PRELIMINARY REPORT OF SEASONAL OVIPOSITION BY *CULEX QUINQUEFASCIATUS* IN SAN ANTONIO, TEXAS[1]

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ABSTRACT. Egg rafts deposited by *Culex quinquefasciatus* were counted daily in 2 oviposition traps in southeastern San Antonio, Texas. Fourteen months of continuous data (1981–82) indicated that the period of greatest oviposition was from May through September. The most favorable ambient temperatures for oviposition were a maximum over 27°C (80°F) or a minimum between 18°C (65°F) and 24°C (75°F). Oviposition continued sporadically in January and February, the coldest months of the winter. Egg rafts were found in the traps in winter following temporary periods of warm weather.

Culex quinquefasciatus Say is a serious vector of disease in the southern United States. In Texas it transmits St. Louis encephalitis, western equine encephalitis and dog heartworm (Buxton and Mullen 1980, Hayes et al. 1971, Lang et al. 1981, Luby et al. 1969). Agencies charged with the responsibility of reducing populations of this species must sometimes intensify their efforts in response to an actual or potential disease outbreak. To be effective, such intensified efforts require accurate information on abundance of *Cx. quinquefasciatus* during the year.

The months of greatest activity of *Cx. quinquefasciatus* vary according to the climate of a geographic locality, usually corresponding to the warmest season of the year. Examples of periods of peak activity which correspond to maximum seasonal temperatures include May through August in northern Florida (Lowe et al. 1974), June and July in Louisiana (Villavaso and Steelman 1970), and May through October in coastal Texas (Hayes 1975). Some climates alter this pattern of summer abundance. For example, populations of *Cx. quinquefasciatus* are nearly constant all year in Fiji where temperature varies little (Goettel et al. 1980). Another example is the Coachella Valley of southeastern California where very hot summer temperatures limit activity during that season (Apperson et al. 1974).

One method of assessing populations of *Culex* is to count the number of egg rafts deposited in oviposition traps containing foul water, the traps acting as artificial oviposition sites. A number of studies used this technique successfully to study various aspects of the bionomics of *Culex* (Hayes 1975, Hayes and Hsi 1975, Leiser and Beier 1982, Lowe et al. 1974, Strickman 1979).

The current study was designed to determine the seasonal activity of a natural population of *Cx. quinquefasciatus* in San Antonio, Texas. Oviposition traps were chosen as an efficient means of following population trends. This paper reports the results of the first 14 months of daily counts of egg rafts.

MATERIALS AND METHODS

The location of this study was a residence in southeastern San Antonio. The neighborhood is an old suburb with numerous mature trees forming a nearly complete canopy over most of the area. The San Antonio River is 1 km from the site. Numerous drainage systems leading toward the river probably contribute larval sites for *Cx. quinquefasciatus*. Abundant collections of discarded tires, buckets and other vessels provide additional larval sites.

Oviposition by *Culex* mosquitoes was monitored using oviposition traps. Each trap was a small plastic trash can (6-liter capacity) containing an attractant developed by Lewis et al. (1974). Ingredients for the attractant were 4 liters of water and 32 g of alfalfa pellets. This mixture was aged in the laboratory for 11 days at 27°C (81°F), at which time it was fully attractive to ovipositing mosquitoes. Traps were exposed to natural populations of mosquitoes for 7 days before replacing the attractant.

Two traps were used in the study. Trap I was located under a 1.5 m high bush adjacent to a garage. A cover of green-painted plywood was supported 10 cm above the trap to protect it from rain. Trap II was located about 25 m from trap I, adjacent to a house and under a 3 m high dense bush (*Pittosporum tobira*). This trap did not need a cover because the bush interrupted most direct rainfall.

Rafts in each trap were counted every afternoon before sunset. If enough rafts were available, 5 rafts from each day's oviposition were reared in separate containers and the resulting fourth-stage larvae identified to species.

