VEHICLE MOUNTED ASPIRATORS[1]

W. L. Bidlingmayer and J. D. Edman

Most mosquitoes are nocturnal and most sampling methods require mosquitoes to be in flight. Examination of collections made by different methods showed blood-engorged females, and those maturing eggs, were not taken in expected numbers. Presumably, these females had little need to fly. Many species rest in ground litter during daylight hours. A collection obtained here at this time should sample the whole population and reflect its actual composition more closely than methods which capture only flying mosquitoes. For this purpose, the use of large aspirators was investigated.

Power vacuum equipment has been used by entomologists to sample insects in the field for many years (Hills, 1933; Johnson *et al.*, 1957; Dietrick, 1961). Basically, each device consisted of an intake, a flexible suction hose, a mesh bag for holding the catch, a blower or fan, and a power source. Most models were carried manually, and collections made from vegetation, ground litter, and other habitats. Van den Bosch *et al.* (1959), used a large truck-mounted aspirator for collecting aphid parasites.

Mosquito numbers are often low, and when small aspirators are used, the desired numbers may not be obtained. In addition, the operator may bias the sample by his operating technique and also by serving as an attractant. Our program required a sampler that would provide large numbers daily with a minimum of human error. A large, vehicle-mounted aspirator would rapidly sample extensive areas and, since the operator's only function was to drive, the area would be sampled in a similar manner each time.

Most details will be omitted in the following description of two different models. In designing and construction, many decisions were made without preliminary tests and a number of variations of our designs would undoubtedly be satisfactory.

The vehicle aspirator consists of a rigid transparent intake, a screen cone with a net bag at the apex, a flexible rubber hose, and a blower powered by the vehicle. The larger model was mounted on a 4-wheel drive Willys Jeep (Fig. 1). The intake consists of two sections; one a heavy (2″ x 2″ x ¼″) angle iron frame 36″ wide and 30″ deep mounted beside the left front wheel (A). A forward extension along

---

[1] Contribution No. 171, Florida State Board of Health, Entomological Research Center, Vero Beach. This investigation was aided by Public Health Service Research Grant AI–06587, from the National Institute of Allergy and Infectious Diseases, Public Health Service.

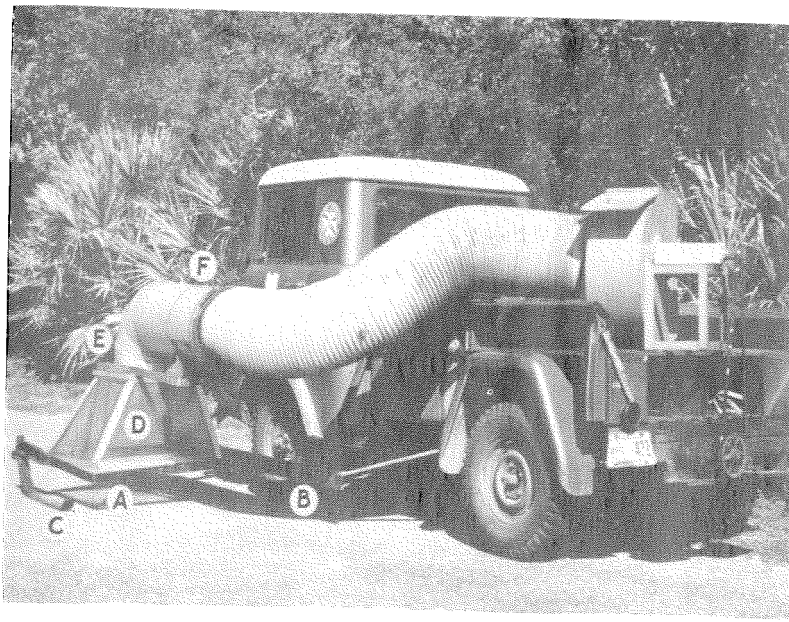

FIG. 1.—Jeep-mounted aspirator.

the outside edge of the frame bore a pivoted (4″ x 1″ dia.) spring steel runner (40″ x 3″ x ¼″) to support the frame (C). The frame was hinged to a longitudinal square iron beam (3″ x 3″ x ¼″) bolted parallel to the chassis of the vehicle (B) so that the runner could follow irregularities in terrain. The intake frame is 8″ above the ground. The other section was a strong welded aluminum (1½″ x 1½″ x 5/32″) frame (D), 35⅜″ wide, 29⅛″ deep and 21″ high, covered with 40 gauge clear vinyl plastic (used in rear windows of convertible automobiles) and surmounted by a 16″ galvanized sheet metal elbow (E). This frame nested within the angle iron frame and was held by a backward projecting bar along the leading edge of the iron frame.

