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ANALYSES OF WATER CONTAINING AEDES SOLLICITANS IN KENTUCKY

ELBERT B. DIXON
Entomologist, Kentucky State Department of Health

The salt-marsh mosquito, *Aedes sollicitans* (Walker), has been found breeding inland where the environment is suitable. For a comprehensive review of these records, the reader is referred to the papers of Carpenter and Middlekauf (1944) and Fellton (1944). Most instances, judging from the literature, have been near oil fields, salt wells, or salt water pools; though Fellton (1944) and the author (1955) record their breeding in the Illinois and the Western Coal Field of Kentucky, respectively. Emphasis has generally been placed on the sodium chloride factor of the habitat; perhaps, because this compound, composing around 78% of the salts in sea water, preponderates all

Fig. 1. A typical habitat of the salt marsh mosquito, Smith Mills, Kentucky.

other salts in oceans, whose tides determine coastal marshes. Fortunately, the author, over three seasons, has been able to observe this mosquito in two habitats, one at the Smith Mills Oil Field containing considerable sodium chloride and another in the Western Coal Field containing less than 102 ppm of chloride ions, the limit for chlorine in drinking water set by the U. S. Public Health Service.

The habitat at the Smith Mills Oil Field resulted from dumping oil well brines into sloughs, once the bed of the Ohio River. Before this pollution, cypress chiefly composed the forest in these low areas; however, now only their dead stumps and trunks remain. The herbicidal action of the salts has entirely prevented the growth of any emergent or floating vegetation, as may be seen in the illustration.

The breeding areas of the Western Coal Field consist chiefly of the eleven mile long Clear Creek Swamp and the two and a half mile long Flat Creek swamp in Hopkins County, though in any area which is capable of being swampy and which receives mine water drainage appears to be a potential habitat of this species. In many instances these areas have vegetation, composed of plants such as the sedge, *Scirpus atrovirens* Willd., graminaceous plants, rushes: *Juncus tenius* Willd., *J. effusus* L., and *J. brachycarpus* Engelm.; and the narrow-leaved cattail, *Typha latifolia* L.

The larvae differ in that where the chloride content is high the gills are small, bud-like, as typically described in the literature, but where the chloride content is low the gills are one or more times the length of the last segment (fig. 2A). In many instances of the latter environment, the gills are grotesquely malformed as illustrated by figures 2B, C, and D.

Since larvae were found in waters of both high and low chloride content, the author feels that a comparison of the waters of both areas would be of some interest to those engaged in the study of this mosquito. However, in that the female is not known to deposit her eggs on water, the incomplete analyses, presented here, are offered only as a reflection of some of the probable chemical factors present in the substrate at the time of oviposition. Before this is presented, it is felt that a brief description of the development of acid mine water would be of interest, and perhaps of bearing, since drainage from ordinary excavations in the Western Coal Field apparently does not have any relation to the habitat of this mosquito.

Almost all coals of the Western Coal Fields are high in sulfur, both organic and inorganic. The inorganic sulfur compounds are principally pyrite and marcasite. McFarlan (1943) states that the black shale overlying number 9 seam often contains concretions of siderite or pyrite, sometimes several feet in diameter. In his description of number 11 seam, he states that a 1/4 to 2 inch band of marcasite typically is present about 9 to 16 inches below the top.

The general assumption is that these minerals are oxidized to ferrous sulfate, which in turn is oxidized to the amber-colored

