INFLUENCE OF MOONLIGHT ON LIGHT TRAP CATCHES OF THE MALARIA VECTOR *ANOPHELES NUNEZTOVARI* IN VENEZUELA

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ABSTRACT. A significant effect ($P = 0.002$) of moonlight on light trap catches of *Anopheles nuneztovari* females was observed during a longitudinal study in western Venezuela. The catch with no moon was 1.86 times larger than with full moon. Nevertheless, moonlight does not seem to have any effect on the composition of adult mosquito population since the difference in the parous rate of females collected during full moon and during no moon was not significant ($P > 0.05$).

INTRODUCTION

Several studies have shown that moonlight influences the flight activity of mosquitoes. Some studies have shown that mosquito flight activity is enhanced during full moon as compared with moonless nights (Bidlingmayer 1964, Davies 1975, Charlwood et al. 1986). Most of the studies have demonstrated that the increased level of illumination in New Jersey light traps during full moon resulted in a smaller catch as compared with periods of no moon (Horsfall 1943, Pratt 1948, Provost 1959, Bowden 1973). In Latin America, the use of light traps for sampling and surveying malaria vectors has not been properly evaluated. The few reports published refer mainly to *Anopheles albimanus* Wiedemann. Apart from the studies of Pratt (1948) with *An. albimanus* in Puerto Rico, no long-series studies have been undertaken in South America to evaluate light trap catches in relation to moon phases. In this paper the results of long-series CDC light trap catches of *Anopheles nuneztovari* Gabaldón in relation to moon phase and parous rate is reported.

MATERIALS AND METHODS

The study was conducted in 3 villages in western Venezuela near the Colombian border (approximately 7°31'N, 71°41'W). The study area and the 3 villages have been described by Rubio-Palis and Curtis (in press). In each village an experimental hut (3 m wide × 5 m long) was built similar to the temporary houses that the people build, and consisted of incomplete wooden walls with many openings, corrugated iron roof and earthen floor (Fig. 1). The experimental huts were located in open meadows about 200 m from the nearest dwelling, although there were some trees and shrubs as close as 3 m. A CDC light trap (Sudia and Chamberlain 1962) operated by a 6-volt rechargeable battery was run simultaneously for 12 h a night in each of the 3 huts with 2 human baits per hut sleeping under nets. Human baits were rotated each night. This procedure was carried out for 2 nights per week, 3 wk per month for 15 months (August 1988–October 1989). It was arranged that routine house spraying with fenitrothion by the Division of Vector Control would not be carried out in the experimental huts in order to avoid interference between the study and the malaria control program.

In the morning, mosquitoes were killed either by freezing or with ethyl acetate or chloroform, identified and a sample of 20 female mosquitoes dissected for parity. Parity was determined by the Polovodova technique (Detinova 1962), i.e., presence or absence of dilatations on the ovariole stalks.

For data analysis the only species considered was *An. nuneztovari*, of which enough numbers were collected. Moon phases were divided as periods of full moon which included 5 days before and 5 days after the full moon, and periods of no moon which included 5 days before and 5 days after the new moon. Only months where there were equal numbers of observations in each village during each moon phase were considered. The Statistical Package for Social Scientists (SPSS/PC+ 1989) was used for data analysis.

RESULTS AND DISCUSSION

During the study 7,636 anophelines representing 9 species were collected in the 3 huts of which 4,363 were *An. nuneztovari* (Table 1). (Rubio-Palis and Curtis 1992).