A sheet metal cylinder 33″ long (F), enclosed a screen cone, and was riveted to the elbow. A door in the side of the cylinder allowed access to the net bag. The net bag was fastened by a rubber band to a collar at the apex of the screen cone.

A blower mounted at the rear of the vehicle was connected to the power take-off by a V-belt. A 16″-diameter flexible rubber hose linked the blower to the catching unit where it was fastened by a lever-operated hose clamp.

For highway travel, the hose clamp was loosened, the hose slipped free, and bent in a U facing the rear. The intake and catching unit were lifted from the intake frame and set behind the cab of the truck. The intake frame was raised to a vertical position and fastened with a snap chain. The nut holding the runner was removed, the runner withdrawn and reinserted from the opposite side, and the nut replaced. This unit can be assembled or disassembled by one man in about 2 minutes.

The smaller model was mounted on a 10 h.p. single cylinder garden tractor (Fig. 2). The intake was 28″ wide 24″ deep and 21″ high and was hinged across the front. No runner was required as

FIG. 2.—Garden tractor aspirator.

the elevation of the leading edge was controlled by a cable between a driver operated lever and the top of the intake. The catching unit is mounted vertically directly above the intake and the air then turns horizontally through a length of 10" flexible rubber hose to the blower. All sections were permanently joined. A special trailer fitted with ramps was used to transport the aspirator to the sampling areas.

The Jeep aspirator was operated in 4-wheel drive, low transfer and low gear, and the tractor aspirator in low gear, both at a speed of about 2–3 m.p.h. A pulley ratio between the blower and power take-off was selected to produce an air velocity of 300–400 linear feet per minute through the hose. Because the intake has a larger cross section, the velocity at the opening is insufficient to collect resting insects; a greater velocity, however, would also pick up much debris. It is the disturbance created by the approach and passage of the leading edge of the intake that causes mosquitoes to take flight. Short lengths of chain can be welded to the intake frame to stir the litter if desired. As the intake is transparent, the flight is nearly vertical, and once well inside the air velocity is great enough to carry them into the net. Mosquitoes slow to fly or incapable of flight would be missed. These would consist mostly of those which had just obtained a blood meal and others which were physically unable to move quickly. However, freshly engorged females quickly regain the ability to fly, so the numbers missed will be small.

The Jeep aspirator has been used in pastures, second growth pine woods and hardwood hammocks. In Florida it is not difficult to make routes in mature hammocks. By clearing winding routes, only occasional trees require removal. These routes did not suffer excessive wear when used once or twice weekly during the season. The tractor aspirator is adapted to areas with soft soils, closely spaced trees and near buildings.

TABLE 1.—Total number of mosquitoes taken in the power aspirator at different hours, in November and December.

Time		0800	0900	1000	1100
Mean Temp. ° C.		14.1	16.4	18.8	20.8
A. mitchellae	♀	47	98	154	249
A. mitchellae	♂	19	44	66	91
A. sollicitans	♀	125	216	230	289
A. sollicitans	♂	41	51	43	54
A. vexans	♀	9	15	25	32
An. crucians	♀	8	10	10	13
P. ciliata	♀	5	6	15	9
P. confinnis	♀	111	252	293	378
P. confinnis	♂	91	135	192	196
Subtotal		456	827	1028	1311
U. lowii	♀	48	84	40	27
U. lowii	♂	64	112	24	11
U. sapphirina	♀	366	332	273	286
U. sapphirina	♂	220	289	254	205
Subtotal		698	817	591	529

TABLE 2.—Composition of mosquito populations as taken by New Jersey light trap, truck trap and vehicle aspirator.

