A PORTABLE SUCTION APPARATUS FOR CAPTURING INSECTS[1]

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A suction apparatus that originally was designed to suck *Phlebotomus* from around tree trunks, has been improved to serve the additional purpose of capturing mosquitoes and other flying insects in the foliage of the forest floor. This paper describes and illustrates the improved apparatus, and discusses some of its applications, with examples drawn from results obtained during 1964 and 1965 in the forest of the Instituto de Pesquisas e Experimentação Agropecuarias do Norte (IPEAN) near Belém, Brazil.

DESCRIPTION OF APPARATUS. As first used, the apparatus consisted of a plastic tube, 13 cm long and 9 cm in diameter, inside which was mounted a 3-volt motor and propeller that created suction in the manner of a vacuum cleaner and drew flying insects past the propeller into a screened basket. This has been adapted for captures in the foliage chiefly by the addition of a handle and of a side-port that allows entering insects to bypass the propeller and thus avoid damage.

Figure 1 shows the design of the improved model. The parts are as follows:

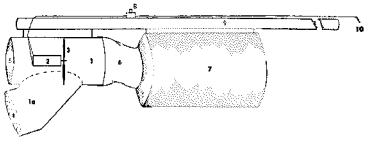

FIG. 1.—Suction apparatus. See text for description of numbered parts.

(1) a plastic tube, 19.5 cm long, 9 cm in diameter, and 4 mm thick, with (1a) a 12-cm long side-port made of the same tubing; (2) a 3 to 4½ volt D.C. motor (Aristorev No. 1, Aristo-craft, 314 Fifth Avenue, New York, N. Y.); (3) an 8-blade propeller made from the lid of a tin can and soldered in place; (4) 2 x 2 mesh wire screening over the side-port, to keep out large debris; (5) 14 x 14 mesh wire screening over the air inlet, to divert insects away from the propeller and into the side-port; (6) nylon netting, closed with a clip when the machine is not in use; (7) a detachable basket, 26 cm long and 15 cm in diameter, made of 32 x 32 mesh wire screening, for receiving the insects; (8) a control switch; (9) a handle, 1 meter long; and (10) wiring leading from a 3-volt power source (flashlight batteries or rechargeable photographer's cell) to the motor.

In Figure 2, the screening has been removed from both ports of the plastic tubing and the motor mounting and the propeller can be seen. Figure 3 shows the air inlet with the fine screening in place and the side-port still unscreened. When

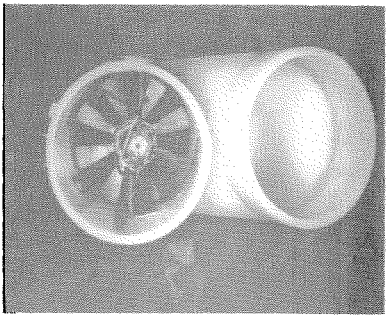

FIG. 2.—Left, air inlet with screening removed to show motor and propeller; right, side-port, also unscreened.

[1] The studies and observations on which this paper is based were conducted with the support of the Fundação Serviço Especial de Saúde Pública of Brazil and The Rockefeller Foundation.

Grateful acknowledgment is made to Dr. José Maria Pinheiro Conduru, director of the IPEAN, for permission to work in that forest.

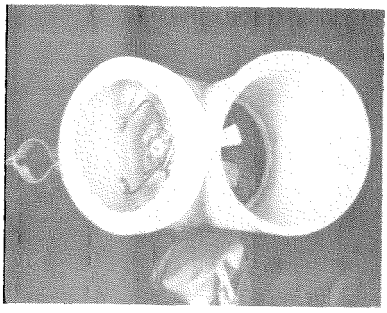

FIG. 3.—Air inlet (left) screened and side-port unscreened.

the apparatus is used for captures in the foliage, the operator beats the foliage with a stick or machete (Figure 4) so that resting insects will fly up and be sucked into the basket. For captures around tree trunks or in rodent burrows, a small branch is agitated to disturb the resting insects. All captures reported were made during the morning hours.

APPLICATIONS. SAMPLING FOR MUSEUM COLLECTIONS. Experience with the suction apparatus during 1964 showed that most of the insects collected in the IPEAN forest were undamaged and suitable for mounting. A random 2-hour capture of October 29, 1964 was kindly analyzed by Dr. Fred Bennett of the Commonwealth Institute of Biological Control, Curepe, Trinidad, and found to contain approximately 50 families of insects (Table 1).

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FIG. 4.—Suction apparatus in use in foliage.

