THE DIVERSIFIED PROGRAM PREREQUISITE TO EFFECTIVE MOSQUITO CONTROL ON CAPE COD

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Some conception of the extent and nature of the mosquito control operations conducted in Barnstable County on Cape Cod may be derived from a relatively small amount of pertinent statistical data pertaining to the area. Since the Cape is a highly developed summer recreational center, adequate control of the mosquito nuisance has a definite bearing upon its economy. The 1950 census showed a native population of 46,381 or 117 persons per square mile; and a summer population of 260,000 or 660 persons per square mile, 82% of whom were visitors on summer vacation. Reasonable protection of these visitors from the ever threatening mosquito nuisance requires a comprehensive control program, which will blanket the entire county comprising a land area of 394 square miles. Using the outstanding physical characteristics of the terrain as a basis, the program may be subdivided as follows: (1) salt marsh breeding, the control of which constitutes the major concern of the project because it involves 1/12 of the total county area and includes, also, the maintenance of 1,500 miles of ditching; (2) the control of 1,200 fresh water swamps with a total area of 4 square miles; and (3) similar problems associated with the 170 great ponds which range in area from 10 to 650 acres, plus those of numerous smaller bodies of water including many permanent brackish pools located along the shore.

On Cape Cod, the salt marsh mosquito (*Aedes sollicitans*) represents the principal nuisance pest. Ditching of the 33 square miles of salt marsh has proved to be the most economical and most effective control method, and has been utilized wherever the soil is of a consistency to withstand tidal erosion. These ditches, which are ordinarily 10 inches wide and 24 inches deep, afford a rapid run-off of tidal water which, if retained on the marsh, would furnish ideal conditions for prolific mosquito breeding. They function, also, as channels through which minnows migrate to the upper reaches of the marsh in search of mosquito larvae upon which they feed. On sandy marshes where ditches are impractical, because of their rapid obliteration by erosive tides, prehatch treatments have been substituted with considerable success. For example, on May 17, 1950, a 4-acre marsh, located at the extreme end of an extensive sandy peninsula known as Nauset beach, was treated with a wet mist applied with a "Tifa" fogging unit at the rate of 1 pound of DDT per acre. The larvicide used in this operation contained 10 gallons of Xylene, 140 gallons of No. 2 fuel oil, and 40 pounds of DDT (technical grade). Periodic observations, after treatment, indicated that no mosquito larvae developed on this marsh during 1950 although flooding reoccurred. Similar observations made during 1951 showed that this prehatch treatment continued effective until August when a thinly scattered larval population became evident.

A second type of unditched salt marsh, under constant surveillance, is the relatively high sandy marsh usually built up along the water's edge, and as a consequence, receives tidal water only at times when a high tide is backed by strong winds. On August 6, 1951, a 25-acre marsh of this type, located on the Nauset peninsula, was examined and found to be dry and hard with no evidence of mosquito breeding. However, a few hours later the marsh was inundated by an unusually high tide. On August 13, adults were numerous in this area and the stand-

