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OBSERVATIONS ON THE DIPTERAN FAUNA IN A FOCUS OF DERMAL LEISHMANIASIS IN THE STATE OF MINAS GERAIS. II. THE DISTRIBUTION OF FAMILIES IN RELATION TO THEIR MEDICAL, VETERINARY AND ECONOMIC IMPORTANCE

PAUL WILLIAMS*
CARLOS B. MARCONDES**
ALBERTO R. FALCÃO***

Miniature light traps were used to collect Phlebotominae in a focus of dermal leishmaniasis in the eastern part of the State of Minas Gerais, Brazil. Over a period of seven months, the other Diptera captured in 179 light trap samples were identified to family level. The traps were placed in eight localities which constituted three different biotopes: three woodland areas, cultivated land, and a peridomestic site. A comparison is made between the totals of Dipterans collected in each biotope, the total numbers of families collected in each biotope and the estimated indices of diversity. Dendrograms representing the degrees of association between families of Diptera in different biotopes are presented. Some families of Diptera are uniformly distributed throughout the study area; a few families seem to have become adapted to areas where human activity has induced the greatest ecological changes. The impact between Dipterans and human well-being is discussed. The available evidence indicates that transmission of dermal leishmaniasis does not occur in areas where sand flies can be captured in greatest densities.

Miniature light traps were one of several collecting devices used routinely to sample populations of Phlebotominae in a focus of dermal leishmaniasis in the Rio Doce Valley of Minas Gerais. Almost invariably, other small Diptera were collected in the traps. Between April and October 1976, all Diptera obtained on 182 trap nights were preserved for identification to family level. General comments on the Dipteran fauna of the study area have already been reported (Williams Marcondes & Falcão, 1981). In the present

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* Departamento de Parasitologia, Instituto de Ciências Biológicas da Universidade Federal de Minas Gerais, Caixa Postal 2486 – 30000 Belo Horizonte – MG.

** Departamento de Fisiologia e Patologia, Centro de Ciências da Saúde, Universidade Federal da Paraíba, 58000 João Pessoa – PB.

*** Centro de Pesquisas René Rachou – FIOCRUZ – Caixa Postal 1743, 30000 Belo Horizonte – MG.

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paper, the data for 179 samples are analyzed to present an impression of the distribution of small Diptera in the study area, to establish associations between the various families collected and to discuss the impact that flies have on the well-being of local inhabitants. It must be emphasized that no attempt was made to provide a comprehensive evaluation of the Dipteran fauna of the area. The study was limited to an assessment of Diptera captured by methods routinely used in studies on the population dynamics of Phlebotomine sand flies.

MATERIALS AND METHODS

Study area. Corrego Barracão is a short valley of 5 – 6 km extent in, approximately, a south-west/north-east axis. The valley mouth is about 10 km north-east of Caratinga (19° 37′ 30″S, 42° 09′ 00″W). A general description of the valley, with illustrations, was published by Mayrink et al (1979).

Traps were set out in eight localities which can be grouped in three categories:

a. **Woodland areas.** Five trapping localities were in secondary forest unamenable for agricultural development. *Woodland area I* comprized two collecting sites in the north-eastern head of the valley. One of the sites was on steeply rising ground on the lower slope of the western side of the valley; a narrow, rapidly flowing stream passed through the site. The other collecting area, separated from the first by pasture, was situated at the top of the east slope of the valley head. No water courses were visible in this site, which contained a large number of armadillo burrows, most of which appeared to be abandoned throughout the study period.

Woodland area II was 1 – 2 km from the valley mouth. Light traps were set on the gently rising northern slope and the more steeply rising eastern slope of the same woodland tract. The two collecting sites were about 1 km apart; neither had running water.

Woodland area III was on the west slope of the eastern side of the valley, about 1 km opposite the eastern slope of *area II* but somewhat nearer the valley mouth and about 1 km to the southeast of the peridomestic area and cultivated land. The site, on steeply rising land, was separated frm adjacent pasture by a rapidly flowing canalized stream.

It was not possible to make measurements of temperature and relative humidity in the woodland sites. Subjectively, the impression was gained that both sites in *area II* were similar to the lower part of *area I* whereas *area III* and the upper part of *area I* were drier and subject to greater daily changes in temperature and humidity.

b. **Cultivated land.** Light traps were set at various points at the sides of rice fields and orchards to the north and east of the peridomestic area. Irrigation channels for the rice fields were the predominant features of this site. Traps were placed along the margins of one rice field abutting grassland, between banana plants, bamboo plants and some high trees at the side of another rice field and in a mango grove separated from a rice field by banana plants.

c. **Peridomestic area.** This was based on one of the more prosperous farms in the valley. The strongly constructed, stilted farmhouse was surrounded by sturdily built out-buildings. An ornamental pond, surrounded by a flower garden, lay immediately to the south of the farmhouse. The mango orchard already mentioned lay to the north-east of the farmyard. Light traps were placed in the following positions: at the side of a pig sty which was at the side of the ornamental pond and where chickens also roosted at night; inside or in front of the opened door of a latrine; at the side of a water storage tank; in an open-sided barn where geese roosted at night; beneath the farmhouse, where dogs sheltered during the day and chickens roosted at night. Fast flowing, canalized water passed along the northern edge of the farmyard and, for present purposes, formed the boundary between the peridomestic site and one part of cultivated land.

