steel pins and hooked behind the jam cleats (G), thus securing the netting during transportation.

While this umbrella-trap was developed primarily for use in sampling adult mosquito populations, it could also be used advantageously in studies on other biting insects such as stable flies, deer flies, blackflies, and biting gnats.

Authors' Note: When this manuscript was sent to the Florida State Board of Health for comment, it was pointed out to us that Mr. J. A. Mulrennan and Mr. R. R. Sheppard had independently developed an essentially identical device over two years ago. Their device was recorded in their reports, but the description of it has never been published.

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SEASONAL SUCCESSION OF MOSQUITO SPECIES AND THE RELATIONSHIP EXISTING BETWEEN DISSOLVED MINERALS IN MOSQUITO-BREEDING WATERS AND SPECIES

CHARLES O. MASTERS

For several years prior to 1953, the author made a rather comprehensive study of the habits of the mosquitoes in Cuyahoga County, Ohio. One of the experiments conducted in 1952 was carried out in order to determine whether or not there would be a succession of species among the mosquito larvae found in a body of water throughout the breeding season, and also, if there might be a relationship existing between the amount of mineral matter dissolved in mosquito-breeding waters and the species found therein.

On June third, 1952, five large metal tanks, 6 feet long, 3 feet wide, and 1½ feet deep, were arranged side by side in a vacant lot and filled with tap water. Various quantities of water were passed through a bushel basket of horse manure and allowed to drain back into the tanks. As the minerals present in the manure came into solution, and passed into the tanks, the total amount of dissolved matter gradually increased. Measurements were made with a Barnstead Purity Meter in order to determine the grains per gallon, in terms of sodium chloride, of mineral matter present. The tap water contained eight grains per gallon as it was run into each of the five tanks. By the use of horse manure, this was increased in the tanks as follows: Tank Number One, 11 g/gal.; Tank Number Two, 14 g/gal.; Tank Number Three, 16 g/gal.; Tank Number Four, 24 g/gal.; Tank Number Five, 40 g/gal.

The color varied from a very light brown (610 millimicrons) to a dark brown. The difference in concentration became more apparent after testing with a Leitz Photometer. The percent transmittance was recorded as follows: Tank Number One, 94%T.; Tank Number Two, 90%T.; Tank Number Three, 83%T.; Tank Number Four, 72%T.; Tank Number Five, 72%T.

Nothing more was added to the tanks except manure water whenever a test with the Purity Meter indicated it was necessary. All of the tanks were fully exposed to sunlight but, because of their large surface area, the temperature never exceeded

82 degrees Fahrenheit. The pH of the water always remained above seven.

Regular collections of larvae were made by means of a net, 6 by 10 inches in size. A single sweep was made just below the surface of the water from end to end of the tank. This method was carried out throughout the summer. The catch was preserved in Carl's Solution (F.A.A.) and kept in a bottle until identifications could be made at a later date.

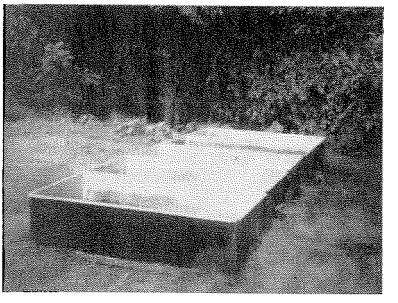

PLATE 1. Photograph of the five tanks as they were arranged in the vacant lot.

The population peaks of pupae usually followed the peaks of early instars by about ten days.

CONCLUSIONS

From the graph, it is obvious that there was a succession of species among the mosquito larvae. It would be of interest to repeat the experiment in a wooded area where there might be a greater variety of mosquitoes present.

