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DIFFERENTIAL ATTRACTION OF VENEZUELAN ANOPHELINES TO HUMAN COLLECTORS

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ABSTRACT. During a longitudinal study on vector biology and malaria transmission in western Venezuela the degree of attraction of mosquitoes to 4 people who carried out landing catches was evaluated. An analysis of variance of the log(x + 1)-transformed data showed that there were no significant differences in attractiveness of various individuals to *Anopheles nuneztovari, Anopheles marajoara,* or *Anopheles triannulatus.*

Various studies have demonstrated that there are differences in the degree of attraction of hematophagous insects, especially of mosquitoes, to different human individuals. For instance, it was shown that adults are more frequently bitten by mosquitoes than infants (Carnevale et al. 1976, Bryan and Smalley 1978), men are more attractive to *Aedes aegypti* (Linn.) than women (Gilbert et al. 1966), and that people with dark skin are more attractive than those with white skin (Smart and Brown 1956). There is evidence that mosquitoes are attracted by carbon dioxide, heat, moisture, and lactic acid. These variables could have consequences for the intensity of disease transmission and could be a source of error in determining the man-biting rate, that is, the number of mosquito bites per person per night.

The man-biting rate is an important parameter in entomological/epidemiological studies of malaria, and it is one of the most sensitive indices used to evaluate efficacy of vector control measures. However, the catches by individual human catchers vary either because of variation in their attractiveness to mosquitoes (Shidrawi et al. 1974) or variation in their catching skill. Curtis et al. (1987) showed that the variation in attraction to humans was genus-specific, that is, in an analysis of variance of numbers of different genera caught by each of 4 people over 72 nights there was a significant genus × person interaction.

In a longitudinal study on vector biology and malaria transmission in western Venezuela the degree of attraction of mosquitoes to 4 people who carried out landing catches was evaluated. Landing catches were carried out by a team of 6 catchers and 2 supervisors inside and outside of experimental huts constructed in 3 selected villages in the vivax-malaria-endemic area of western Venezuela (approximately 7°31′N, 71°41′W). The study area and villages were described by Rubio-Palis and Curtis (1992). Mosquitoes were collected for 12 h (1900–0700 h), 2 nights per week per village, from July 1988 to October 1989. Catchers worked in pairs for shifts of 4 h (1900–2300, 2300–0300, 0300–0700 h) with one catcher outdoors and one indoors. Catchers rotated each night between shifts and between indoors vs. outdoors (Rubio-Palis and Curtis 1992). Analyses were carried out on data from the 4 catchers with 6 months of previous experience using the 3 most common species, *Anopheles (Nyssorhynchus) nuneztovari* Gabaldon, *Anopheles (Nys.) marajoara* Galvao and Damasceno *sensu lato,* and *Anopheles (Nys.) triannulatus* (Neiva and Pinto), collected during the period of highest anopheline density, corresponding to the rainy seasons of August–December 1988 and June–October 1989. Catchers were local male residents, 17–35 years old, with skin color ranging from white to black. The Statistical Package for Social Scientists (1989) was used for data analyses.

Summary species counts indicated that catcher RB collected more *An. nuneztovari* and *An. marajoara s.l.* than the other collectors but fewer *An. triannulatus* than JC, whereas L collected fewer of each species than any other catcher (Table 1). To determine if these variations were significant, analysis of variance of the log(x + 1)-transformed data was carried out (Tables 2 and 3). The differences observed in total caught

Table 1. Number of *Anopheles* of the 3 most common species collected by each person during sessions of 4 h per night between July 1988 and October 1989.

Person	Age (years)	No. nights	*An. nunez-tovari*	*An. mara-joara*	*An. trian-nulatus*
RB	32	88	7,796	608	380
FS	17	92	7,453	438	516
L	18	89	4,998	355	359
JC	35	90	5,583	490	601

Table 2. Analysis of variance of the number of the 3 most common anopheline species caught for catchers (4) and time of night (1900–2300, 2300–0300, 0300–0700 h) between August and December 1988 and June and October 1989 (data were log transformed).

Source of variation	Sum of squares	df	Mean square	F	*P*
Main effects					
Catcher	1.432	3	0.477	1.781	0.16
Species	119.025	2	59.513	214.213	0.0001
Time	18.758	2	9.379	33.759	0.0001
2-way interactions					
Catcher × species	0.993	6	0.165	0.596	0.73
Catcher × time	5.910	6	0.985	3.545	0.002
Species × time	7.256	4	1.814	6.529	0.001
3-way interactions					
Catcher × species × time	1.437	12	0.120	0.431	0.95
Residual	86.402	311	0.278		

among catchers were not significant ($P = 0.16$), whereas there was a highly significant difference between species and time of collection and month and significant species × time and species × month interactions.

These results confirmed previous reports that *An. nuneztovari* was by far the most abundant species in the study area, that mosquito numbers were strongly dependent on rainfall and humidity, and that there were characteristic hour-by-hour variations in biting (Rubio-Palis and Curtis 1992). Furthermore, these hour-by-hour patterns vary between the species and the times of seasonal peaks also vary somewhat between the species (Rubio-Palis and Curtis 1992). The factorial analysis of variance showed that the interaction between catcher and time was significant, suggesting that some of the catchers maintained alertness throughout the night better than others. However, the catcher × species interaction was not significant, indicating no real difference in the attractiveness of different individuals to these closely related anopheline species, in contrast to the results for the members of the genera *Anopheles, Culex,* and *Mansonia* reported by Curtis et al. (1987).

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Table 3. Analysis of variance of the number of the 3 most common anopheline species caught for catchers (4) and month (August–December 1988 and June–October 1989) (data were log transformed).

Source of variation	Sum of squares	df	Mean square	F	*P*
Main effects					
Catcher	1.4051	3	0.350	1.126	0.34
Species	118.610	2	59.305	190.515	0.0001
Month	24.660	9	2.740	8.802	0.0001
2-way interactions					
Catcher × species	1.190	6	0.198	0.637	0.70
Catcher × month	5.153	27	0.191	0.613	0.94
Species × month	14.020	18	0.779	2.502	0.01
3-way interactions					
Catcher × species × month	5.304	54	0.098	0.316	0.99
Residual	70.662	227	0.311		

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