Trapping programme. The types of miniature light traps were described by Williams, Marcondes & Falcão (1981). Placement of traps was determined by reference to a Table of Random Numbers. Traps were set out at 17.00 – 18.00h and were retrieved at 07.00 – 08.00h the following day.

Preservation and identification of material. As soon as the traps arrived in the laboratory, the contained insects were narcotized with cigarette smoke so that Phlebotomine sand flies could be removed. The remaining insects were then killed with chloroform. Small Diptera were preserved in vials of 70% ethyl alcohol; larger specimens were preserved dry between layers of tissue paper. Specimens were identified to family level with the aids of the keys by Brues Melander & Carpenter (1954) and Borrer & Delong (1969).

Analysis of data. Geometric means (M_G) were calculated to determine the mean densities of *all* Diptera in each biotope. The modified geometric mean (M_W) of Williams (1973) was computed to determine the mean densities of each family in each site. Arithmetic means were used to calculate the average number of families per trap night in each biotope. Means were compared by a method of analysis of variance for samples of unequal sizes (Winer, 1962 ; pp 210 – 218). Indices of diversity were estimated by the graphical methods (not illustrated herein) of Southwood (1978 :pp. 421-423). Indices of associations between families were calculated by the formula:

$$I = 2\frac{J}{A + B} - 0.5$$

where I = the index of association, J = the numbers of individuals of families A and B collected jointly in samples, and $A + B$ = the total numbers of families A and B collected in all samples obtained in a particular biotope (Southwood, 1971 :p. 332). The values obtained by using this formula range from + 1.00 (complete association) to – 1.00 (complete dissociation). Indices of association between all families collected in a given biotope were arranged in matrices from which dendrograms were constructed by the method of Southwood (1971 :pp. 342 – 344).

RESULTS

A preliminary analysis of data (Marcondes, 1978) showed that the three different types of miniature light traps used in the investigation had indices of similarity of 90% or more with regard to the mean densities of the different families of Diptera collected. The results obtained with different collected devices can, therefore, be combined.

General pattern of Dipteran distribution. This basic information is given in Table I.

Although the M_G values varied 104.42 – 199.53 flies per trap night, no statistically significant differences could be established by analysis of variance. Of the 26 families of Diptera collected in the study area, the highest number (23) was recorded in woodland area II and the lowest (11) in the peridomestic site. Despite this range of 11 – 23, there is no statistically significant difference between the mean numbers of families captured per trap night in the five biotopes. Indices of diversity ranged from 6.33 (III) to 7.59 (I) in woodland areas and that for the peridomestic area (7.38) fell within these limits. The index of diversity in cultivated land (9.02) was higher than those of all other biotopes.

TABLE I

Summary of Diptera captured with miniature light traps in five biotopes of *Corrego Barracão, município* of Caratinga-MG (Standard deviations shown in parentheses)

	Sites				
	I	*II*	*III*	*IV*	*V*
Mean density (M_G) of Diptera per trap night	104.42(3.70)	118.51(3.29)	121.62(3.73)	199(4.73)	107.15(2.94)
Total number of families collected	18	23	13	20	11
Mean number ($\overline{x}$) of families per trap night	6.82(2.86)	7.05(2.58)	5.81(2.32)	7.78(2.56)	7.25(1.57)
Estimated index of diversity	7.59	7.72	6.33	9.02	7.38

Distribution of families. Table II shows the distribution patterns of the 15 families collected in small numbers. None of these families were recorded in the peridomestic site and only three (Simuliidae, Sepsidae and Tachinidae) were represented in woodland area III. Eight of the "rare" families recorded in cultivated land were also collected in one or more of the woodland areas. The family Ephydridae was exceptional and was recorded only in cultivated land. Of the 13 specimens of Ephydridae collected, 11 were captured together.

TABLE II

Mean densites (M_W) of the 15 families of Diptera collected in small numbers in *Corrego Barracão, município* of Caratinga-MG.

Families	Sites				
	I	*II*	*III*	*IV*	*V*
Dixidae	0.02	–	–	0.02	–
Simuliidae	0.04	0.05	–	0.01	0.04
Anisopodidae	–	0.02	–	0.01	–
Bibionidae	–	–	–	0.01	–
Rhagionidae	–	0.02	–	0.03	–
Dolichopodidae	0.10	0.12	–	0.05	–
Tephritidae	–	–	–	*	–
Sepsidae	–	0.02	–	0.02	0.04
Lauxaniidae	0.02	–	–	0.11	–
Ephydridae	–	0.01	–	–	–
Drosophilidae	0.02	0.06	–	0.08	–
Diastatidae	0.02	0.03	–	–	–
Muscidae	0.05	0.03	–	0.01	–
Sarcophagidae	–	–	–	0.01	–
Tachinidae	–	–	–	–	0.04

* Less than 0.01

Table III shows the mean densities of 11 families obtained at rates exceeding 0.1 flies per trap night in at least four of the biotopes. Apart from Chaoboridae (absent from woodland area III) each family was represented in each biotope. There are no statistically significant differences between the respective mean densities of Ceratopogonidae, Chironomidae, Mycetophilidae, Sciaridae, Cecidomyidae, Phoridae and Chloropidae in each of the five biotopes.

