SOME PERSONAL OBSERVATIONS ON THE TREATMENT OF CLEAR LAKE, CALIFORNIA FOR THE CONTROL OF THE CLEAR LAKE GNAT

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I had the good fortune on September 15 and 16, 1949, to witness the treatment of Clear Lake in California, for the control of the Clear Lake gnat (*Chaoborus astictopus* Dyar and Shannon). Without doubt, this operation together with the research leading to the final operation, was among the most unique ever carried out in the field of entomology.

This is not a scientific report of the research or of the control procedure. It is, rather, a brief popular account of this unusual insect control program.

The Clear Lake gnat problem is strictly a local one confined to Lake County, California. During summer months on warm calm evenings, the gnats are on the wing in countless millions. They create a serious nuisance in many ways by sheer weight of numbers. They are strongly attracted to lights. Homes are invaded. They smear windshields on cars. They plug car radiators. They make any function unpleasant, either indoors or outdoors, by contaminating foods. Their presence in such huge numbers creates a favorable situation for spiders; practically everything becomes encased in a veil of spider webs. The gnats constitute a health problem, I am told, because a number of local people have developed allergies to them.

This otherwise wonderful recreational area could not develop to its maximum potential because of the gnat nuisance. It is believed, and I think rightly, that gnat abundance at Clear Lake is the only reason people from near-by metropolitan areas do not take full advantage of this splendid recreational area. The people of Clear Lake are naturally anxious to control the gnat, not only to relieve a personal nuisance, but also with the hope that the area will develop from a financial standpoint.

A great deal of research has gone into the Clear Lake gnat problem. In the early thirties research was undertaken by the University of California. Basic information on the gnat's biology was obtained, and possibilities of utilizing light traps were also studied as a control measure.

Congress appropriated funds to the Bureau of Entomology and Plant Quarantine in 1938 to study the biology and control of the gnat. This work was undertaken by the Division of Insects Affecting Man and Animals, then headed by Dr. F. C. Bishopp.

Mr. A. W. Lindquist was placed in charge of the research station located at Clear Lake. He was assisted by Dr. C. C. Deonier. Intensive studies were undertaken on the life history, habits, ecology, and possible control measures during 1938 to 1942. Valuable scientific information was obtained, not only about the gnat itself but also with regard to other forms of aquatic life including fish. All promising control measures were explored. Among these were light traps and burning of gasoline in areas where the eggs of the gnat had accumulated, usually along the shore line. No control program was initiated, however. During the war the work was discontinued and the personnel were assigned to the Bureau's laboratory at Orlando, Florida, for research on other problems then demanding solution.

In 1946 Mr. Lindquist was placed in charge of the Corvallis, Oregon, laboratory of the Bureau. Fortified with the vast amount of experience he had gained at Orlando in research on mosquitoes and other problems involving the use of new insecticides, he undertook exploratory

studies to determine if the gnat larvae or adults might be controlled with the new chemicals. It was difficult to carry out a research program at Clear Lake from Corvallis headquarters. Nevertheless, through a series of brief trips, he and his assistants demonstrated, by laboratory tests, that the application of certain chemicals offered exceptional promise as a control measure for the gnat larvae. DDT was among the most effective of the new materials when used at dosages as low as 1 part to 100 million parts of water. TDE appeared equally outstanding.

The primary unanswered questions were (1) Will treatment of a lake with these insecticides kill the gnat larvae? (2) Will control be obtained without killing fish?

Various formulations of DDT and TDE were then tested against gnat larvae under different conditions. The California Fish and Game Department cooperated by testing the formulations against fish. Finally it was decided that TDE applied as an emulsion concentrate offered most promise from both the standpoint of larvicidal efficiency and safety to fish. A small lake of about 75 acres near Clear Lake was selected for a "pilot plant" test, in December 1947. Mr. Lindquist and Mr. Roth of the Corvallis laboratory applied the treatment at the rate of 1 part of TDE to 45,000,000 parts of water. Mr. Garth Murphy of the California State Fish and Game Department studied the effects of the treatment on fish directly and also studied the important question of possible long range effects of the treatment on fish due to destruction of aquatic life consumed as food by fish.

The experiment was considered a success. Complete control of the gnat larvae was attained after about one month. A few fish were killed, however. Death of the few fish was attributed largely to improper dispersion of the emulsion in the water.

To be certain, however, a second test was made in 1948 in another small lake. TDE was applied at the rate of 1 part of TDE to 75 million parts of water. Complete control of the gnat larvae was attained in this test without apparent harmful effects on the fish.

Residents of Lake County, California were greatly interested in the progress of these experiments. They cooperated in every possible way and supported the work by meeting a part of the expenses of the research program. They organized a gnat and mosquito abatement district under the laws of the State of California. Then the County appropriated funds for a program to treat big Clear Lake. The Bureau of Vector Control of the California State Health Department, allocated part of the funds and cooperated in other ways.

When residents of Lake County showed determination to go through with a program to treat Clear Lake, Mr. Lindquist told them that according to the experimental results a successful program might be possible. He advised the County Supervisors and the abatement organization, however, that a venture of this type represented a long jump from treating a lake of 50 acres to treating one of 40,000 acres. No one could be sure, he explained, that the treatment would be a success but he offered to assist in every way possible, and agreed to provide necessary technical supervision in planning and carrying out the program. The county officials consulted with California State game specialists and Mr. Murphy was assigned to assist and to observe the effects of the insecticidal application on fish. The many details of arranging the program were carried out by Lake County residents. Tom Garner, County Clerk, Mr. Hitchcock, Chairman of the County Supervisors, J. K. Peterson, and many others did an excellent job in arranging all the details of the general plan which Mr. Lindquist proposed to them.

