

**CULICOIDES LATREILLE (DIPTERA, CERATOPOGONIDAE)
IN BRAZILIAN AMAZON. V. EFFICIENCY OF TRAPS AND
BAITS AND VERTICAL STRATIFICATION IN THE
FOREST RESERVE ADOLPHO DUCKE**

Rosana S. Veras¹
Eloy G. Castellón²

ABSTRACT. Monthly catches were carried out during five days/month in the Adolpho Ducke Forest Reserve (Manaus, Amazonas), from February 1990 to January 1991 in order to assess the sandfly fauna of that region, evaluate the attractiveness of these insects with regard to different kinds of traps and baits and to know vertical stratification of these insects. The traps and baits used in catches were: Disney traps with baits: *Didelphis* sp., *Gallus* sp. and *Mesocricetus* sp.; CDC light traps at three vertical levels (1m, 5m and 10m); Suspended trap (5m) and Malaise trap (1m) and catches on bases of tree-trunks. The most efficient type was the CDC. Malaise and Suspended did not collect specimens of *Culicoides* Latreille, 1809. The Disney traps with baits only attracted specimens of *C. fusipalpis* Wirth & Blanton, 1973. In vertical stratification, the CDC trap placed at 1m caught 898 specimens of nine species; at 5m 895 specimens were collected which belonged to 13 species; and at 10m 224 specimens of 14 species were collected. Two thousand and forty-six specimens of *Culicoides* were captured, being about 5,66% males and 94,34% females, which belonged to 17 different species; the most frequent were *C. fusipalpis* (43,05%), followed by *C. pseudodiabolicus* Fox, 1946 (32,79%), *C. hylas* Macfie, 1940 (12,31%) and *C. foxi* Ortiz, 1950 (3,71%). The other 13 species totalized 8,15%.

KEY WORDS. Diptera, Ceratopogonidae, *Culicoides*, traps and baits, vertical stratification, Amazon

The insects of the genus *Culicoides* Latreille, 1809 are known by several names in different countries; in Brazil they are called "maruins", "mosquitos pólvora" and "mosquito do mangue" (FORATTINI *et al.* 1958). The bite of these insects is painful and gives a burning sensation. The bite may cause serious damages to the skin of sensitive persons, sometimes with a strong reaction (SHERLOCK & GUITTON 1964). Only the females are bloodsuckers.

Several kinds of traps and baits are in use by dipterologists to collect material for taxonomic and ecological studies, and to assess the geographical distribution, seasonal variation, relative abundance and vertical stratification of several species.

1) Instituto Nacional de Pesquisas da Amazônia, Fundação Universidade do Amazonas. Alameda Cosme Ferreira 1756, 69083-970 Manaus, Amazonas, Brazil. CAPES scholarship student.

2) Instituto Nacional de Pesquisas da Amazônia, Coordenação de Pesquisas em Entomologia. Alameda Cosme Ferreira 1756, 69083-970 Manaus, Amazonas, Brazil.

The CDC trap has been used by several authors for surveys of the dipterous fauna in many parts of the world, obtaining good results in the collections of populations of anthropophilic and non-anthropophilic species.

The Disney trap (DISNEY 1965) whose main purpose is to collect insects who are attracted towards different kinds of animal bait, has been used in the study of food preferences with different animal baits and has a proven efficiency in the capture of bloodsucking Diptera.

The suspended trap (RAFAEL & GORAYEB 1982) has been used to collect Tabanids in different altitudinal layers in the forest. Gorayeb (comunicação pessoal) used this kind of trap at different heights from the soil (1.6m, 7m and 23m), obtaining specimens of 33 species of tabanideous with a significant variation between different heights in connection with the number of species collected.

The Malaise is a kind of interception trap, used to collect insects who fly at low highs. However, it can be suspended at different heights among the trees.

The insects who shelter in the cracks, roots and tree cavities can be captured through the collections on the bases of the trees with a modified CDC.

