Annotated list
of the Ceratopogonidae (Diptera)
# of Suriname

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_____ Summary

In collections from the coast, savanna and forest regions of Suriname, mainly from 1979-1982, Ceratopogonidae of 25 species (20 Culicoides, 3 Forcipomyia, 1 Atrichopogon and 1 Stilobezzia) were identified. Notes on their biology, distribution and medical importance are included.

Key words : Diptera — Ceratopogonidae — Culicoides — Forcipomyia — Atrichopogon — Stilobezzia — Suriname.

_____ Résumé

LISTE ANNOTÉE DES CERATOPOGONIDAE DU SURINAM. Des captures effectuées dans 24 localités du Surinam situées dans la région côtière, dans la savane et en forêt, principalement au cours des années 1979-1982, ont permis l'identification de 25 espèces de Cératopogonides (20 Culicoides, 3 Forcipomyia, 1 Atrichopogon et 1 Stilobezzia). Les espèces les plus fréquentes sur appât humain étaient Culicoides guyanensis dans la région côtière, C. travassosi dans la savane, C. paraensis et C. pseudodiabolicus en forêt. Des infections à Mansonella ont été observées chez des habitants de la savane en 1982, mais leur fréquence paraît diminuer ; le vecteur non encore identifié, pourrait être C. travassosi.

Mots-clés : Diptera — Ceratopogonidae — Culicoides — Forcipomyia — Atrichopogon — Stilobezzia — Surinam.

1. Introduction

Biting midges of the family Ceratopogonidae are serious pests of people in many parts of the world, vectors of the human filaria worms Mansonella ozzardi, M. perstans and M. streptocerca (formerly Dipetalonema perstans and D. streptocerca) and of arboviruses that infect humans such as Oropouche virus (Linley et al., 1983). They are also vectors of various animal parasites including Onchocerca of horses and cattle, blue tongue virus of sheep and the Protozoa Haemoproteus and Leucocytozoon of birds. On the other hand, some Ceratopogonids are beneficial to us, such as those that pollinate rubber (Hevea) trees.

Although biting midges are often severe pests in the coastal and savanna regions of Suriname (Where they are known as " Mampieren "), and infections with M. ozzardi and M. perstans were once common in people of the savanna (Fros, 1956), the Ceratopogonidae have been little studied in Suriname. Bruijning (1957) reported three species from collections made in 1951-1955 : Culicoides debilipalpis, C. paraensis and " C. guttatus " (which probably included several other species ; see section 6 below).

Wirth's catalogue (1974) listed no Ceratopogonidae for Suriname specifically (though it falls within the ranges he gave for some widespread species). By then, 43 species were known from Guyana and 18 from French Guyana.

During the course of other work for the Suriname Ministry of Health from 1979-1982, mainly on the distribution of Anopheline mosquitoes (Hudson, 1984), I collected Ceratopogonids whenever possible, and also made 14 monthly visits to Matta, a village in the savanna where Mansonelliasis was formerly common in the inhabitants, for the primary purpose of collecting Ceratopogonidae. Rozendaal and Slootweg (1984) collected Ceratopogonids and mosquitoes at two Amerindian villages, Bigi Poika and Galibi, from May to July 1982, as part of their study of Mansonelliasis. The following list of species, which is based on their records, Bruijning's (1957) and my own, must be treated as provisional because many parts of Suriname have not yet been surveyed and further study would probably reveal many more species. Wirth and Blanton (1973) reported 60 species of *Culicoides* alone from the Amazon region of Brazil.

2. Collection and identification of specimens (1979-82)

The midges were caught mostly at night, from human bait or at lights, by touching them with a small, wet paint brush, and transferring them to a vial of diluted liquid detergent. An alternative method of catching midges around humans, tried at Matta, Bigi Poika and Galibi, was the paddle trap (Nathan, 1981 and references therein), a 12 × 15 cm rectangle of plastic fly screen wetted with cooking oil and mounted on a stick. The collector whirled the stick around him, the midges stuck to the oil and were later removed by washing in detergent. This method was convenient when there were too many midges to capture individually. Ceratopogonids were also caught in CDC miniature light traps (Hausshers Machine Works, Toms River, N.J., U.S.A.), fitted with cages of a material too fine to let the midges through. In Paramaribo, the insects that came to streetlamps of various types were compared by placing bowls of detergent solution under them each night (Hudson, 1985), and the catches often included Ceratopogonids.