At a 1% level of probability (unless otherwise stated) Tipulidae, Psychodidae (including Phlebotominae), Chaoboridae and Culicidae were, statistically, more abundant in cultivated land or the peridomestic site of both than they were in one or more of the woodland areas. The mean density of Tipulidae in cultivated land is significantly higher than those in all three woodland sites and that for the peridomestic site is significantly greater than that in woodland area III. The means for Psychodidae in cultivated land and the peridomestic site are not significantly different. But both values are significantly

TABLE III

Mean densities (M_W) of families of Diptera collected in densities greater than 0.10 flies per trap night in at least four of the biotopes in *Corrego Barracão, município* of Caratinga-MG. (Standard deviations shown in parentheses).

Families	*Sites*				
	I	*II*	*III*	*IV*	*V*
Tipulidae	1.69 (1.47)	2.11 (2.77)	0.85 (2.18)	7.71 (1.18)	3.57 (1.05)
Psychodidae	9.23 (4.77)	10.30 (2.96)	8.07 (4.94)	35.31 (7.37)	46.59 (3.47)
Chaoboridae	1.57 (3.16)	0.31 (1.57)	–	7.51 (5.13)	2.39 (3.26)
Culicidae	1.04 (2.40)	1.37 (2.53)	0.62 (1.82)	2.47 (3.93)	2.78 (2.83)
Ceratopogonidae	1.82 (2.85)	2.76 (3.26)	3.06 (2.89)	2.63 (3.61)	3.15 (3.31)
Chironomidae	27.84 (4.53)	13.69 (4.49)	16.43 (5.10)	25.30 (4.58)	11.91 (3.00)
Mycetophilidae	0.58 (2.24)	0.18 (1.49)	0.04 (1.19)	0.38 (2.14)	0.15 (1.50)
Sciaridae	3.79 (4.06)	2.01 (2.77)	1.99 (4.16)	3.03 (3.25)	1.23 (2.42)
Cecidomyidae	35.31 (4.13)	62.37 (3.84)	68.88 (3.54)	77.50 (3.56)	20.86 (2.60)
Phoridae	0.23 (1.52)	0.50 (1.70)	0.17 (1.41)	0.51 (1.93)	0.27 (1.52)
Chloropidae	0.07 (1.22)	0.27 (1.78)	0.25 (1.52)	0.22 (1.62)	0.17 (1.52)

higher than those for all three woodland sites. The density of Culicidae in woodland area III is significantly lower than that in the peridomestic area and at a 5% level of significance than that in cultivated land. There is no significant difference between the densities of Chaoboridae in cultivated land and the peridomestic site, nor does the density of this family differ significantly in the peridomestic site from those in woodland areas I and II. The density of this family is significantly higher in cultivated land than in woodland area I and II; at a 5% level of significance, chaoborids were more abundant in woodland area I than in area II.

Distribution of Phlebotominae. The mean densities of sand flies in each of the five biotopes were calculated in three ways:

(a) Expressing the M_W of sand flies as a percentage of ΣM for all families, Phlebotominae accounted for only 1.68% of all Diptera in cultivated land, for 1.73 – 4.66% in woodland sites but for 15.48% in the peridomestic site.

(b) Expressing the M_W of sand flies as a percentage of ΣM_W of Psychodidae, they accounted for only 7.80% in cultivated land, 20.45 – 43.50% in woodland areas and 30.93% in the peridomestic site.

(c) Expressing the M_W of sand flies as a percentage of the ΣM_W of all haematophagous groups (Ceratopogonidae + Culicidae + Phlebotominae + Rhagionidae + Simuliidae), they represented 70.85% of haematophagous diptera in the peridomestic site, 51.79% in woodland area II but less than 40% in cultivated land and the other two woodland areas.

The mean density of 14.41 sand flies per trap night in the peridomestic site is significantly higher at a 1% level than the corresponding values in all other sites. At a 5% level of significance, Phlebotominae were more abundant in woodland area II (4.48 flies per trap night) than in area III (1.74).

Associations between groups of Diptera. Phlebotominae are here treated separately from non-haematophagous Psychodidae. The dendrograms shown in Fig. 1 refer to woodland areas and those in Fig. 2 to cultivated land and the peridomestic site. The numbers shown on the dendrograms indicate the level of association at each branch.

The dendrogram for woodland area II breaks down into three main components:

(a) A non-associated group of 10 families (Sepsidae, Muscidae, Rhagionidae, Dolichopodidae, Tephridae, Bibionidae, Simuliidae, Dixidae, Sarcophagidae and Anisopodidae) within which Rhagionidae and Dolichopodidae show a slight degree (+0.20) association. The complete association (+1.00) between Sepsidae and Muscidae is due to the fact that singletons of both families happened to be captured in the same trap.

