Colonization of blackflies in seasonal streams in an onchocerciasis-endemic area of Guatemala with reference to voltinism of Mayacnephia aguirrei

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Colonization of blackflies in seasonal streams in an onchocerciasis-endemic area of Guatemala with reference to voltinism of *Mayacnephia aguirrei**,**

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Abstract: Colonizing order of the blackfly species and voltinism of *Mayacnephia aguirrei* were studied in seasonal streams in an onchocerciasis-endemic area of Guatemala. *Mayacnephia aguirrei* colonized first, then *Simulium metallicum*, *S. horacioi* and *S. ochraceum* appeared, followed by *S. callidum* and *S.* (*Hemicnetha*) spp. The colonizing order of these species coincided with the order of a preference for stream discharge from small to large. *Mayacnephia aguirrei* had at least three generations in a year.

INTRODUCTION

Alternation of the dry and rainy seasons affects remarkably the conditions of streams in Guatemala. Watercourse, which markedly expands in the rainy season and reduces in the dry season, influences the species composition and population density of blackflies. Takaoka (1981, 1982) paid special attention to seasonal streams as breeding places for the vector species of onchocerciasis in an endemic area in Guatemala. During the rainy season, many seasonal streams harbor the immatures of *Simulium ochraceum* Walker, the main vector of the disease, and of *S. metallicum* Bellardi, *S. callidum* (Dyar and Shannon) and *S. horacioi* Okazawa and Onishi, which are all possible or potential vectors. Okazawa and Yamagata (1985) found *Mayacnephia aguirrei* Dalmat occurring principally in seasonal streams in the same area. Thus, the seasonal streams are important breeding places as well as perennial streams for the vectors and other blackflies. But the biological observations on the blackflies in the seasonal streams are still insufficient.

This paper reports the colonizing order of blackflies and voltinism of *M. aguirrei* in seasonal streams in an onchocerciasis endemic area of Guatemala.

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Survey Streams and Methods

Two streams, the Guachipilín and the Verde, were chosen for the study. Both streams are located to the west of the active volcano, Pacaya, in the Department of Escuintla, Guatemala. Sampling stations were situated in the uppermost sector of the two streams, where water runs only in the rainy season and for the subsequent 1 or 2 months. The altitudes of the stations were 1,250 m in the Guachipilín and 1,400 m in the Verde. The distance between the station and the nearest permanent stream was 10 m in the Guachipilín and 800 m in the Verde. The widths of the streams were both less than 1 m. The stream bed is composed of basal rock, stones and mud at either station. The two streams run through coffee plantations and forests. The water temperature was 18–20°C throughout the study period.

For a quantitative sampling, unit time collection was made once every 2 weeks in the Guachipilín and once a month in the Verde from May to October, 1978. During a 10-min period larvae and pupae of blackflies were collected with a forceps and were preserved in a 70% alcohol solution in the field. The maximum head widths of all larvae collected were measured under the microscope at 40× magnification following laboratory identification.

Results and Discussion

Blackfly species and relative abundance in seasonal streams

Eight species in the Guachipilín Stream and five in the Verde Stream were collected (Table 1). The five species in the Verde, *S. metallicum, M. aguirrei, S. horacioi, S. callidum* and *S.* (*Hemicnetha*) spp., were collected also in the Guachipilín and represented within the six top ranks in abundance. *Simulium ochraceum,* which was collected only in the Guachipilín, was the fourth most abundant there.

Among these species, *M. aguirrei* has a particular habitat preference for seasonal streams (Okazawa and Yamagata, 1985). The other species breed in both perennial and seasonal streams near the sampling stations (Takaoka, 1981, 1982).

Table 1 Blackfly species and numbers of the immatures collected in the Guachipilín and the Verde Streams.