Specimens for taxonomic study were macerated by placing them overnight in Nesbitt's solution (chloral hydrate 80 g, conc. HCl 5 ml, water 50 ml) or in

liquid phenol. The heads, bodies and wings were then mounted on a microscope slide in separate small drops of a 1 : 1 mixture of liquid phenol and Canada balsam (method of Wirth and Marston, 1968). When the mixture was almost dry the preparation was covered with a larger drop of Canada balsam and a cover glass.

Culicoides specimens were identified with the aid of publications by Wirth and Blanton (1973) and Aitken *et al.* (1975). A few slides of each species were sent to Dr W. W. Wirth at the U.S. National Museum, Washington, D.C., who confirmed or corrected the identifications. Specimens of *Atrichopogon*, *Forcipomyia* and *Stilobezzia* were kindly identified by Dr Wirth. Nomenclature follows Wirth's catalogue (1974). Almost all the slides were left in the collection of the Bureau of Public Health, Paramaribo.

3. Collections sites

All collection sites except Weg Naar Zee were within a few metres of human habitations. A map of Suriname showing the main rivers, vegetation zones and four of the collection sites has been published recently (Hudson, 1984). Suriname is customarily divided into the coast, savanna and rainforest regions.

In the coast region, most of the shoreline and river mouths are covered with mangrove and brackish water swamp. The remainder of the coast region, about 9 % of the total area of Suriname, has a natural cover of open swamp and hydrophytic forest. Most of the cultivated land and the human population (total 352,000 in 1980) are found here. Collections were made in the capital, Paramaribo (pop. 130,000) ; at the western border town of Nieuw Nickerie ; behind the mangrove swamp at Weg Naar Zee, on the coast northwest of Paramaribo ; at the farming community of Meerzog and the Marienburg sugar estate, across the Suriname river from Paramaribo ; and at the Amerindian village of Galibi (by Rozendaal and Slootweg, 1984) at the mouth of the Marowijne (Maroni) river.

Behind the coast region is the savanna, about 6 % of the total area, which is covered with quartz sand and low, sparse vegetation except for the gallery forests along the rivers. The region is thinly populated. Collections were made at the Amerindian villages of Bigi Poika (5°27' N, 55°30' W, by Rozendaal and Slootweg, 1984), Pikien Saron (5°25' N, 55°22' W), Matta (5°29' N, 55°21' W) and Bigiston (5°25' N, 54°08' W, on the Marowijne), and at the

agricultural experiment station of Coebiti (55°22′ N, 53°30′ W). On each of the 15 monthly visits to Matta, a human bait catch was made beside a house from 18 00-20 00 hrs and the CDC trap run for the same period at the edge of a nearby thicket. There is also some savanna in the extreme south of Suriname, on the Brazilian border, but no collections were made there.

The remainder of Suriname is mostly covered with mesophytic rainforest, part of the northern Amazon forest system. It is inhabited by about 30,000 Maroons (the descendants of escaped African slaves) and 2,000 Amerindians, who practise shifting cultivation near the river banks. The greatest number of collections (509 man-hours of human bait catches, 52 nights with the CDC trap) were made at Aseli Kamp (4°17′ N, 54°23′ W), a semi-permanent settlement of seven houses on the Lawa river, as part of a study of *Anopheles darlingi* (Hudson, 1984). Ceratopogonidae were also caught on human bait at the Maroon settlements of Stoelmans Eiland (4°22′ N, 54°24′ W) on the Lawa river ; Drietabbetje (4°06′ N, 54°42′ W) and Godoholo (4°00′ N, 54°49′ W) on the Tapanahony ; Victoria Oil Palm Estate (5°08′ N, 55°00′ W) on the Suriname ; Poesoegroenoe (4°35′ N, 55°48′ W) and Makka Kreek (5°13′ N, 55°25′ W) on the Saramacca ; Kabo experimental farm (5°16′ N, 55°43′ W) and Tonka forest project nearby ; and at Km 10 of the main access road (4°48′ N, 57°23′ W) to the Kabalebo hydroelectric project (now discontinued) in west Suriname.

The climate of Suriname is hot all the year round (mean 27.4° C in Paramaribo) and humid (mean 83 %). The average annual rainfall is 2 200 mm at Paramaribo (1931-60), a bit higher in the interior. There are four seasons : the long rainy (May to mid-August), the long dry (August to November), the short rainy (December to January) and the short dry (February to April), but these seasons often vary on time of onset and duration, and there is some rain in every month.

4. Collections from 1979-1982 : general

A grand total of 3 479 Ceratopogonidae were caught from 1979-1982, of which 2 248 were at human bait and the rest in the CDC trap or at other lights (table I). These figures include the collections of Rozendaal and Slootweg (1984).

