

# PREVALENCE AND ABUNDANCE OF CERTAIN INLAND *CULICOIDES* LARVAE AS RELATED TO THE HYDROGEN ION (pH) CONCENTRATION IN THE SOIL<sup>1</sup>

WILLIAM W. SMITH<sup>2</sup>

During February, March, and the first two weeks in April, 1964, 207 soil samples were collected from presumed *Culicoides* breeding sites in Alachua County, Florida, analyzed for pH value, and processed to recover the *Culicoides* larvae (chiefly third and fourth instars). The samples were taken from the muddy margins of lakes, ponds, ditch banks and similar areas subject to occasional floodings where larvae of *C. haematopotus* Malloch, *C. stellifer* (Coq.), and *C. crepuscularis* Malloch were believed to occur. Rearings of samples of the larvae recovered indicated that *C. haematopotus* was most abundant, *C. stellifer* moderately abundant, and *C. crepuscularis* less common.

During the collection period, rainfall was slightly deficient so that leaching, and dilution of soil water due to excessive precipitation was minimized.

**SAMPLING METHODS AND AREAS SAMPLED.** Soil samples were collected with a soil-sampler which cut a cylindrical plug 2¼ inches in diameter and about 3 inches deep. Two plugs were taken at each sampling site and deposited in a one-quart oil can. The remainder of the can above the samples was filled with clean builder's sand and flooded with tap water. This caused the larger larvae present to ascend from the soil into the sand and water above the soil. At the end of 24 to 48 hours, the sand and water were scooped from the can into a small enamel pan and swirled rapidly by hand, additional tap water having been added. The turbid water was decanted

<sup>1</sup> Partially supported by NIH Grant GM-12322.

<sup>2</sup> Entomology Department, Univ. of Fla., Gainesville.

from the enamel pan into a 100-mesh sieve after a very brief settling period. The larvae and debris strained out by the sieve were washed into a finger bowl with a wash bottle. The contents of the bowl were examined under a low-power binocular microscope and larvae were removed by a pipette for use in rearing studies.

The method for larval recovery is essentially that used by Bidlingmayer (1957) to recover larvae of salt-marsh-breeding *Culicoides*. He found that it recovered about 85 percent of the older instars. Similar soil samples were collected for pH determination as near as possible to those taken for larval recovery studies. These soil samples were dried, sieved, and their pH value determined by the Soil Testing Laboratory of the University of Florida.

The ecological areas sampled consisted of (1) the shoreline of the shallow end of a small permanent lake (Biven's Arm) with an approximate surface area of 1 square mile. Aquatic vegetation, consisting largely of water lilies, *Nymphaea* sp., water hyacinths, *Eichhornia* sp., and duckweed, *Lemna* sp., covered the water surface of the shallow end of this lake. The narrow shoreline margin was overspread by a thin, dark, organic coat underlain by sand; (2) the margin of a small semi-permanent lake about one-quarter mile in surface area, partially surrounded by a low swampy region (Sugarfoot Swamp) frequently flooded by heavy rains. During the sampling period relatively little vegetation was present in the water and along the muddy shoreline margin where soil samples were obtained; (3) a small portion of the shore margin and wooded bank of

an old lake bed (Payne's Prairie) now a low, wet pastureland with semi-aquatic plants in the wet areas and sedges and semi-aquatic grasses intermixed with pasture grasses in the drier parts. The gradually sloping banks are covered by deciduous trees such as magnolia, sweet gum, and oaks, and small intermittent ponds are present in low spots. Soil samples were taken from the low bank margin, around the edge of the small ponds in the woods, and along the banks of small ditches which channel overflow water from the ponds into the Prairie. Samples from this area were more heterogeneous than from the two previous areas.

In addition, a small number of soil samples (21) were taken from five miscellaneous locations where conditions appeared favorable for *Culicoides* larvae. These locations were along the shore of Newnan's Lake, a large permanent lake about 5 miles east of Gainesville, and along the margins of several flood ponds formed during the previous year.

