MOSQUITO COLLECTIONS BY CDC MINIATURE LIGHT TRAPS AND LIVESTOCK-BAITED STABLE TRAPS AT CALLAO, UTAH

J. K. OLSON, ROBERT E. ELBEL AND KEITH L. SMART

Ecology and Epidemiology, Biological Division, Deseret Test Center, Dugway, Utah 84022

The purpose of this study was to find a simple and efficient method of sampling mosquito populations in west central Utah. From 22 May to 30 September 1966, CDC Miniature Light Traps (Sudia and Chamberlain, 1962), with dry ice supplement (Newhouse *et al.*, 1966), and livestock-baited stable traps, modified from Magoon (1935), were used in support of an extensive arbovirus endemicity survey of Callao, Utah. Callao is a small farming community located on the east side of the Deep Creek Mountains which are near the west central border of Utah. This community is bounded on the north and east by the Great Salt Lake Desert, and derives its water from creeks which originate in the Deep Creek Mountains and from artesian springs which occur throughout the area.

Mosquitoes were breeding in pools formed from mountain creeks and from spring water. Willows (*Salix* spp.), tamarix (*Tamarix pentandra*), sedges (*Scirpus* spp.), cattail (*Typha angustifolia*), saltgrass (*Distichlis stricta*), cottonwoods (*Populus* spp.), Russian olive (*Elaeagnus angustifolia*), and rabbit brush (*Chrysothamnus* spp.) were in and around the pools and running water. Vegetation between these water sources consisted primarily of greasewood (*Sacrobatus vermiculatus*), gray molly (*Kochia vestita*), and sagebrush (*Artemisia tridentata*). Pickleweed (*Allenrolfea occidentalis*) occurred north and east of Callao as the elevation decreased towards the desert floor. Mosquito species known to occur in the Callao area prior to 1966 were as follows: *Aedes campestris*, *A. cataphylla*, *A. dorsalis*, *A. fitchii*, *A. nigromaculis*, *A. niphadopsis*, *A. schizopinax*, *A. vexans*, *Anopheles earlei*, *A. franciscanus*, *A. freeborni*, *Culiseta incidens*, *C. inornata*, *Culex erythrothorax*, *C. tarsalis*, and *Psorophora signipennis* (Nielsen and Rees, 1961).

METHODS. Eight primary collecting sites comprised an area approximately 2 miles wide by 20 miles long around Callao: two sites were located at a marsh approximately 12 miles north; five sites were located at marshes, ponds, and irrigated fields in and bordering the farming area; and one site was located at a small creek reservoir 7 miles south. At each site two stable traps were placed adjacent to each other; one was baited with a horse and the other with a steer. Wire corrals, approximately 20 feet in diameter, were constructed on one side of each trap for livestock exercise. The animals were locked in the stable traps at two sites each evening, Monday through Friday, so that collections were obtained from each site at least once a week. Also, at each site two to four CDC Miniature Light Traps were positioned at least 100 feet apart and at least 100 feet from the nearest stable trap. Light traps were placed where vegetation was greatest which resulted in various patterns of light traps to stable traps. The position and number of light traps were determined with the help of Dr. Verne F. Newhouse, National Communicable Disease Center, U. S. Public Health Service. Each evening, 5 days a week, all light traps were set into operation. The field and laboratory methods were similar to those described by Sudia and Chamberlain (1967). Mosquitoes were sealed in vials and stored in an insulated box containing dry ice until transferred to an ultra-low temperature cabinet (−65° C.) at the Dugway Processing Laboratory. Mosquitoes were examined on a CDC chill table (Sudia, Chamberlain, and Collier, 1965); identified by sight using the abbreviated key of Elbel (1968); and pooled by species, week of collection, site, and type of trap. Elbel or Olson checked all identifications under a stereomicroscope placed on a chill table.

RESULTS. As shown in Table 1, 16 species of mosquitoes were collected. Light trap collections provided representatives of all 16 species, but the livestock-baited stable trap collections provided representatives of 9 species. The light trap collections included specimens of *Aedes flavescens*, *A. melanimon*, and *Culex pipiens* which were new records for Callao. Of a total of 83,751 female mosquitoes collected, 60.9 percent were from light traps, and 39.1 percent were from livestock-baited stable traps. *Aedes dorsalis*, *Anopheles freeborni*, *Culex erythrothorax*, *C. tarsalis*, and *Culiseta inornata* were the five predominant species, and constituted 99.6 percent of the total collections. Collecting percentages for the five predominant species summarized below were based on the data presented in Table 1.