The midges caught on or around human bait were all *Culicoides* species except for 11 *Forcipomyia stylifera* and one *F. genualis*. The predominant man-

biting species were *Culicoides paraensis* and *C. pseudodiabolicus* in the rainforest, *C. travassosi* in the savanna and *C. guyanensis* in the coast region. *C. foxi* was the only species represented in all three regions. Midge nuisance was much more severe on the coast and on the savanna than it ever was in the rainforest, where the appearance of *C. paraensis* at human bait was sporadic and unpredictable.

Nearly all the Ceratopogonids from the CDC trap in the rainforest were caught at Aseli Kamp in May and June 1981, and they were mainly *Culicoides hylas* and other species not taken at human bait. The CDC trap at Matta never caught any Ceratopogonids, though many *Culicoides travassosi* were caught on human bait nearby. Captures at lights in the coast region also consisted mainly of species not taken at human bait.

5. Notes on particular species

Br = record from Bruijning (1957) ; R & S = record from Rozendaal and Slootweg (1984). Other records are based on collections by the author and assistants, unless otherwise indicated.

Forcipomyia genualis

Paramaribo, April-May 1980, in house, 4 ♀ 4 ♂ ; Marienburg sugar estate, April 1980, alighted on man but did not bite, 1 ♀.

Forcipomyia stylifera

Bigiston, April 1979, biting man, 10 00 hrs, 27 ♀.

Forcipomyia fuliginosa

Paramaribo, March 1980, in house, 1 ♀ ; Marienburg sugar estate, June 1980, in house, 1 ♀. This species is world-wide in distribution ; females suck the blood of caterpillars (Wirth, 1974).

Artichopogon sp. nr. *fusculus*

Aseli Kamp, July 1979, CDC trap, 11 ♀. Adults pollinate rubber trees (Wirth, 1974).

Culicoides filariferus

Coebiti, March 1982, on man, 1 ♀ ; Bigi Poika, May-July 1982, on men, 7 ♀ (R & S) ; Paramaribo, July 1981, at lights, 6 ♀. No *C. filariferus* were caught in the rainforest in 1979-82, but Bruijning's (1957) taxonomic notes suggest that the six

TABLE I

Ceratopogonidae collected in Suriname, 1979-1982, at human bait (females), in CDC traps and at other lights (females and males)

Genus, (Subgenus), species, Author(s)	At human bait			CDC traps,lights		Total
	Rain-forest	Sav-anna	Coast	Rain-forest	Coast	
Forcipomyia (Forcipomyia)						
genualis (Loew)	0	0	1	0	8	9
Forcipomyia (Lasiohelea)						
stylifera (Lutz)	0	27	0	0	0	27
Forcipomyia (Microhelea)						
fuliginosa (Meigen)	0	0	0	0	2	2
Atrichopogon						
sp. nr fusculus (Coq.)	0	0	0	11	0	11
Culicoides (Hoffmania)						
filariferus (Hoffman)	0	8	0	0	6	14
foxi Ortiz	16	34	1	0	0	51
fusipalpis Wirth & Blanton	4	5	0	0	0	9
hylas Macfie	0	0	0	1064	0	1064
ignacioi Forattini	6	0	0	0	0	6
insignis Lutz	0	3	1	0	12	16
pseudodiabolicus Fox	100	46	0	102	0	248
trinidadensis Hoffman	0	0	30	0	0	30
travassosi Forattini	0	1619	0	0	0	1619
Culicoides (Macfiella)						
phlebotomus (Williston)	0	0	3	0	0	3
Culicoides (Oecacta)						
acotylus Lutz	0	45	0	0	0	45
cruciferus Clastrier	0	0	1	0	0	1
debilipalpis Lutz	0	6	5	0	0	11
fluvialis Macfie	0	0	0	5	0	5
glabrior Macfie	0	0	0	7	0	7
guyanensis Floch & Abonnenc	0	0	193	0	0	193
leopoldi Ortiz	0	0	0	1	0	1
lopesi Barretto	0	0	0	1	0	1
paraensis Goeldi	94	0	0	1	0	95
tetrathyris Wirth & Blanton	0	0	0	7	0	7
Stilobezzia (Stilobezzia)						
coquilletti Kieffer	0	0	0	0	4	4
Totals	220	1793	235	1199	32	3479

females he caught at Apetina and Poeketie on the Tapanahony river in 1952 and reported as *C. guttatus* were actually *C. filariferus* (or less likely *C. pseudodiabolicus*).