(b) A group of four families (Drosophilidae, Mycetophilidae, Chloropidae, Lauxaniidae) that are not closely associated with one another but clearly separated (−0.31) from group *a*.

(c) The remaining 10 entities are clearly dissociated (−0.57) from the 14 families in the first two groups. Phoridae and Chaoboridae are only marginally members of this group and Culicidae is not closely associated with the other Nematocerans. Cecidomyidae and Chironomidae (+0.98) are completely associated and are very closely linked to Psychodidae other than Phlebotominae (+0.94). Ceratopogonidae and Phlebotominae form a closely associated (+0.90) sub-group which links with Tipulidae and with the Psychodid/Chioronomid/Cecidomyid sub-group at +0.83.

In woodland areas I and II, there are two sub-groups of complete association, Cecidomyidae-Chironomidae and Phlebotominae-Sciaridae-other Psychodidae. In both areas, these five are closely linked with Ceratopogonidae. The very close association (+.96) between Tipulidae and Chaoboridae in area I contrasts with their virtual non-association in area II; Chaoboridae were not taken in area III. Culicidae are not closely linked with other Nematocera in all three woodland areas or in the peridomestic site.

In the peridomestic site Psychodidae (other than Phlebotominae), Chironomidae and Cecidomyidae form a group of absolute (+1.00) association. Tipulidae and Phlebotominae are also completely (+0.98) associated. The two sub-groups are so closely associated (+0.96) that they can be considered to form a five-entity group of complete association.

The highest levels of association are shown in the dendrogram for cultivated land. Within the range of experimental error, nine entities, having association levels of +0.93 or more, can be considered to have complete association. This is the only site where Tipulidae are closely associated with Chironomidae, Psychodidae (other than Phlebotominae) and Cecidomyidae. The dendrogram for cultivated land is the only example in which Culicidae and Chaoboridae (apart from the close link between Tipulidae and Chaoboridae in woodland area I) are closely associated with other Nematoceran elements of the study area.

As the target group for the light-trapping programme, Phlebotominae deserve special attention. In woodland areas I and III, Phlebotominae were most closely associated with Sciaridae and other Psychodidae; in woodland area II, sand flies were most closely associated with Ceratopogonidae; in cultivated land, Phlebotomines were closely linked with eight other groups of Nematocera and most closely associated with Ceratopogonidae. The closest link of sand flies in the peridomestic site was with Tipulidae.

DISCUSSION

Trap performance. Southwood (1978) critically examined the utility of light traps in ecological studies, and Williams, Marcondes & Falcão (1981) mentioned further limitations of the actual equipment used in the present survey. It is now necessary, before discussing the distribution of dipterans in *Corrego Barracão,* to consider the possibility that the results obtained were unduly influenced by differences in the performance of traps in the different biotopes.

There was scant or no ground vegetation in the two open sites (cultivated land and the peridomestic area). Presumably, lights in these two situations had greater spheres of influence and disorientated insects at greater distances from the traps than did those set in woodland. The presumed greater light range in cultivated land, for example, could account for the higher density of dipterans recorded there. In the two open sites, there was probably a reduction in trap performance on moonlit nights (Bidlingmayer, 1967). In the peridomestic area only, trapping results were most likely influenced by the dim electric lights that illuminated the farmhouse and some outbuildings for part of the night.

There were other influences on trapping results in woodland. Unlike the peridomestic site, there were no extraneous lights. In contrast to the two open sites, moonlight could have had little, if any, influence in the woodland areas; in each, the overhead canopy was sufficiently dense to obscure even the brightest moonlight. The presence of ground vegetation in woodland could have had a considerable influence on trap performance. In actual collecting positions in each of the woodland areas, the amount of ground vegetation varied from relatively scanty (but never as sparse as that in the two open sites) to very dense. In setting out traps, the minimum of disturbance was made to vegetation because one of the aims of the exercise was to sample the Dipteran fauna in the natural setting. Because of this aim, and due to the proximity of ground vegetation, it is reasonable to suppose that miniature light traps in woodland had smaller spheres of influence than those set out in cultivated land and the peridomestic site. Because the ground vegetation in the woodland sites was unevenly spaced, the light emanating from a trap would have been unevenly transmitted. In several woodland collecting positions, there was dense vegetation on one side of the trap but much sparser vegetation on the opposite side. In such conditions, a light trap would have had an irregular sphere of influence.

The various environmental factors that probably influenced trap performance in the different biotopes apparently balanced out, or were reduced to a minimum, in the course of the survey. Although the mean densities of all dipterans varied from 104.42 ± 3.70 flies per trap night (woodland area I) to 199.53 ± 4.37 (cultivated land), the differences were not statistically significant. Similarly, whilst the total numbers of families recorded in different biotopes ranged from 11 (peridomestic site) to 23 (woodland area II), the mean ($\bar{x}$) number of families collected per trap night only varied between 5.81 ± 2.32 (woodland area III) to 7.78 ± 2.56 (cultivated land), and these differences are not statistically significant.