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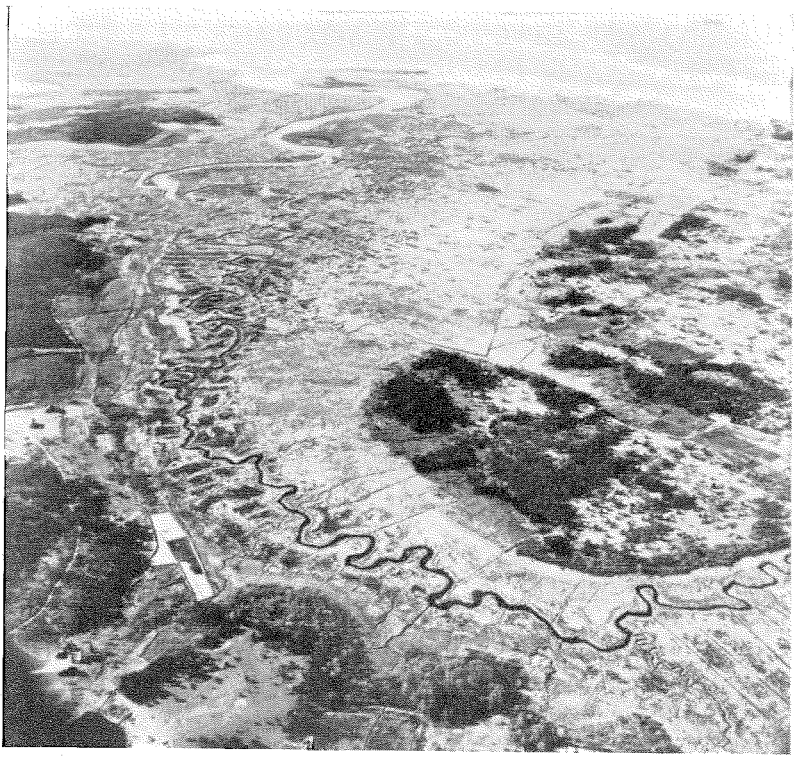

FIG. 1. Typical Cape Cod inlet with mosquito control ditching.

ing water on the marsh contained large quantities of larvae and pupae. The area was treated immediately with a DDT-oil spray applied with a 150 gallon hydraulic spray unit mounted on a power wagon especially equipped for salt marsh operations. The spray contained 10 gallons of Xylene, 140 gallons of No. 2 fuel oil, and 50 pounds of DDT (technical grade). From two loads, a total of 246 gallons of fuel oil and 82 pounds of DDT were applied, thus providing oil at the rate of approximately 10 gallons per acre and DDT at the rate of 3 pounds per acre. After treatment, the marsh was examined periodically, and although flooding reoccurred, no larvae appeared during the remainder of the 1951 mosquito breeding season. The unusually heavy dosage of DDT was decided upon because of the fact that some of the spray was being applied directly to water surfaces.

One of our most aggravating problems is the control of mosquito breeding in cedar swamps, which have been practically impenetrable since the hurricane of 1938, except for short periods during the winter months when the standing water is coated with ice. During the early months of 1951, while these swamps were frozen over, a series of 4 adjoining swamps, with a total area of 10 acres, were subjected to prehatch treatment. By utilizing knapsack dusters, 50% wettable was applied to the ice at the rate of 1 pound of DDT per acre. In order to attain uniform distribution and eliminate any substantial loss by drifting, the dust

was applied during a period when wind velocity was approximately 5 miles per hour. As a result of this treatment, no mosquito nuisance occurred in these swamps during the 1951 breeding season.

Another problem of long standing is the control of *Mansonia perturbans* breeding in those ponds and lakes which support an abundant cattail growth. In 1947, the experimental treatment consisted of an application of residual DDT to vegetation located in the immediate vicinity of the water area. In spite of this treatment of the probable mosquito resting places, adults in numbers sufficient to create a nuisance penetrated the barrier. As a result, it was necessary to resort to fogging as a means of alleviating this nuisance. In more recent years, the host plant (cattail) has been sprayed during the first week of June or before the new growth attains a height of 10 inches above the water surface. The residual spray of 50% wettable DDT is applied at the rate of 1 pound of DDT per acre by means of a 150 gallon hydraulic spray unit equipped with a 500 foot extension hose. The cattail field is divided into strips approximately 50 feet wide and each strip treated as an individual unit in order to facilitate a more even distribution of the insecticide. In treating, the extension hose is dragged out along the edge of the strip as spraying proceeds from the proximal to the