Culicoides foxi

Widespread on human bait but nowhere in large numbers. Stoelmans Eiland, January 1980, 1 ♀ ; Victoria oil palm estate, May 1980, 1 ♀ ; Kabo, March 1982, 3 ♀ ; Coebiti, March 1982, 3 ♀ ; Bigi Poika, May-July 1982, 22 ♀ (R & S) ; Pikien Saron, January 1982, 2 ♀ ; Matta, April 1981, 1 ♀, January 1982, 2 ♀, March 1982, 1 ♀ ; Zanderij, April 1954, 1 ♀ (Br, see section 6 below) ; Galibi, July 1982, 1 ♀ (R & S). Also in CDC trap, Aseli Kamp, June 1981, 14 ♀. *C. foxi* is distibuted from Mexico through Central and South America to Colombia and Argentina. It is a common forest and plantation species in Trinidad (Aitken *et al.*, 1975).

Culicoides fusipalpis

Widespread but uncommon on human bait. Aseli Kamp, January 1980, 1 ♀, June 1981, 1 ♀ ; Makka Kreek, October 1981, biting by day, 1 ♀ ; Tonka forest project, March 1982, 2 ♀ ; Coebiti, March 1982, 2 ♀ ; Bigi Poika, July 1982, 2 ♀ (R & S).

Culicoides hylas

Aseli Kamp, June 1981, CDC trap, 678 ♀ 386 ♂.

Culicoides ignacioi

Tonka forest project, March 1982, biting men at 20 : 00 hrs, 6 ♀.

Culicoides insignis

Paramaribo, May 1980, in house, 1 ♀ ; Paramaribo, July 1981, at lights, 9 ♀ 2 ♂ ; Bigi Poika, May-July 1982, on men, 3 ♀ (R & S) ; Galibi, July 1982, on man, 1 ♀ ; Domburg (on Suriname river, 15 km South-east of Paramaribo), May 1951, 1 ♀ (Br, as *C. guttatus*, see section 6 below).

Culicoides pseudodiabolicus

Widespread and sometimes common on human bait in the rainforest and savanna regions. Aseli Kamp, July 1979, 52 ♀, August 1979, 11 ♀, July 1980, 2 ♀, October 1980, 1 ♀, May-June 1981,

31 ♀ ; Stoelmans Eiland, January 1980, 2 ♀ ; Kabo experimental farm, March 1982, 7 ♀ ; Pikien Saron, January 1982, 3 ♀ ; Coebiti, March 1982, 1 ♀ ; Bigi Poika, May-July 1982, 35 ♀ (R & S). Also in CDC trap, Aseli Kamp, June 1981, 96 ♀ 6 ♂. *C. pseudodiabolicus* is distributed from Honduras through to Ecuador, French Guyana and Brazil. It is common in Trinidad, where it has been taken biting 29 m up in the forest canopy (Aitken *et al.*, 1975).

Culicoides travassosi

The commonest midge in the savanna region on human bait and sometimes a severe pest. Matta, August 1979, 196 ♀, March 1981 to May 1982, 373 ♀ ; Matta and Zanderij, 1951-1955, 233 ♀ (Br, as *C. guttatus*, probably some *C. foxi* as well, see section 6 below) ; Pikien Saron, January 1982, 2 ♀ ; Coebiti, March 1982, 3 ♀ ; Bigi Poika, May-July 1982, 956 ♀ (R & S). *C. travassosi* females at Matta did not appear before sunset and showed a very pronounced peak of biting activity from 15 to 30 minutes after sunset. The greatest numbers were caught in May and June (long rains) and in January (short rains), with few or none from September to November (long dry season), as shown in table II. Both in

TABLE II

Mean numbers of *Culicoides travassosi* females per man-hour caught at human bait in the evenings (18 00-20 00 hrs) at Matta, Suriname, 1981-1982. Combined results for midges caught biting the collectors and (by paddle traps) flying around them

Month	Season	Numbers/catcher/hour (Totals in parentheses) 1981	Numbers/catcher/hour (Totals in parentheses) 1982
Jan.	Short rainy	-	6.25 (25)
Feb.	Short dry	-	0.25 (1)
March	" "	3.0 (6)	4.0 (16)
April	" "	0.25 (1)	0.0 (0)
May	Long rainy	9.0 (36)	5.2 (21)
June	" "	34.0 (272)	-
July	" "	3.0 (9)	-
Aug.	" "	0.25 (1)	-
Sept.	Long dry	0.0 (0)	-
Oct.	" "	0.0 (0)	-
Nov.	" "	0.25 (1)	-
Dec.	Short rainy	0.0 (0)	-

1981 and in 1982 there was a slight decresae in the numbers biting from March to April, at the beginning of the long rainy season.