The estimated indices of diversity are, perphaps, the best means of comparing the Dipteran fauna in different parts of the valley. Although the densities and relative proportions of some families varied, the similarities of the diversity values indicates considerable uniformity of the structure of the Dipteran fauna throughout the valley. The slightly higher index of diversity in cultivated land is most probably linked to the more open nature of the ground and a better trap performance in this situation.

Distribution of families. The 15 families listed in Table II can probably be placed in one of four categories:

(a) Insects that are not normally active at night.

(b) Nocturnally active insects that are not disorientated by low intensity light.

(c) Nocturnally active insects that are susceptible to low intensity lights but with sufficiently strong powers of flight to have evaded frequent capture in miniature light traps.

(d) Insects that are as rare in the valley as the trapping results indicate.

To determine the status of each of these 15 families and to allocate them to one of the foregoing categories would require a comprehensive survey of Diptera by the simultaneous use of a variety of capture methods. The present study was limited to recording other groups of Diptera commonly captured in traps used routinely for the collection of Phlebotominae. The results merely show that all of these 15 families were rarely captured in miniature light traps used to collect sand flies in *Corrego Barracão.*

In assessing trap performance on the basis of mean capture rates in *Corrego Barracão*, Williams, Marcondes & Falcão (1981) recognized four density-related categories. The same categories can be applied to interpret the data given in Table III.

(a) Families occurring in densities greater than 10 flies per trap night. This category includes only Cecidomyidae and Chironomidae in all five biotopes and Psychodidae in woodland area II, cultivated land and the peridomestic site.

(b) Families collected at rates of 1.00 – 9.99 flies per trap night. This includes Psychodidae in woodland areas I and III, Ceratopogonidae and Sciaridae in all five biotopes, Tipulidae and Culicidae in all sites except woodland area III, and Chaoboridae in woodland area I, cultivated land and the peridomestic site.

(c) Families represented by 0.10 – 0.99 flies per trap night. This group includes Phoridae in all biotopes; Mycetophilidae and Chloropidae in all but woodland areas III and I, respectively; Chaoboridae in woodland area II. Of the families listed in Table II, Dolichopodidae (woodland area I and cultivated land) and Lauxaniidae (woodland area II) can also be included in this category.

(d) Families captured at rates of less than 0.10 flies per trap night. With the exceptions noted above, this category includes the families listed in Table II. Of the families listed in Table III, only Chloropidae (woodland area I) and Mycetophilidae (woodland area III) fall into this group.

The results of analysis of variance suggest that each of seven families listed in Table III (Ceratopogonidae, Chironomidae, Mycetophilidae, Sciaridae, Cecidomyidae, Phoridae, Chloropidae) are, in fact, uniformly distributed through *Corrego Barracão* and are not especially associated with any particular biotope. On the other hand, it would appear the Culicidae, Chaoboridae, Psychodidae and Tipulidae are unevenly distributed through the valley.

Culicidae are uniformly distributed through the valley apart from the fact that mosquitoes occurred in lower density in woodland area III than in the peridomestic site and cultivated land. These differences can be related to the types of water in the three biotopes. The edge of woodland area III had a rapidly flowing canalized stream; cultivated land had canalized streams interspaced by pools of stagnant water; the peridomestic site contained an ornamental pool of stagnant water.

The other three unevenly distributed families are most probably adapted to the two areas where human activity has brought about the greatest changes in the ecology of *Corrego Barracão.* Psychodidae (including Phlebotominae) seem to be best adapted to the peridomestic site and, to a lesser extent, to cultivated land. Tipulidae and Chaboridae are, possibly, more adapted to cultivated land. The distribution of Chaoboridae in woodland is also interesting. Absent from woodland area III, chaoborids were less abundant at the mouth of the valley than in the valley head.

Associations between groups of Dipterans. The dendrograms shown in Figs 1 and 2 must be interpreted cautiously, and within the stated limitations of the present study. Fundamentally, the degrees of association merely reflect similarities in flight activity of Diptera susceptible to capture by the collecting devices used. No additional conclusions can be drawn from the information presented.