Species	Number of larvae (pupae)	
	Guachipilín	Verde
Mayacnephia aguirrei	403(19)	214(10)
Simulium ochraceum	101(2)	0
S. metallicum	413(4)	387
S. horacioi	38(2)	139(1)
S. callidum	32	9
S. parrai	5	0
S. (*Hearlea*) sp.	13	0
S. (*Hemicnetha*) spp.	109	48
Total	1,114(27)	797(11)

Colonization of blackflies in the seasonal streams

In the Guachipilín, *M. aguirrei* colonized soon after the appearance of water flow in late May to early June, then *S. metallicum* and *S. horacioi* in late June, *S. ochraceum* in early July, followed by *S. callidum* and *S.* (*Hem.*) spp. in late July (Fig. 1). *Simulium ochraceum* appeared on July 11, one month later than *M. aguirrei* and 2 weeks later than *S. metallicum* and *S. horacioi.* Some larvae of *S. ochraceum* collected on that date were matured with black histoblast (pupal respiratory organ). But the larvae of *S. metallicum* and *S. horacioi* were small in size at the first appearance in late June. Considering the larval period of about 2 weeks (Dalmat, 1955), first larvae of *S. ochraceum* may have appeared in the same period as those of *S. metallicum* and *S. horacioi.* The same order of colonization in species was observed also in the Verde (Fig. 2).

The first peak of the larval density was observed in June for *M. aguirrei,* July for *S. metallicum* and *S. horacioi,* August for *S. callidum* and *S.* (*Hem.*) spp., and late August for *S. ochraceum* (Figs. 1 and 2).

Water flow in the seasonal streams was unstable at the beginning of the colonization of *M. aguirrei,* but became stable at appearance of *S. metallicum* and *S. horacioi* in spite

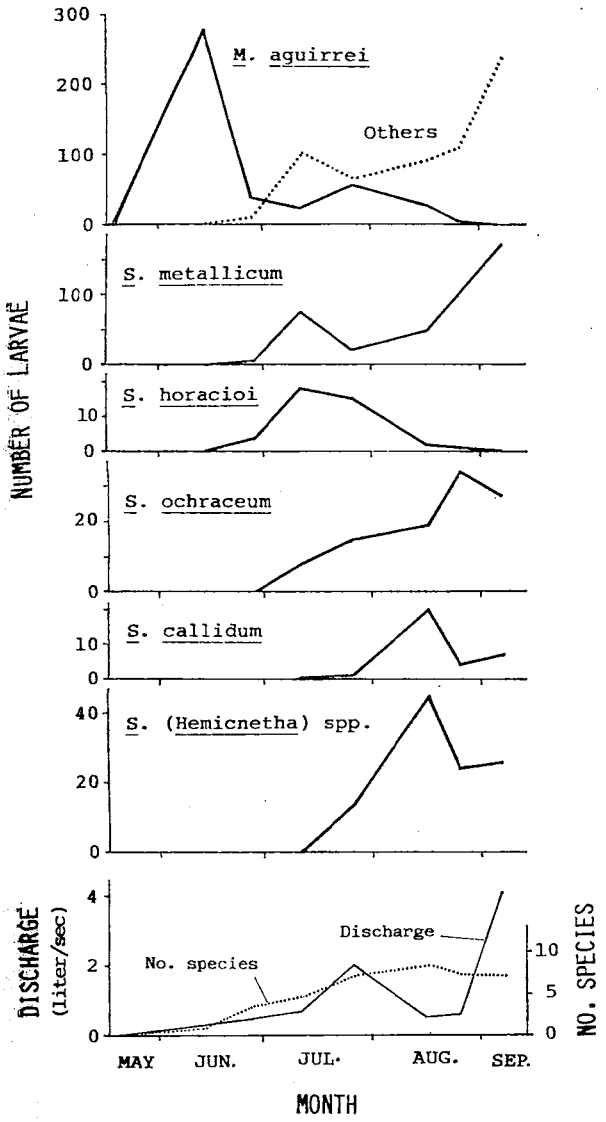

Fig. 1 Appearace of blackfly immatures in the Guachipilín at the onset of rainy season.