The wing of a *C. travassosi* female from Matta is illustrated in fig. 1. Four specimens from Matta lacked the small dark spot on vein R_{4+5} near the distal end of the second radial cell, and one specimen caught at Bigi Poika by Rozendaal and Slootweg had only one white spot in cell M_1 distal to the white spot straddling vein M_2. All these aberrant specimens were examined by Dr Wirth and judged to be *C. travassosi*. This species had previously been known only from the Amazon region of Brazil (Wirth, 1974).

Culicoides trinidadensis

Weg Naar Zee, April 1981, on man, 11 00 hrs, 30 ♀. The beach and Mangrove swamp at Weg Naar Zee were infested with large midges which often came to bite even in the middle of the day and in strong winds.

Culicoides phlebotomus

Galibi, July 1982, on men at night, 3 ♀ (R & S). *C. phlebotomus* is distributed on the mainland from Mexico down to Ecuador and Brazil and also in the West Indies. It is the most widespread and pestiferous midge of sandy beaches in Trinidad (Aitken *et al.*, 1975), and the vector of *Mansonella ozzardi* there (Nathan, 1981).

Culicoides acotylus

Widespread but uncommon on human bait in the savanna region. Matta, March-April 1981, 4 ♀, August 1981, 2 ♀, October 1981, 2 ♀ ; Pikien Saron, January 1982, 2 ♀ ; Bigi Poika, May-July 1982, 35 ♀ (R & S).

Culicoides cruciferus

Paramaribo, June 1980, biting man in house, 1 ♀.

Culicoides debilipalpis

Widespread but uncommon ou human bait in the savanna and coast regions. Matta, March 1981, 5 ♀ ; Bigi Poika, May-July 1982, 1 ♀ (R & S) ; Galibi, July 1982, 5 ♀ (R & S). Females were also caught in the rainforest region in 1952, one at Nason on the Marowijne, two at Godoholo and six at Poeketi on the Tapanahony (Br). In Trinidad, *C. debi-*

lipalpis is common in forests and also found in plantations and savanna (Aitken *et al.*, 1975). The name *C. debilipalpis* Lutz, 1913, may soon be changed to *C. lahillei* (Iches, 1906), which has priority (Spinelli and Wirth, *Rev. Soc. Ent. Argentina*, in press).

Culicoides fluvialis

Aseli Kamp, June 1981, CDC trap, 5 ♀.

Culicoides glabrior

Aseli Kamp, June 1981, CDC trap, 7 ♀.

Culicoides guyanensis

The commonest midge on human bait in the coast region, often a severe pest, biting mostly at dawn and dusk. Females were encountered at almost all sites visited near mangrove swamps, where the larvae develop. Nieuw Nickerie, February-March 1979, 115 ♀ ; Weg Naar Zee, January 1982, 7 ♀ ; Meerzorg, January 1980, 21 ♀ ; Galibi, August 1981, 12 ♀ ; Galibi, July 1982, 38 ♀ (R & S). *C. guyanensis* is a severe pest in Trinidad (Aitken *et al.*, 1975) and became a serious problem in the Panama Canal Zone when dredged saline mud was pumped into a freshwater swamp (Altman *et al.*, 1970a). Chemical larvicides were ineffective, and cold fogging gave only temporary control of the adults, but flooding the swamp with fresh water again solved the problem (Altman *et al.*, 1970b).

Culicoides leopoldi

Makka Kreek, October 1981, CDC trap, 1 ♀.

Culicoides lopesi

Aseli Kamp, June 1981, CDC trap, 1 ♀.

Culicoides paraensis

Widespread and sometimes common on human bait in the rainforest region, but females were sporadic and unpredictable in their appearance. Sometimes they attacked by day. Most were caught in the long rainy season. Aseli Kamp, July 1979, 1 ♀, May-June 1981, 3 ♀ (and 1 ♀ in CDC trap) ; Drietabbetje, May 1980, 5 ♀ ; Godoholo, May 1980, 51 ♀ (biting in mid-afternoon) ; Poesoegroenoe, April 1981, 4 ♀ ; Makka Kreek, October 1981, 12 ♀ ; Kabalebo road km 10, May 1981, 18 ♀ (A. Baboeram). Females were also caught at Alinsoe and Aloepie on the West Paroe river in May 1952, Poeketi and Saje on the Tapanahony in

June 1952, and at Sara on the upper Suriname river in September 1955 (Br).

