

## MOSQUITO ACTIVITY IN TEXAS DURING THE 1971 OUTBREAK OF VENEZUELAN EQUINE ENCEPHALITIS (VEE): II. VIRUS INCIDENCE IN MOSQUITO SAMPLES FROM THE SOUTH TEXAS PLAINS<sup>1</sup>

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**ABSTRACT.** Light traps in the Maverick-Dimmit, Zapata-Starr, and Brooks-Kenedy areas of Texas collected 32,490 mosquitoes which were tested for viruses. *Psorophora confinnis* predominated in the Maverick-Dimmit collections. *Aedes sollicitans* predominated in the Zapata-Starr collections, and *P. cyanocephala* in the Brooks-Kenedy col-

lections. No viruses were isolated from Brooks-Kenedy pools. WEE was isolated from *A. sollicitans*, *A. theileri*, and *Culex tarsalis*, and SLE and VEE from *P. confinnis* from Maverick County. WEE was isolated from *C. tarsalis* and VEE from *A. sollicitans* and *P. confinnis* from Zapata County.

**INTRODUCTION.** Although human and equine cases of Venezuelan equine encephalitis (VEE) peaked in Texas during mid-July 1971, sporadic outbreaks of this disease continued to occur during the latter part of July and throughout the fall of 1971 (Sudia *et al.*, 1972). These latter outbreaks were centered, for the most part, among horse herds in the South Texas Plains (Fig. 1). Mosquito samples were collected in the vicinity of some of these horse herds by Texas A&M University personnel during August, 1971 and were subsequently tested for virus. The results presented here reflect the relative size, species composition, and virus incidence for female mosquito populations surveyed by Texas A&M personnel in the South Texas Plains between 10 and 26 August 1971. During this period, suspected cases of VEE were still being reported from counties bordering the Rio Grande; and the status of mosquito populations, as to their potential for maintaining the disease in this part of the State, remained uncertain.

**METHODS.** Methods of collecting and handling mosquitoes in the field were similar to those described by Sudia and Cham-

berlain (1967). CDC Miniature Light Traps in combination with insulated bags containing dry ice were used to sample female mosquito populations (Newhouse *et al.*, 1966; Sudia and Chamberlain, 1962). Resulting mosquito samples were sealed in vials and stored in a frozen state on dry ice until they were shipped to the laboratories either at the Center for Disease Control (CDC), Atlanta, Georgia, or at Texas A&M University, College Station, Texas. In the laboratory, the samples were transferred to an ultra-low temperature cabinet ( $-50^{\circ}$ ) where they were held for subsequent identification, pooling and virus assay.

Mosquito samples processed by CDC were tested for virus in duck embryo monolayer cultures (DEC) with agar overlay. DEC in 1-oz bottles were inoculated with 0.1 ml of mosquito suspension and observed for plaque formation daily for 10 days. If plaques developed, cultures were passed in DEC with fluid overlay. The resulting virus suspension was identified by neutralization tests in DEC as described by Chappell *et al.* (1971). Suspensions of mosquitoes processed at Texas A&M were inoculated into 2 or 3-day-old suckling mice (SM) at the rate of 0.02 ml of mosquito suspension per mouse. Brains of mice which became prostrate or died during the 7-day observation period were passed into an additional litter of SM. Viruses present in the second SM passage brain suspensions were identified by a combination of hemagglutination inhibition, complement fixation and

<sup>1</sup> This research was conducted in cooperation with the Agricultural Research Service, U.S. Department of Agriculture and approved for publication as TA10838 by the Director, Texas Experiment Station.

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neutralization tests utilizing standardized reagents supplied by CDC.

Regions of the South Texas Plains surveyed by Texas A&M field teams are shown in Figure 1. The specific areas surveyed and placement of light traps in the Maverick-Dimmit and Zapata-Starr County regions were governed by the locations of observed and/or reported equine encephalitis cases. In these regions, traps were set in the immediate vicinity of horses which had either died recently from a disease symptomatic of VEE or were sick at the time of survey. Other traps were set at varying distances up to 20 miles away from these horses.

In the Brooks-Kenedy County region, light traps were set near herds of horses which had been vaccinated with TC-83 VEE vaccine on or about 3 July 1971. Other traps

were set at the precise locations where these same horses had been vaccinated and held for a period of time after vaccination. No suspected cases of encephalitis had been reported for these latter horse herds even though they were in the epizootic area.

**RESULTS.** At least 25 species representing 6 mosquito genera were present in light trap collections from the 3 South Texas Plains regions surveyed by Texas A&M field teams during August 1971 (Table 1). *Psorophora confinnis* was the predominant species in collections from the Maverick-Dimmit region. This species was second to *Aedes sollicitans* in Zapata-Starr County and to *Psorophora cyaneescens* in collections from the Brooks-Kenedy County region.

A total of 32,490 mosquitoes pooled from samples collected in the three South Texas regions were tested for virus. Of this total, 17,775 specimens were from the Maverick-Dimmit County region, 11,306 were from the Zapata-Starr County region and 3,409 were from the Brooks-Kenedy County region. These subtotals represented 45, 100 and 36 per cent of the total mosquitoes collected by light traps in the respective regions. No viruses were isolated from Brooks-Kenedy County mosquito pools. However, virus isolates were made from mosquitoes collected in the other two regions (Table 2).

