PAROUS RATES FOR SYLVATIC *ANOPHELES* MOSQUITOES IN TWO AREAS OF COLOMBIA S.A.[1]

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Examinations of the ovaries of hematophagous insects have proven to be an important source of information of the blood-feeding habits and age composition of females. The importance of age structure data as a method in assessing the epidemiological importance of mosquito vectors has been reviewed by Detinova (1962, 1968) and Ungureanu (1974). The objective of the present study was to determine the parous rates for sylvatic *Anopheles* populations in 2 regions in Colombia endemic for malaria.

MATERIALS AND METHODS

From August 1973 through April 1974, monthly collections were made of sylvatic *Anopheles* adults in 2 areas of Colombia where the potential malaria vectors *An. triannulatus* (Neiva & Pinto, 1922), *An. oswaldoi* (Peryassu, 1922) and *An. mattogrossensis* Lutz & Neiva, 1911, were known to occur. One collection station was located at "Tres Esquinas," altitude 220 m in the Intendencia of Caqueta on the Orteguaza river in the Colombian Amazonian region. This area is characterized by abundant small marshes, swamps, pools and creeks. The average relative humidity is 85% and the average temperature is 25°C. Precipitation averages about 700 mm per month. The area is classified as lowland tropical rain forest and the human population is sparse.

The other collection station was located about 30 km from the "Calderón Texaco" oil camp near Puerto Boyacá, altitude 175 m in the departamento of Boyacá. This area is hilly terrain with narrow gullies and remnant patches of virgin tropical forest surrounded by grassland, swamps and cultivated clearing. During the rainy seasons the low lying areas are often flooded. Small lakes and permanent swamps with aquatic plants such as *Pistia stratiotes* and *Eichornia azurea* are common features. The entire area is surrounded by tropical rain forest. Several thousand people populate the area and the principal cultivated crops are corn, rice, plantain and cassava. Cattle and other domestic animals are common. The average relative humidity is 78%, the average temperature 28°C, and monthly precipitation averages 300 mm. June to early August and December to early February are dry months with very little rain. *Anopheles* adults were collected using four light traps (Chaniotis and Anderson 1968). The traps were hung from tree branches 1.5–2.0 m above the ground and were operated all night.

Dissections were performed immediately after capture on freshly killed specimens; after dissection, the ovaries were transferred to separate drops of distilled water on a microscope slide and allowed to dry. When completely dry, the differentiation was made between females that have deposited eggs (parous females) and those that have not yet deposited eggs (nulliparous) as indicated by the condition of the tracheal system of the ovaries (Detinova 1962).

RESULTS AND DISCUSSION

The Detinova method (1962), based on changes in the tracheal system of the ovaries, was used because the ovaries of *An. triannulatus* are very small. This makes detection of dilatations of the ovarian tubulus difficult to determine (Davies et al. 1971). A total of 1167 *Anopheles* females were collected from Tres Esquinas of which 1004 were dissected, and 2832 females were collected from Puerto Boyacá of which 1420 were dissected. *An. triannulatus* was common in both areas, whereas *An. oswaldoi* and *An. mattogrossensis* were only common in the Tres Esquinas area.

An. triannulatus was the most abundant species captured in Tres Esquinas (41%), but none of the 3 species was captured in large numbers in spite of 172 trap-nights. All 3 species were obtained simultaneously only at the beginning of the dry season. In the Tres Esquinas area, the parous rate was generally low throughout the year (Table 1). Only in March and April did the parous rate reach a high level (0.81) for *An. oswaldoi*; the rest of the year it fluctuated between 0.35 and 0.47. *An. mattogrossensis* was

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Table 1. Captures and dissections of female *Anopheles triannulatus* in Tres Esquinas—August 1973 to April 1974.

Date	Number Captured	No. Per trap-night	No. Dissected	Parous rate
8,9,10,11,12 August	153	31	61	0.26
12,13,14,15,16 September	60	12.0	54	0.50
29,30,31 October	2	0.7	—	—
1,2,3,4,5,6,7,8 November	35	4.4	24	0.50
1,2,3,4,5 December	128	26	128	0.42
11,12,13,14,15 16,17,18 January	100	12	100	0.30
26,27,28 February	7	2.3	—	—
1,2,3,4 March	5	1.2	—	—
26,27,28,29,30 April	0	0.0	—	—
Total	490		367	

Table 2. Captures and dissections of female *Anopheles triannulatus* in Puerto Boyacá—August 1973 to April 1974.

Date	Number Captured	No. Per trap-night	No. Dissected	Parous rate
29,30,31 August	946	315.3	264	0.45
1,2,3,4 September	600	150.0	230	0.59
3,4,5,6 October	460	115.0	263	0.50
21,22,23 November	340	113.3	242	0.71
14,15 December	110	55.6	91	0.56
28,29,30 January	100	33.3	84	0.75
19,20,21,22 February	250	62.5	246	0.66
29,30,31 March	0	0.01	—	—
1,2 April	26	13.0	—	—
Total	2.832		1.420	

obtained only between October and January, and the parous rate fluctuated between 0.32 and 0.58. This parous rate indicates that *An. oswaldoi* might be a potential vector of malaria in the Tres Esquinas area during March and April.

In Puerto Boyacá, *An. triannulatus* was caught in large numbers during most of the rainy season but was nearly absent during the dry season in March and April (Table 2). The density of *An. triannulatus* decreased gradually after a peak in August until none was captured in March (Fig. 1). The parous rates reached the high levels of 0.75 and 0.71 only in January and November. In Puerto Boyacá the parous rates tended not to vary, indicating that the age structure of the populations was rather stable. In both high and low mosquito population densities the parous rate remained high.