The distribution of *C. paraensis* extends from Pennsylvania, U.S.A. in the north through Central America and the West Indies south to Argentina (Wirth, 1974). In Trinidad, females have been caught on beaches (Aitken *et al.*, 1975). In Brazil, they are found on the coast at Belém, Pará (Wirth and Blanton, 1973), and at Salvador, Bahia, where they have been severe pests, causing dermatitis on the legs, especially of women (Sherlock, 1963). Their absence from the coast region of Suriname is remarkable. The biology of *C. paraensis* has recently been reviewed by Linley *et al.* (1983) because of its importance as a vector of Oropouche virus to humans. Females bite mainly by day. A trimodal biting cycle with peaks from 07 00-08 00, 12 00-13 00 and 17 00 hrs was observed in the Amazon region of Brazil and a similar pattern was seen by Sherlock (1963) in Salvador, Bahia. The larvae can develop in cacao pods and banana stumps, and population can become very dense around human habitations.

Recent work suggests that *C. paraensis* is a species complex including three other described species (*filiductus* Wirth, *neoparaensis* Tavares and Sousa and *quasiparaensis* Clastrier) and two undescribed. The identity of the Suriname population and of vector of Oropouche virus are currently in doubt (W. Wirth, personal communication, 1986).

Culicoides tetrathyris

Aseli Kamp, June 1981, CDC trap, 7 ♀. This species was previously known only from Panama and Brazil (Wirth, 1974).

Stilobezzia coquilletti

Paramaribo, at lights inside house, May 1980, 1 ♀, December 1980, 2 ♂, January 1981, 1 ♀. *Stilobezzia* adults are predators on other small insects. They have large and apparently raptorial claws.

6. The *Culicoides guttatus* group

Bruijning (1957) reported *Culicoides guttatus* (Coquillett) from the rainforest, savanna and coast regions of Suriname, but he was following Macfie (1948, *in* Bruijning in treating *C. filariferus*, *C. pseudodiabolicus*, *C. trinidadensis* and some other species as junior synonyms of *C. guttatus*. A more recent revision reinstates *C. filariferus*, *C. pseudodiabolicus* and *C. trinidadensis* as good species (Aitken *et al.*, 1975).

The type locality of *C. guttatus* proper is in São Paulo and it has been found only in southern Brazil (Wirth, 1974), so we have the problem of the true identity of Bruijning's *C. guttatus* records.

One of Bruijning's slides with five *Culicoides* females and the label " Zanderij, 5-6 April 1954 ", but no identification label, was found in Paramaribo in 1979. Four of the specimens were identifiable as *C. travassosi* and one as *C. foxi*. (Bruijning probably had not seen the description of *C. travassosi*, which was published in the same year as his paper). I could not find any more of Bruijning's specimens, but fortunately his paper includes notes on the differences in wing venation between specimens from different localities. From these notes, the five specimens mentioned above and my own collections from 1979-1982, I suspect that Bruijning caught *C. travassosi* and some *C. foxi* at Matta and Zanderij, *C. insignis* at Domburg, and *C. filariferus* (and/or possibly *C. pseudodiabolicus*) at Apetina and Poeketi. There is no reason to suppose that he caught any *C. guttatus* proper in Suriname.

