USE OF THE TRUCK TRAP FOR EVALUATING ADULT MOSQUITO POPULATIONS[1]

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The truck trap is a non-attractant sampler that has proven extremely valuable for measuring the level of nocturnal mosquito flight activity. As mosquitoes are not in continuous flight throughout the night, the proportion of the total population in flight at different times will vary, large changes occurring not only from night to night, but from hour to hour. The truck trap differs from most adult sampling methods by going to the mosquito rather than depending upon the mosquito to come to the trap. The sample is taken over an extensive area, and the collection is presumably a composite of varying mosquito densities over the entire route. This enables the truck trap to be relatively free of one of the major biases of stationary traps; that of sampling a restricted area occupied by above or below average numbers of mosquitoes. Consequently it is very sensitive to changes in the numbers of mosquitoes in flight and should be useful as a means of measuring population changes in connection with mosquito control programs.

A history of the use of this method of collecting mosquitoes can be given briefly. Chamberlin and Lawson (1945) and Stage (1947) mounted a screen funnel on the fender of an automobile. De Zulueta (1950) used a similar device on the savannahs of eastern Colombia. Provost (1952, 1955, 1957) used both fender and roof mounted truck traps, essentially similar to the one used today, as part of a comparison of various sampling methods. Further studies with the truck trap were made by Bidlingmayer (1961, 1964, in preparation).

As minor changes have been made, a description of the current trap will not be repetitive. The trap consists of a large net of fiber glass screening fastened to a pyramidal wooden frame (Fig. 1). The mouth of the trap is 7 feet wide, 2 feet high and tapers back approximately 10 feet to a 4 x 4 inch opening. The trap is so designed that the wooden 2 x 2 framework is on the outside, creating a smooth interior. A cloth marquisette bag is fitted over the rear opening by means of four loops around its mouth, and the tail of the bag is supported in a horizontal position by being clipped (clothespin, clip-board clamp, etc.) to a support that projects about 15 inches to the rear of the opening. This support is parallel to and above the collection bag; it does not lie within it. The leading edges of the trap are of tempered hardboard. The trap is mounted a few inches above the roof of a vehicle with the lower edge of the trap extended somewhat in front of the windshield. Mosquitoes are held in the net by the forward motion of the vehicle.

At the start of each run a numbered bag is attached to the trap, the end of the bag clipped to the support, and the vehicle driven over the route at a speed of 20 to 25 m.p.h. At the end of each run the driver dismounts and hurriedly removes the net. Because of the horizontal position of the net, losses due to the brief delay that occurs before the driver can get to the rear of the vehicle will be negligible. There is no evidence that the lights on the vehicle have any effect on the collections.

No method of sampling flying mosquitoes will take all species proportionate to their occurrence in the total population. Certain species venture into open areas,

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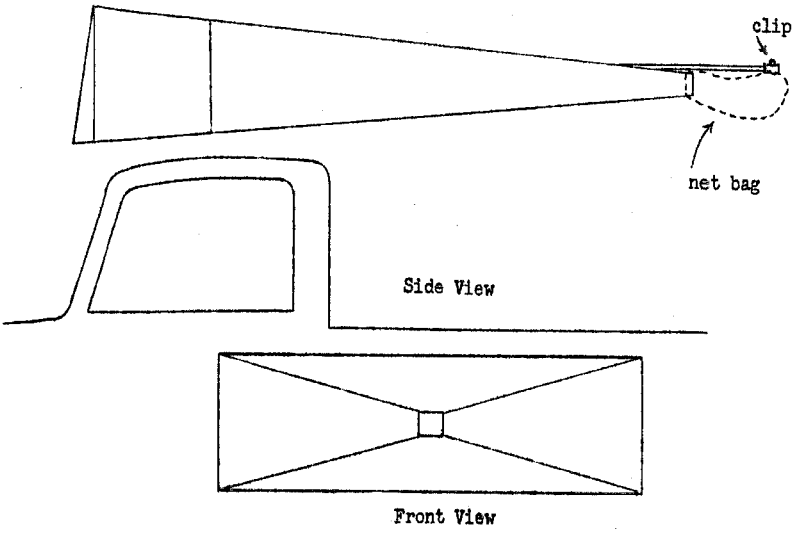

FIG. 1.—Diagrammatic side and front views of truck trap.

such as roadways, much less frequently than others. *Culiseta melanura* and *Anopheles quadrimaculatus* strongly favor wooded areas. *Culex nigripalpus, Uranotaenia lowii, Deinocerites cancer, Mansonia perturbans, Mansonia indubitans, Anopheles punctipennis* and *Aedes sticticus* venture out more readily while *Anopheles crucians, Psorophora confinnis, Uranotaenia sapphirina, Aedes vexans, Aedes taeniorhynchus* and *Aedes sollicitans* invade open areas freely (Bidlingmayer, ms in preparation). The truck trap has been found satisfactory for most species with the possible exception of *Cs. melanura* and *An. quadrimaculatus*. Thus, the presence of equal numbers of two species in a truck-trap collection indicates only equal numbers where the collection was made; off the roadways their numbers will be equal only if they are similar in flight habits.

