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OPERATIONAL AND SCIENTIFIC NOTES

EFFECT OF A LUNAR ECLIPSE ON THE FLIGHT ACTIVITY OF MOSQUITOES IN THE UPPER GULF COAST OF TEXAS[1]

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ABSTRACT. Adult mosquito flight activity was monitored at a coastal marshland site in Chambers County, TX, before, during, and after a total eclipse of the moon on August 16, 1989. A vehicle-mounted mobile interceptor trap and a stationary, dry ice-baited CDC miniature light trap were used in this monitoring effort. *Aedes sollicitans, Anopheles crucians, Culex salinarius,* and *Psorophora columbiae* were mosquito species most abundantly represented in collections made by both traps during the 12-h study period. The numbers of each of these species collected by the vehicle-mounted trap decreased during the lunar eclipse and increased when the full moon was exposed. Collections of these same species by the light trap increased during the lunar eclipse and decreased when the full moon was exposed.

Numerous factors have been identified as having an influence on mosquito flight activity. Increased humidity resulted in an increase in flight activity for *Aedes vexans* Meigen (Platt et al. 1958) and *Culex nigripalpus* Theobald (Dow and Gerrish 1970). Temperature has been shown to influence mosquito flight activity (Bradley and McNeel 1935, Bidlingmayer 1974, Carroll and Bourg 1977). High wind velocities can reduce mosquito flight activity (Bradley and McNeel 1935, Bidlingmayer 1974, Service 1980). Increased mosquito activity was observed in Mexico during the 1991 total solar eclipse (Palma 1991). This note is to document effects of a total lunar eclipse on August 16, 1989 on flight activity of mosquitoes at a marshland site in the Anahuac National Wildlife Refuge along the southern coastal edge of Chambers County, TX.

On this night, the sky was clear, with clouds forming only at sunrise, at which time a 5-min shower of rain occurred. Official sunset on August 16 was 2002 h (CDST) and official sunrise on August 17 was 0650 h. The full moon rose at 1955 h on August 16. The lunar eclipse began at 2021 h, was total between 2120 and 2256 h, and ended at 2356 h. Ambient air temperature at the start of mosquito activity assessments was 29°C and dropped slowly to a sunrise temperature of 26°C. Relative humidities rose from 64 to 92%. Wind was negligible throughout the night, although small gusts up to 3.2 km/h from the southeast occurred occasionally.

Adult mosquito activity was continuously monitored at this site from 2000 h on August 16 to 0630 h on August 17, using a combination of a vehicle-mounted mobile trap and a stationary, dry ice-baited CDC miniature light trap (Newhouse et al. 1966). The vehicle-mounted trap consisted of a funnel-shaped 16-mesh nylon net, 122 × 76 cm at the rectangular frontal opening and tapering posteriorly to a 10 cm circular opening, which led to a removable collection bag. The trap was secured to the roof of the vehicle by elastic bands. The light trap was baited with *ca.* 1.5 kg of dry ice (Newhouse et al. 1966) encased within a padded mailing envelope and suspended adjacent to the trap. The trap was operated by a 6-V lantern battery. A removable mesh collection bag was attached to the CDC trap.

The mobile trap was operated at speeds of 19–24 km/h along a 2.82-km shell road located in an intermediate brackish marsh region of the Anahuac National Wildlife Refuge. The route was orientated in a northeasterly to southwesterly direction and was exposed to the perpendicular prevailing winds. The stationary CDC trap was suspended from a 1.5-m pole in an adjoining pasture. Both vehicle-trap and light-trap collections were initiated one hour before sunset on August 16, continuing throughout the night and ending approximately one hour after sunrise on August 17. Three 15-min collections per hour were made with each trap. Following each traverse of the mobile trap, collections from both traps were removed, labeled, and placed in an ice chest containing dry ice for preservation and

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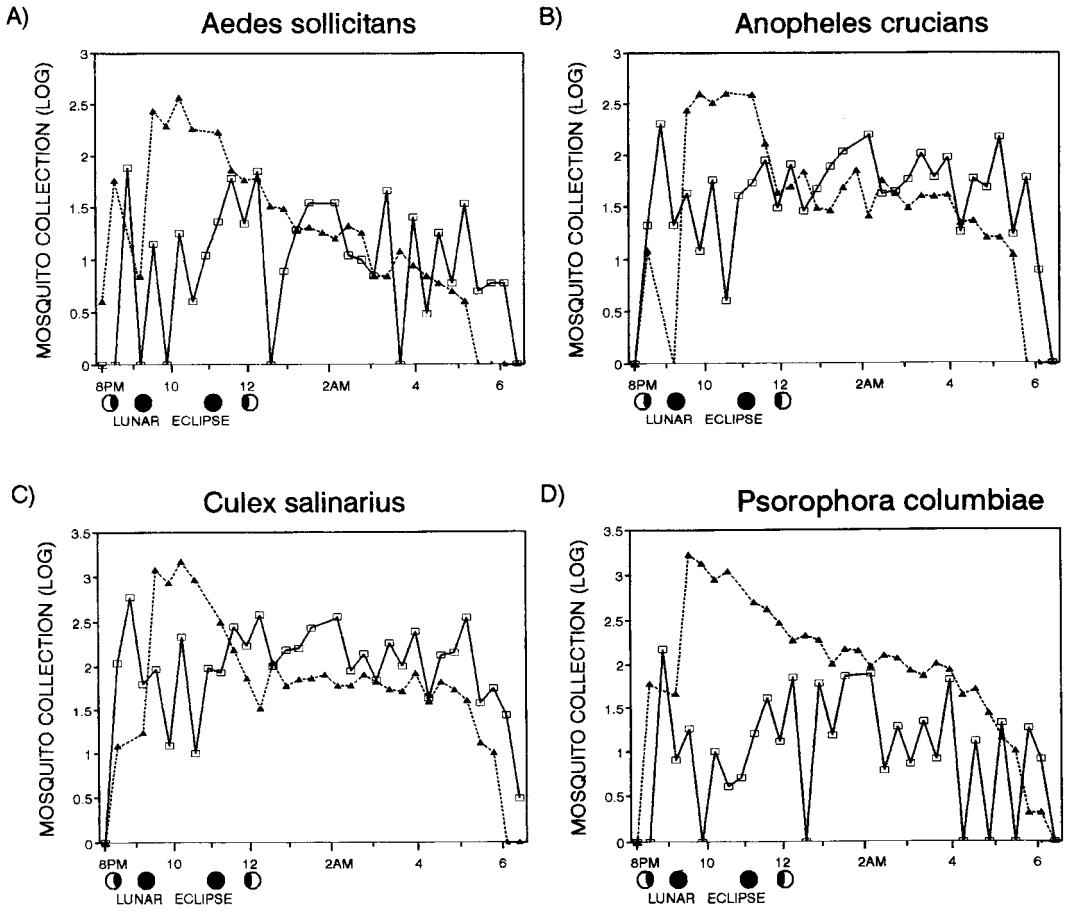

