A METHOD OF OBTAINING AN INDEX TO *AEDES* DENSITIES IN IRRIGATED PASTURES *

D. C. THURMAN, Jr.[1] AND E. W. Mortenson [2]

A knowledge of mosquito population densities is desirable for the evaluation of the success of mosquito control measures, for intelligently directing control work, and for the investigations of epidemiologists, toxicologists, and ecologists. The biologist studying the natural history of mosquitoes is faced with the problem of developing methods for the determination and the comparison of mosquito indexes. Mosquito species live under such a variety of conditions, and have such variable habits, that few generalizations can be drawn for the species of a single genus. The many species of the genus *Aedes* within the several subgeneric classifications show great variability in their reaction to ecological factors. This variability makes it difficult to develop methods of population measurement or of indexes thereto which can be generally applied to all species within the genus.

Any method for making an estimate of adult mosquito population calls first for an understanding of the ecology of the adult mosquito. This is required to interpret correctly any of the data collected. With irrigated pasture mosquitoes it is important to have a thorough understanding of the cycle of development in the pasture and to be able to judge with each record made the relationship that this record has to the over-all mosquito population.

During July, August, and September of the 1949 mosquito season, observations were made, almost daily, of the habits of the *Aedes* mosquitoes in irrigated pastures in the San Joaquin Valley of California. For the purpose of obtaining indexes to densities of adult *Aedes* in pastures, a cloth flag (see Fig. 1) was devised with which

FIG. 1—An entomologist takes flag counts of *Aedes* mosquitoes in a California pasture, 1949, for determining indexes to pasture mosquito density.

to standardize counting procedures. The cloth flags were made of white domestic, one yard square, with two sides tacked to dowel sticks allowing the flag to be held upright and rigid. The count was made in an area of 2′ x 2′ which was marked on the flag. In making an observation, the operator walked for a distance of approximately 30 paces into the pasture, turned his back to the wind, spread the cloth against his legs and counted the mosquitoes landing on the leeward side. Counts were made for only the first 30 seconds

* A contribution from the Bureau of Vector Control, California State Department of Public Health, California Mosquito Control Association and the Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Ga.

[1] S. A. Sanitarian, PHS, Bureau of Vector Control, Berkeley, California.

[2] Parasitologist, Bureau of Vector Control, Berkeley, California.

after the operator stopped. Subsequent counts were made at distances of at least 30 paces over the area being studied until the operator felt that the area had been sufficiently sampled. An average or mean flag count for use as a comparative index was obtained from a number of counts in the pasture.

For a short period, daily observations on the habits of adult *Aedes* also were made in a pasture near Manteca, California. These daily flag counts are recorded in Table 1 where they are compared with

made in the Manteca pasture were chiefly of *Aedes nigromaculis* (Ludlow).

In many instances it was found that densities of *Aedes* in the pastures were too low to obtain a usable mean mosquito count with a white flag. Therefore, it was decided that different colors of flags would be tested to determine those which would sample the lowest densities and give a usable mean count. For this reason, during September a study was made in Merced County in which the attractiveness of flags of six different colors was measured and

TABLE 1.—Average daily counts of female *Aedes nigromaculis* (Ludlow) from two light traps and from cloth flags. Manteca, San Joaquin County, California, July and August, 1949.

Date	Number of Mosquitoes				Number Stations Counted
	Trap 1	Trap 2	From Cloth Counts		
			High Count	Mean	
July 20			8	2.3	37
21	Not operated		45	8.2	14
		Pasture Flooded			
25	" "		3	0.2	14
28	3	22	Population very low		
29	0	3	No counts made		
30	1	16			
31	0	50			
		Emergence Began			
Aug. 1	3	7			
2	524	37	250	85.6	16
		Emergence Completed			
3	318	2656	200	79.9	24
4	338	1592	76	25.3	24
5	5	230	64	21.8	24
6	4	32	300	75.3	24
7	0	84	120	47.6	24
8 *	28	100	No counts made.	Aerosoled at 6 P. M.	
9	28	100	3	0.2	24
10	1	2	8	1.4	12
11	Not operated	9	11	1.5	18
12	35	Not operated	10	1.3	18
13 **	14	7			
14	14	7			

* Collection in light trap for July 8 removed on 9th.
** Collection in light trap for July 13 removed on 14th.

light trap collections taken during the same period. It will be noted that the mean flag count remained high for a period of about a week after emergence began. During this period, there was a quick rise in population to a peak in the light trap collections following emergence of adults from the aquatic habitat. Counts

compared. The results of this study appear in Table 2, where it will be noted that pasture *Aedes* preferred the flags made with dark grey cloth. The mean mosquito count on the dark grey flags of 1.5 mosquitoes per count was significantly higher than counts for flags of the white, green, light grey, and white with black backing

TABLE 2.—Color preference of adult *Aedes nigromaculis* (Ludlow) females determined by use of cloth flags. Neilsen's pasture, Merced County, California, September, 1949.

Color	*Total Mosquitoes for 30 Counts*	*Mean (Mosq./Count)*	*Highest Single Count*
White with black backing	9	.3	2
White	12	.4	3
Green	22	.7	4
Light Grey	37	1.2	5
Red	40	1.3	5
Dark Grey	44	1.5	6
TOTAL	164	.9	
Standard deviation		.159	

colors. This mean was slightly higher than that for the red flag (1.3), but this difference was not significant. In this connection, it may be noted that Gjullin (1947) found black clothing to be preferred in a study of the rate of attack of *Aedes dorsalis* (Meigen) and *Aedes lateralis* (sticticus) when compared with blue, red, tan, green, yellow, and white clothing.

DISCUSSION

With day-biting mosquitoes which attack man, such measures as biting rates may be used as indexes of density. The use of these rates will be influenced by personal differences between operators, the time of day, weather conditions for the day, proximity to the habitat of the aquatic stage, and the habits of the species being studied. The use of the "cloth flag" counting method is subject to the same variables. It provides a measured study area which can be somewhat more closely standardized than such techniques as "pants leg" counts or "shirt sleeve" counts. The method is limited in application, being most suitable to irrigated pasture areas in the Central Valley of California.

The total density of the mosquito population cannot, of course, be determined by this method, but the index obtained is believed to bear a constant relationship to the total population. Further studies of the many factors involved will be necessary to establish this relationship and to determine the limitations of the method for practical use.

SUMMARY

A method for using square cloth flags for obtaining an index to *Aedes* densities in irrigated pastures in California is described and its use is discussed. This method is considered particularly well adapted for studies on the bionomics of pasture *Aedes* in California.

Note: Assistance of Johnson T. Prescott, Entomologist, Bur. of Vector Control, is acknowledged.

Literature Cited

GJULLIN, C. M. 1947. Effect of clothing color on the rate of attack on *Aedes* mosquitoes. *Jour. Econ. Ent.* 40:326–327.

See Page 217