It is essential the pattern of mosquito flight activity during the night be understood before planning a truck trap sampling program. The night should be divided into eight approximately equal periods; an evening twilight period which starts at sunset and ends at astronomical twilight, the dark period from the end of twilight until midnight, and the dark period from midnight until the start of dawn, each divided into thirds, and a morning twilight period which begins at astronomical twilight and terminates at sunrise.

Mosquito flights are influenced by meteorological factors, e.g., wind, temperature and light, and the sensitivity of the truck trap made it the preferred method for studying quantitative changes in flight activity. It was necessary to investigate the effects of light first and this required relatively uniform weather conditions. Truck-trapping was conducted during the warmer months and consequently there has been little opportunity to investigate other factors. During recent studies (Bidlingmayer, 1964) the flight activity during the twilight periods at 0–10, 20–30, 40–50 and 60–70 minutes after sunset, and at 70–60, 50–40, 30–20, 10–0 minutes before sunrise, was determined (Fig. 2). During the dark periods of the night three or more truck runs were made during each period and the values shown are a mean for each period.

The light intensities during the twilight

periods are determined primarily by the sun and the illumination patterns vary little from day to day. The light intensities during the dark periods of the night are determined primarily by the moon. The illumination levels during the night will vary with the current moon phase.

The flight activity levels of female *A. taeniorhynchus* at different light intensities during the night shown in Fig. 2 have been converted from previously published data into percentages to simplify presentation of the relationship between flight activity and illumination. The largest collections of the night were taken at 40–50 minutes after sunset, and this has been arbitrarily set at 100 percent. The values of all other collections during the night have been determined in relation to it. The numbers taken at different moon phases during the first three truck runs of the evening and the last three truck runs of the morning did not differ significantly and these have been combined. Nor did the numbers taken during the dark periods of the night at new moon and the dark half of quarter moon differ significantly, and these also have been combined.

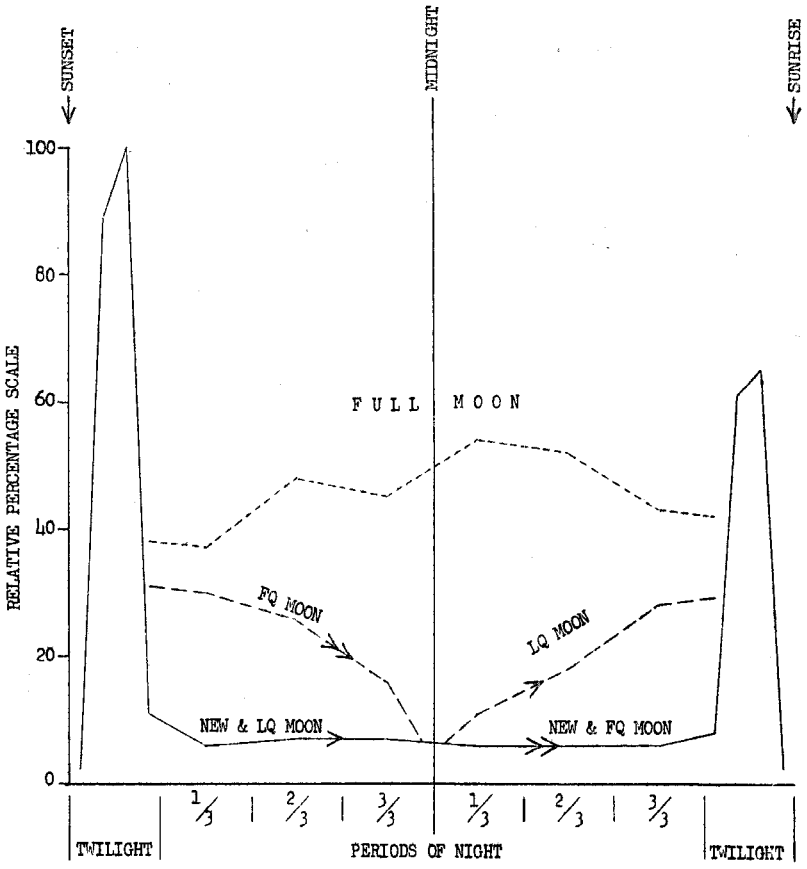

FIG. 2.—Relative levels of flight activity of female *A. taeniorhynchus* at different times of the night during different moon phases.

In Fig. 2 it may also be seen that as the light intensity declined following sunset, mosquito flight activity at first increased rapidly and then fell to a lower level. While the numbers taken during the first three runs were unaffected by the moon, the level of the fourth run was determined by the current moon phase. Collections taken between 60 and 70 minutes after sunset or before sunrise show that full moon collections were always greatest, followed by the luminous half of either first quarter or last quarter moon, then the dark half of either first quarter or last quarter moon, and with new moon collections smallest. The morning twilight runs, while smaller, were a mirror image of the evening runs. Collections taken but a few minutes apart during the crepuscular periods will vary drastically in size.

