicoides dominicii* Ortiz, 1951, *Bol. Lab. Clín. "Luis Razetti"* 16 475-8, 1952.
- Moignoux, J., *Culicoides nubeculosus* Meig. (Diptère, Ceratopogonide), hote intermédiaire possible de la filaire *Onchocerca reticulata* Dies. en Camargue, *Compt. Rend. Séan. Acad. Sci.* 233 102-3, 1951.
- Mukerji, S., On a new species of *Culicoides* (*Culicoides clavipalpis* sp. nov.) with notes on the morphology of the mouth-parts and male terminalia of an Indian *Culicoides*, *Indian J. Med. Res.* 18 1050-8, 1931a.
- , Morphology of the pharynx of female *Culicoides* and its taxonomic importance, *Nature* (London) 127 339-40, 1931b.
- Neiva, A., and Penna, E. B., Viajem científica pelo norte da Bahia sudoeste de Pernambuco, sul do Piauí e de norte a sul de Goiaz. *Mem. Inst. Oswaldo Cruz* 8 74-224, 1916.
- Nicholas, W. L., The bionomics of *Culicoides austeni*, vector of *Acanthocheilonema perstans* in the rain-forest of the British Cameroons, together with notes on *C. grahamii* and other species which may be vectors in the same area, *Ann. Trop. Med. and Parasitol.* 47 187-206, 1953a.
- , The dispersal of *Culicoides grahamii* and *C. austeni* from their breeding-sites prior to their taking a blood meal, *Ann. Trop. Med. and Parasitol.* 47 309-23, 1953b.
- Nicholas, W. L., Gordon, R. M., and Kershaw, W. E., The taking up of microfilariae in the blood by *Culicoides* spp. *Trans. Roy. Soc. Trop. Med. and Hyg.* 46 377, 1952.
- Nicholas, W. L., Kershaw, W. E., Keay, R. W. J., and Zahra, A., Studies on the epidemiology of filariasis in West Africa, with special reference to the British Cameroons and the Niger Delta, III, The distribution of *Culicoides* spp. biting man in the rain-forest, the forest fringe and the mountain grasslands of the British Cameroons, *Ann. Trop. Med. and Parasitol.* 47 95-111, 1953.
- O'Connor, F. W., Filariasis in Antigua, *J. Trop. Med. and Hyg.* (London) 40 42-8, 1937.
- Ortiz, I., Insectos hematófagos del Estado Falcón con citación de una especie nueva (*Culicoides variipennis* Coquillett), *Rev. Policlínica Caracas*, 11 258-60, 1942.
- , Contribución al estudio de la entomología médica del Estado Falcón, *Bol. Lab. "Luis Razetti"* 4 247-51, 1944.
- , Nota sobre nuevos Ceratopogónidos hematófagos para Venezuela, *Bol. Lab. Clín. "Luis Razetti"* 15 326-9, 1949.
- , Estudios en *Culicoides*, *Rev. San. Assist. Social* 15 429-65, 1950.
- , Estudios sobre *Culicoides* (Diptera, Ceratopogonidae) VII, *Culicoides dominicii* n. sp. y clave para el reconocimiento de las especies venezolanas, *Novedades Cient. Contrib. Occas. Mus. Hist. Nat. La Salle Caracas, Venezuela Ser. Zool.* No. 5, 1-12, 1951a.
- , Estudios en *Culicoides* (Diptera. Ceratopogonidae) VI., *Culicoides briceñoi* n. sp., *Bol. Lab. Clín. "Luis Razetti"* 16 442-3, 1951b.
- , 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 re-descripción de algunas otras poco conocidas, *Rev. San. Assist. Social* 16 573-605, 1951c.
- , Nota sobre la presencia de "*Culicoides eublepharus*" Macfie, 1948 (Díptera, "Ceratopogonidae") en Venezuela. Descripción de la armadura genital del macho *Acta Cient. Venez.* 3 129, 1952a.
- , Entomología médica, Los insectos del género *Leptoconops* Skuse, 1889 (Dip-

- tera, Ceratopogonidae) en Venezuela. Descripción de una nueva especie: *Leptoconops* (L.) *venezuelensis* y redescipción de la hembra de *Leptoconops* (L.) *torrens* (Townsend, 1893), *Rev. San. Asist. Social* 17, 163-71, 1952b.
- , Nota sobre la presencia en Venezuela de un nuevo Ceratopogónido hematófago *Lasiohelea styliifer* (Lutz, 1913), *Rev. San. Asist. Soc.* 17 241-4, 1952c.