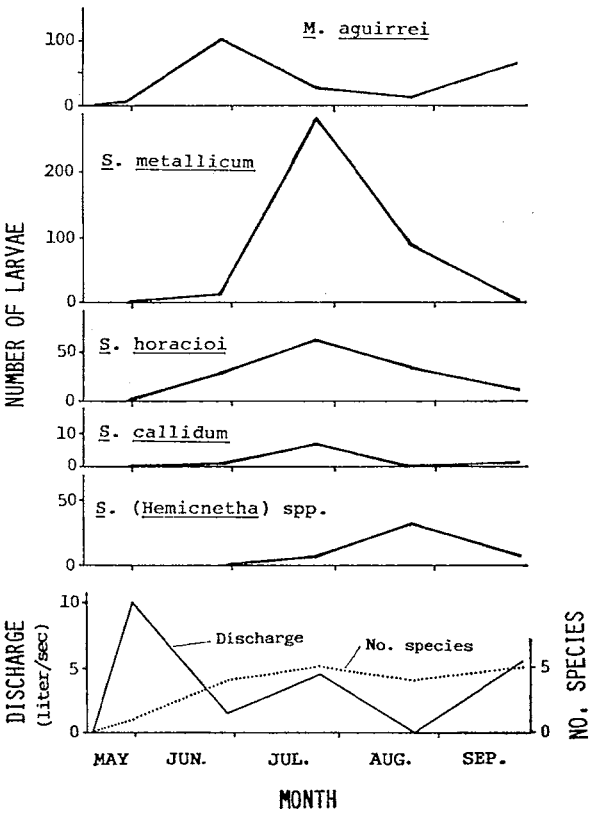

Fig. 2 Appearance of blackfly immatures in the Verde at the onset of rainy season.

of low levels of stream discharge. The discharge was maximal during the first half of the rainy season when *S. callidum* and *S.* (*Hem.*) spp. appeared. Larval density of *M. aguirrei* decreased and that of the other species increased with augmentation of stream discharge (Fig. 1). The number of species collected at each sampling time increased as the stream discharge became greater.

Thus, blackfly species colonize in sequence in the seasonal streams with lapse of time after the beginning of water flow. Preference of each species for stream discharge was reflected in the colonization order. *Mayacnephia aguirrei* prefers newly flowing streams and is tolerant to unstable water flow. Yamagata (1984) shows the sequence of discharge preference of four anthropophilic species, *S. horacioi, S. ochraceum, S. metallicum* and *S. callidum,* in the ascending order of discharge. From his illustration the minimum discharge level at which larvae were collected is almost the same for the first three species above. The minimum discharge is greater in *S. callidum* than in the other species. The present study showed that *S. horacioi, S. ochraceum* and *S. metallicum* began to colonize in the same period preceded by *M. aguirrei* and followed by *S. callidum.* The sequence of the minimum discharge levels at which different species occurred was similar to the colonization order obtained for those species in the seasonal streams. This suggests that the stream discharge is one of the important factors which determine the sequential colonization of blackflies in seasonal streams.

Voltinism of Mayacnephia aguirrei

Mayacnephia aguirrei had at least three generations at the sampling station in the Guachipilín in 1978. Frequency distribution of larval head widths at each sampling time

