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Chrysops silacea and *C. dimidiata*: fly densities and infection rates with *Loa loa* in the Chaillu mountains, Congo Republic

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Abstract

The densities, infection rates with *Loa loa*, and parous rates of *Chrysops silacea* and *C. dimidiata* were studied in various ecological zones throughout the Chaillu mountains in the People's Republic of the Congo. In the rainy season, *C. dimidiata* was the major vector in the forest, whereas *C. silacea* was predominant in the cleared forest zones. Fly densities were higher in the forest (natural forest or palm-grove) than in the villages. Parous and infection rates varied according to the ecological zone. The infection rate of parous females was related to the microfilarial rate in the human population, indicating that the *Chrysops* populations were extremely stable in the rainy season.

Introduction

In the Chaillu mountains, People's Republic of the Congo, filariasis due to *Loa loa* is transmitted by 2 vectors, the day-biting *Chrysops silacea* and *C. dimidiata* (NOIREAU & GOUTEUX, 1989). Blood screening surveys conducted in 7 villages in the area showed that 18·9% of the Bantu population and 10·6% of the Pygmy group were infected with *L. loa* microfilariae (NOIREAU *et al.*, 1989). In this highly endemic area, little is known about the vectors apart from their host preferences (GOUTEUX *et al.*, 1989). Indeed, most entomological studies on loaiasis have been conducted by British teams in West Africa, in Kumba (Cameroon) and in Nigeria (GORDON *et al.*, 1950; DAVEY & O'ROURKE, 1951; DUKE, 1955). This paper presents data on the distribution of the vectors, their infection rates and parity rates in the forest region of Central Africa.

Materials and Methods

Study area and collecting sites

The study was conducted in a region of South Congo, the Chaillu mountains. Four collecting sites were selected.

(i) Ngave, a Bantu village situated on a road in the rain-forest. The trees have been cleared from the immediate vicinity of the huts. The collecting site was the village centre.

(ii) Moutalango, an isolated Pygmy community in the forest. The collecting site was inside the camp.

(iii) Bandzoko, another small Pygmy hunting camp situated in rain-forest. The collecting site was between the huts.

(iv) Missama, a large village on the Sibiti-Komono road. The forest in the vicinity has been cleared for banana plantations. Four collecting sites were selected, one in the village centre, one in a palm-grove 3 km from Missama, and 2 in the mature forest 6 km from the village (one site at ground level and the other on a platform built at a height of 26 m in the canopy).

Studies on Chrysops

The work was carried out in 1988 during the rainy seasons (January, March and December) except for the last visit in Ngave which was in June, at the beginning of the dry season.

Flies were captured by 1–4 individuals stationed by a wood fire from 0800–1800 for 3–6 d, depending on the catching site and date of collection (Table 1). The flies were identified and the density of each species at the respective collecting sites was calculated as the number of flies caught per man-hour (f/mh). The flies originating from Ngave and Missama forest were dissected to assess their physiological age (DUKE, 1960). In addition, the head, thorax and abdomen of parous females were placed in 3 drops of saline solution and examined under a compound microscope for filarial infection. Larval stages were identified by the morphological characteristics described by ORIHEL & LOWRIE (1975).

Results

Fly densities

Table 1 shows the results of the catches carried out in the various ecological zones. In January 1988, *C. dimidiata* was the predominant species in the dense forest zones where the Pygmy camps were established. Fly densities were extremely high (25·7 f/mh for both species combined at Moutalango, 19·1 f/mh at Bandzoko).

However, in the same month in Missama, a village in a cleared area of the forest, *C. silacea* was the predominant species in all the collecting sites. In addition, the fly densities were much lower (3·4 f/mh in the village and 10·0 f/mh in the palm grove) than those observed in the dense forest. Further studies carried out in December 1988 in Missama confirmed that the ground densities in the forest (13·7 f/mh in the natural forest and 11·0 f/mh in the palm-grove) were higher than in the village (2·8 f/mh). In the forest canopy the fly densities (5·9 f/mh) were only half what they were on the ground. *C. dimidiata* accounted for 21·9% of the catches compared to 12·6% on the ground ($P<0·01$).

In Ngave, the densities of *C. silacea* and *C. dimidiata* were comparable in January, then *C. silacea* became the predominant species until the end of the rainy season.

Parous and infection rates of Chrysops

The results of the dissections of the flies captured at Ngave are given in Table 2. The average parous and infection rates did not differ significantly between the species (respectively 26·5% and 4·2% in *C. silacea* and 23·4% and 4·1% in *C. dimidiata*). However, the percentage of parous females increased significantly at the beginning of the dry season (56·0% in June compared with 23·5% in January for *C. silacea*; $P<0·001$). The percentage of infective flies (with third-stage (L3) larvae morphologically indistinguishable from those of *L. loa* in the head) reached 1·6% in March for *C. silacea*. The catches in Missama forest in December 1988 (Table 3) showed lower average parous and infection rates than those obtained at Ngave, respectively 17·4% and 2·8% for *C. silacea*, 20·9% and 1·1% for *C. dimidiata*. In particular, the

Table 1. Densities of *Chrysops silacea* and *C. dimidiata* at the different collecting sites

Place	Collecting site	Date of collection	No. of man-hours capture-time	*C. silacea* No. of flies	*C. silacea* Density[a]	*C. dimidiata* No. of flies	*C. dimidiata* Density[a]
Ngavé	Village	Jan. 88	120	323	2·7	345	2·9
		Mar. 88	120	368	3·1	207	1·7
		Jun. 88	120	25	0·2	3	0·0
Moutalango	Forest camp	Jan. 88	160	1015	6·3	3102	19·4
Bandzoko	Forest camp	Jan. 88	60	262	4·4	881	14·7
Missama	Village	Jan. 88	60	171	3·4	1	0·0
		Dec. 88	40	103	2·6	7	0·2
	Palm-grove	Jan. 88	50	428	8·6	71	1·4
		Dec. 88	50	436	8·7	115	2·3
	Forest-floor	Dec. 88	30	360	12·0	52	1·7
	Canopy	Dec. 88	30	139	4·6	39	1·3

[a]Expressed as flies per man-hour.