7. Literature for identification of the *Culicoides* species found

Of the 20 *Culicoides* species so far recorded in Suriname, all but four (*hylas, ignacioi, lopesi* and *travassosi*) are included in the key of Aitken *et al.* (1975) and all but five (*cruciferus, guyanensis, lopesi, phlebotomus* and *trinidadensis*) in the key of Wirth and Blanton (1973). It does not at present seem worth publishing a new key for the Suriname species, because the Suriname fauna is still little known. Collections at only one site, Aseli Kamp, produced seven new records and further surveys would probably produce many more. The species not yet recorded in the rainforest are more likely to be from the Amazonian than from the Caribbean fauna. In the meantime, the key in Aitken *et al.* (1975) could be modified to include *C. hylas, ignacioi* and *travassosi*, by incorporating information from Wirth and Blanton (1973). *C. hylas* would key out to *C. heliconiae* in couplet 5 of the key in Aitken *et al.* (1975), but has the sensillae on the third palpal segment in a shallow pit, rather than scattered, and in having a dark spot on the mid knee. *C. travassosi* would key out to *C. foxi* in couplet 7, but has an additional pale spot in cell R_5, near the wing tip (fig. 1). *C. ignacioi* would key out to *C. pseudodiabolicus* in couplet 8 but it is larger, has much darker halteres and more strongly contrasted wing markings.
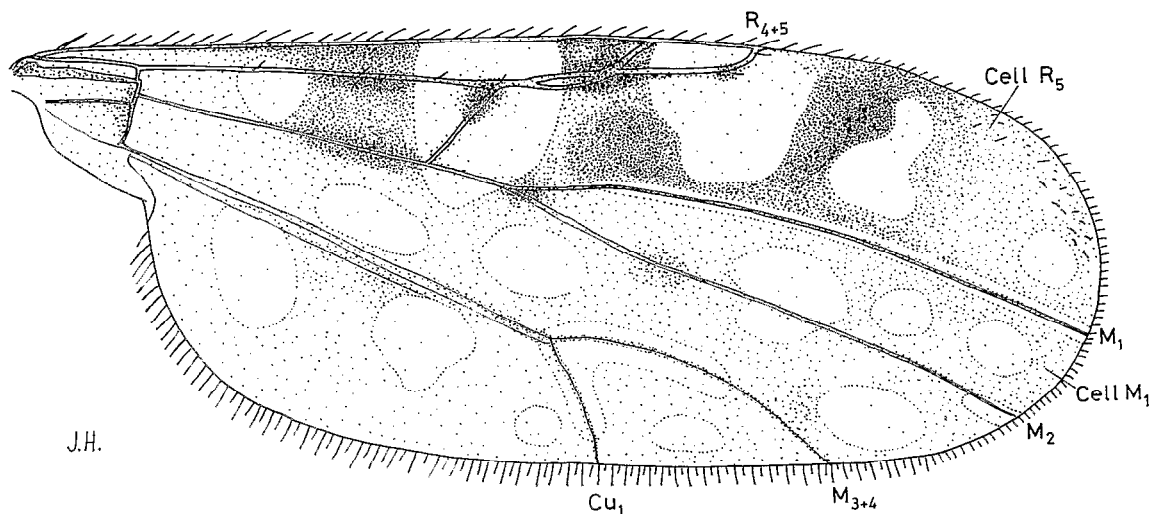
FIG. 1. — Wing of *Culicoides travassosi* female caught on human bait at Matta, 15 August 1979.

8. Medical importance

Microfilariae of *Mansonella ozzardi* and *M. perstans* have both been found in people in the savanna and coast regions of Suriname, but their prevalence has declined greatly in recent years. Thick blood films taken in savanna villages revealed that 24 % of the inhabitants were infected with *Mansonella* spp. in 1952 (Fros, 1956) and 31 % in 1971, but according to later surveys using the more-sensitive membrane filter technique, the overall infection rates were only 2 % in 1979 and 3.8 % in 1982 (Rozendaal and Slootweg, 1984 and references therein). At Bigi poika in the savanna, the infection rate was 43 % in 1952 and 24 % in 1971, with both *M. ozzardi* and *M. perstans* present, but 6 % in 1979 and 8 % in 1982, with only *M. perstans* detected. At Galibi on the coast, the infection rate was 55 % in 1971, with both species found, but no infections at all were detected in 1979 nor in 1982. Rozendaal and Slootweg (1984) suggest changes in Amerindian housing and natural reductions in *Culicoides* populations at Galibi as possible reasons for the disappearance of *Mansonella* there.

No vectors of *M. perstans* in the New World have yet been specifically identified, and only three vectors of *M. ozzardi* : *Culicoides furens* in Haiti, *Culicoides phlebotomus* in Trinidad and *Simulium amazonicum* (Simuliidae) in the Amazon region of Brazil (Linley *et al.*, 1983). Of these three vectors, only *C. phlebotomus* has been recorded in Suriname, and only from

Galibi. According to the inhabitants of Galibi (as reported by Rozendaal and Slootweg, 1984), the midge nuisance had decreased when changing river currents washed away the mangrove near the village. One would expect this to decrease the population of *Culicoides guyanensis*, still the most abundant midge on human bait at Galibi in 1982, because its larvae live in mangrove, but *Culicoides phlebotomus* in Trinidad is associated with sandy beaches and river mouths, not with mangrove (Aitken *et al.*, 1975). Galibi has been surveyed only in July and October ; surveys in other months would be worthwhile. In villages in the savanna region, *Culicoides travassosi* was by far the most abundant midge on human bait, though not caught in the dry season. Moreover, Bruijning (1957) observed filaria larvae in the proboscis of two " *Culicoides guttatus* " (probably *C. travassosi*) that the had caught at Matta. Although the most abundant species is not necessarily the vector, other species are so much rarer that we may reasonably suspect *C. travassosi* to have been the vector in the savanna region. No Simuliidae were caught in the savanna or coast regions from 1979-1982.

Oropouche virus was first isolated from a man with fever in Trinidad, but no epidemics have been recorded there (Linley *et al.*, 1983). In the Amazon region of Brazil, however, Oropouche virus has caused some major epidemics of fever in towns and cities. The urban vectors seem to be primarily *Culicoides paraensis* and secondarily the mosquito *Culex quinquefasciatus* (Roberts *et al.*, 1981). There is also a

forest cycle with primates, sloths, birds and possibly other vertebrates as reservoir hosts, and with forest mosquitoes (*Aedes serratus*, *Coquillettidia venezuelensis*) and possibly forest midges as the enzootic vectors (Linley *et al.*, 1983).