This paper presents data from 21 July 1981 to 18 September 1982 for trap I and from 30

[1] Opinions and assertions contained herein are the private views of the author and are not to be construed as official, nor as reflecting the views or endorsements of the United States Air Force or of the Department of Defense.

September 1981 to 18 September 1982 for trap II. Data were analyzed by computing the 7-day moving average (Downing 1976) of the daily number of rafts collected in each trap. The averages were calculated by computing the mean of the observation in question and the 6 previous observations. Daily maximum and minimum temperatures were similarly analyzed, but precipitation was treated on a simple daily basis. All weather data were collected by

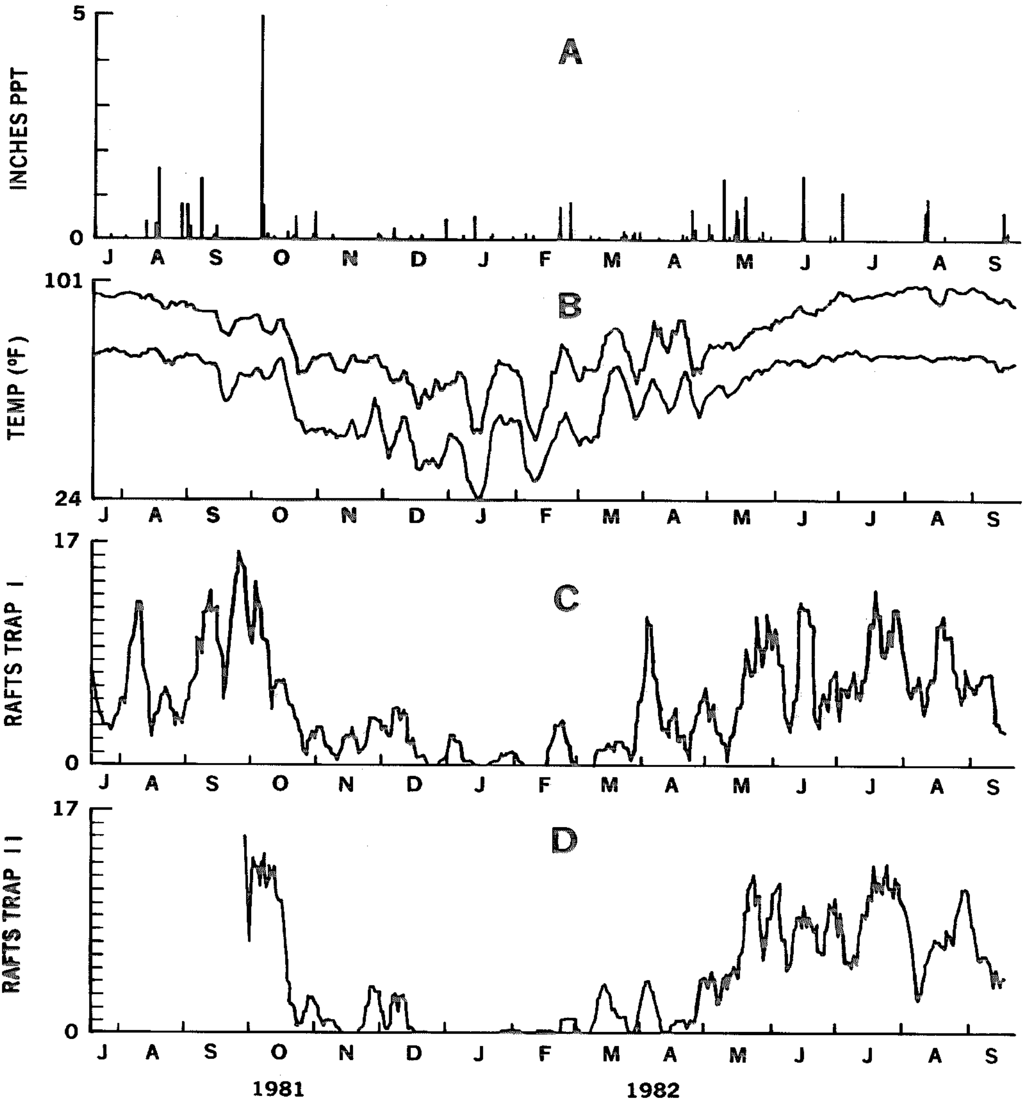

Fig. 1. Precipitation (A), maximum/minimum temperature (B), and oviposition by *Culex quinquefasciatus* (C and D) from 21 July 1981 through 18 September 1982 in southeastern San Antonio, Texas. Egg rafts were collected in 2 oviposition traps located 25 m from each other. Temperatures and numbers of egg rafts are 7-day moving averages.

Kelly Air Force Base, about 15 km from the study site.

RESULTS AND DISCUSSION

The abundance of *Culex* in the study area was demonstrated by collection of a total of 2139 egg rafts. Of these, 2128 were deposited by *Cx. quinquefasciatus*. The other 11 egg rafts were deposited by *Cx. restuans* Theobald.

Seasonal distribution of egg rafts of *Cx. quinquefasciatus* is presented in Fig. 1 and the correspondence of oviposition to temperature is presented in Tables 1 and 2. Despite differences in actual number of rafts, the 2 traps presented the same seasonal pattern of oviposition. The greatest number of egg rafts were deposited when maximum temperatures exceeded 27°C (80°F) and when minimum temperatures were between 18°C (65°F) and 24°C (75°F). The warm season from May through September included the most days satisfying these temperature conditions. The number of rafts during the warm season fluctuated in cycles which corresponded in part to periods of excessively high minimum temperatures. During