At first there seemed to be no correlation between the number of mosquitoes actually "produced" by the tanks and the

RESULTS

	TANKS					
	1	2	3	4	5	
Number of Mosquito Species Collected:	3	3	5	5	5	
Early Instars:	701	447	574	1,450	2,628	
Percentage:	12	7	9	24	48	
Late Instars:	657	1,189	762	1,378	2,223	
Percentage:	10	19	12	22	37	
Total:	1,358	1,636	1,336	2,828	4,851	12,009
Percentage:	11	13	11	23	42	
Pupae Collected:	235	681	401	475	263	
Percentage:	11	33	19	25	12	
Number and Percentage by Species.						Total
Culex pipiens	566	1,114	463	1,218	2,013	5,374
Percentage:	86.30	93.80	60.77	88.41	90.59	
C. restuans	59	53	276	93	168	649
Percentage:	8.90	4.40	36.22	6.74	7.55	
Anopheles punctipennis	32	22	9	11	2	76
Percentage:	4.80	1.80	1.18	0.79	0.08	
Aedes triseriatus	0	0	13	8	28	49
Percentage:			1.70	0.58	1.25	
C. apicalis	0	0	0	48	0	48
Percentage:				3.48		
O. signifera	0	0	0	0	12	12
Percentage:					0.53	
Aedes cinereus	0	0	1	0	0	1
Percentage:			0.13			
Date of Greatest Production of Pupae:	6/24 8/15 8/19	8/12	6/24 7/28	6/24	6/24	
Daphnia Collected:	1,745	1,718	2,922	0	11	

amount of available salts present in the water, but that was so only because the author expected the population to be in direct proportion to the amount of dissolved mineral matter. Actually the number of larvae present in the tanks containing most of the mineral matter was greater but the number of adults produced was always less. In fact, the tank containing most of these salts produced only twelve percent of the adults produced by all of the tanks which was significantly no more than the number produced by the tank containing the least amount of mineral matter. Similarly, more daphnia were produced in the tanks containing the least amount of dissolved mineral matter.

The mortality rate among mosquito larvae seemed to be highest during the period between the third instar and the pupal stage.

Once more, using the quantity of mosquito pupae present as an index to the tanks' productivity rate, the greatest number of adults was produced during the third week of June. From that day on, the rate gradually declined in spite of the fact that manure was being regularly added to the tanks in order to maintain the proper salt concentration.

Since only seven species of mosquitoes were identified in the tanks, there was not much evidence as to whether or not there was any correlation between species and the amount of dissolved mineral matter present. Most of the species were distributed equally in the various tanks but *A. punctipennis* seemed to show a preference for the more dilute habitats whereas *O. signifera*, a common tree-hole species, was taken only in the most highly concentrated mineral waters.

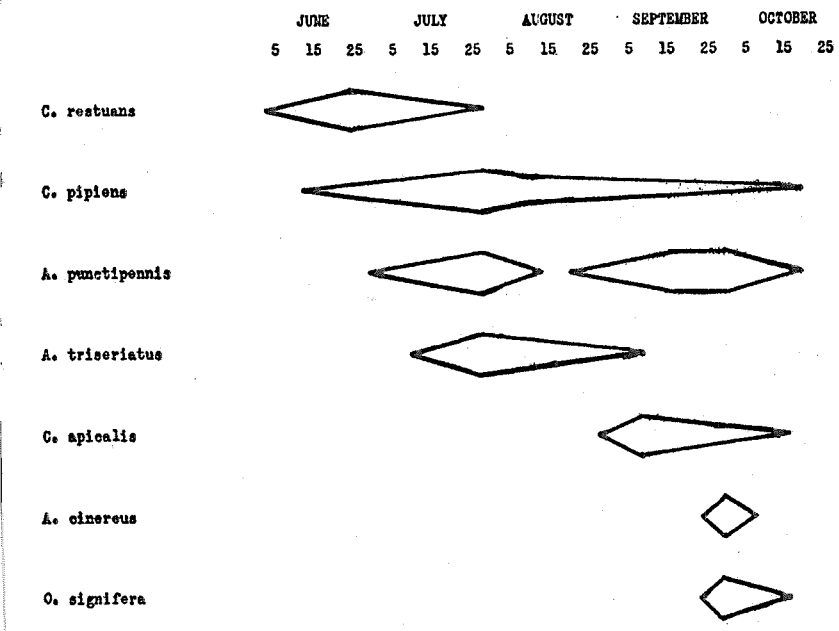

PLATE 2. Graph showing the succession of species during the mosquito season of 1952.