Seven of the 15 months of collections had equal numbers of observations during periods of full moon and no moon (3 nights each), and were used in the analysis (Table 2). The analysis of variance of the log-transformed data showed that there was significant effect of month ($P = 0.0001$) and moon phase ($P = 0.002$) on the number of *An. nuneztovari* collected but no significant effect of village ($P = 0.15$). Two and three-way interactions were not significant. The mean number of *An. nuneztovari* collected with

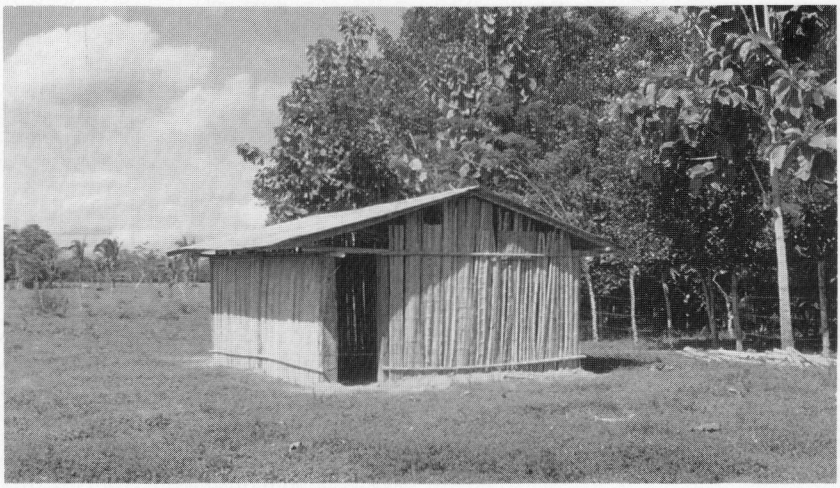

Fig. 1. Experimental hut (3 m wide × 5 m long).

Table 1. Anophelines collected in CDC light traps in Jabillos, Caño Lindo and Guaquitas between August 1988 and October 1989. The traps were run for a total of 82 nights (984 h) in each village.

Anopheles species	Jabillos	Caño Lindo	Guaquitas	Total
nuneztovari	1,263	995	2,105	4,363
triannulatus	252	5	469	726
albitarsis	181	31	274	486
oswaldoi	64	20	67	151
neomaculipalpus	49	6	47	102
rangeli	52	7	36	95
strodei	12	3	35	50
benarrochi	0	0	1	1
pseudopunctipennis	0	1	0	1
Not identifiable[1]	475	527	659	1,661
Total	2,348	1,595	3,693	7,636

[1] Due to loss of legs, wings, scales, etc.

Table 2. Number of *Anopheles nuneztovari* collected in light traps in 3 villages in western Venezuela during periods of full moon and new moon (3 nights each) between January and September 1989.

	Caño Lindo		Guaquitas		Jabillos	
Month	Full	New	Full	New	Full	New
January	26	60	5	27	25	44
February	24	14	1	8	0	5
April	1	5	0	2	0	0
June	50	35	53	32	8	1
July	158	66	84	124	54	42
August	66	172	166	482	70	201
September	6	116	54	142	29	51
Total	331	468	363	817	186	344

no moon was 1.86 times larger than during full moon. Similar results have been reported by other authors for different mosquito genera although the ratios reported for New Jersey light traps were higher (Provost 1959; Bidlingmayer 1964, 1974). Although the light traps were operated inside experimental huts, the results are similar to those where the traps are operated in the open (Pratt 1948). This is probably due to hut design, which allows increased illumination levels within the hut.

It has been demonstrated that the differences in mosquito catches at different moon phases is not the result of increased flight activity at new moon but an increased attractiveness of the light-trap (Provost 1959).

The parous rates of *An. nuneztovari* during full moon (27.8%, $n = 212$) and no moon (28.4%,

$n = 292$) were not statistically significant ($P > 0.05$) as tested by the Mantel-Haenszel chi-square test (Kirkwood 1988) stratified by village and season. Similar results have been reported by Bidlingmayer (1974).

When interpreting data from light traps it is important to consider that moon phases do affect the attractiveness of the trap to mosquitoes, which is a "function of each species' optimal level of nocturnal illumination" (Bidlingmayer 1985). For *An. nuneztovari*, it would be important to take moon phase into account when surveying for this species with light traps.

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