

difficult to penetrate and treat. In the winter these willow growths are covered by heavy snowfall and it is possible to effectively pre-hatch the area on the surface of the snow.

5. "Tossits", the small gelatinous capsules containing 12% DDT and 4½% BHC have proved extremely useful in these recreational areas. Each "Tossit" will effectively treat about 100 square feet of water surface. They can be used in almost any type of situation and have a good residual effect. In this program they were especially valuable when carried by inspectors and used in treating pools found in rugged terrain that would be difficult to reach and treat with knapsack pumps.

6. Some of the other hydrocarbons

have been used experimentally in these two recreational areas with promising results. To date it has been unnecessary to use other larvicides extensively, as DDT, supplemented with Tossits, has produced complete control in the Brighton area and has produced excellent results at Camp Cloud Rim and vicinity.

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CONTROL OF BITING GNATS IN NORTH SALT LAKE CITY, UTAH (DIPTERA : HELEIDAE)

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A program for the control of the biting gnat—*Leptoconops kerteszi* var. *americanus* was conducted in North Salt Lake City, Utah during the spring of 1949, 1950 and 1951. The results of the work in 1949 have been published (Rees and Smith, 1950). The control program was continued in 1950 with marked improvements and was repeated in 1951 with complete success, as measured by the absence of gnat annoyance in the area. The program consisted of two phases: first, determination of the location and size of the area in which the gnats are produced, and second, the determination of the most effective and economical methods of control.

SURVEY

The first phase, that of determining the location and size of the area in which the gnats are produced, was at first extremely difficult, time-consuming and expensive.

The gnat-producing areas involved, as eventually determined are shown in Fig. 1. The larvae of this gnat develop in moist soil and do not appear on the surface until the time of pupation. In the first surveys that were made to locate the larvae, soil samples were taken at measured intervals, then washed, screened and examined in the laboratory under magnification. This was a slow, laborious method and too expensive to be practicable.

In 1950 it was observed that when the larvicide was applied to the surface of the ground, just prior to the time of pupation, the larvae exposed themselves, and squirmed around for several minutes before dying. Under these conditions they were readily visible to the unaided eye.

As a result of these observations several different insecticides such as DDT, lindane, chlordane, toxaphene and rothane were used in water emulsions of 1.0, 2.5, 5.0, and 10.0 percent, to determine the most effective insecticide and concentra-

tion to be used for this purpose. There was no significant difference in the effects of the insecticides tested, but the length of time required to produce maximum activity of the larvae apparently varied with the concentration of the larvicide. The following table is general and may be applied to each of the insecticides tested.

TABLE I

Solution Concentration	Length of time of activity after application	Time of maximum activity after application
Percent	Minutes	Minutes
1.0	5 to 25+	12+
2.5	1 to 20+	8+
5.0	1 to 9+	2+
10.0	1 to 5+	1+

Depending on the time required before a treated sample could be checked by observation, 1.0, 2.5, and 5.0 percent solutions worked equally well in making such a survey. In most instances a 10.0 percent solution apparently killed or inactivated the larvae before they exposed themselves for a sufficient length of time for accurate detection. As a result of these tests, a 2.5 percent solution of DDT was adopted for use in the chemical method used in 1951 for locating the gnat larvae in the soil. The use of this concentration allowed ample time for an observer to follow the person applying the larvicide and check each sample about eight minutes after application, at the time of maximum activity of the larvae.

In using this chemical spot-treatment method in 1951, it was found advantageous to remove the vegetation with a two-edged triangular weed cutter before applying the insecticide. The insecticide was then applied with a hand pump equipped with a fine nozzle. Square-foot areas were sprayed until the ground was thoroughly wet. The location was marked with a stake and examined for larvae five to ten minutes after the insecticide was applied.

To check the accuracy of this survey method frequent samplings were made in

areas known to contain larvae. The method always worked if the larvae were near the surface of the ground ready for pupation. The location of the larvae and therefore the time for running the chemical survey was determined by examining soil samples taken periodically until it was determined that the larvae were susceptible to chemical treatment. As all the larvae in the area developed at about the same rate the entire area was treated as soon as possible after the chemical survey. This chemical spot-treatment method developed in 1951 made it possible to complete the larval survey in about one-eighth the time and expense required to complete the survey in 1949 and 1950 by the soil sample method.

The second phase of the program was that of eliminating the gnats, using the most effective and economical methods. As reported (Rees and Smith, 1950), DDT applied at the rate of one pound per acre in 28 gallons of water is very effective in destroying the larvae by a direct kill. Since the larvae are concentrated in the soil in certain limited areas while other areas are free from larvae, it is feasible to treat the soil containing larvae with DDT as soon as the limits of the gnat-producing area are determined. The DDT solution was applied with power equipment when possible and by hand when necessary.

The ground where the gnats develop has a high water content in the spring of the year, making it impractical to treat some of it with ground equipment. Later in the season the water table recedes and the ground dries out allowing the use of heavy equipment. This led to the effective use of DDT applied in the fall as a pre-hatch treatment. The areas treated were known to contain larvae the previous spring, and DDT as a pre-hatch was applied in November at the rate of two pounds per acre in about 28 gallons of water. On the 30 acres treated in this manner in the fall of 1950, no gnat larvae were found in the spring of 1951, nor were adult gnats taken in the box traps located on this area during the season.