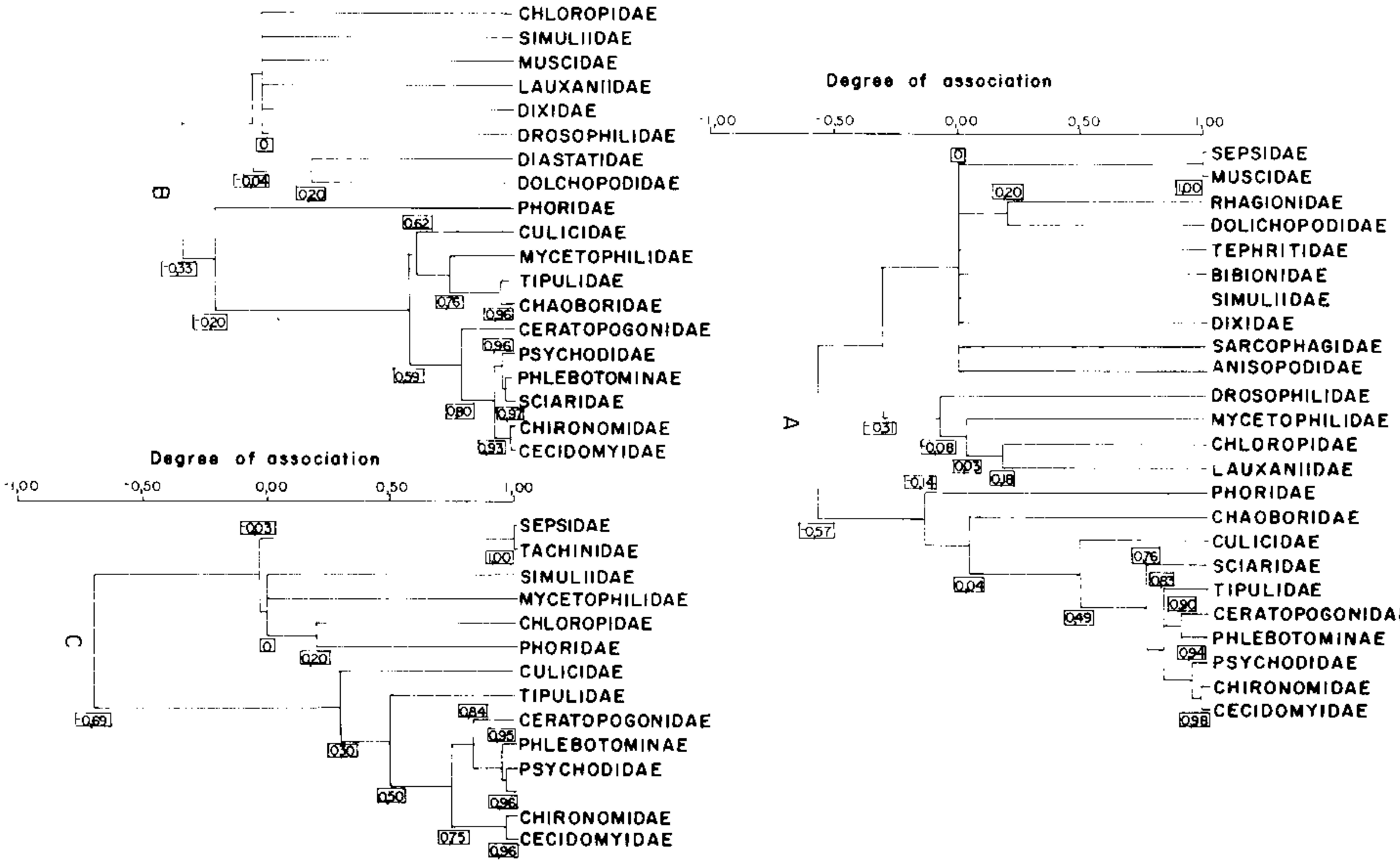

Fig. 1 – Dendrograms showing degrees of association between families of Diptera in *Corrego Barracão*. A – Woodland area II, B – Woodland area I. C – Woodland area III.