The pattern of mosquito flight activity at different moon phases during the middle of the night can also be seen. Here the number of mosquitoes captured is related to both the phase and the elevation of the moon, *i.e.*, the larger the moon and the higher it is above the horizon, the greater the collections will be. At full moon the number of mosquitoes in flight during the night is high and relatively uniform. At quarter moon the largest numbers are taken when the moon is at zenith; near midnight the moon is close to the horizon and the amount of illumination is reduced, and at this time collections are much smaller. Collections at new moon and the dark halves of quarter moon are low.

In view of this behavior, the following conclusions regarding the use of a truck trap to evaluate mosquito populations can be made.

A. During the crepuscular periods:
   1. The starting times of each run are based on local times of sunset and sunrise, and this schedule must be rigidly followed throughout the season. All truck runs must retrace the same route and a mean value obtained for the entire twilight period. This mean is best compared with other crepuscular means taken on different days or from other areas.
   2. Crepuscular sampling is best adapted to intensive sampling of a relatively small area.

B. During the dark periods:
   1. When the moon is not shining, direct comparisons can be made between other dark period collections taken at different places, dates or times. When the moon is shining, collections taken during the moonlit periods must be reduced to new moon levels as shown in Table 1. These values are based on mosquito flight responses on days 29, 0, 1, 6, 7, 8, 14, 15, 16, 22, 23, and 24. The values shown for the other days were obtained by interpolation. Although the values shown are for female *A. taeniorhynchus,* the lunar effect appears to be similar, although possibly smaller, for other species. Until specific information is available, these values may be reduced up to one-half for other species.
   2. Truck runs need not retrace the same route. Although an area can be sampled by a single run, more reliable data are secured by multiple collections. The number of collections possible during the dark periods will vary due to seasonal changes in the duration of the night.

No temperature effects on mosquito flight activity have been observed above 17° C., but collections taken below this temperature were depressed. Wind velocities along a truck route are necessarily variable. Most nights at Vero Beach were calm, but collections taken when winds were 3 m.p.h. or greater were only 17 percent as large as when the night was calm.

It has been convenient to use truck trap routes of about 3 miles in length. Because only the forward motion of the vehicle retains the catch in the net, the presence of frequent traffic lights or stop signs along the route will necessitate equipping the bag opening of the truck

TABLE 1.—Extent truck trap collections of female *A. taeniorhynchus* are increased by moonlight above new moon values according to moon age and elevation above the horizon at different periods of the night. Data obtained for days 29, 0, 1, 6, 7, 8, 14, 15, 16, 22, 23 & 24; other days by interpolation.

			Eve. twilight	Midnight						Morn. twilight
				1/3	2/3	3/3	1/3	2/3	3/3	
Moon Age	NM	0	...	...	...	...	...	...	...	...
		1	...	...	...	...	...	...	...	...
		2	...	...	...	...	...	...	...	...
		3	...	1.2	...	...	...	...	...	...
		4	...	2.0	...	...	...	...	...	...
		5	...	2.5	1.8	...	...	...	...	...
		6	...	3.6	2.8	1.5	...	...	...	...
	FQ	7	...	4.6	3.6	2.3	...	...	...	...
		8	...	5.1	4.3	3.0	...	...	...	...
		9	...	5.7	5.1	3.7	1.5	...	...	...
		10	...	6.1	5.6	4.3	2.5	...	...	...
		11	...	6.5	6.2	4.9	3.3	2.5	...	...
		12	...	6.7	6.5	5.5	4.3	3.3	...	...
		13	...	7.0	6.9	6.1	5.2	4.4	3.6	...
		14	1.2	7.2	7.2	7.2	7.2	7.2	5.4	1.2
	FM	15	1.2	7.2	7.2	7.2	7.2	7.2	7.2	1.2
		16	1.2	5.4	7.2	7.2	7.2	7.2	7.2	1.2
		17	...	3.6	4.4	5.2	6.1	6.9	7.0	...
		18	...	...	3.3	4.3	5.5	6.5	6.7	...
		19	...	...	2.5	3.3	4.9	6.2	6.5	...
		20	...	...	...	2.5	4.3	5.6	6.1	...
		21	...	...	...	1.5	3.7	5.1	5.7	...
		22	...	...	...	...	3.0	4.3	5.1	...
	LQ	23	...	...	...	...	2.3	3.6	4.6	...
		24	...	...	...	...	1.5	2.8	3.6	...
		25	...	...	...	...	...	1.8	2.5	...
		26	...	...	...	...	...	...	2.0	...
		27	...	...	...	...	...	...	1.2	...
		28	...	...	...	...	...	...	...	...
		29	...	...	...	...	...	...	...	...

trap with a valve to prevent losses during stops.

Records should be kept by the driver as to meteorological conditions and any other occurrences that might affect the collection.

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