The objective of this work was to assess the efficiency of different traps and baits in the capture of *Culicoides* and to evaluate the vertical stratification of this genus in the Adolpho Ducke Forest Reserve, Amazon state, Brazil.

MATERIAL AND METHODS

This work was made in an area of the primary forest at the Adolpho Ducke Forest Reserve, of the National Research Institute of the Amazon Region, Manaus, situated at 26 km of the AM 010 Road; with geographic position (03°S, 59°W), consisting of an area of 10.072 Ha and with approximated elevation of 80 to 100 meters above the sea level. Data about vegetation, refer to LECHTHALER (1956), AUBREVILLE (1961), HIGUCHI (1981).

Types of collections

The catches were made for 12 months, during five days/month, from February 1990 to January 1991. Five different types of collecting strategies were used to capture *Culicoides*: Light trap CDC, Disney traps with animal baits, Suspended trap, Malaise trap and collections on the base of the trees.

CDC traps (SUDIA & CHAMBERLAIN 1962)

Three CDC type were used; each trap was placed at different heights from the soil: 1m, 5m and at 10m, working from 18:00 pm until 6:00 am next day.

Disney traps (DISNEY 1965)

These traps were put at a height of 50 cm from the soil and protected from the rain with plastic, put at 50cm above each trap. A slim layer of mineral oil was applied in the higher surface of the trays to facilitate the fixation of the insects. Three Disney traps were used with three different kinds of baits: *Didelphis* sp. (opossum); *Gallus* sp. (chicken) and *Mesocricetus* sp. (hamster). The baits were placed at 18:00 and removed at 6:00 h. The captured insects were removed with brushes and entomological tweezers and conserved in 70% alcohol.

Suspended trap (RAFAEL & GORAYEB 1982)

The modification made to elaborated pattern by RAFAEL & GORAYEB (1982) consisted in to place a black textile connected to interne superior border that attract the insects, who goes to the collector tube.

This trap was settled at 5m height from the soil working from 18:00 pm until 6:00 am next day.

Malaise trap (TOWNES 1962)

This trap was settled with the inferior border at the ground and the four superior borders stretched and fixed, with cords, at the branches of the trees and it worked from 18:00 pm until 6:00 am next day.

Catches on bases of tree-trunks

They were done using a modified CDC trap, working as an aspirator and a tulle bag coupled to its opposite edge aiming to collect the insects who take shelter in cracks, holes and reentrances of the tree bases. The trapping at a height of 1.2m, mainly in trees with a diameter superior 2m. The modifications done to the model worked up by SUDIA & CHAMBERLAIN (1962) consisted of adding a little PVC tube in the shape of a 10cm lenght cone, 12cm of diameter at the inferior base and 8cm at the superior opening, coupled in the inferior side of the cylinder/trap, as well as the removal of the lid and the source of light to make handling easy.

The collections with the modified CDC were done in the morning from 8:00 to 9:00 h and in the afternoon from 14:00 to 15:00 h, totalizing 120 hours of collections. The collected material was separated and submitted to the process of preparation, clearing and assembly on a slide with cover slide, according to the methodology used by CASTELLÓN & FERREIRA (1991).

The mounting was made on a stereoscopic microscope with the aid of two dissecting needles. The specimens were removed from the phenol and individually put at the center of a slide, in a drop of Canada balsam, dissected and covered by a cover slide of the size 11 x 11mm. The slide containing the mounted material was placed in a stove at 38°C temperature to dry for about 3 to 4 days. Afterwards the species was identified.

RESULTS

Two thousand and forty six (2,046) specimens of *Culicoides* were collected, belonging to 17 species, in a period of 12 months.

The species and the total number of specimens (females and males) collected in the different traps and baits are listed in table I.

