equine encephalomyelitis in upstate New York: Studies of a 1976 epizootic by a modified serologic technique, hemagglutination reduction, for rapid detection of virus infections. Amer. J. Trop. Med. Hyg. 27:1240–1245.

Vianna, N., E. Whitney, T. Bast, R. Deibel, J. Doll and J. Culver. 1971. California encephalitis in New York State. Amer. J. Epidemiol. 94:50–55.

Whitney, E. and H. Jamnback. 1965. The first isolation of Powassan virus in New York State. Proc. Soc. Exper. Biol. Med. 119:432–435.

PREFERRED BREEDING MEDIA OF THE STABLE FLY, *STOMOXYS CALCITRANS*, IN NORTHWESTERN FLORIDA[1]

DAVID F. WILLIAMS[2], ANDREW J. ROGERS[3], PHIL HESTER, JOE RUFF AND RICHARD LEVY[4]

West Florida Arthropod Research Laboratory, Florida Department of Health and Rehabilitative Services, Panama City, FL 32401

ABSTRACT. Breeding media of the stable fly *Stomoxys calcitrans* (L.) were studied over a 41-month period (1972–1975) in 7 counties in northwestern Florida. Quantitative samples were collected routinely and the number of immatures was recorded for each type of breeding medium. The largest numbers of larvae and pupae were found in decomposing silage and green chop which had been used for feeding dairy animals. During these studies agricultural areas were found to be the primary source of stable flies in the northwestern Florida area.

The stable fly, *Stomoxys calcitrans* (L.), is a major pest of livestock and man throughout much of the world. It is a pest of considerable importance to livestock and dairy industries, and to tourist and recreational facilities along lakeshores and coastal areas.

Outbreaks of the stable fly (known as the "dog fly" in northwestern Florida') were reported in the literature as early as 1936 by King and Lenert. Early studies on the biology, breeding sites, and control operations around Panama City, Florida, were reported by Simmons and Dove (1941 and 1944) and Dove and Simmons (1942).

Although much research has been done on the stable fly, there is need for additional studies on the field biology of these flies. This knowledge would be especially helpful for planning and conducting control measures.

One of the major insect problems in the northwestern Florida area occurs when large numbers of stable fly adults accumulate along Gulf tourist beaches, particularly from Panama City to Pensacola, Florida. This area consists of 15 counties of which 8 border on the Gulf of Mexico. This study was carried out mainly in 7 counties: 3 coastal (Gulf, Bay, and Walton) and 4 inland (Washington, Jackson, Calhoun, and Holmes). This paper reports on breeding media and location of immature stable flies in this area over a 41-month period (1972–1975).

[1] This research was supported in part by Cooperative Agreement No. 12–14–100–10, 930(33) between the United States Department of Agriculture and the West Florida Arthropod Research Laboratory.

[2] Present Address: Insects Affecting Man and Animals Research Laboratory, AR, SEA, USDA, P. O. Box 14565, Gainesville, Florida 32604.

[3] Present address: 1607 DeWitt St., Panama City, Florida 32401.

[4] Present address: Lee County Mosquito Control District, P. O. Box 2237, Fort Myers, Florida 33902.

MATERIALS AND METHODS

Immature populations (larvae and pupae) were monitored throughout northwestern Florida at known and potential breeding sites. Sampling for fly breeding was conducted at dairy farms, livestock yards, poultry houses, swine farms, horse stables, beef cattle farms, peanut litter, and any other agricultural operation that appeared to be a potential breeding site of stable flies. In addition, piles and rows of decaying grasses and other vegetation along bayshores, lakeshores, beaches, and canals were sampled. After an extensive survey was completed, certain major breeding sites from dairy farms, a freshwater canal, and the shoreline of a large lake were selected for continuous sampling of immature breeding. Other areas were monitored at 2-month intervals or when conditions indicated the probability of breeding. Once breeding was discovered at a selected site, samples were collected by using a galvanized metal pan ($6 \times 6 \times 2$ in deep) with a sharpened edge. The inverted sampling pan was forced down into the breeding medium and a quantitative sample (72 $in.^3$) was removed. The sample was then placed in a plastic bag, tagged with the appropriate information and returned to the laboratory for analysis. Usually 3–4 samples were taken at random from each breeding site. Data concerning size of breeding area and type of breeding medium were recorded at each sampling site. Laboratory analysis of each sample was conducted with a Berlese funnel and after a 5-day period the number of stable fly larvae were counted and each sample checked by hand for pupae and puparia which were added to the number of larvae. This yielded the total immature stable flies per sample.

One ft^3 samples of breeding material containing larvae and pupae were also collected. Some of these samples were placed in emergence cages to determine the number of adult flies that would emerge over 30 days. Other samples were placed in Berlese funnels and analyzed for immatures. Using these data, it was then possible to estimate the percent reduction from larval to adult stage.

By estimating the number of immatures per ft^3 based on the 72 in^3 samples and correlating this with the size of the breeding area, the natural mortalities, and adult emergence rates, a reasonable estimate of the stable fly population could be calculated for any particular site.