The variation of the density of the populations and the parous rates of mosquitoes in 2 areas may be due to different ecological and biological requirements of the females. Some of the factors increasing the capacity of a potential vector to transmit human malaria are a high parous rate, a high density, and the anthropophilic habit of the vector, (MacDonald 1952). Since *An. triannulatus* feed readily on man especially in the absence of other animals, and its density and parous rates were high in Puerto Boyacá, this species might be a potential vector of malaria in that area. On the other hand, based on low parous rates and low population densities *An. triannulatus* seems of little epidemiological importance in the transmission of malaria in the Tres Esquinas area.

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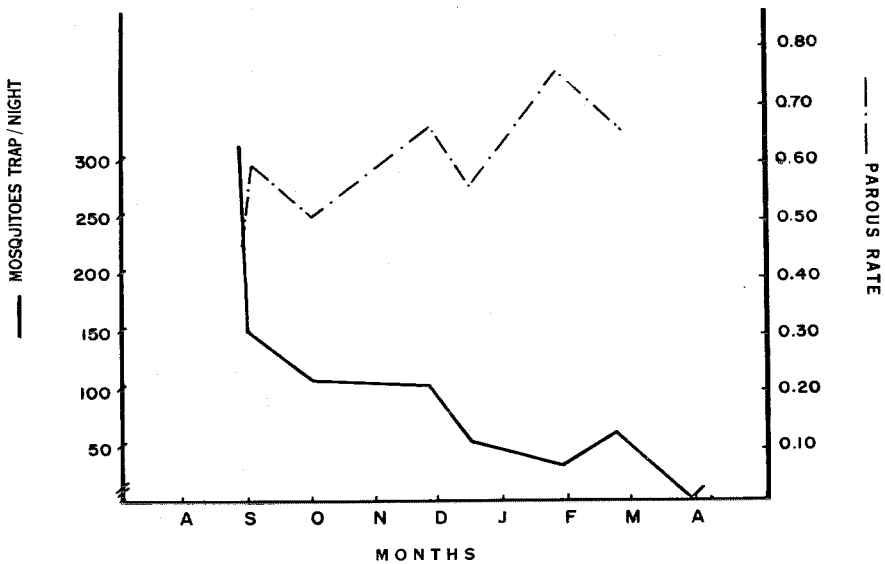
DENSITY AND PAROUS RATE DISTRIBUTION OF FEMALE ANOPHELES TRIANNULATUS IN PUERTO BOYACA 1973 — 1974



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THE EFFECT OF CULTURE AGE ON THE INFECTIVITY OF PREPARASITES OF THE MOSQUITO PARASITE *ROMANOMERMIS CULICIVORAX*

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The mermithid nematode *Romanomermis culicivorax* Ross and Smith has been studied extensively over the past few years as a biological control agent of larval mosquitoes. It has been mass cultured in several laboratories with mosquito larvae as the *in vivo* host for the parasitic stage and moist sand for the free living stages. In this procedure, sand cultures are flooded to induce the hatch of preparasitic (infective-stage) nematodes.

In studies of effect of culture age on the yield and survival of preparasites, Petersen (1978) found that cultures of *R. culicivorax* require about 8 wk to mature before substantial numbers of preparasites are produced at ambient temperatures. Peak hatches can be obtained when cultures are 11–19 wk old. Hatch steadily decreases thereafter and essentially ceases after about 36 wk. After hatching, the preparasite is highly infective for only 36–48 hr, but may remain motile for an additional 24–36 hr (Brown and Platzer 1977, Kurihara 1976). This loss of infectivity with retention of motility undoubtedly accounts for the low levels of infection sometimes reported when cultures are used immediately after being shipped long distances. The preparasites are known to hatch prematurely under these conditions, and many are rendered non-infective by the time they are used. This should not occur in laboratories where the cultures are produced. However, while using standard procedures and dosage rates, the author often observed widely fluctuating infection levels during week-to-week mass rearing. Since a rather common practice was to flood older cultures (20–30 wk old) to obtain the inoculum for the weekly mass-rearing cycle, the infectivity of the preparasites from these older cultures became suspect as the cause of lower-than-normal levels of infection. Therefore, a study was conducted to determine if the infectivity of preparasites was significantly different between older and younger cultures.

The test consisted of flooding 10-, 20-, and 30-wk-old cultures for 16 hr and then carefully counting the preparasites from each culture with volumetric dilutions. Only actively swimming nematodes were counted. The mean for 6 counts was used to determine the volume of preparasite-containing water to add to the test container. Four replications of 50 first-instar *Culex pipiens* were exposed to 500 preparasites each in 500 ml of water for each of the 3 cultures (12 exposures per test). The tests were conducted at ambient temperatures 26–27C) and were replicated 5 times (60 exposures total). The extent of parasitism was determined visually 7–8 days after exposure. Each value reported in Table 1 is the mean for 4 replications. Test means were separated with Duncan's multiple range test.

In each test but one, the mean percentage infection was highest for preparasites from 10-wk-old cultures; in Test 4, the infection levels at 10 and 20 wk were essentially the same. Parasitism for 10-wk-old cultures (80.2%) was significantly higher ($P = <0.05$) than for 20-wk-old cultures (53.2%). The 30-wk-old cultures averaged 41.6% parasitism, which was not significantly different than that of the 20-wk-old cultures; however, the difference between the 10- and 30-wk-old cultures was highly significant ($P = <0.01$).

Though this is a relatively simple observa-