The most frequent species were *Culicoides fusipalpis* Wirth & Blanton, 1973 (43,05%), *C. pseudodiabolicus* Fox, 1946 (32,79%); followed by *C. hylas* Macfie, 1940 (12,31%) and *C. foxi* Ortiz, 1950 (3,71%); the others 13 species totalized 8,15%.

The trap by which the largest number of species was collected, was the CDC light trap with 98,6% of the total, followed by the collections at bases of tree-trunks with 0,8% and in the Disney traps with 0,6%.

Table I. Species and specimens of the genus *Culicoides* collected in different traps and baits in the Adolpho Ducke forest reserve, during February of 1990 to January of 1991.

<i>Culicoides</i> species	CDC Traps						Disney baits						Base of tree		Total		Total Geral
	1m		5m		10m		<i>Didelphis</i>		Hamster		<i>Gallus</i>		F M		F M		
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
<i>Culicoides bricenoi</i>	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2
<i>C. dasyophrus</i>	0	0	3	0	1	1	0	0	0	0	0	0	1	0	5	1	6
<i>C. eublepharus</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>C. foxi</i>	15	0	48	0	13	0	0	0	0	0	0	0	0	0	76	0	76
<i>C. fusipalpis</i>	380	0	413	5	67	3	9	0	1	0	3	0	0	0	873	8	881
<i>C. glabrior</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>C. hylas</i>	77	41	66	13	26	16	0	0	0	0	0	0	5	8	174	78	252
<i>C. insignis</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>C. lahillei</i>	11	0	19	6	21	0	0	0	0	0	0	1	0	52	6	58	
<i>C. leopoldoi</i>	0	0	2	1	2	0	0	0	0	0	0	0	0	4	1	5	
<i>C. lutzi</i>	21	0	21	1	8	1	0	0	0	0	0	1	0	51	2	53	
<i>C. paraensis</i>	0	0	12	2	2	1	0	0	0	0	0	0	0	14	3	17	
<i>C. paucienfuscatu</i>	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0	2	
<i>C. pseudodiaboli</i>	348	2	253	11	53	4	0	0	0	0	0	0	0	654	17	671	
<i>C. quasiparaensis</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
<i>C. reticulatus</i>	0	0	15	0	2	0	0	0	0	0	0	0	0	17	0	17	
<i>C. verecundus</i>	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0	2	
Total	855	43	856	39	198	26	9	0	1	0	3	0	8	8	1930	116	2046

Of the specimens collected in CDC, 898 (43,90%) were captured in the trap settled at 1m height from the soil; 895 (43,74%) were collected at 5m height and 224 (10,95%) were found in the trap settled at 10m height.

In the collections at bases of tree-trunks 16 specimens of four species were captured: *C. hylas* (5 females and 8 males), *C. dasyophrus* Macfie, 1940 (1 female), *C. lahillei* Ichas, 1906 (1 female) and *C. lutzi* Costa Lima, 1937 (1 female). *Culicoides hylas* was the only species who had male specimens, captured in catches on bases of the tree-trunks, with a frequency of 0,63% of the total, while *C. dasyophrus*, *C. lahillei* and *C. lutzi* occurred together and with a frequency of 0.05%.

From the 13 specimens captured in the Disney traps, nine were captured with *Didelphis* sp. bait, three with *Gallus* sp. bait and one with *Mesocricetus* sp. This kind of strategy collected only *C. fusipalpis* specimens.

No collections were obtained with the Malaise and Suspended traps.

Vertical stratification

The results were obtained with the CDC trap.

In the CDC trap settled at 1m height we collected 9 species, in the CDC at 5m height we captured 14 species and in the one settled at 10m height we collected 13 species (Tab. I).

In the CDC trap settled at 1m height above the soil we collected 898 specimens of the following species: 380 females of *C. fusipalpis*, 350 (348 females and 2 males) of *C. pseudodiaboli*, 118 (77 females and 41 males) of *C. hylas*, 21 females of *C. lutzi*, 15 females of *C. foxi*, 11 females of *C. lahillei*, 1 female of *C. glabrior* Macfie, 1940, 1 female of *C. insignis* Lutz, 1913 and 1 female of *C. quasiparaensis* Clastrier, 1971.