- Ortiz, I., and Mirsa, M., Estudios en *Culicoides* (Diptera, Ceratopogonidae) VIII, Sobre una nueva especie del Grupo *haematopotus*: *Culicoides venezuelensis* n. sp., *Arch. Venez. Patol. Trop. y Parasitol. Méd.* 2 137-44, 1950.
- , Estudios en *Culicoides* (Diptera Ceratopogonidae), Descripción de dos nuevas especies: *Culicoides avilaensis* y *C. discrepans*, y el del macho de *C. leopoldoi* Ortiz, 1951. Redescipción de *C. limai* Barreto, 1944, *C. baueri* Hoffman, 1925, *C. lichyi* Floch & Abonnenc, 1949 y *C. pusillus* Lutz, 1913, *Rev. San. Asist. Social* 16 593-605, 1951.
- , Sobre las especies Americanas del género "*Culicoides*" Latr. (Diptera, "Ceratopogonidae") con una espermoteca, *Acta Cient. Venez.* 3 125-8, 1952a.
- , *Culicoides* de Venezuela, Redescipción de 10 especies con la descripción de algunos sexos no conocidos, *Rev. San. Asist. Social* 17 257-79, 1952b.
- Ortiz, I., and Peña Garcia, B., Sobre la presencia de algunos insectos hematófagos (Diptera, Ceratopogonidae, Heleidae), en los Estados Zulia y Falcon, *Apuntes Cient. Cabimas, Zulia, Venezuela* 1 6-8, 1948.
- Osten Sacken, C. R., Catalogue of the described Diptera of North America. Misc. Coll. Smithsn. Inst. No. 270, 276 p., 1878.
- Painter, R. H., The biology, immature stages and control of the sandflies (biting Ceratopogoninae) at Puerto Castilla, Honduras, *Ann. Rep. Med. Dep. United Fruit Co.* 15 245-62, 1926.
- Parker, A. H., Observations on the seasonal and daily incidence of certain biting midges (*Culicoides* Latreille—Diptera, Ceratopogonidae) in Scotland, *Trans. Roy. Ent. Soc. London* 100 179, 1949.
- , Studies on the eggs of certain biting midges (*Culicoides* Latreille) occurring in Scotland, *Proc. Roy. Ent. Soc. London Ser. A* 25 43-52, 1950.
- Patel, P. G., Note on the life-history of *Culicoides oxystoma*, with some remarks on the early stages of *Ceratopogon*, *Rep. 4th Ent. Mtg. Pusa*, p. 272-8, 1921.
- Patton, W. S., *Culicoides kiefferi*, n. sp.: a new Indian blood-sucking midge, *Indian J. Med. Res.* 1 336-8, 1913.
- Peacock, A. D., Cameron, A. E., Downes, J. A., and Morison, G. D., The second report on control of midges by a sub-committee of the Scientific Advisory Committee, Dept. of Health for Scotland, H. M. S. O., Edinburgh, 11 pp., 1948.
- Philippi, R. A., Aufzählung der chilenischen Dipteren, *Verhandl. Zool.-Bot. Gesell. Wien* 15 628-30, 1865.
- Pijoan, M., Gerjovich, H. J., Hopwood, M. L., Jachowski, L. A., and Romine, J. T., Studies on new insect repellents, *U. S. Nav. Med. Bul.* 46 1506-22, 1946.
- Platts, N. G., Shields, S. E., and Hull, J. B., Diking and pumping for control of sand flies and mosquitoes in Florida salt marshes, *J. Econ. Ent.* 36 409-12, 1943.
- Poey, F., El jején, *Oecacta furens* Poey. *Mem. sobre la Hist. Nat. de la Isla de Cuba* 1 236-43, 1851.
- Pomerantzev, B. I., Beiträge zur Morphologie und Anatomie der Genitalien von *Culicoides* (Diptera, Nematocera), *Mag. Parasitol., Leningrad* 3 183-214, 1932.
- Pratt, F. C., Notes on punkies, U. S. Dept. Agr. Bur. Ent. Bul. 64, 23-8, 1907.
- Purcell, F. M., A dengue-like fever in the Gold Coast, *Trans. Roy. Soc. Trop. Med. and Hyg.* 30 541-4, 1937.

- Rees, D. M., and Smith, J. V., Effective control methods used on biting gnats in Utah during 1949 (Diptera: Ceratopogonidae), *Mosquito News* 10 9-15, 1950.
- , Control of biting gnats in North Salt Lake City, Utah (Diptera: Heleidae), *Mosquito News* 12 49-52, 1952.