TABLE 1.—Analysis of the collection of October 29, 1964 in the IPEAN forest *

Order	Family	No. species	No. individuals
Diptera	Tipulidae	>10	32
	Culicidae	20	166
	Bibionidae	2	>10
	Psychodidae	>5	>20
	Cecidomyiidae	>10	>100
	Mycetophilidae	>20	>20
	Ceratopogonidae	>10	>100
	Chironomidae	>20	>1000
	Dolichopodidae	3	>20
	Phoridae	5	>50
	Trypetidae	5	>20
	Lonchaeiidae	10	>50
	Chloropidae	5	>30
	Agromyzidae	2	5
	Drosophilidae	10	50
	Sarcophagidae	1	2
	Undetermined—1	1	10
	Undetermined—2	1	2
	Undetermined—3	1	1
Hymenoptera	Ichneumonidae	1	2
	Braconidae	20	>100
	Cynipidae	5	20
Hymenoptera *cont.*	Mymaridae	2	>10
	Eulophidae	4	>10
	Chalcididae	1	1
	Pteromalidae	2	5
	Dryinidae	1	1
	? Diapriidae	1	1
	Undetermined	1	>10
Hemiptera	Coccidae	1	1
	Jassidae	10	30
	? Derbidae	1	1
	Fulgoridae	2	4
	Miridae	1	4
	Cryptostemmatidae	2	>10
	Lygaeidae	1	1
	Reduviidae	1	1
	Undetermined	1	4
Coleoptera	Chrysomelidae	5	10
	Coccinellidae	1	1
	Staphylinidae	1	1
Lepidoptera	Unsorted (probably 8)	8	15
Collembola		1	10
Neuroptera	Hemerobiidae	1	1

* Kindly provided by Dr. Fred Bennett, Commonwealth Institute of Biological Control, Curepe, Trinidad.

Virus Laboratory is directed toward the study of mosquito-borne viruses, the mosquito was of prime interest in the collections. The male mosquito is especially appropriate for taxonomic studies because the male genitalia are often distinctive and may be the only recognized characteristic separating species. Use of the suction apparatus enabled collection for identification of many males that were not otherwise attracted to human bait or to traps using animals as bait.

SURVEY OF AN AREA FOR MOSQUITO FAUNA. It is often desirable to know what mosquitoes (or other insects) inhabit a given area at a given time. Trapping techniques that use an animal as bait or that require the insect to enter a trap with a narrow opening are usually selective and may not give a clear picture of the overall make-up of the insect population in the area. During 1964 and 1965, mosquitoes captured with the suction apparatus represented a greater variety of species than was obtained with any of six other capture techniques, as shown below:

Capture technique	No. species recognized*
Light trap	27
Trinidad No. 10 trap with mouse bait	42
Mouse bait exposed under hood	44
Night capture on human bait	44
Modified Magoon trap with chicken bait	45
Day capture on human bait	59
Suction apparatus	63

* Several of the types of mosquitoes present in the IPEAN forest are not identifiable to species in our present state of knowledge. The number of "species recognized" in each collection is therefore less than the actual number collected.

It should be noted that the ingenuity of the operator of the suction apparatus in locating resting places of insects may influence the variety of the capture. During 1964 and 1965, *Culex* (*Microculex*) *stonei* was found principally around tree trunks,

Phlebotomus around tree trunks and in rodent burrows, and *Culex* (*Culex*) spp. mainly resting in foliage of plants of the family Selaginellaceae. In addition, ground depressions and fallen, decayed, hollow tree trunks often were more productive than ordinary terrain. Theoretically, capture of forest canopy mosquitoes should also have been possible, but preliminary efforts to accomplish this by attaching the suction apparatus to a long pole were not productive.

CAPTURE OF RECENTLY FED INSECTS FOR BLOOD MEAL DETERMINATION. Examination of 10,321 mosquitoes and *Phlebotomus* from captures in the ground foliage of the IPEAN forest revealed 907 recently engorged individuals. Most of these appeared to have taken blood meals, although a few were *Uranotaenia* spp. females that had a clear liquid in their abdomens. An additional 109 individuals were visibly gravid. The specific host source of the blood found in recently engorged insects can often be readily determined, and such information is useful in studies of the transmission cycles of various parasitoses and viroses.