Table 2. Parous, infection and infective rates of *Chrysops silacea* and *C. dimidiata* at Ngave[a]

	C. silacea Jan. 88	*C. silacea* Mar. 88	*C. silacea* Jun. 88	*C. dimidiata* Jan. 88	*C. dimidiata* Mar. 88	*C. dimidiata* Jun. 88
No. of females examined	323	368	25	345	207	3
No. of parous females	76 (23·5)	100 (27·2)	14 (56·0)	101 (29·3)	28 (13·5)	1 (33·3)
No. of females with L1-L2-L3	13 (4·0)	17 (4·6)	0	19 (5·5)	4 (1·9)	0
No. of females with L3						
Anywhere	6 (1·9)	6 (2·2)	0	9 (2·6)	2 (1·0)	0
In head	4 (1·2)	6 (1·6)	0	4 (1·2)	1 (0·5)	0
Percentage of parous females with L1-L2-L3	17·1	17·0	–	18·9	14·3	–

[a]*Notes:* Figures in parentheses are percentages. L1, L2, L3 = first, second and third stage larvae respectively.

Table 3. Parous, infection and infective rates of *Chrysops silacea* and *C. dimidiata* in Missama forest[a]

	C. silacea Forest-floor	*C. silacea* Canopy	*C. dimidiata* Forest-floor	*C. dimidiata* Canopy
No. of females examined	360	139	52	39
No. of parous females	70 (19·4)	17 (12·2)	8 (15·4)	11 (28·2)
No. of females with L1-L2-L3	10 (2·8)	4 (2·9)	1 (1·9)	0
No. of females with L3				
Anywhere	1 (0·3)	2 (1·4)	0	0
In head	1 (0·3)	1 (0·7)	0	0
Percentage of parous females with L1-L2-L3	14·3	23·5	12·5	0

[1]*Notes.* Figures in parentheses are percentages. L1, L2, L3 = first, second and third-stage larvae respectively.

rate of parous *C. silacea* was significantly lower (17·4% compared with 26·5%; $P<0.001$). In the canopy the population of *C. dimidiata* was older than that of *C. silacea* (28·2% of parous females compared with 12·2%; $P<0.02$). Finally, in Ngave as in Missama, the percentages of infected parous flies ranged from 12·5% to 23·5% according to the series (excluding the small series of 39 *C. dimidiata* caught in the canopy in Missama). The average percentages were 15·8% (*C. silacea*) and 17·7% (*C. dimidiata*) in Ngave.

Discussion

From this study it was possible to determine the most favourable ecological zones for both vectors of loaiasis in the Chaillu mountains. Thus, *C. silacea* was the predominant species in the cleared forest, particularly in the villages and in their immediate vicinity. On the other hand, the abundance of *C. dimidiata* seemed to be related to its ecological dependence on the natural vegetation, particularly in the forest. Indeed, in agreement with the results of DUKE (1958), the relative proportion of *C. dimidiata* in the catches was higher in the forest canopy than on the ground. Both species seemed equally sensitive to the rainfall, as shown by studies carried out in Ngave where a rapid decrease of the populations was observed in June when the rains became less frequent before ceasing altogether.

The overall vectorail densities varied considerably according to the ecological zones. In particular, a marked contrast was observed between the forest zones where the Pygmies usually live (25·7 f/mh in Moutalango) and the Bantu villages (less than 6 f/mh). However, among the Pygmies of this zone who are the most exposed to *Chrysops* bites, the prevalence of *L. loa* microfilarial carriers was significantly lower than among the Bantus (NOIREAU *et al.*, 1989). The difference between the infection rates in both populations thus cannot be accounted for solely by man-vector contact, as suggested by KERSHAW *et al.* (1953), but rather by individual variation in the immune response which may be of genetic origin.

The parous and infection rates of both species were similar, confirming the studies of DUKE (1960). However, these rates differed according to the capture zone, as demonstrated in Missama and Ngave. This variability could be related to many factors such as ecological characteristics of the environment (distance of the collecting site from breeding sites) and the proximity and abundance of the microfilarial reservoir. Thus, in Kumba, the parous rate of captured female *Chrysops* was higher than in our study zone (DUKE, 1960). The infection rates of *Chrysops* reported by CONNAL & CONNAL (1922), GORDON *et al.* (1948) and DUKE (1958, 1959), all under 8·0%, are comparable to those reported in this study. The infection rate of parous females was similar to the prevalence of *L. loa* microfilarial carriers in the same area (NOIREAU *et al.*, 1989). These results confirm the role played by man as preferential food host (NOIREAU & GOUTEUX, 1989), the high vectorial ability of *Chrysops*, and the great stability of the fly population.

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