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THE HOST-FEEDING PATTERNS OF *CULEX QUINQUEFASCIATUS* IN MISSISSIPPI[1]

M. L. BERTSCH[2, 3] AND B. R. NORMENT[2]

Department of Entomology, Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, Mississippi State, MS 39762

ABSTRACT. Blood-feeding patterns of *Culex quinquefasciatus*, analyzed by a simple percentage calculation of the total number of blood-meals that had been derived from a specific host, indicated a preference for avian hosts. Percent avian feedings decreased from 70.3% to 59.6% from June through August 1976. The trend reversed by October when 77.5% of the blood-meals were avian. Similarly, during the period May through July 1977, the avian preference ranged from 96.3% in May to 57.2% in July.

INTRODUCTION

In recent years St. Louis encephalitis (SLE) has occurred in epidemic proportions in Mississippi and other states. St. Louis encephalitis is known to be a cyclic disease within the bird-mosquito complex, with occasional involvement of humans. In Mississippi it has been generally accepted that *Culex quinquefasciatus* Say is responsible for the transmission of SLE to man, since SLE virus positive mosquito populations have been isolated. Tempelis et al. (1967), found that 96% of engorged *Cx. quinquefasciatus* had fed on birds. However, Suyomoto et al. (1973) determined that only 56% of *Cx. quinquefasciatus*, in the southern United States, had utilized an avian host. *Culex tarsalis* Coq., a known vector of SLE in the western United States, shifts from bird hosts during the spring and early summer, to mammals during the mid- and late summer months (Tempelis 1975). This trend was reversed in the fall with a return to birds as the preferred host. As variable feeding patterns have been demonstrated for *Cx. quinquefasciatus* (Hess et al. 1968), the objective of this investigation was to determine the blood-feeding patterns for this species during the summer months.

MATERIALS AND METHODS

Two study areas were selected in Oktibbeha County, Mississippi, one urban and the other rural. The urban study area was within the city limits of Starkville (east central Mississippi), and the rural area consisted of the campus, Plant Research Center and the Animal Research Center of Mississippi State University (MSU). Six resting stations were selected randomly within each of the study areas. Typical resting stations consisted of culverts, garages, animal shelters, bridges and livestock barns. Engorged specimens were collected three times weekly from 15 March to 15 October 1976 and 15 March to 31 July 1977. The resting stations

[1] Publication No. 5267. Mississippi Agricultural and Forestry Experiment Station.

[2] Graduate Research Assistant and Professor, respectively, Department of Entomology. Address reprint requests to B. R. Norment, Drawer EM, Mississippi State, MS. 39762.

[3] Present Address: U. S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD 21010.

were randomly sampled every 7 days. Specimens were returned to the laboratory daily and placed in the freezer until processed. A tray of ice covered with filter paper maintained the specimens in an immobile condition during identification and processing. Abdomens from engorged specimens were placed in size "0" gelatin capsules and held at −65°C until assays were conducted. Blood-meals were analyzed by the capillary precipitin technique of Tempelis and Lofy (1963) at the Arbovirus Ecology Laboratory, Centers for Disease Control, Fort Collins, CO, and results were analyzed using a percentage calculation. The data were analyzed by simple linear regression on arcsin transformed percent feeding on birds as a function of month.