- Rieth, J. T., Die Metamorphose der Culicoidinen (Ceratopogoninen), *Arch. Hydrobiol. und Planktonkunde Suppl.* 2 377-443, 1915.
- Roberts, E. W., The artificial feeding of *Culicoides nubeculosus* in the laboratory, *Nature* (London) 166 700, 1950.
- Roman, E., Sur quelques moucheron piqueurs de la région lyonnaise appartenant au genre *Culicoides* (Diptères, Ceratopogonidés), *Bul. Soc. Linn. Lyon.* 10 38-9, 1941.
- Romaña, C., and Wygodzinsky, P., Acerca de la transmisión de *Mansonella ozzardi* (Manson) (*Filaria tucumana* Biglieri y Araoz.), *An. Inst. Med. Region. Univ. Nac. Tucumán* 3 29-34, 1950.
- Root, F. M., Notes on mosquitoes and other bloodsucking flies from Porto Rico, *Amer. J. Hyg.* 2 394-405, 1922.
- , Notes on blood-sucking arthropods collected at Tela, Honduras and Port Limon, Costa Rica during the summer of 1924, *Ann. Rep. Med. Dept. United Fruit Co.* 13 207-9, 1924.
- Root, F. M., and Hoffman, W. A., The North American species of *Culicoides*, *Amer. J. Hyg.* 25 150-76, 1937.
- Saunders, L. G., On the life history, morphology and systematic position of *Apelma Kieff* and *Thyridomyia* n.g. (Diptera, Nemat. Ceratopogoninae), *Parasitol.* 17 252-77, 1925.
- Sergent, E., Observations sur la biologie d'un Cératopogonine piqueur et suceur de sang: *Holoconops mediterraneus* J. J. Kieffer 1921, *Arch. Inst. Pasteur l'Afrique du Nord* 2 119-20, 1922.
- Sergent, E., Parrot, L., and Donatien, A., Quelques observations sur la biologie des Cératopogonines d'Algérie, *Cong. Internat. d'Entom. Paris* 2 743-9, 1933.
- Shannon, R. C., and del Ponte, E., Cuatro notas sobre especies nuevas de Dípteros nematóceros hematófagos o nó de la República Argentina, *Rev. Inst. Bact. Dept. Nac. Hig.* 4 724-36, 1927.
- Sharp, N. A. D., Development of microfilaria perstans in *Culicoides grahmi*, a preliminary note, *Trans. Roy. Soc. Trop. Med. and Hyg.* 21 70, 1927.
- , *Filaria perstans*; its development in *Culicoides austeni*, *Trans. Roy. Soc. Trop. Med. and Hyg.* 21 371-96, 1928.
- Shields, S. E., and Hull, J. B., The seasonal incidence of sand flies in Florida, *J. Econ. Ent.* 36 625-6, 1943.
- Skuse, F. A. A., Diptera of Australia, VI, The Chironomidae, *Proc. Linn. Soc. N. S. Wales* 4 215-311, 1889.
- Smith, J. B., Insects of New Jersey, Suppl. to 27th. Ann. Rep. New Jersey State Bd. Agric., pp. 628, 1900.
- Smith, L. M., and Lowe, H., The black gnats of California, *Hilgardia* 18 157-183, 1948.
- Snodgrass, R. E., The feeding apparatus of biting and disease-carrying flies: a wartime contribution to medical entomology, *Smithsn. Inst. Misc. Collect.* 104 Publ. 3732, 1-51, 1943.
- Snow, W. E., and Pickard, E., A survey of arthropods of public health significance in the Chestuee Creek watershed, Biol. Sect., Malaria Control Branch, Tennessee Valley Auth., Wilson Dam, Alabama, 52 pp., 1953.
- Staeger, C., In *Krøjer's Naturhist. Tidsskr.* 2 (13) 593, 1839.
- , Groenlands Antliater in *Krøher's Naturhist. Tidsskr.* N. Ser. 1, 346-69, 1844.

- Stanford, J. S., Notes on Diptera attacking man in Sevier County, Utah, *Pan-Pacific Ent.* 7 99-100, 1931.
- Stephens, E. A., Some observations on a Pappataci like fever occurring in Cuba. *U. S. Nav. Med. Bul.* 18 368-70, 1923.
- Steward, J. S., *Onchocerca cervicalis* (Railliet and Henry 1910) and its development in *Culicoides nubeculosus* Mg. Rep. Dir. *Cambridge Univ. Inst. Anim. Path.* 3 272-84, 1933.
- , Fistulous withers and poll-evil. Equine and bovine Onchocerciasis compared with an account of the life-histories of parasites concerned, *Vet. Rec. N. Ser.* 15 1563-73, 1935.