the cool season, from October through April, temperatures varied widely. Oviposition during the cool season corresponded closely to periods when the minimum temperature exceeded 7°C (45°F) or when the maximum temperature exceeded 21°C (70°F). Rainfall throughout the year bore no apparent relation to oviposition activity. Hayes and Hsi (1975) reported a similar lack of correspondence between oviposition and rainfall. They also observed a strong corre-

Table 1. Relation of maximum temperature to oviposition by *Culex quinquefasciatus* in the field, 21 July 1981 through 18 September 1982, San Antonio, Texas.

Interval of daily maximum temperature (°F)[1]	No. of observations	Mean daily no. of rafts in 2 traps[1,2]	Range of daily no. of rafts[1]
45.1–50	9	0.09 a	0–0.3
50.1–55	7	0.07 a	0–0.3
55.1–60	9	0.5 a	0–1.4
60.1–65	18	0.8 a	0–2.7
65.1–70	51	2.2 a	0–7.3
70.1–75	53	2.8 a	0–7.1
75.1–80	36	5.4 b	2.3–9.7
80.1–85	45	11.7 c	2.4–25.2
85.1–90	39	19.0 de	3.6–32.2
90.1–95	59	12.6 c	6.1–26.2
95.1–100	95	14.4 de	4.8–25.4
100.1–105	4	15.0 ce	12.5–17.8

[1] Calculated from 7-day moving averages.
[2] Means not sharing a common letter were significantly different at the 95% level as determined by an F-test and least significant differences (Steel and Torrie 1960).

Table 2. Relation of minimum temperature to oviposition by *Culex quinquefasciatus* in the field, 21 July 1981 through 18 September 1982, San Antonio, Texas.

Interval of daily maximum temperature (°F)[1]	No. of observations	Mean daily no. of rafts in 2 traps[1,2]	Range of daily no. of rafts[1]
20.1–25	3	0.07 a	0–0.1
25.1–30	3	0.2 a	0–0.3
30.1–35	12	0.2 a	0–0.8
35.1–40	20	0.5 a	0–2.6
40.1–45	16	1.4 a	0–6.6
45.1–50	52	2.4 a	0–7.3
50.1–55	39	2.8 a	0.3–7.0
55.1–60	23	7.0 b	0.8–25.2
60.1–65	33	7.6 b	2.8–28.0
65.1–70	44	16.3 c	2.7–32.2
70.1–75	133	14.6 c	6.1–26.2
75.1–80	47	12.2 d	4.8–17.8

[1] Calculated from 7-day moving averages.
[2] Means not sharing a common letter were significantly different at the 95% level as determined by an F-test and least significant differences (Steel and Torrie 1960).

spondence between oviposition and temperature, especially minimum temperature.