RESULTS AND DISCUSSION

During 1976, 821 engorged *Cx. quinquefasciatus* were collected; 100 were collected in 1977. Of the 821 abdomens that were analyzed, 205 failed to react with all antisera that were available for testing (Table 1). An avian feeding preference was observed, particularly during the months of June, July, August and September when 70.3, 61.1, 59.6 and 77.5% feedings, respectively, were observed. Of mammalian hosts, equine and bovine were the preferred blood-meal sources with subsequent positives recorded for canines and rabbits in August and September. Columbiformes were initially the preferred avian host, with a predominance of feeding on domestic fowl and passerines during the period of June–September. In 1977, only 126 sera were analyzed, of which 10 were non-reactors for any antisera, whereas 31 were positive for birds but negative for the screening antisera (Table 2). Human feedings were recorded only during 1977; positives were recorded for May and July. As in 1976, a decided avian feeding preference was noted in 1977. The *Cx. quinquefasciatus* feedings on birds were 96.3, 89.5 and 57.2% in May, June and July, respectively. Other mosquito species collected in low numbers were *Cx. restuans* Theobald and *Cx. salinarius* Coq. Of the 28 *Cx. restuans* collected in 1976 and 1977, precipitin analysis revealed that passerines (57%) were the most frequent blood source followed by Columbiformes (18%) and domestic fowl (7%). Conversely, of the 12 *Cx. salinarius* specimens analyzed, 58% had fed on birds and 42% on mammals. The most frequent feedings were recorded from domestic fowl and horses.

The domestic fowl population (MSU poultry complex), which represented approximately 11,000 birds (1976 and 1977), was confined, thus affording a readily available host throughout the study period. Tempelis et al. (1970) reported that *Cx. quinquefasciatus* primarily fed on birds with approximately 31% feeding on mammals. Ritchie and Rowley (1981) reported that *Culex* spp. (*Cx. pipiens* Linn., *Cx. restuans* and *Cx. salinarius*) fed predominantly on birds but exhibited a midsummer increase in their feeding on mammals. Magnarelli (1977) re-

Table 1. *Culex quinquefasciatus* host utilization, 1976.

	Month collected						
	March	April	May	June	July	August	Sept
Blood-meal	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
				*Negative**			
	0	0	0	1 (2.7)	17 (6.9)	12 (2.8)	0
				Mammals			
Human	0	0	0	0	0	0	0
Equine	1 (33.3)	0	0	1 (2.7)	33 (13.4)	64 (14.7)	2 (2.0)
Bovine	1 (33.3)	0	0	5 (13.5)	41 (16.6)	55 (12.7)	6 (6.1)
Canine	0	0	0	0	0	1 (0.2)	1 (1.0)
Rabbit	0	0	0	0	0	23 (5.3)	11 (11.2)
Other	0	0	0	1 (2.7)	0	1 (0.2)	0
Negative**	0	0	0	3 (8.1)	5 (2.0)	19 (4.4)	2 (2.0)
				Birds			
Chicken	0	0	0	16 (43.3)	97 (39.3)	166 (38.2)	48 (49.0)
Columbiform	0	0	3 (100.0)	2 (5.4)	0	0	0
Passeriform	0	0	0	0	10 (4.0)	23 (5.3)	7 (7.1)
Other	0	0	0	0	0	0	0
Negative**	1 (33.3)	1 (100.0)	0	44 (21.6)	44 (17.8)	70 (16.1)	21 (21.4)

*—Non-reactor for any antisera.
**—Reaction positive for indicated animal group but negative for screening antisera.

Table 2. *Culex quinquefasciatus* host utilization, 1977.

	Month collected				
	March	April	May	June	July
Blood-meal	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
			*Negative**		
	0	0	0	4 (6.0)	6 (21.4)
			Mammals		
Human	0	0	1 (3.7)	0	2 (7.1)
Equine	0	0	0	0	0
Bovine	0	0	0	0	0
Canine	0	0	0	3 (4.5)	4 (14.3)
Rabbit	0	0	0	0	0
Other	0	0	0	0	0
Negative**	0	0	0	0	0
			Birds		
Chicken	0	1 (25.0)	0	3 (4.5)	0
Columbiform	0	0	5 (18.5)	2 (3.0)	0
Passeriform	0	1 (25.0)	16 (59.3)	39 (58.2)	8 (28.6)
Other	0	0	0	0	0
Negative**	0	2 (50.0)	5 (18.5)	16 (23.9)	8 (28.6)

*—Non-reactor for any antisera.
**—Reaction positive for indicated animal group but negative for screening antisera.