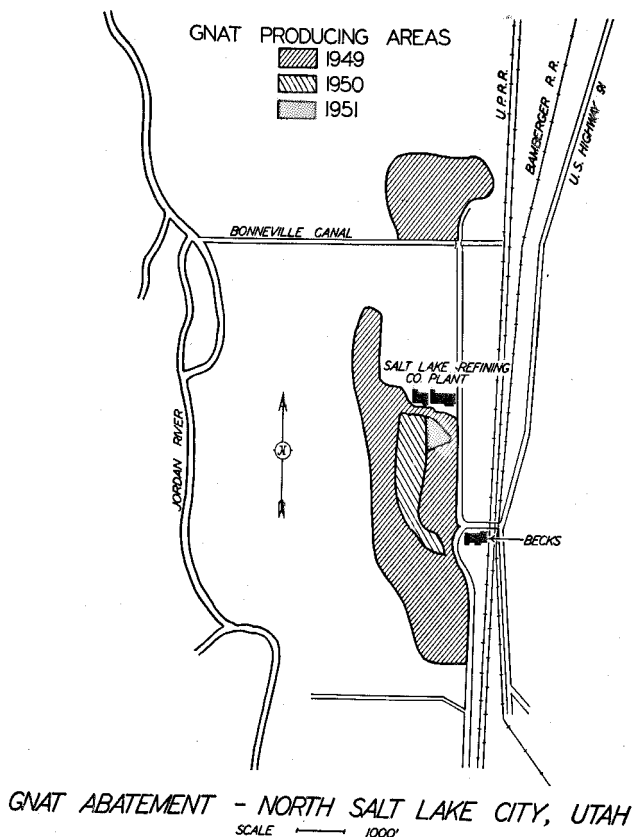


FIG. 1. Gnat-producing areas involved in the tests described.

Naturalistic methods of destroying gnat larvae such as by soil cultivation and lowering the water table are under investigation with promising results to date.

Box traps as described in the previous published report have been used each year to collect the emerging adults. This procedure is a means of determining the productiveness of different areas and the effectiveness of the control methods.

The accompanying graph (Fig. 2) illustrates the effects of the control program from 1949 to 1951 inclusive, as determined by the number of acres producing gnats and the number of adult gnats emerging from the treated and untreated area according to box trap collections. Each

trap covered three square feet of breeding area.

SUMMARY

A project for the control of biting gnats was conducted in North Salt Lake City, Utah, during the spring of 1949, 1950, and 1951. A study of the biology and habits of these gnats has also been in progress throughout the year from the spring of 1948 to the present. During this study a chemical spot-treatment method for a larval survey was developed which makes it possible to complete the sampling in the field in a relatively short time, eliminating laborious washing, screening and microscopic examination of soil samples in the laboratory.

GNAT ABATEMENT IN NORTH SALT LAKE CITY, UTAH

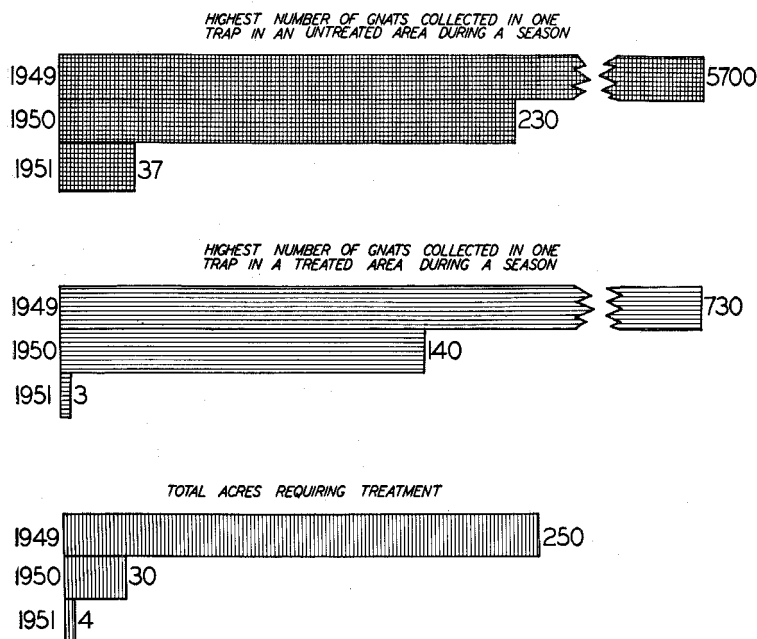


FIG. 2. Effects of gnat abatement program in 1949, 1950 and 1951.

Chemicals including DDT, lindane, chlordane, toxaphene and rothane were used on an experimental or extended basis for soil treatment, to destroy the gnat larvae. These chemicals were applied in different concentrations for a direct kill, and as a pre-hatch or residual. In addition, soil cultivation, such as plowing and disking, as well as drainage, were applied in an attempt to prevent gnat production. The number of gnats, as a result of this control program, has been substantially reduced each year until in 1951 the gnats, as an annoyance factor, were eliminated from the controlled area.

CONCLUSIONS

1. The biting gnats in North Salt Lake City, Utah, have been effectively controlled, over a three year period, as the result of a gnat control program.

2. The control measures developed have proved to be effective and practical and may eventually eliminate the gnats from this area.

3. The effective and practical control measures developed consist of a chemical method for determining the presence of the larvae in the soil and the application of one pound of DDT per acre for a direct kill or two pounds per acre as a pre-hatch treatment.

4. Results obtained to date in preventing gnat production by soil cultivation and drainage are promising.

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