- , Applications of "Gammexane" to arthropods of veterinary importance, *Nature* (London) 158 636, 1946.
- Surcouf, J., and González-Rincones, R., Diptères piqueurs et suceurs de sang actuellement connus de la République de Venezuela, *Arch. Parasitol. Paris* 15 248-314, 1912.
- Thienemann, A., Chironomiden-Metamorphosen I, *Arch. f. Hydrobiol. und Planktonkunde* 19 585-623, 1928.
- Thomsen, L. C., Aquatic Diptera, Part V, Ceratopogonidae, N. Y. (Cornell Univ.) Agr. Exp. Sta. Mem. 210, 57-80, 1937.
- Tokunaga, M., Sand flies (Ceratopogonidae, Diptera) from Japan, *Tenthredo* 1 233-338, 1937.
- , Biting midges from Japan and neighboring countries including Micronesian Islands, Manchuria, North China and Mongolia, *Tenthredo* 3 58-165, 1940.
- Townsend, C. H. T., An interesting blood-sucking gnat of the family Chironomidae, *Psyche* 6 369-71, 1893a.
- , *Oecacta furens* in Jamaica, *J. Inst. Jamaica* 1 381, 1893b.
- , IV, Contributions from the New Mexico Biological Station.—No. 2, On a collection of Diptera from the lowlands of Rio Nautla, in the State of Vera Cruz, *Ann. and Mag. Nat Hist.* Ser. 6. 19 16-34, 1897.
- , The insect vector of uta, Peruvian disease, *J. Parasitol.* 2 67-73, 1915.
- Trapido, H., DDT residual spray control of sandflies in Panama, *J. Econ. Ent.* 40 472-5, 1947.
- Travis, B. V., Studies of mosquito and other biting-insect problems in Alaska, *J. Econ. Ent.* 42, 451-7, 1949.
- Travis, B. V., and Morton, F. A., Insect repellents and nets for use against sand flies, *Proc. N. J. Mosquito Extermin. Assoc.* 37 154-6, 1950.
- Travis, B. V., Morton, F. A., and Cochran, J. H., Insect repellents used as skin treatments by the Armed Forces, *J. Econ. Ent.* 39 627-9, 1946.
- Tucker, R. W. E., The insects of Barbados, *J. Agr. Univ. P. R.* 36 330-63, 1952.
- Twinn, C. R., Note on the biting midge, *Culicoides obsoletus* Mgn. in eastern Canada, *Canad. Ent.* 63 248, 1931.
- Van Den Berghe, L., and Chardome, M., The geographical distribution of *Acanthocheilonema streptocerca* in the Belgian Congo, *Trans. Roy. Soc. Trop. Med. and Hyg.* 46 99-102, 1952.
- Van Volkenberg, H. L., Parasites and parasitic diseases of horses in Puerto Rico, *Bul. P. R. Agr. Exp. Sta.* 37, 1-19, 1935.
- Vargas, L., Nota sobre el papel de algunos artrópodos en la transmisión de *Onchocerca volvulus*, *Rev. Inst. Salub. y Enferm. Trop.* 2 365-73, 1941.
- , *Culicoides diabolicus* en Mexico, Caracteres del macho, *Rev. Inst. Salub y Enferm. Trop.* 5 163-9, 1944.

- , Nota sobre Ceratopogónidos y *Culicoides*, *Rev. Inst. Salub. y Enferm. Trop.* **6** 41-9, 1945.
- , *Culicoides travisi* Vargas. n.n., *Rev. Inst. Salub. y Enferm. Trop.* **10** 233-4, 1949a.
- , Lista de los *Culicoides* del mundo (Diptera, Heleidae), *Rev. Soc. Mex. Hist. Nat.* **10** 191-218, 1949b.
- , *Beltranmyia* n. subgen. de *Culicoides* (Insecta: Heleidae), *Rev. Inst. Salub. y Enferm. Trop.* **13** 33-6, 1953a.
- , *Culicoides wirthomyia* n. sp. y *Culicoides stigmatis* Wirth, 1952, (Insecta, Diptera), *Rev. Inst. Salub. y Enferm. Trop.* **13** 227-31, 1953b.
- Vimmer, A., Neue species aus der Unterfamilien Ceratopogoninae, *Sborn. Ent. Odd. Národ Mus. Praha.* **10** 130-44, 1932.
- Walker, F., List of the specimens of Dipterous insects in the collection of the British Museum **1** 25-7, 1848.