		Females in Different Egg Stages				
			Percentage in Stage			Percentage of all ♀♀ with Blood
Species	Method	No. Examined	I, II	III, IV	V	
A. taen.	N.J.	1350	88	11	1	1.7
	Truck	7095	70	11	19	9.0
	V.A.	4388	76	15	8	17.4
C. nigri.	N.J.	888	93	2	4	1.4
	Truck	4272	79	5	17	4.9
	V.A.	486	81	10	9	9.9
P. conf.	N.J.	371	92	5	2	1.4
	Truck	4056	75	10	15	12.4
	V.A.	1881	65	29	7	53.0

Every sampling method has limitations as well as advantages. Table 1 shows the influence of collection time on numbers captured during the winter months. Collections were made along the west shoulder of four abandoned north-south roads. Collecting times were rotated among the four routes.

Most species were taken in increasing numbers as the hour advanced which corresponds with increasing temperatures. Presumably, at low temperatures some mosquitoes do not respond quickly enough to be captured. Only *Uranotaenia* spp. were taken in greater numbers early in the morning. The subsequent decline was probably due to movement off the roadway to avoid the direct rays of the sun. The optimum collecting time will vary with temperature, species and geographic area.

A preliminary comparison of collections from the vehicle aspirator with other trapping methods was made. Table 2 shows the composition of *Aedes taeniorhynchus, Culex nigripalpus* and *Psoro-*

TABLE 3.—Percentage of engorged females of different species and state of blood digestion, taken in vehicle aspirators.

Species	Total Number Captured	With blood <1/2 digested	With blood >1/2 digested	% engorged
Ae. atlanticus	158	22	3	15.8
infirmatus	1,284	120	66	14.5
taeniorhynchus	3,790	128	80	5.5
vexans	1,095	92	62	13.1
An. crucians	55	15	5	36.4
Cu. nigripalpus	25,858	1,738	960	10.4
(*Mel.*) spp.	7,282	394	314	9.7
Cs. melanura	58	6	2	13.8
M. perturbans	654	99	102	30.7
P. confinnis	5,033	698	362	21.1
ferox	867	60	45	12.1
U. lowii	4,961	167	172	6.8
sapphirina	1,248	109	85	15.5

phora confinnis populations as taken by different methods.

The New Jersey light trap took the largest proportion of early egg stages (Christophers 1911), the vehicle aspirator of middle stages, and the truck trap (Bidlingmayer 1966) of gravid females. The vehicle aspirator took the largest proportion of blood engorged females and the New Jersey light trap the least.

Because of the importance of blood engorged mosquitoes in curent host determination studies, a sample group is shown in greater detail in Table 3. The engorgement rate can be seen to vary considerably between species. While less than half digested blood meals are preferred for precipitin tests, satisfactory results are frequently obtained with older blood, particularly from large mosquitoes. The percentage engorged will also vary between areas, as the data presented in Tables 2 and 3 were taken from different localities.

This method of collecting is adapted to those species which rest on the ground during daylight hours. Vehicle aspirators will be of greatest value when a representative sample of a population, or those segments of a population seldom taken by other techniques, are required.

References

BIDINGMAYER, W. L. 1966. Use of the truck trap for evaluating adult mosquito populations. Mosq. News 26(2):139–143.

CHRISTOPHERS, S. R. 1911. The development of the egg follicle in anophelines. Pauldism, No. 2, pp. 73–88.

DIETRICK, E. J. 1961. An improved backpack motor fan for suction sampling of insect populations. J. Econ. Ent. 54:394–395.

HILLS, O. A. 1933. A new method for collecting samples of insect populations. J. Econ. Ent. 26:906–910.

JOHNSON, C. G., SOUTHWOOD, T. R. E., and ENTWISTLE, H. 1957. A new method of extracting arthropods and molluscs from grassland and herbage with a suction apparatus. Bull. Ent. Res. 48:211–218.

VAN DEN BOSCH, R., SCHLINGER, E. I., DIETRICK, E. J., HAGEN, K. S., and HOLLOWAY, J. K. 1959. The colonization and establishment of imported parasites of the spotted alfalfa aphid in California. J. Econ. Ent. 52(1):136–141.