All isolations from Maverick-Dimmit County mosquito pools came from mosquitoes collected in Maverick County. This county was surveyed on two separate occasions: once 10-12 August and again 24-26 August 1971. The St. Louis encephalitis (SLE) virus isolate and three of the Western equine encephalitis (WEE) virus isolates recorded from the Maverick-Dimmit area in Table 2 were made from samples collected in Maverick County during 10-12 August. WEE isolates from these samples include the ones from *Aedes sollicitans* and *A. thelcter* as well as one of the two WEE isolates recorded for *Culex tarsalis*. The other WEE virus isolate from *Culex tarsalis* and the 6 VEE virus isolates from *Psorophora confinnis* represent virus isolations made from mosquitoes collected in Maverick County 24-26 August. One of the six VEE virus isolates

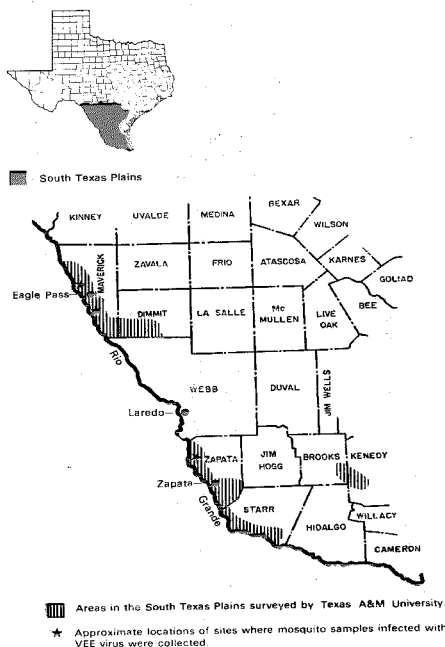


FIGURE 1.—Areas in the South Texas Plains surveyed for adult mosquito activity by Texas A&M University field teams 10-26 August 1971.

came from 468 specimens of *P. confinnis* collected approximately 6 miles north of Eagle Pass, Texas; and the other 5 isolates of this virus were made from 1,805 specimens collected approximately 9 miles south of Eagle Pass near El Indio, Texas (Fig. 1).

All virus isolates from Zapata-Starr County mosquito pools came from mosquitoes collected in Zapata County during 17-19 August (Table 2). Five of the VEE virus isolates were made from 6,665 specimens of *Aedes sollicitans* collected on the J. W. Mecom Ranch approximately 30 miles south of Laredo, Texas in Zapata County (Fig. 1). The other VEE virus isolate from 2,150 specimens of *Psorophora confinnis* as well as the WEE virus isolate from 175 specimens of *Culex tarsalis* were also from mosquitoes collected on the Mecom Ranch.

**DISCUSSION.** On the basis of the relative size and species composition of female mosquito populations, it appears that there was sufficient vector support for VEE virus in each of the three South Texas regions surveyed by Texas A&M during August, 1971 (Table 1). At least nine of the mosquito species listed by Sudia and Newhouse (1971) as suspected vectors of VEE in Texas during 1971 were common to collections from each of the South Texas regions surveyed during this study (Table 1). In addition, Brooks-Kenedy County collections included specimens of *Culex nigripalpus*, which was incriminated as a vector of VEE during the 1961 outbreak of this disease in Guatemala (Sudia *et al.*, 1971). Nevertheless, VEE virus was isolated from mosquito samples collected in only limited areas bor-

TABLE 1. Number of female mosquitoes collected per trap for light traps set in the South Texas Plains, 10-26 August 1971.

Species	No. of Mosquitoes Collected Per Trap in		
	Maverick-Dimmit County Region (28 Traps)	Zapata-Starr County Region (18 Traps)	Brooks-Kenedy County Region (19 Traps)
<i>Aedes bimaculatus</i> (Coquillett)	—	—	0.9
<i>Aedes fulvus pallens</i> Ross	<0.1	—	—
<i>Aedes sollicitans</i> (Walker) <sup>a</sup>	301.6	379.3	24.9
<i>Aedes taeniorhynchus</i> (Wiedemann) <sup>a</sup>	40.4	0.2	85.9
<i>Aedes ibelcter</i> (Dyar) <sup>a</sup>	23.4	14.2	55.9
<i>Aedes vexans</i> (Meigen)	118.3	10.1	—
<i>Aedes zoosopbus</i> (Dyar and Knab)	0.5	—	9.5
<i>Anopheles crucians</i> Wiedemann <sup>a</sup>	3.4	—	3.9
<i>Anopheles pseudopunctipennis</i> Theobald <sup>a</sup>	42.1	3.7	4.7
<i>Anopheles punctipennis</i> (Say)	0.6	—	—
<i>Anopheles quadrimaculatus</i> Say	0.9	—	0.2
<i>Culex coronator</i> Dyar and Knab	21.6	6.7	3.5
<i>Culex nigripalpus</i> Theobald <sup>b</sup>	<0.1	—	<0.1
<i>Culex quinquefasciatus</i> Say	0.7	—	—
<i>Culex salinarius</i> Coquillett	27.5	1.1	0.5
<i>Culex tarsalis</i> Coquillett	13.4	9.7	0.5
<i>Culex thriambus</i> Dyar	<0.1	—	—
<i>Culex</i> ( <i>Melanocnion</i> ) species <sup>a</sup>	70.4	1.2	14.5
<i>Culex</i> species	0.3	—	—
<i>Deinocerites matbesoni</i> Belkin and Hogue	—	—	0.2
<i>Psorophora ciliata</i> (Fabricius) <sup>a</sup>	5.8	2.2	55.2
<i>Psorophora confinnis</i> (Lynch Arribálzaga) <sup>a</sup>	537.1	129.3	115.7
<i>Psorophora cyaneicens</i> (Coquillett) <sup>a</sup>	8.0	8.6	117.5
<i>Psorophora discolor</i> (Coquillett) <sup>a</sup>	167.0	51.6	41.4
<i>Psorophora signipennis</i> (Coquillett)	24.3	10.2	—
<i>Uranotaenia lowii</i> Theobald	—	<0.1	0.1
All species	1385.6	628.1	534.9