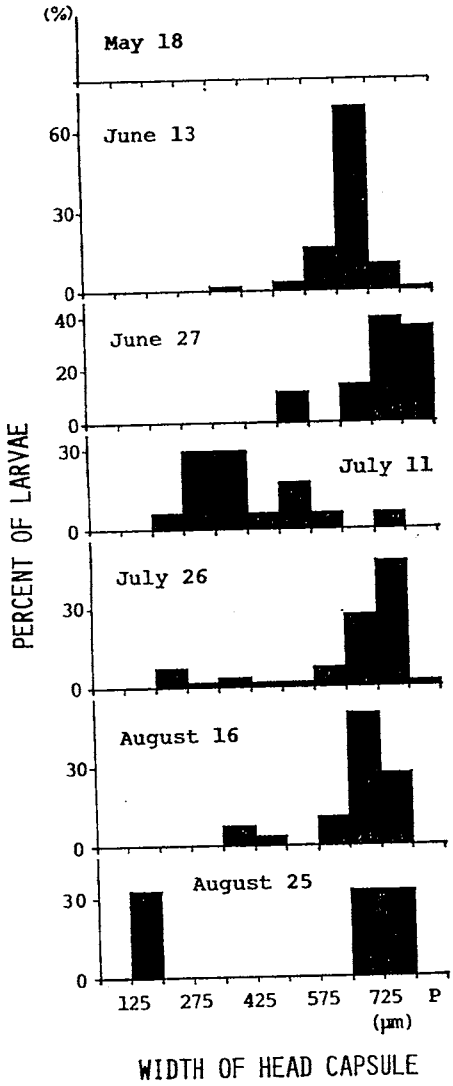

Fig. 3 Frequency distribution of the larval head widths of *Mayacnephia aguirrei* in the Guachipilín.

is shown in Fig. 3. The first generation occurred soon after the beginning of water flow in late May to early June. Larvae with black histoblast appeared in mid June. Pupae of the first generation were collected in late June. Small larvae of the second generation appeared in early July and pupation in late July. The water level was low for about 2 weeks during the period of interruption of the rainy season in mid August. The third generation appeared in late August when the water level was still low. No immatures were collected after September. About 1 month was necessary for *M. aguirrei* to complete one generation.

Larval density of each generation in the Guachipilín decreased from the first generation to the third as the rainy season proceeded (Fig. 1). The density at the regular sampling station was low in late August, while a much higher density was observed at a small gently inclined cascade located 200 m upstream from the sampling station. The subterranean part of the stream interrupted the surface water flow between the cascade and the sampling station. Main breeding places for *M. aguirrei* moved further upstream in correspondence with the upstream extension of the seasonal streams. In the Verde, the larval density of *M. aguirrei* once decreased before the interruption of the rainy season, when the stream discharge diminished to 0.05 liter/sec, and increased again later (Fig. 2). The decrease in water discharge in the Guachipilín was not so much as in the Verde during that period and the larval density showed no increase later. These facts suggest that *M. aguirrei* prefers streams with very small stream discharge for oviposition.

The date of the first occurence of water flow varied from year to year in correspondence with the beginning of the rainy season. In 1978, for example, water flow with large larvae of *M. aguirrei* was found on May 30 in the Verde, with pupae on June 13 in the Guachipilín, while, in 1980, streams were still dried up on June 18 in both systems and water flow with larvae was first observed as late as June 30 in the Guachipilín. Usually the water flow occurs approximately 1 month after the first rainfall of the rainy season. The duration of water flow in the seasonal streams may affect the number of generations of *M. aguirrei* in a given year.

In contrast to the frequent occurrence in the seasonal streams shortly after the inception of water flow, no larvae of *M. aguirrei* were found in the small perennial streams in the dry season (Okazawa and Yamagata 1985). This suggests that this species get through the dry half-year either in the egg or adult stage but not in the larval stage. This species appears to be harmless to men since no adult females were captured on human baits throughout the year near the sampling station in the Guachipilín (Takaoka, 1981). Other *Mayacnephia* species in Guatemala also breed in seasonal streams (Wygodzinsky and Coscarón, 1973). Voltinism and stage at which they pass the di

eason are unknown.

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摘　要

季節的な河川でのブユの出現と *Mayacnephia aguirrei* の化性

グァテマラにおけるオンコセルカ症流行地の季節的河川で，水が流れ始めてから，どのようなブユ種がどのような順序で出現してくるかを観察した．またそこで *M. aguirrei* が年に何世代を繰り返すかを調べた．

雨期に入り川に水が流れ始めると間もなく *M. aguirrei* が出現し，*Simulium metallicum*, *S. horacioi*, *S. ochraceum* が続き，その後 *S. callidum*, *S.* (*Hemicnetha*) spp. が現われた．出現の順序は川の流量の好みの順序と一致し，少ない水量を好む種から順に出現した．

M. aguirrei は多化性の種で，少なくとも年3世代をもつ．