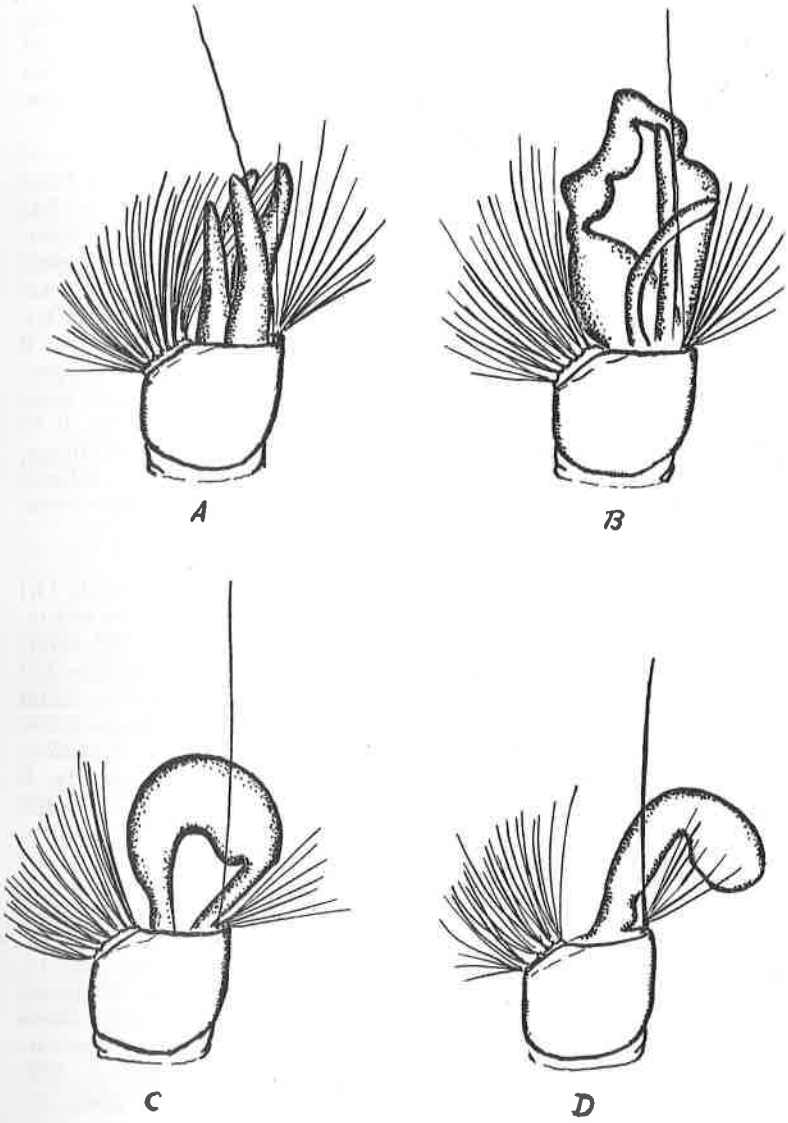

Fig. 2. Anal gill modifications of *Aedes sollicitans* larvae found in waters of the Western Coal Field of Kentucky. Figure A depicts those characteristically found in the area. Figures B, C, and D depict malformations.

ferric sulfate. Subsequently the ferric sulfate hydrolyzes to ferric hydroxide, which with hydrated iron oxide, precipitates out, coloring the waters and their courses red; hence, the name "red-water." Sulfuric acid results from these reactions. Not all bituminous mine drainage, however, is acid; some are either neutral or alkaline. Almost all of the mine drainage in the Western Coal Field is acid.

Of six water analysis containing larvae in the Western Coal Field, the color varied from 10 to 120; the pH, 2.9 to 3.1; turbidity, 2 to 110 ppm; total acidity ($CaCO_3$), 71 to 990 ppm; mineral acidity, 0 to 210 ppm; total solids, 1,370 to 5,360 ppm; suspended solids, 0 to 450 ppm; chlorides, 5 to 16 ppm; total hardness ($CaCO_3$), 580 to 1,860 ppm; total alkalinity ($CaCO_3$), 0 ppm; hydroxide alkalinity, 0 ppm; carbonate alkalinity, 0 ppm; bicarbonate alkalinity, 0 ppm; calcium, 180 to 270 ppm; magnesium, 19 to 120 ppm; sulfates, 1,000 to 3,500 ppm; total iron, 4.5 to 45 ppm; manganese, 8 to 30 ppm; fluorides, 0 to 0.8 ppm. The pH of 17 water samples of coal-mine drainage, including the preceding, varied from pH 2.4 to 3.6. Fifteen water samples from Ohio, Webster, and Hopkins counties, analyzed for chlorides, contained from 2.7 to 16 ppm.