ported that *Cx. pipiens* acquired blood almost exclusively from passeriform birds. However, other studies have reported shifts from preferred avian blood-meal sources to mammalian sources (Kokernot et al. 1969, Suyomoto et al. 1973). Previously, Hayes et al. (1973), suggested that mosquito population densities might influence the extent of feeding upon various hosts. Furthermore, Reeves (1971) indicated that an increased proportion of feedings on birds is diverted to mammals when the vector population is large because most species of birds are intolerant to attack by large numbers of mosquitoes. According to Hayes et al. (1973), the species composition and age structure of vertebrate host populations within an ecosystem may have a greater influence upon the proportion of birds and mammals being fed upon than would the relative numbers of birds and mammals.

These data indicated an avian host utilization preference by *Cx. quinquefasciatus* during the spring and early summer months with an increased mammalian host preference during mid-to-late summer. However, when analyzed statistically, a nonsignificant ($p > 0.20$) trend of decreasing percent bird feeding was observed. Thus, the observed shifts in bird to mammal feeding are more likely associated with increased mosquito densities which occurred during July and August (Bertsch and Norment, unpublished data). Of interest also was the total absence of human feedings during 1976 and only extremely limited human feeding activity in 1977 which suggests that *Cx. quinquefasciatus* may not be the primary vector of SLE to humans.

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STATISTICAL EVALUATION OF GROUND APPLIED ULV MALATHION ON NATURAL POPULATIONS OF *AEDES VEXANS* AND *CULEX* SPECIES

PAUL R. GEERY, ROBERT E. HOLUB AND RICHARD R. KEEN
Desplaines Valley Mosquito Abatement District, 8130 Ogden Avenue, Lyons, IL 60534

ABSTRACT. New Jersey light trap data collected daily from 1977 through 1981 were analyzed to evaluate the efficacy of ground applied ultra-low volume (ULV) malathion against natural populations of *Aedes vexans* and *Culex* species mosquitoes. A comprehensive statistical evaluation of the light trap data for the three days before and three days following ULV application demonstrated statistically significant declines averaging 21% in the female population of *Ae. vexans* and 27% in female *Culex* species.

INTRODUCTION

Ground ultra-low volume (ULV) application of insecticides used to reduce adult mosquito populations has undergone numerous evaluations since its introduction over a decade ago (Mount et al. 1968). Some investigators utilizing ovitrap data concluded that local ULV application exerts no significant effect on natural adult populations (Strickman 1979). However, local attempts to duplicate these results have been unsuccessful due to the extremely high variability found with this method (unpublished data). Some researchers using caged mosquitoes under simulated natural conditions have obtained very high mortality rates (Alvarez 1974). However, the rates observed in a caged mosquito population do not necessarily reflect those of a natural, dynamic population. Thus, a need for an alternate method of evaluation of ULV applied malathion against natural populations exists. Our analysis with light trap data was completed in an attempt to satisfy this need.

MATERIALS AND METHODS

The Desplaines Valley Mosquito Abatement District, covering 76.5 mi² in the western Chicago suburbs, has operated ten New Jersey light traps at established locations throughout the district since 1941. These locations consist of five backyards in residential areas, two backyards bordering wooded floodplains, one backyard bordering a cemetery, one wooded site and one golf course. Since 1977, the traps have had the added capacity to sample mosquito populations over weekends without human intervention, (a time controlled carriage shifts a separate collection jar into position for each weekend day) consequently providing a daily count. Data collected from these ten traps for the five years 1977–81 provide the basis for this study.

Adulticiding operations covering the entire district were performed about 32 times over the 5-yr period. All ULV applications were made with truck-mounted LECO-HD (Lowndes Engineering Co. Inc., Valdosta, GA) aerosol generators dispensing 91% malathion at a rate of 3.5 fl. oz./min. at a vehicle speed of 8 mph. Applications were made during evening, premidnight hours when adult mosquitoes were most active (unpublished data) and only when weather conditions were acceptable for the parameters of ULV application.

Retrospective analysis of the District's adulticiding records for this period demonstrated