- Wanson, M., Observations sur la biologie des Cératopogonidés et des Simulidés du Bas-Congo, *Ann. Soc. Belge Méd. Trop.* **19** 97-112, 1939.
- Warmke, H. E., Studies on natural pollination of *Hevea brasiliensis* in Brazil, *Sci.* **116** 474-5, 1952.
- Wehr, E. E., and Lucker, J. T., Insects and helminths in Insects, The Yearbook of Agriculture. U. S. Dept. Agr., Washington, D. C., p. 169-79, 1952.
- Whitehead, F. E., Damage to livestock by blood sucking midges, Rep. Okla. Agr. Expt. Sta. 1932-1934, p. 264-8, 1934.
- Wille, J., Uebersicht der landwirtschaftlich wichtigen Insekten von Rio Grande do Sul (Brasilien), *Ztschr. f. Angew. Ent.* **11** 415-26, 1925.
- Williams, R. W., Observations on the bionomics of *Culicoides tristriatulus* Hoffman with notes on *C. alaskensis* Wirth and other species at Valdez, Alaska, Summer 1949, *Ann. Ent. Soc. Amer.* **44** 173-83, 1951a.
- , The immature stages of *Culicoides tristriatulus* Hoffman, *Ann. Ent. Soc. Amer.* **44** 430-40, 1951b.
- Williston, S. W., On the Diptera of St. Vincent (West Indies), *Trans. Ent. Soc. London*, pp. 253-446, 1896.
- Wilson, C. S., Control of Alaskan biting insects, *Pub. Health Rep.* **66** 917-22, 1951.
- Wilson, C. S., Applewhite, K. H., and Redlinger, L. M., Heavy ground aerosol generators for the control of adult biting insects in Alaska, *Mosquito News* **9** 97-101, 1949.
- Winnertz, J., Beitrage zur kenntnis der Gattung *Ceratopogon*, *Linnaea Entomologica* **6** 1-80, 1852.
- Wirth, W. W., The genus *Culicoides* in Alaska (Diptera, Heleidae), *Ann. Ent. Soc. Amer.* **44** 75-86, 1951a.
- , A new biting midge of the genus *Leptoconops* from Florida, with new records of other American species (Diptera, Heleidae), *Proc. Ent. Soc. Wash.* **53** 281-4, 1951b.
- , New species and records of Virginia Heleidae (Diptera), *Proc. Ent. Soc. Wash.* **53** 313-26, 1951c.
- , The Heleidae of California, Univ. Calif. Pub. Ent. **9**, 95-266, 1952a.
- , Two new species of anthropophilic *Culicoides* from Guatemala (Diptera: Heleidae), *J. Parasitol.* **38** 245-7, 1952b.
- , The immature stages of two species of Florida salt marsh sand flies (Diptera: Heleidae), *Fla. Ent.* **35** 91-100, 1952c.
- Wirth, W. W., and Blanton, F. S., Studies in Panama *Culicoides* (Diptera: Heleidae): I, Descriptions of six new species, *J. Wash. Acad. Sci.* **43** 69-77, 1953a.

- , Studies in Panama *Culicoides* (Diptera, Heleidae), II, Descriptions of six additional new species, *J. Parasitol.* **39** 229-36, 1953b.
- , Studies in Panama *Culicoides* (Diptera, Heleidae), III, A new species related to *phlebotomus* (Williston), *Ent. News* **44** 113-20, 1953c.
- Woke, P. A., Arthropods of sanitary importance in the Republic of Nicaragua, Central America, *Amer. J. Trop. Med.* **27** 357-75, 1947.
- , Observations on Central American biting midges (Diptera, Heleidae), *Ann. Ent. Soc. Amer.* **47** 61-74, 1954.
- Wolcott, G. N., Insectae Portoricensis, *J. P. R. Dept. Agr.* **7** 5-313, 1923.
- , Entomología Económica Puertorriqueña, Bol. P. R. Dept. Agr. Trab. Estac. Expt. Insular **32**, 1-176, 1924.
- , Entomologie D'Haiti, Port au Prince, 440 pp. 1927.
- , "Insectae Borinquenses" A revised annotated check-list of the insects of Puerto Rico, *J. Agr. Univ. P. R.* **20** 1-600, 1936.
- , A supplement to "Insectae Borinquenses", *J. Agr. Univ. P. R.* **25** 33-158, 1941.
- , The insects of Puerto Rico, Diptera, *J. Agr. Univ. P. R.* **32** 417-532, 1948.
- Zetterstedt, J. W., Insecta Lapponica, Lipsiae, 820 pp., 1838.
- , *Diptera Scandinaviae* **12** 4860, 1855.