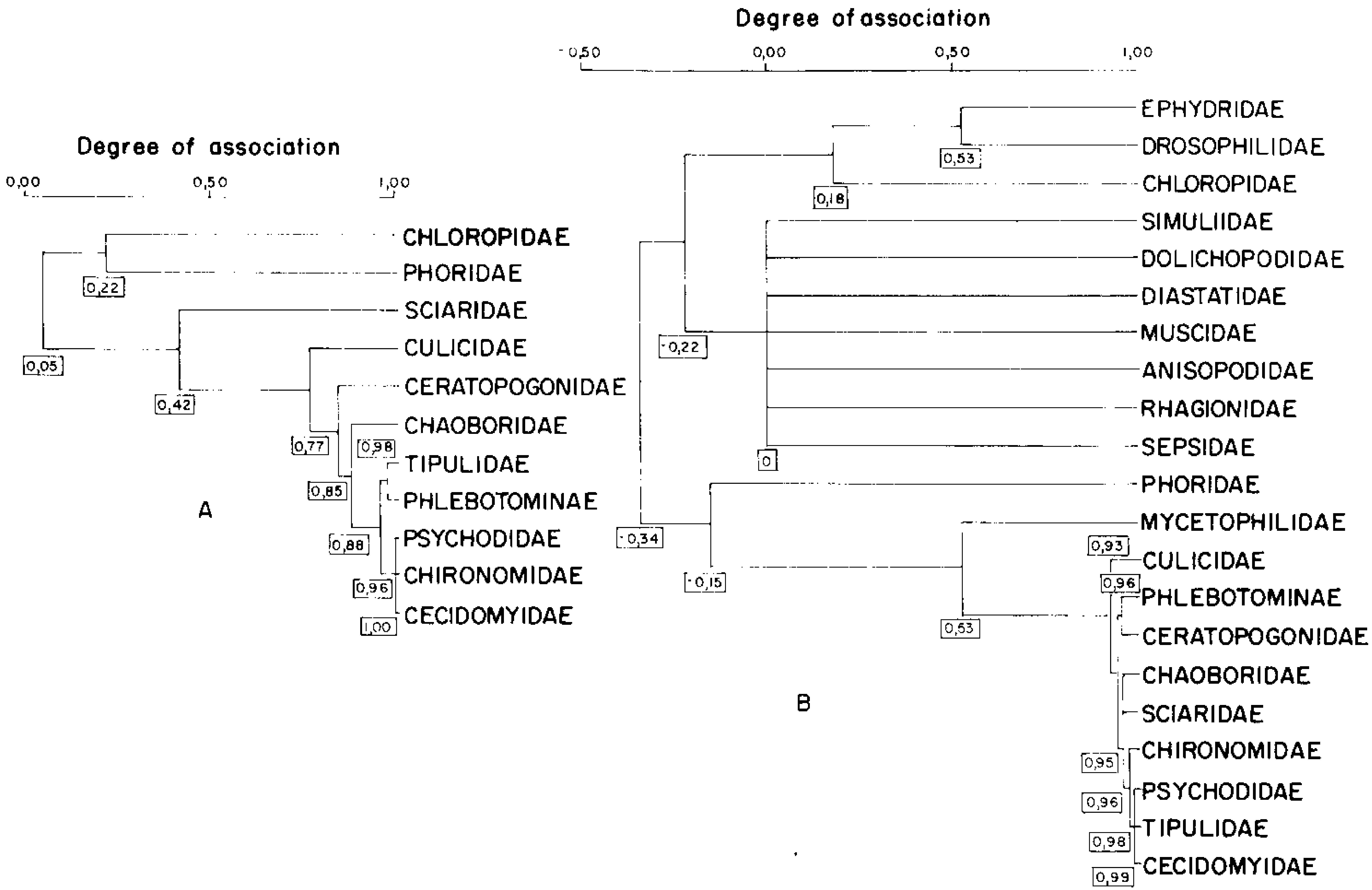

Fig. 2 – Dendrograms showing degrees of association between families of Diptera in A – cultivated land and B the peridomestic area.

Close associations could reflect that traps were set near the breeding sites of associated families. But the breeding sites of two closely associated groups taken in light traps might have been quite different. Cecidomyids and chironomids were totally associated, as adults collected in miniature light traps, throughout the study area but the immature stages of the two families occupy quite different habitats. The converse also holds. The immature stages of Culicidae and Chaoboridae occupy the same habitats but, with the exception of cultivated land, adults of the two families were not closely associated in miniature light traps set out in *Corrego Barracão*. However, the lack of association between Culicidae and Chaoboridae in the adult stage might reflect the fact that chaoborid larvae prey on immature mosquitoes.

Similarities in the nutritional requirements of adult Diptera can also be discounted as an explanation for close association in miniature light trap collections. The two groups with exclusively haematophagous females (Culicidae and Phlebotominae) were closely associated in cultivated land but nowhere else in the valley.

It cannot even be certain that apparently closely associated Dipteran groups were actually in active flight at the same hours of the night or in the same conditions of temperature and relative humidity. Although nine groups were highly associated in cultivated land, there can be no certainty that they were all flying at the same times.

The dendrograms are of greatest utility as a means of comparing the population profiles in the five biotopes, most especially for the 11 families listed in Table III. Allowing for the fact that Chaoboridae were not collected in woodland area III and that Mycetophilidae were rare in the same site, the profiles of population structure at the two extremes of the valley (areas I and III) are very similar. The slightly different profile for woodland area II is mainly due to the closer association between Ceratopogonidae and Phlebotominae and a difference in the relationships of Sciaridae.

Apart from a close association between Tipulidae and Phlebotominae and a more distant relationship between sand flies and ceratopogonids, the population profile for the peridomestic area is most similar to that of woodland area II. This result is not too surprising. A narrow tract of woodland, not sampled in the present study, extended from the peridomestic area to another farmhouse that was separated from the northern part of woodland area II only by an orange grove.

The dendrogram for cultivated land is quite different. This could be due to a greater abundance of the nine closely associated groups, to more extensive flight activity on the part of the nine groups, or a reflection of improved trap performance in more open ground. Whatever the actual underlying reason for the difference, the results clearly indicate that it is in cultivated land that man-induced changes have had the greatest impact on the population structure of Diptera as revealed by the use of miniature light traps.

Economic importance of dipterans in Corrego Barracão. Nearly all the families listed in Table III are a potential or, more likely, an actual but unrecognized menace to the well-being of the inhabitants of the valley.

Immature stages of Cecidomyidae either form galls in food crops or are leaf miners. The high incidence of this family in all five of the biotopes studied could indicate that gall midges represent a pest problem for local farmers. The most effective remedy against plant infestations, according to Oldroyd (1964), is to remove and burn the damaged parts of the plant. Obviously, this is a laborious and time-consuming method of control.