<sup>a</sup> Species incriminated as possible vectors of VEE in South Texas in 1971 (Sudia and Newhouse, 1971).

<sup>b</sup> Species incriminated as a possible vector of VEE in Guatemala in 1969 (Sudia *et al.*, 1971).

TABLE 2. Virus isolations from female mosquitoes collected in the South Texas Plains during 10-26 August 1971.

Mosquito Species	Collected In			
	Maverick-Dimmit County Region		Zapata-Starr County Region	
	Total No. Tested	Virus: No. of Isolates	Total No. Tested	Virus: No. of Isolates
<i>Aedes sollicitans</i> (Walker)	4,733	WEE: 1 (1/4733) <sup>a</sup>	6,827	VEE: 5 (1/1365)
<i>Aedes triseriatus</i> Dyar	488	WEE: 1 (1/488)	256	—
<i>Culex tarsalis</i> Coquillett	289	WEE: 2 (1/144)	175	WEE: 1 (1/175)
<i>Psorophora confinnis</i> (Lynch Arribáizaga)	6,740	SLE: 1 (1/6740) VEE: 6 (1/1123)	2,327	VEE: 1 (1/2327)
Other species	5,565	—	1,721	—
Total	17,775	WEE: 4 SLE: 1 VEE: 6	11,306	WEE: 1 SLE: 0 VEE: 6

<sup>a</sup> Fraction in parentheses indicates minimal mosquito field infection rate (MFIR). This rate assumes presence of only one infected mosquito per infected pool.

dering the Rio Grande in Maverick and Zapata Counties (Table 2; Fig. 1). Also, each mosquito sample positive for VEE virus was collected no farther than 1 mile from a suspected case of encephalitis in a horse. It should be noted that there were no blood engorged specimens present in mosquito pools found positive for VEE.

*Aedes sollicitans* appeared to be the primary VEE vector on the Mecom Ranch in Zapata County. The actual minimal field infection rate (MFIR) for VEE virus in populations of *A. sollicitans* on this ranch was higher than that given for the entire Zapata-Starr County region in Table 2. In this case, the actual MFIR was probably nearer to 1/1333. Similarly, the MFIR for VEE virus in *Psorophora confinnis* populations on the same ranch was probably nearer to 1/2150. These two adjusted rates are based on the actual number of specimens collected on the Mecom Ranch that were tested for virus.

*Psorophora confinnis* appeared to be the most important vector in the Maverick County outbreak of VEE during the latter part of August 1971. The actual MFIR for VEE virus in *P. confinnis* populations from VEE-positive sites in Maverick County

ranged between 1/361 and 1/468. Again, these latter rates of infection are considerably higher than those calculated for the entire Maverick-Dimmit County region (Table 2).

Before the results of this study were obtained, VEE was considered as the most potentially imposing medical and veterinary health hazard in extreme south Texas during the fall of 1971. For this reason, the isolation of other viruses (SLE and WEE) from mosquitoes collected along the Rio Grande was very interesting. The incidence and frequency of WEE isolations and corresponding MFIRs suggest that (1) WEE was very active in Maverick County in mid-August; and (2) that *Culex tarsalis* was the primary vector in the Rio Grande areas surveyed by Texas A&M. The absence of virus within mosquito samples collected near horses vaccinated for VEE in Brooks and Kenedy Counties is also of interest. These latter results tend to support the findings of Taylor and Buff (1972), who determined that horse-to-mosquito-to-horse transmission of TC-83 vaccine virus does not seem to occur in the field.

ACKNOWLEDGMENTS. The authors

wish to thank Drs. W.D. Sudia and V.F. Newhouse and the rest of the staff formerly of the Arbovirus Ecology Unit, CDC, Atlanta, Georgia, for their part in processing mosquito samples and gathering the data presented in this paper.

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