RESULTS AND DISCUSSION

Results of the immature sampling are shown in Table 1. The data show that decomposing silage and green chop (freshly cut sorghum), common dairy feeds used in northwestern Florida, were the most prolific breeding materials sampled for stable flies. The heaviest infestation of stable fly larvae and pupae during the entire study period was found in silage at a dairy farm in July 1972. The largest single sample of stable fly immatures was obtained from silage at a dairy farm in March 1974 (1,205 larvae in a 72 in^3 sample or an estimated 28,920 per ft^3). The results of ft^3 samples placed in Berlese funnels and emergence cages to determine percent reduction from larval stage to adult are shown in Table 2. The average reduction was 72%.

The mean number of larvae per ft^3 for all samples collected during this study was 2,755 larvae per ft^3. The average size of the breeding areas at dairy farms and other livestock areas was 626 ft^3. Thus: 2,755 larvae per ft^3 x 626 ft^3 equals 1,724,630 larvae per area minus 72% reduction (from larval stage to adult) or 482,896 adult stable flies emerging from the average breeding area in northwestern Florida. This assumes of course that similar reductions occurred in the breeding areas as recorded in the emergence cage tests.

As a general rule, most dairymen in this area feed silage from about October through May and feed green chop the remaining period (B. Harris, Jr., personal communication). This evidence, in addition to the large number of dairy farms occurring in northwestern Florida, the

Table 1. Numbers of stable fly larvae and pupae collected from several types of breeding media in northwestern Florida during a 41-month study from 1972 to 1975.

Month	Location	Type of material	No. collected in 72 in³ sample		Estimated no./ft³	
			Mean	Range	Mean	Range
January	Dairies	Silage and hay	78	1– 215	1,881	24– 5,160
	Livestock yard	Manure and hay	55	4– 119	1,320	96– 2,856
	Freshwater canal	Coontail, *Ceratophyllum demersum* L.	22	2– 46	528	48– 1,104
February	Dairies	Silage	125	1– 596	2,993	24–14,304
March	Dairies	Silage	181	1–1,205	6,345	1,128–28,920
April	Dairies	Silage, hay, & oats	76	1– 363	1,818	24– 8,712
May	Dairies	Silage, green chop	105	1– 437	2,526	24–10,488
	Freshwater lake	Eurasian watermilfoil, *Myriophyllum spicatum*	51	16– 85	1,224	384– 2,040
June	Dairies	Silage, green chop & hay	193	37– 716	4,608	48–15,096
	Freshwater canal	Pondweed, *Potamogeton* spp.	14	2– 37	336	48– 888
July	Dairies	Silage & green chop	343	1– 684	8,309	24–16,416
August	Dairies	Green chop	54	1– 321	1,300	24– 7,704
	Freshwater canal	Pondweed, *Potamogeton* spp. and Coontail, *Ceratophyllum demersum* L.	135	13– 382	3,240	312– 9,168
September	Dairies	Silage & green chop	84	1– 328	2,015	24– 7,872
October	Dairies	Silage & green chop	93	10– 207	2,245	240– 4,968
	Freshwater canal	Pondweed, *Potamogeton* spp.	55	14– 102	1,320	366– 2,448
November	Dairies	Silage & manure piles	69	2– 480	2,701	48–11,520
	Freshwater canal	Pondweed, *Potamogeton* spp.	115	22– 207	2,760	528– 4,968
	Freshwater lake	Eelgrass, *Vallisneria americana* Michx.	229	127– 330	5,496	3,048– 7,920
December	Dairies	Silage	89	11– 291	2,127	264– 7,896

Table 2. Percent reduction from larval to adult stages from ft³ samples of silage collected at dairy farms in northwestern Florida, 1973.

Sample[a]	Average no./ft³		Percent reduction
	Larvae	Adults	
1	3501	1426	59
2	3603	618	83
3	4640	1519	67
4	4842	1144	76
Mean	4147	1177	72

[a] Each sample represents 4 replicates.

long flight range of the stable fly and heavy outbreaks of stable flies on the beaches in the absence of bay grass deposits along shorelines, indicates agricultural areas as one of the primary source of stable flies in this area. Previous reports indicate that bay grasses deposited on shorelines were the primary source of stable fly outbreaks along the Gulf beaches. Although these grass deposits occasionally contribute to the problem, they appear to be less important than agricultural areas as a source of these flies. The production of stable flies in agricultural areas can be enormous and the reduction of fly populations in these areas must be considered when planning long range control programs.

References Cited

Dove, W. E. and S. W. Simmons. 1942. Control of stable fly or "dog fly" breeding in shore deposits of bay grasses. J. Econ. Entomol. 35(4):582–589.

King, W. V. and L. G. Lenert. 1936. Outbreaks of *Stomoxys calcitrans* (L.) ("dog flies") along Florida's northwest coast. Fla. Entomol. 19(3):33–39.

Simmons, S. W. and W. E. Dove. 1941. Breeding places of the stable fly or "dog fly" *Stomoxys calcitrans* (L.) in northwest Florida. J. Econ. Entomol. 34(3):457–462.

Simmons, S. W. and W. E. Dove. 1944. Observations on the biology of the stable fly in Florida. J. Econ. Entomol. 37(5):680–685.