Oropouche virus has not yet been recorded in Suriname, but could easily have been overlooked because the chief symptoms (fever, headache, myalgia, arthralgia, dizziness and photophobia) are also found in many other diseases. *Culicoides paraensis*, the principal vector, was found widely but not abundantly in the rainforest in 1979-1982, and major epidemics are unlikely at present because most rainforest settlements are small and isolated. Suriname could become more respective to Oropouche virus transmission if there was more human settlement in the rainforest region, or if the distribution of *C. paraensis* extended to the coast, as it has done in Brazil. Transport of live midges from the rainforest

to the coast is more likely in the closed cars, lorries and aircraft that are increasingly used, than it is in the open canoes that were once the sole means of transport. Further surveys of Ceratopogonid populations in Suriname will be required at regular intervals to monitor any changes in the populations of potential vectors.

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REFERENCES

AITKEN (T. H. G.), WIRTH (W. W.), WILLIAMS (R. W.), DAVIES (J. B.) and TIKASINGH (E. S.), 1975. — A review of the bloodsucking midges of Trinidad and Tobago, West Indies (Diptera : Ceratopogonidae). *J. Ent.* (B), 44, 2 : 101-144.

ALTMAN (R. M.), KEENAN (C. M.) and BOREHAM (M. M.), 1970a. — An outbreak of *Culicoides guyanensis* in the Canal Zone. *Mosq. News*, 30 : 231-235.

ALTMAN (R. M.), KEENAN (C. M.) and PEARSON (W. G.), 1970b. — Control of *Culicoides* sand flies, Fort Kobbe, Canal Zone in 1968. *Mosq. News*, 30 : 235-240

BRUIJNING (C. F. A.), 1957. — Notes on the common species of *Culicoides* (Diptera : Ceratopogonidae) from Surinam in relation to *ozzardi*-filariasis. *Doc. Med. geogr. trop.*, 9 : 169-172.

FROS (J.), 1956. — Filariasis in Southamerican Indians. *Doc. Med. geogr. trop.*, 8 : 63-69.

HUDSON (J. E.), 1984. — *Anopheles darlingi* Root (Diptera : Culicidae) in the Suriname rainforest. *Bull. ent. Res.*, 74 : 129-142.

HUDSON (J. E.), 1985. — Trials of yellow lamps for reducing plagues of itch moths in Suriname. *IPLE Lighting Journal*, 50, 1 : 42-44.

LINLEY (J. R.), HOCH (A. L.) and PINHEIRO (F. P.), 1983. — Biting midges (Diptera : Ceratopogonidae) and human health. *J. Med. Entomol.*, 20, 4 : 347-364.

NATHAN (M. B.), 1981. — Transmission of the human filarial parasite *Mansonella ozzardi* by *Culicoides phlebotomus* (Williston) (Diptera : Ceratopogonidae) in coastal north Trinidad. *Bull. ent. Res.*, 71 : 97-105.

ROBERTS (D. R.), HOCH (A. L.), DIXON (K. E.) and LLEWELLYN (C. H.), 1981. — Oropouche virus. III. Entomological observations from three epidemics in Pará, Brazil, 1975. *Am. J. Trop. Med. Hyg.*, 30, 1 : 165-171.

ROZENDAAL (J. A.) and SLOOTWEG (R. S.), 1984. — The prevalence of *Dipetalonema perstans* and *Mansonella ozzardi* among Suriname Amerindians, and distribution and ecology of possible vector insects. *Surinaams Med. Bull.*, 8, 3 : 102-111.

SHERLOCK (I. A.), 1963. — O problema do *Culicoides* em Salvador, Bahia. *Rev. Bras. Malariol.*, 15 : 567-591.

WIRTH (W. W.), 1974. — A catalogue of the Diptera of the Americas south of the United States. 14. Family Ceratopogonidae. São Paulo, Museu de Zoologia, 89 p.

WIRTH (W. W.) and BLANTON (F. S.), 1973. — A review of the maruins or biting midges of the genus *Culicoides* (Diptera : Ceratopogonidae) in the Amazon basin. *Amazoniana*, 4, 4 : 405-470.

WIRTH (W. W.) and MARSTON (N.), 1968. — A method for mounting small insects on microscope slides in canada balsam. *Ann. Entomol. Soc. Amer.*, 61, 3 : 783-784.