DISCUSSION. As shown in Table 2, the average light trap collections for *Aedes dorsalis*, *Culex erythrothorax*, *C. tarsalis*, and *Culiseta inornata* exceeded the average livestock-baited stable trap collections during the entire study period. However, for *Anopheles freeborni* the average livestock-baited stable trap collections exceeded the average light trap collections. The light trap/stable trap ratios greater than 1.0 indicated a higher average collection in the light traps than in the stable traps. These ratios exceeded 1.0 for the predominant species except *A. freeborni*. Because the stable traps were adjacent, there was a possibility that mosquitoes might not differentiate between the horse and the steer; therefore, data in Table 1 for the horse-baited and steer-baited stable trap collections were combined to produce one livestock-baited stable trap average.

From Table 1 it can be seen that light trap collections provided over 90 percent of the totals for each of the species *Aedes dorsalis*, *Culex erythrothorax*, *C. tarsalis*, and *Culiseta inornata*; but livestock-baited stable trap collections provided less than 10 percent. Although 73.6 percent of the *Anopheles freeborni* were collected in livestock-baited stable traps, the light traps still provided a significant collection of 26.4 percent of the total. Livestock-baited stable traps failed to attract four species of *Aedes*, one species of *Anopheles*, one species of *Culex* and one species of

Species	Total	Percent of grand total	Percent in light traps	Percent in stable traps
Aedes dorsalis	5,831	7.0	92.0	8.0
Anopheles freeborni	42,779	51.1	26.4	73.6
Culex erythrothorax	2,887	3.4	94.9	5.1
Culex tarsalis	26,094	31.2	98.4	1.6
Culiseta inornata	5,795	6.9	96.9	3.1
	83,386	99.6	60.8	39.2

Culiseta, but these species were collected in light traps. However, the livestock-baited stable traps did collect representatives of the five predominant species. The differential advantage of the light traps in attracting the minor species could be significant should these species become implicated in an arbovirus infection chain. The stable trap proved to be an effective means of collecting *A. freeborni* in that 96.2 percent of the total stable trap collections were of this species; conversely, 22.2 percent of the total light trap collections were *A. freeborni.*

The Magoon trap was selected as the basic design because of the need for (1) a trap sturdy enough to hold the large livestock available and (2) a collapsible trap whose components could be transported by truck over rough terrain with minimal damage. Roberts (1965) described a stable trap with screen on the lower two thirds of the sides and three louvered entrances. Blanton, Keenan, and Peyton (1955) used the stable trap of Bates (1944) which had screen on the upper half of the sides above the one louvered entrance. In contrast, the stable trap used during our study had screen covering the upper one-sixth of the sides; and the one louvered entrance located approximately four feet from ground level. Roberts (1965) reported from Mississippi that approximately 94 percent of the total mosquitoes were collected in steer-baited stable traps, and approximately 6 percent were collected in light traps. The steer-baited stable trap also collected representatives of 23 mosquito species, and the light traps collected representatives of 16 species. Blanton, Keenan, and Peyton (1955) reported that collections from horse-baited stable traps in Panama provided representatives of 14 of the 17 genera of mosquitoes known to occur there. A total of 4,478 trap nights resulted in the

Table 1.—Light trap and stable trap collections of female mosquitoes collected at Callao, Utah for the period 22 May to 30 September 1966

Species	Collected in: Light trap	Horse-baited Stable trap	Steer-baited Stable trap	Total
Aedes				
cataphylla	3	...	...	3
dorsalis	5,369	347	115	5,831
fitchii	2	...	...	2
flavescens *	33	...	4	37
melanimon *	2	...	...	2
nigromaculis	36	2	...	38
niphadopsis	6	...	...	6
schizopinax	3	1	...	4
vexans	123	11	9	143
Anopheles				
franciscanus	7	...	...	7
freeborni	11,309	15,638	15,832	42,779
Culex				
erythrothorax	2,739	63	85	2,887
pipiens *	10	...	...	10
tarsalis	25,668	215	211	26,094
Culiseta				
incidens	113	...	...	113
inornata	5,613	112	70	5,795
Total:	51,036	16,389	16,326	83,751

* New records for the Callao area.

TABLE 2.—Monthly averages per trap night* and light trap/stable trap ratios** for the five predominant mosquito species collected at Callao, Utah from horse-baited and steer-baited stable traps for the period 22 May–30 September 1966.

Species		Collected during 22 May-3 Jun	4 Jun-1 Jul	2 Jul-29 Jul	30 Jul-26 Aug	27 Aug-23 Sep	24 Sep-30 Sep
Aedes dorsalis	Light trap	9.74	3.65	0.69	0.40	2.19	2.20
	Stable trap	5.40	2.10	0.13	0.10	0.17	....
	Ratio	1.80	1.74	5.31	4.00	12.88	....
Anopheles freeborni	Light trap	3.84	8.57	6.77	7.26	0.88	1.44
	Stable trap	68.86	154.78	152.17	57.90	3.33	....
	Ratio	0.06	0.06	0.04	0.12	0.26	....
Culex erythrothorax	Light trap	0.24	0.08	0.95	2.71	2.25	1.29
	Stable trap	0.22	0.05	0.49	1.04	0.32	....
	Ratio	1.09	1.60	1.94	2.61	7.03	....
Culex tarsalis	Light trap	8.76	14.77	12.55	25.18	1.70	0.25
	Stable trap	0.56	0.78	1.57	2.50	0.58	....
	Ratio	15.64	18.94	7.99	10.07	2.93	....
Culiseta inornata	Light trap	0.96	5.25	1.23	3.22	2.42	1.19
	Stable trap	0.62	1.00	0.37	0.22	0.44	....
	Ratio	1.55	5.25	3.32	14.64	5.50	....