The program was carried out in every way according to plan. The actual treatment of the lake was made in an excellent manner.

The date for making the treatment was set for September 15, 1949. At dawn that

day six tugs, each pulling barges loaded with drums of TDE emulsion base containing 30 percent of TDE, 10 percent of Triton x-100 and 60 percent of xylene, were on their way to the respective sections of the lake assigned to them for treatment. See figure 1.

The emulsion concentrate was applied undiluted to the water through a small hose by gravity feed. It was applied in the wake of the barges as shown in figure 2 in order to obtain efficient emulsification in the water. The rate of delivery had been calculated beforehand, taking into account the speed of the tugs, the average depth of the water, and width of "swath." The desired rate of application was 1 part of TDE to 75,000,000 parts of water. The schedule called for completion of the treatment in two days, which necessitated distributing 14,000 gallons of insecticide concentrate.

The enthusiasm of the people of Lake County was the real highlight of the occasion. This operation was not an experiment in any way to them—it meant the end of the Clear Lake gnat. They designated the date of the treatment as "G E day"—G E, meaning "Gnat Eradication." A replica of the gnat, 4 feet long (Figure 3) was constructed by the local undertaker. The effigy was called "G. Nat." It was placed in a coffin on the Court House lawn where it lay in state for several days prior to its disposition for all to "mourn." (Figure 3)

Every resident of the county apparently was present on the night of September 15

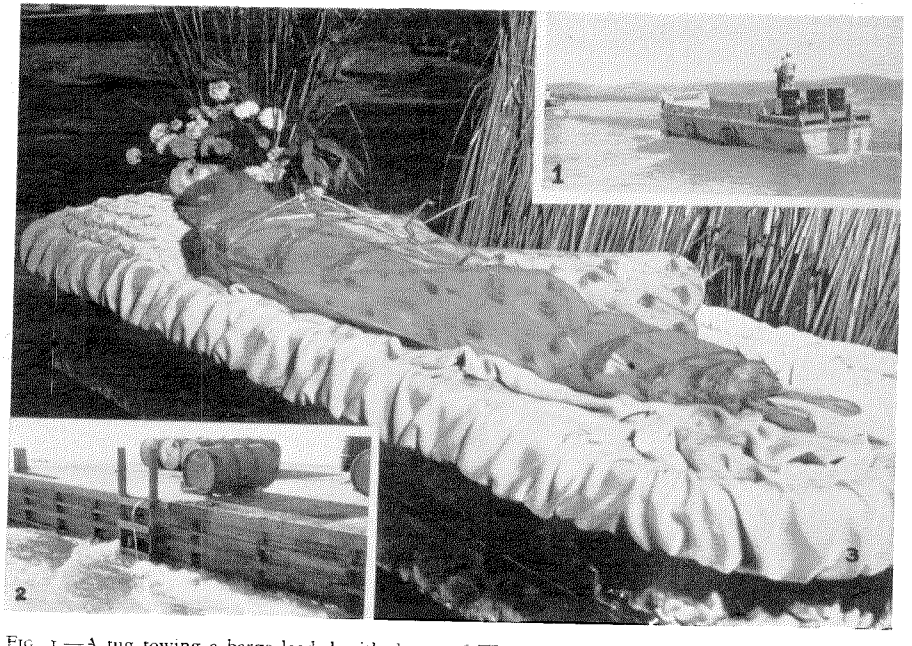

FIG. 1.—A tug towing a barge loaded with drums of TDE emulsion concentrate. The tug and barge are *en route* to the sector of the lake where material was applied.

FIG. 2.—Emulsion concentrate draining by gravity into water where turbulence created by movement of barge results in emulsification.

FIG. 3.—Effigy of "G. Nat" lying in state for ceremony celebrating death of the gnats.

to pay final tribute to Mr. G. Nat. A number of notables were present, and a clever, well prepared eulogy was delivered by Mr. Crump, a local attorney. This was followed by a song about the gnat, written by another Lake County resident. It was sung to the tune of "We'll be glad when you are dead—you rascal you."

Following the ceremony, "G Nat" was placed on a bier in the lake and burned.

The celebration was certainly premature to those of us who know about the many disappointments that can occur in the best planned control projects, especially in new ones. I am sure all entomologists present, especially Mr. Lindquist, felt serious responsibility in developing this program, and he, more than anyone else realized how disappointed the people would be if the program failed to accomplish the objective.

The results of the treatment are being reported more fully by Mr. Lindquist and his associates, and by Garth Murphy, Arve Dahl (Bureau of Vector Control of California) and others. Although at this writing it is too early to estimate the success of the program, it can be stated that a good share of the estimated 714,000,000,000 gnat larvae (Mr. Lindquist's figure) in Clear Lake were dead within 48 hours after the treatment was applied.

Entomologists know that eradication means 100 percent kill, and they realize that if even one percent of a species survives it may be only a short time before the original numbers are back again. Nevertheless, we hope the treatment undertaken will mean relief from the gnat to residents of Lake County for at least a year. If so, in my opinion, the program will have been a great success.