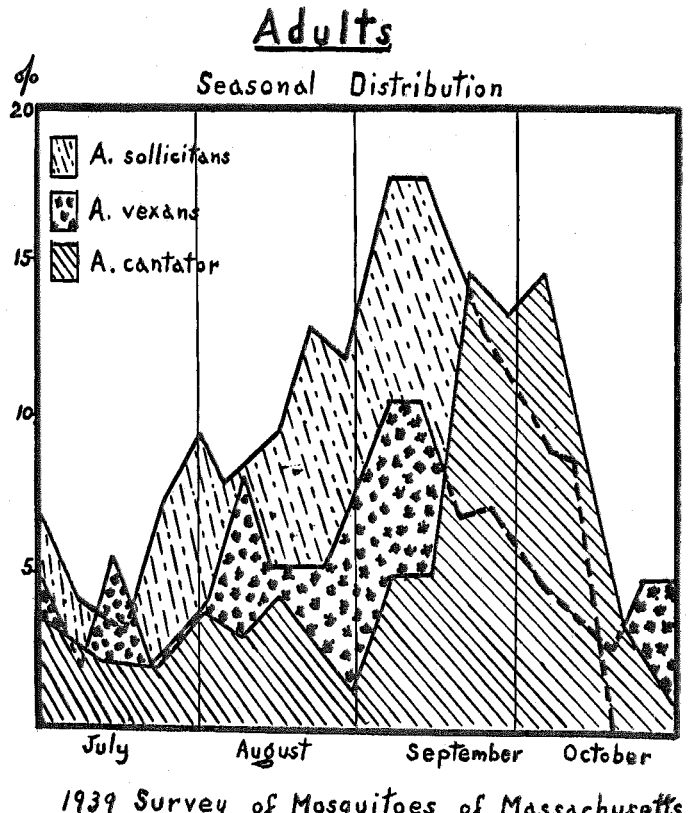

FIG. 2. Chart showing predominating species of mosquitoes on Cape Cod and their relative peaks of production.

distal end. This method has provided effective control of *Mansonia perturbans* in our cattail fields, a fact well substantiated by voluntary testimonials from individuals who reside in the vicinity of the *Mansonia* breeding areas.

During the summer of 1951, the Cape Cod Mosquito Control Project resorted to a rather extensive fogging and aeroplane spraying program. These were emergency measures adopted to meet critical mosquito breeding conditions. Our experience with adulticides was rather disappointing but did serve to strengthen our confidence in ground spraying equipment as a supplement to the basic drainage method.

MOSQUITO CONTROL: EXTENSIVE VERSUS INTENSIVE TECHNIQUES

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Mosquito control techniques are in a constant state of change. Species distribution, topography, political structure, individuality of operators and many other conditions are predetermining factors in the mechanics of any mosquito control program. But it has been observed that the gradual change is from an extensive to an intensive technique. By definition, we understand the term *Extensive Technique* to mean the working of a large area with a limited number of treatments as opposed to the term *Intensive Technique* in which small areas are worked or treated on a more frequent schedule.

The rapid development of chemical controls resulted in an immediate attempt by many operators to treat large breeding areas. Numerous varieties of equipment mounted on vehicles, tractors, boats, trailers and airplanes came into use. Improved insecticides appeared rapidly and have continued to out-distance the modifications of large scale dispersal equipment and operators' abilities. Operational costs were compared with permanent control expenses and found to be desirable to taxpaying constituents. In one county, as in many others, all permanent maintenance of drainage was discontinued and all plans for future ditching, drainage and fill were cancelled. Initial costs were less than $1.00 per taxable person per year and controls were as much as 95 percent efficient. Everything favorable to *extensive techniques* was being experienced. Even inaccurate results collected by inadequate formulae and interpreted incorrectly were published, accepted and credited. Many insecticide producers were and still are unable to meet demands. Equipment manufacturers found a ready market for anything that could be adapted to the immediate need of the mosquito control operator and at almost any price. Laborers, supervisors and directors were producing better results than ever before. It was a simple matter to extend the areas controlled and limit or omit mosquito control sanitation programs. One small county bought seven airplanes. Another county bought four airplanes and declared openly that more planes would be purchased if found necessary. In fact, the only limitation on the extent of the control area seemed to be the amount of money available. Since this amount had been predicated on experienced costs for permanent control measures, considerable funds were available.

Only those mosquito control organizations which were stabilized by long experience and were fortunate in having highly trained personnel available could