$$\text{* Monthly average per trap night} = \frac{\text{Total mosquitoes collected per month}}{\text{Total light traps operating per month.}}$$

$$\text{** Ratio} = \frac{\text{Monthly average per trap night (light trap)}}{\text{Monthly average per trap night (stable trap).}}$$

capture of 161,284 mosquitoes. Of this total, 38,082 (23.6 percent) were *Anopheles* species and the remaining 123,202 (76.4 percent) were other mosquitoes.

In the Callao study a greater number and variety of culicine species might have been obtained from livestock-baited stable traps had traps with more screen been used. However, it would appear that for west central Utah CDC Minature Light Traps alone would provide a sufficient sampling of the mosquito species. Light traps have the added advantage of greater operational adaptability without the limitations inherent in livestock care.

SUMMARY. At Callao, Utah 83,751 female mosquitoes representing 16 species were collected during the spring, summer, and fall of 1966. Of this total 60.9 percent representing all 16 species were collected in CDC Miniature Light Traps, and 39.1 percent representing 9 species were collected in livestock-baited stable traps. Regarding the five predominant species, the average light trap collections exceeded the average livestock-baited stable trap collections for *Aedes dorsalis, Culex erythrothorax, C. tarsalis,* and *Culiseta inornata;* but the reverse was true for *Anopheles freeborni.*

ACKNOWLEDGMENTS. Grateful appreciation is expressed to Dr. Telford H. Work, Dr. Roy W. Chamberlain, Dr. W. Daniel Sudia, and Dr. Verne F. Newhouse, National Communicable Disease Center, U.S. Public Health Service, for advice and assistance in field and laboratory methods of collecting and processing mosquitoes, and particularly to Dr. Newhouse who helped initiate the program at Callao. Sincere thanks are expressed to D. Elmer Johnson and Dr. Lewis T. Nielsen, University of Utah, for checking questionable identifications; to the military and civilian staff of the Ecology and Epidemiology Division, Dugway, Utah, particularly to

Trevor R. Williams, James A. Albin, Lawrence E. Stipe, Donald R. Thompson, and Clayton R. Kyte, who participated in the field and laboratory phases of the program during the entire study period; and to Dr. William C. Reeves, Dean, School of Public Health, University of California, Berkeley, for helpful criticism during the preparation of the manuscript.

Literature Cited

BATES, MARSTON. 1944. Notes on the construction and use of stable traps for mosquito studies. J. Nat. Malaria Soc. 3:135–145, 2 figs.

BLANTON, FRANKLIN S., KEENAN, CHARLES M., and PEYTON, E. L. 1955. Mosquitoes collected in horse-baited traps in Panama during 1951 to 1953 inclusive as an index to malaria control. Mosq. News 15:39–42.

ELBEL, ROBERT E. 1968. Sight identification key for mosquitoes of the Great Salt Lake Basin. Mosq. News 28:167–171,2 pls.

MAGOON, E. H. 1935. Portable stable trap for capturing mosquitoes. Bull. Ent. Res. 26:363–69, 2 figs.

NEWHOUSE, V. F., CHAMBERLAIN, R. W., JOHNSTON, J. G., and SUDIA, W. D. 1966. Use of dry ice to increase mosquito catches of the CDC Miniature Light Trap. Mosq. News 26:30–35.

NIELSON, LEWIS T., and REES, DON M. 1961. An identification guide to the mosquitoes of Utah. Univ. Utah Biol. Ser. 12:1–58, 57 figs.

ROBERTS, R. H. 1965. A steer-baited trap for sampling insects affecting cattle. Mosq. News 25:281–285, 3 figs.

SUDIA, W. D. and CHAMBERLAIN, R. W. 1962. Battery-operated light trap, an improved model. Mosq. News 22:126–129, 3 figs.

SUDIA, W. DANIEL, and CHAMBERLAIN, ROY W. 1967. Collection and processing of medically important arthropods for arbovirus isolation. U. S. Dept. Hlth. Educ. Wel., Pub. Hlth Ser., Nat. Communicable Dis. Cent. 29 pp., 62 figs.

SUDIA, W. DANIEL, CHAMBERLAIN, ROY W., and COLLIER, MINTON I. 1965. CDC entomological chill table, a refrigerated unit for use in processing mosquitoes for arbovirus isolation study. Mosq. News 25:385–389, 3 figs.