COMPARISON OF RELATIVE NUMBERS OF RESTING MOSQUITO FAUNA IN ADJACENT BUT DIFFERING ECOLOGICAL ZONES. The suction apparatus has proved useful in the study of the ecology of mosquitoes, especially those believed to transmit viruses in the IPEAN forest. During April and May 1964 and again from August 1964 through March 1965, captures were made systematically in four adjacent but ecologically distinct zones of the forest to obtain data on the relative abundance of different mosquito types. The four zones may be briefly described as follows:

Zone 1: secondary forest, 200 x 30–60 M; cleared about 10 years ago but rotting trunks of some of the large fallen trees still remain; heavy ground foliage, consisting mostly of *Selaginella stellata* and *Pariana* sp. with some scattered *Heliconia pritacorim,* forms good coverage for resting mosquitoes. Zone 2: primary forest, 250 x 80 M; less ground cover than Zone 1, with *S. stellata* and *Pariana* sp. occurring only where a fallen tree allows sunlight to enter; many depressions, and forest floor covered by dead leaves; about half the area is firm high ground, the rest low ground. Zone 3: mixture of open high grass, primary forest, and swamp forest bordering the Aurá River, a small tributary of the Guamá River; 150 x 400 M. Zone 4: old secondary forest cut about 20 years ago, U-shaped, 20 x 200 M; bordering a rubber plantation and separated from the other three zones by a road; in the part contiguous with the road, vegetation is similar to that of Zone 1, in the inner part similar to that of Zone 2.

Although certain parts of the zones were noted to have more mosquitoes than other parts, an effort was made to treat each zone as a whole. On any given morning, only one zone was studied.

As shown in Table 2, the greatest numbers of female mosquitoes and *Phlebotomus* were captured in Zones 1 and 2. *Culex* (*Culex*) was most commonly encountered in Zone 1, young secondary forest with heavy ground cover, while *Culex* (*Melanoconion*), other *Culex,* and *Aedes* were obtained most frequently in Zone 2, primary forest. During September, October, and November, when *Culex* (*Melanoconion*) reached peak population levels, captures in Zone 2 averaged 41 females per 2-hour capture while for the

TABLE 2.—Numbers of female mosquitoes and *Phlebotomus* captured with the suction apparatus in four zones of the IPEAN forest.

Zone	1	2	3	4
Capture hours..	57	54	51	37
Mosquito genus				
Aedes	225	381	105	92
Culex (*Culex*)	1,095	852	413	243
Culex (*Melanoconion*)	665	702	340	319
Other *Culex*	1,052	1,298	619	468
Other genera* and *Phlebotomus*	356	592	274	184

* Includes *Haemagogus, Mansonia, Orthopodomyia, Psorophora, Aedomyia, Uranotaenia, Limatus, Phoniomyia, Sabethes, Trichoprosopon, Wyeomyia,* and *Anopheles.*

other three zones the average was 19. Captured male mosquitoes were distributed differently from females but outnumbered them in all zones except 4. In Zone 1, the ratio was 2:1.

Some of the differences in totals between zones may be due to daily climatic fluctuations, and definite conclusions as to the relative numbers of mosquito types in each zone would obviously require many more observations over a considerably longer period.

DETERMINATION OF MONTHLY VARIATION IN ABUNDANCE OF DIFFERENT MOSQUITO TYPES. In Table 3, the data from the study just described are arranged to show the monthly variations in capture rates for the different types of ground foliage mosquitoes. Females of *Culex* (*Culex*) were captured in greatest numbers during May and September, those of *Culex* (*Melanoconion*) during February, March, and October, and those of other *Culex* during May and October. Peak capture rates for male mosquitoes of these types did not necessarily coincide with the rates for females. Although these data do not provide an adequate basis for drawing definite conclusions as to monthly variations in mosquito populations, they illustrate the type of ecological information that can be obtained with use of the suction apparatus.

TABLE 3.—Monthly variations in capture rates for different types of resting mosquitoes. Numbers captured per 10 capture hours using suction apparatus.

Year and month		*Culex* (*Culex*)		*Culex* (*Melanoconion*)		Other *Culex*		*Aedes*		Other genera	
		M	F	M	F	M	F	M	F	M	F
1964	April	848	184	130	63	105	126	11	21	24	70
	May	699	198	75	69	218	262	38	48	41	113
1964	August	312	143	102	72	139	168	11	35	12	153
	September	337	232	145	108	156	213	88	52	17	58
	October	651	143	334	148	282	303	241	114	7	59
	November	93	29	168	122	101	129	39	18	12	31
	December	75	63	75	59	43	83	66	21	16	24
1965	January	242	74	181	103	75	71	156	58	21	33
	February	184	93	280	154	149	164	31	29	12	48
	March	385	102	453	228	213	211	20	25	17	53

ISOLATION OF VIRUSES FROM RESTING MOSQUITOES. The number of female mosquitoes captured with the suction apparatus has been comparable to the numbers obtained with other techniques, although its use involves considerable labor in separating mosquitoes from the rest of the catch. Through March 1965, a total of 616 pools comprising 10,313 mosquitoes captured with the suction apparatus had been processed for virus isolation attempts, and one virus strain had been recovered, as reported elsewhere.

SUMMARY. A portable suction apparatus for capturing flying insects both in the ground foliage of the forest floor and around tree trunks has been designed and used successfully in a rain forest near Belém, Brazil. Some of its applications are discussed.