One water sample, containing larvae, from Smith Mills Oil Field had the following analysis: color, 100; pH, 2.8; turbidity, 10; total acidity ($CaCO_3$), 370 ppm; mineral acidity, 190 ppm; total solids, 19,000 ppm; dissolved solids, 18,500 ppm; suspended solids, 500 ppm; chlorides, 9,400; total hardness ($CaCO_3$), 2,700 ppm; carbonate hardness, 0 ppm; non-carbonate hardness, 2,700 ppm; total alkalinity ($CaCO_3$), 0 ppm; hydroxide alkalinity, 0 ppm; carbonate alkalinity, 0 ppm; bicarbonate alkalinity, 0 ppm; calcium, 990 ppm; magnesium, 47 ppm; sulfates, 4,000 ppm; total iron, 4 ppm; manganese, 24 ppm; fluorides, 0 ppm.

As a comparison of these with a typical habitat, a sample from a salt marsh on Pine Island, Florida, was collected; this sample had the following analysis: color, 200; pH, 6.7; turbidity, 300; total acidity ($CaCO_3$), 68 ppm; mineral acidity, 0 ppm; total solids, 19,400 ppm; dissolved solids, 19,100 ppm; suspended solids, 300 ppm; chlorides, 9,000 ppm; total hardness ($CaCO_3$), 2,170 ppm; carbonate hardness, 320 ppm; non-carbonate hardness, 1,850 ppm; total alkalinity ($CaCO_3$), 320; hydroxide alkalinity, 0 ppm; carbonate alkalinity, 0 ppm; bicarbonate alkalinity, 320 ppm; calcium, 212 ppm; magnesium, 400 ppm; sulfates, 1,460 ppm; total iron, 5.0 ppm; manganese, 0 ppm; fluorides, 0 ppm.

Only one sample collected in Kentucky, that from the Smith Mills Oil Field, contained any appreciable amount of chloride ions. All, including that from the salt marsh in Florida, pos-

sessed considerable amounts of sulfates. In all habitats in Kentucky, there was evidence of pollution from oil well brines or mine drainage.

LITERATURE CITED

Carpenter, Stanley J. and Woodrow W. Middlekauf. 1944. Inland Records of Salt Marsh Mosquitoes. *Jour. Ec. Ent.* 37 (1): 108.

Dixon, Elbert B. 1955. The Spread of *Aedes sollicitans* (Walker) in Kentucky. *Mosquito News* 15 (1): 42.

Fellton, Herman L. 1944. The Breeding of the Salt-Marsh Mosquito in Midwestern States. *Jour. Ec. Ent.* 37 (2): 245-247.

McFarlan, Arthur C. 1943. *Geology of Kentucky.* Kentucky. 531 pp.

NEWS OF TENNESSEE SCIENCE

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University of Tennessee

The National Science Foundation granted to the U-T Dept. of Botany, University of Tennessee, funds for the purchase of a Gray Herbarium Card Index for use in the Tennessee Flora Project. This index, consisting of over 250,000 cards, lists most of the names of plants described from the Americas with citations and often synonyms. It has been received and is now filed in the Biology Building of the University of Tennessee, and is available to botanists not only from Tennessee but also from our entire region.

The Seventh Annual Wildflower Pilgrimage will be held in the Great Smoky Mountains National Park at Gatlinburg, Tennessee, April 24 - 27, 1957. Field trips and motorcades will be led daily by Park Naturalists, trained botanists and photographers. In addition to wildflowers, one trip will feature mosses and fers. There will be morning bird trips and illustrated lectures in the evening. For further details, writet to the Department of Botany, The University of Tennessee, Knoxville.

Dr. L. R. Hesler, U T Professor of Botany and Dean of the College of Liberal Arts, has received a grant of $8,500 from the National Science Foundation to continue studies on the mushrooms of the Southeast.

Dr. John M. Woodward of the U-T department of Bacteriology has received a $4800 grant from the Office of Naval Research to continue metabolism studies on rats in connection with experiments to determine the cause of death in tularemia.

The U-T department of electrical engineering will cooperate with the Georgia Institute of Technology in basic research on the directions from which meteors come toward the earth. This research is being conducted for the U. S. Office of Naval Research under terms of a $50,000 contract.

The U-T mechanical engineering department has been awarded a $60,000 contract by the AEC for research on the designing of nuclear power plants. The research will be directed by Prof. P. F. Pasqua.

The National Science Foundation has awarded a grant of $12,300 to the U-T Engineering Experiment Station for experiments on the flow of liquids over rough surfaces. The experiments are being conducted by Dr. Harry H. Ambrose, professor of Civil Engineering.

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