In collects with CDC traps settled at 5m height from the soil 895 specimens were found: 418 (413 females and 5 males) of *C. fusipalpis*, 264 (253 females and 11 males) of *C. pseudodiabolicus*, 79 (66 females and 13 males) of *C. hylas*, 48 females of *C. foxi*, 25 (19 females and 6 males) of *C. lahillei*, 22 (21 females and 1 male) of *C. lutzi*, 15 females of *C. reticulatus* Lutz, 1913, 14 (12 females and 2 males) of *C. paraensis* Goeldi, 1905, 3 females of *C. dasyophrus*, 3 (2 females and 1 male) of *C. leopoldoi* Ortiz, 1951, 1 female of *C. bricenoi* Ortiz, 1951, 1 female of *C. eublepharus* Macfie, 1948, 1 female of *C. paucienfuscatus* Barbosa, 1947 and 1 female of *C. verecundus* Macfie, 1948.

In collections with CDC traps settled at 10m height from the soil we collected 224 specimens: 70 (67 females and 3 males) of *C. fusipalpis*, 57 (53 females and 4 males) of *C. pseudodiabolicus*, 42 (26 females and 16 males) of *C. hylas*, 21 females of *C. lahillei*, 13 females of *C. foxi*, 9 (8 females and 1 male) of *C. lutzi*; 3 (2 females and 1 male) of *C. paraensis*, 2 (1 female and 1 male) of *C. dasyophrus*, 2 females of *C. leopoldoi*, 2 females of *C. reticulatus*, 1 female of *C. bricenoi*, 1 female of *C. paucienfuscatus* and 1 female of *C. verecundus*.

The species *C. fusipalpis*, *C. pseudodiabolicus*, *C. hylas*, *C. foxi*, *C. lahillei* and *C. lutzi* were common at three levels. *C. quasiparaensis*, *C. glabrior* and *C. insignis* were collected only at 1m height. *C. paraensis*, *C. reticulatus*, *C. leopoldoi*, *C. dasyophrus*, *C. bricenoi*, *C. paucienfuscatus* and *C. verecundus* were common in the CDC at 5 and 10m; while *C. eublepharus* was collected only at 5m height.

DISCUSSION

Efficiency of traps and baits

During the period of February 1990 to January 1991 the collection methods used showed differences as to the efficiency of the capture of *Culicoides*.

On the bases of the trees-trunks we collected only four species in 16 specimens *C. hylas* (5 females, 8 males), *C. dasyophrus* (1 female), *C. lahillei* (1 female) and *C. lutzi* (1 female) which not only represents a low diversity of species but also proved to be inefficient in the capture of these insects. This methodology in fact, has not been used by others authors for collecting *Culicoides*.

In the Disney traps with three different baits, *C. fusipalpis*, the only species collected with this strategy showed a preference to the bait *Didelphis* sp.; CASTELLÓN & FERREIRA (1991) using animal baits at night collected, four anthropophilous species, demonstrating that *C. fusipalpis* and *C. foxi* were the most frequent species. These facts proved that *C. fusipalpis* has a tendency toward zoophilia and anthropophilia. According to TURNER (1972), the traps with animal bait are very used in studies of the activity of adult of the bloodsucking species of *Culicoides*. According to HAIR & TURNER (1968) a great diversity of blood sources is available to female *Culicoides* and the potential of these insects acting as vectors of a disease depends strongly on its blood sources. JAMBACK & WATHEWS (1963) and HAIR & TURNER (1968) reported that *C. sanguissuga* feeds in a great order of hosts such as birds (turkey and chicken) and mammals (goats, rabbits and hamsters). Our results do not