Fig. 1. Logarithmic values for numbers of predominant mosquito species (females) collected in a vehicle-mounted trap (solid line) and a CDC miniature light trap (broken line) operated in an intermediate marsh in the Anahuac National Wildlife Refuge in Chambers County, TX, during the total lunar eclipse of August 16, 1989.

later identification. Empty bags were replaced on each trap and the next collection period commenced. Ambient air temperature, wind speed and direction, humidity, light intensity, precipitation, and degree of cloud cover were measured and recorded between collection runs. In the laboratory, mosquitoes were separated and identified using the keys of Darsie and Ward (1981). Numeric values for mosquitoes collected by each method were transformed to a logarithmic value (log $[x + 1]$, where x = number of mosquitoes collected) (Bidlingmayer 1969). Data were analyzed by ANOVA (SAS 1985) with numbers of mosquitoes collected during each collection period being dependent variables and environmental parameters designated as independent variables. The lunar eclipse was categorized as either partial, total, or absent and was included as a categorical independent variable.

Ten mosquito species were represented in collections by the 2 trapping methods over the 12-h study period. *Aedes sollicitans* (Walker), *Aedes taeniorhynchus* (Wied.), *Anopheles crucians* Wied., *Anopheles quadrimaculatus* Say, *Coquillettidia perturbans* (Walker), *Culex erraticus* (Dyar and Knab), *Culex salinarius* Coq., and *Psorophora columbiae* (Dyar and Knab) were represented in collections from both vehicle and light traps. In addition to these, *Uranotaenia* sp. and *Psorophora ciliata* (Fabricius) were represented in collections from vehicle and light traps, respectively. Only *Ae. sollicitans, An. crucians, Cx. salinarius,* and *Ps. columbiae* females were collected in sufficient numbers to be used in this analysis.

Vehicle trap collections indicate *An. crucians* and *Cx. salinarius* females initiated their flight activity at 2020 h (Figs. 1B, 1C), whereas *Ae. sollicitans* and *Ps. columbiae* began their flight

activity at 2040 h (Figs. 1A, 1D). All 4 mosquito species were collected by 2020 h with the CDC trap. *Aedes sollicitans* and *Ps. columbiae* were collected earlier by light traps than by vehicle-mounted traps. Both trapping techniques indicate an early peak in mosquito activity occurring at or before 2040 h and lasting approximately 20 min.

Of the various environmental parameters measured during the night of the study, only the lunar eclipse and associated light intensity changes were found to have a significant effect ($P < 0.05$) upon the flight activity of the 4 mosquito species collected by both trapping methods (Fig. 1). Collections of each species from the vehicle trap decreased in size as the eclipse reached totality, while collections made concurrently in the light trap increased. The increased numbers of mosquitoes collected by vehicle trap at 2215 h, during the darkest phase of the eclipse, could not be explained. As the full moon began to reappear *ca.* 2300 h, mosquito numbers in the vehicle trap collections increased thereafter and those in the light trap began to decrease. Following the eclipse, mosquito activity gradually declined with few or no mosquitoes collected by official sunrise (Fig. 1). Light intensity during the total phase of the eclipse was 0.60 lux and was 1.18 lux throughout the remainder of the night.

The results from vehicle trap collections are probably more indicative of actual mosquito activity and the effect of a lunar eclipse on this activity than are results from the light trap. As noted by Bidlingmayer (1966), vehicle-mounted traps provide a more unbiased, nonattractant form of sampling adult mosquito populations than do light traps. In this regard, Bidlingmayer (1964) reported that *Ae. taeniorhynchus* females were collected by vehicle-mounted traps in greater numbers during times when the moon was full or in one of its quarter phases than during a new moon phase. In our study, vehicle-mounted trap collections before and after the lunar eclipse were larger than those made during the eclipse, corresponding to observations by Bidlingmayer (1964) on full moon nights. The smaller collections during the eclipse are consonant with observations by Bidlingmayer (1964) during new moon phases.

The effectiveness of the light emitted by the CDC light trap was enhanced during the dark phase of the lunar eclipse, at which time increased numbers of mosquitoes were collected. Provost (1959), using New Jersey light traps in Florida, collected *ca.* 6 times more mosquitoes during new moon phases than were collected at full moon. Similar observations were reported by Bradley and McNeel (1935), Horsfall (1943), and Pratt (1948). The total eclipse in this study would provide ambient light intensities comparable to those on new moon nights and apparently with similar effects on mosquito light trap collections.

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