Sciaridae includes species which are leaf miners. The best control method is as for Cecidomyidae.

Larvae of Tipulidae can cause serious damage to the roots of cereal crops. In *Corrego Barracão*, adult tipulids were taken in greatest density in miniature light traps set near rice fields.

Chironomids were collected in substantial numbers throughout the valley. In some parts of Africa, large numbers of these non-biting midges are the proven cause of respiratory allergies in man (Cranston, Gad El Rab & Kay, 1981). They could also be an important cause of rhinitis in *Corrego Barracão*.

Although Phoridae were not abundant in the valley, they were uniformly distributed and it should be remembered, in dealing with medical problems of the local inhabitants, that scuttle flies are most probably under-estimated as the causative organisms of intestinal, pulmonary and urogenital myiases (Disney & Smith, 1978). The dangers of phorid infestations is aggravated by the fact that the majority of house-holds in *Corrego Barracão* completely lack sanitary installations. Most inhabitants of the valley relieve themselves in woodland or in the orchards immediately adjacent to their dwellings.

Chloropids were not especially numerous but were widely distributed through the valley. Although eye flies do not have skin piercing mouth parts, some species can rasp dermal lesions and the more delicate areas of skin (Harwood & James 1979). These flies are particularly attracted to the eyes of mammals, to superficial wounds and cutaneous lesions, and to exposed genitalia. They have been associated, in the New World with the transmission of streptococcal skin infections, acute bacterial conjunctivitis, yaws and bovine mastitis.

Because Ceratopogonidae do not occur in great density in any part of the valley, it is unlikely that the haematophagous members of the family are involved in the circulation of pathogenic organisms. Nevertheless, the risks exist that viral diseases could be introduced into *Corrego Barracão*. Thus, a species of *Culicoides* has been incriminated as a vector of Oropouche virus in the Amazon region (Dixon et al, 1981; Pinheiro et al, 1982) and *Culicoides* are the suspected vectors of Blue Tongue virus, a disease of sheep already recorded in Minas Gerais. Of more immediate medical significance is the risk that *Culicoides* could cause allergic skin conditions such as those reported from Puerto Rico (Areán & Fox, 1955) and the Brazilian State of Bahia (Sherlock & Guitton, 1964 a, b; 1965; Sherlock, 1965).

It is also unlikely that nocturnally active Culicidae could be involved in the transmission of pathogens to man and domestic animals. At the levels at which they were collected, it is unlikely that they occur in sufficiently high numbers to maintain the circulation of mosquito-borne diseases. Culicidae could be an occasional biting nuisance for persons sensitized to mosquito bites. But the pattern of immunological reactions to haematophagous insects is such that repeated exposure usually results in desensitization. Desensitized adults probably suffer little or no incovenience from mosquito bites. Children most probably react more strongly.

Psychodidae, the predominant group in the peridomestic site and the second commonest in cultivated land, are of medical interest for four reasons. Psychodidae larvae can cause pseudomyiasis (Harwood & James, 1979); adult flies can be a cause of asthma (Oldroyd, 1964); adult females of certain Phlebotominae can inflict painful bites and cause skin allergies; and sandflies are the only known vectors of leishmaniases.

The distribution of Phlebotominae in *Corrego Barracão* is interesting. If the peridomestic area used in the present study is truly representative of conditions throughout the valley, local habitants have greatest contact with phlebotomines near their houses. This finding does not necessarily mean peridomicilary transmission of leishmaniasis in the area. In an epidemiological analysis of cases of cutaneous and muco-cutaneous leishmaniasis in the Rio Doce Valley since 1965, M. Dias (personal communication, 1982) has found no evidence that the diseases are acquired near dwellings. Because peridomestic transmission has to be excluded, it must be assumed that patients become infected in biotopes with relatively low densities of sand flies or by species that are rarely captured in miniature light traps. Further details of the phlebotomine fauna of the valley will be given in a later paper.

RESUMO

Foram usadas armadilhas luminosas para coleta de flebotomíneos em um foco de leishmaniose tegumentar a leste do Estado de Minas Gerais, Brasil. Durante um período de sete meses as 179 amostras de outros Dipteros capturados com armadilhas luminosas foram identificadas a nível de família. As armadilhas foram colocadas em oito locais constituídos de três diferentes biótopos: três áreas de floresta, áreas cultivadas e peridomicílio. Foi feita uma comparação entre o total de Dipteros coletados em cada biótopo, o total de famílias coletadas em cada biótopo, sendo estimado o índice de diversificação. São apresentados dendrogramas com o grau de associação entre as famílias de Dipteros em diferentes biótopos. Algumas famílias de Dipteros foram uniformemente distribuídas através da área estudada; poucas famílias parecem ter se adaptado às áreas onde a atividade humana causou as maiores mudanças ecológicas. É discutido o impacto entre os Dipteros e o bem estar humano. As evidências obtidas neste trabalho indicam que a transmissão da leishmaniose tegumentar não está atualmente ocorrendo nas áreas estudadas, apesar da alta densidade de flebótomos capturados.

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