RESULTS AND CONCLUSIONS. Table 1 shows that the pH of the soil samples ranged from 3.8 to 8.5, the largest number of samples (97) falling in the range 5.6 to 6.9. Of the 48 samples with the most acidic pH range (3.8-5.5), only 18.7 percent contained *Culicoides* larvae and only 20 larvae were recovered. The 97 samples from the slightly acidic range (pH 5.6-6.9) appeared to be most favorable for the presence of larvae, 57.7 percent being positive. A total of 587 larvae were recovered from these samples. The 62 samples ranging from neutral to slightly basic (pH 7.0-8.5) were a little more favorable for larval habitation than those of

TABLE 1.—Prevalence and abundance of *Culicoides* larvae in soil samples within certain pH ranges.

pH ranges	No. samples	% Samples positive	No. larvae	Aver. no. larvae per sample
3.8-5.5	48	18.7	20	0.42
5.6-6.9	97	57.7	587	6.05
7.0-8.5	62	29.0	62	1.00
Totals	207	40.1	669	3.23

the highest acidic range. Twenty-nine percent were positive and a total of 62 larvae were recovered.

The percentage of total samples which had *Culicoides* larvae (40.1) and relatively low number of larvae per sample (3.23) suggest that larval breeding places were localized and not heavily infested. However, only about two-fifteenths of a square foot of surface area was covered in each sample, and breeding areas were extensive.

With reference to the ecological areas sampled (Table 2), Sugarfoot Swamp

as previously explained. Samples taken from the margins of woodland ponds had pH values generally below 5.2 and rarely contained larvae, presumably because of the higher soil acidity. Twenty-two samples of 52 had pH values above 7.0 and also rarely contained larvae. The totals (26.9 percent positive, 0.8 larva per sample) are consequently lower than for the preceding two areas but higher than those for the miscellaneous samples taken from widely separated regions.

The majority of the samples (16 of 21)

TABLE 2.—Prevalence and abundance of *Culicoides* larvae as related to pH ranges of soil samples from specific ecological areas.

Area	pH range	No. samples	% samples positive	No. larvae	Aver. no. larvae per sample
Biven's Arm	6.0-8.5	71	42.3	118	1.7
Sugarfoot Swamp	5.2-6.8	63	61.9	508	8.0
Payne's Prairie	3.8-8.1	52	26.9	42	0.8
Newnan's Lake & others	4.9-7.6	21	4.8	1	0.05

was most heavily populated by *Culicoides* larvae, presumably because the majority of the soil samples (57 of 63) were within the pH range of 5.6-6.9 which was indicated in the preceding table to be most favorable. Almost 62 percent of the samples collected there contained larvae, the average number per sample (8.0) being much greater than that for the other areas sampled.

Biven's Arm Lake had samples with higher pH values (6.0-8.5) in general than the other regions, and since many of the 71 samples were within the intermediate range of pH favorability (7.0-8.5), an intermediate result was apparent. More samples contained larvae (42.3 percent positive) and more larvae were present (1.7 per sample) than in the Payne's Prairie and miscellaneous regions, but not as many as shown for the most desirable pH range exhibited by the Sugarfoot Swamp (Area 2) samples.

In Payne's Prairie the wide pH range (3.8-8.1) indicates the heterogeneity of the samples taken from different locations

taken from the shore of Newnan's Lake and the margins of flood ponds had pH values above or below the most favorable pH range shown in Table 1. Consequently the percentage of samples positive was very low (4.8 percent) and only one larva was recovered.

It was concluded that soils with a slightly acidic pH range were more favorable for the presence and abundance of three species of mud-dwelling *Culicoides* larvae than soils with lower or higher pH ranges.

#### ACKNOWLEDGMENTS

The advice and assistance of Dr. James NeSmith, Soils Specialist, IFAS, Soils; Mr. J. H. Varnell, Jr., Graduate Assistant in Entomology; and Mr. Murray E. Nance, Jr., Student Assistant, in connection with this study are gratefully acknowledged.

#### Literature Cited

- BIDLINGMAYER, W. L. 1957. Studies on *Culicoides furens* at Vero Beach. Mosq. News 17:292-94.