An examination of oviposition activity during winter months (Fig. 2) indicated the response of the species to cold weather. The coldest 2 days of the winter in 1981–1982 occurred on 11 January with a maximum of −2°C (28°F) and a minimum of −8°C (17°F), and on 6 February with a maximum of 1°C (33°F) and a minimum of −4°C (25°F). The oviposition trap actually froze during these periods, yet oviposition occurred 9 days after the cold in January and 7 days after the cold in February. Other periods of oviposition in Fig. 2 also indicate that egg rafts were deposited following short periods of warmer temperatures. Mature larvae, pupae or adults evidently survived or avoided extreme cold and then developed in less than 10 days to a stage capable of oviposition.

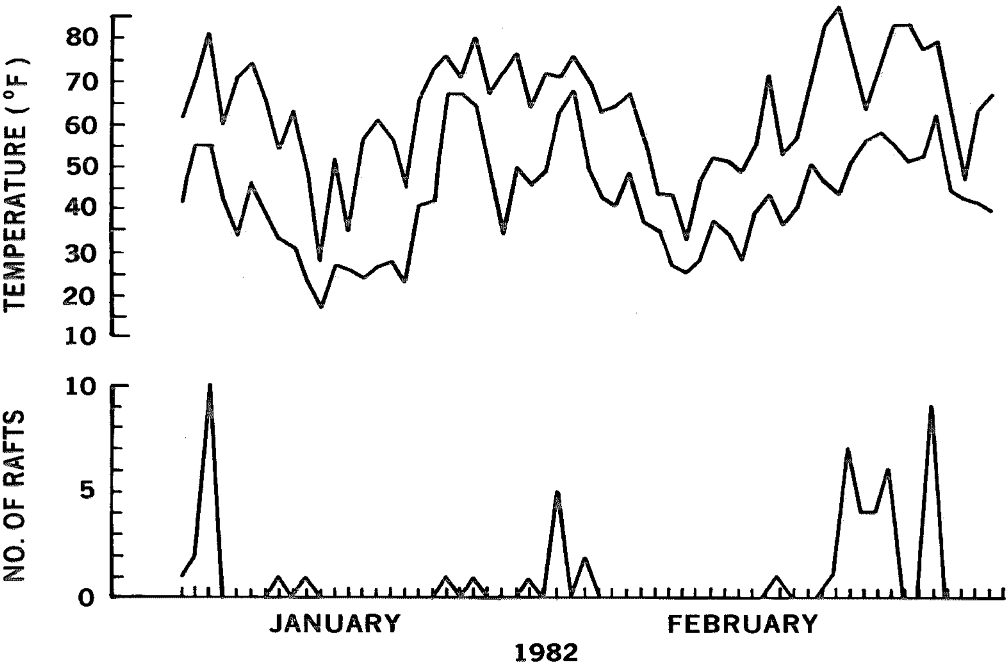

Fig. 2. Ambient maximum/minimum temperature and total number of egg rafts of *Culex quinquefasciatus* in 2 oviposition traps during January and February 1982 in southeastern San Antonio, Texas.

Several workers have studied development of *Cx. quinquefasciatus* under winter conditions. In the laboratory, temperatures as low as 10°C (50°F) and daily photoperiods as short as 10 hr may slow development but not stop it (Tekle 1960; Eldridge 1966, 1968). Outdoors, this species oviposits during brief warm periods following freezing temperatures (Smittle et al. 1975) and completes larval development in cold water (Hayes and Hsi 1975). In the current study, adult populations evidently declined during the winter, but the chain of active development continued.

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