prove this assertion, since with baits of *Gallus* sp. and *Mesocricetus* sp., the results were negative; HUMPREYS & TURNER (1973) used hamsters as baits, but their use was interrupted after 10 nights of collections, because they captured few *Culicoides*. According to these authors, if there are factors such as CO₂, dampness perspiration, body heat or other not specified emanations from the host it could be considered the hypothesis of that as bigger the quantity of attractives. GUTTMAN (1972) used little animals (rabbits, chickens and hamsters) as baits and concluded that do not attract the main species who attack big animals and the man. TIKASINGH (1972) in collections with human bait collected four species of *Culicoides*: *C. diabolicus*, *C. pusillus*, *C. furens* and *C. foxi*; CASTELLÓN (comunicação pessoal); CASTELLÓN (1990) and CASTELLÓN & FERREIRA (1991) used the same methodology and showed the anthropophilic behavior of seven species: *C. foxi*, *C. fusipalpis*, *C. lahillei*, *C. paraensis*, *C. pseudodiabolicus* and *C. totatangae*. According to CASTELLÓN & FERREIRA (1991), the diversity of bloodsucking species is connected to the preference for hosts and attractiveness of traps and baits, among others factors.

The Malaise and Suspended traps did not prove to be efficient in collecting of *Culicoides*, a fact also observed by COSTA (comunicação pessoal).

Vertical stratification

The specimens of the genus *Culicoides* appeared more frequently in the CDC traps put at 1 and 5m of height from the soil, with strong predominance of three species: *C. fusipalpis*, *C. pseudodiabolicus* and *C. hylas*, followed by *C. foxi*, yet in the trap put at 10m the number of specimens of these species was minor (Tab. I). Other species collected are listed in table I.

The CDC trap with the highest diversity of captured species was that put at 5m height (14), followed by the trap at 10m (13) and that at 1m (9). Six species (*C. foxi*, *C. fusipalpis*, *C. hylas*, *C. lahillei*, *C. lutzii* and *C. pseudodiabolicus*) were found at the three levels, however, with different frequencies, and seem to respond in the same way to the climatic and biological conditions reigning in the place. Only three species at the 1m level appeared: *C. glabrator*, *C. insignis* and *C. quasiparaensis*. The latter for the number of specimens collected can be considered as a rare species in the place. At the levels of 5 and 10m there was a difference relative to the number of captured specimens, but not to the number of species: seven species were common at these two levels: *C. bricenoi*, *C. dasyophrus*, *C. leopoldoi*, *C. paraensis*, *C. paucienfuscatus*, *C. reticulatus* and *C. verecundus*; probably showed this behavior in function of the search for blood as food and of its phototaxia. KETTLE (1962) mentioned that some species of *Culicoides* are common at the soil level others are frequent in the canopy of the trees, and some are equally abundant at all heights. WILLIAMS (1955) observed in Georgia that of all collected species of *Culicoides* 44% were at 2m of height, 15% at 8m, and 40% at 13m. CASTELLÓN *et al.* (1993) in collections made with CDC at 4m, in an area of secondary forest in the Ducke Reserve, reported the presence of 23 species, the most abundant were *C. hylas* (52,94%) and *C. pseudodiabolicus* (24,10%) of which the species *C. foxi* and *C. fusipalpis* were captured with lower frequency. CASTELLÓN *et al.* (1990) worked in three different areas in the Brazilian Amazon and found that *C. pseudodiabolicus*

and *C. hylas* were the most abundant species, however in the present study the frequency at the different heights of these two species was inverted. The collections of *C. fusipalpis* and *C. foxi* were very inexpressive in the different altitudinal layers. These results are evidence that there occurs a substitution of species in different areas and that the major or minor abundance of species could depend on the different traps and baits used, period of collects and altitudinal layers, not excluding the weather factors among others. According to CHANIOTIS *et al.* (1971), "The seasonal dynamics of the phlebotomines population are the product of a complex interplay between the biotic potential of different species and the resistance of the environment the eater of a number of abiotic physical variables".

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