

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 tax-paying 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

stand the pressure of these most radical changes. New mosquito districts began to form and to declare their abilities to eradicate or eliminate the mosquito hazard.

These preliminary events are responsible for the present day movement or change which has a great potential worthy of note. It is observed that taxpaying constituents are becoming more limiting to the amount of money "sprayed away." Costs of this extensive technique have increased until \$4.00 to \$10.00 per taxable head per year are being reported. Mosquito control workers are realizing their folly in the omission of permanent control projects. In some areas Mosquito Districts require a certain percentage of all funds to be directed to permanent measures. The U. S. Soil Conservation Service has shown that the prolific breeding of certain areas is greatly reduced by reclamation projects. Lake or swamp maintenance is found to be profitable in the production of game fish with the simultaneous reduction of mosquito breeding.

A ten-acre "borrow pit" was easily and inexpensively modified to produce several hundred pounds of fish monthly. Its importance as a breeding area was greatly reduced when "bank sanitation" and water fertilization was instituted. The cost of this new technique is much less than the cost of chemical control prior to reclamation. In addition, the water table of the adjacent area is retained and agriculture does not suffer which frequently resulted from excessive drainage. Even in areas where mosquito control continues to be necessary subsequent to reclamation, greater ease of treatment is experienced and more efficient results are produced.

The worst condition which has followed this extensive technique is an observed reduction in operator proficiency. This may be due in part to confusion brought on by the great variety of chemicals and machines. The best analyses of reports from very reliable testing and research centers prove difficult to interpret in terms of operational requirements. These

conflicting data are almost impossible of assimilation by the practically trained field men. Adequate sources of scientific interpretation into field mechanics and directions are lacking. Dangers to operating personnel as well as possible harm and damage to persons and wildlife in treated areas are increasing daily. As a result more stringent controls by responsible agencies have already made their appearance.

And so we can see the movement to an *intensive technique* has been along lines of least resistance. Where knowledge, money and equipment are scarce, the intensive technique was to be expected. But is this the answer? Surely, in certain states where the extensive technique never was developed, but permanent controls were augmented with good larviciding procedures, the most stable mosquito control efficiency is maintained.

Where airplane spraying can be accomplished at a cost of \$.25 to \$.35 per acre including the insecticide, it is still an excellent tool. Reports from many districts show the cost of aerial applications have risen to rates from \$.55 to \$.75 per acre. This tool for extensive insecticide dispersal is good but is self-limiting. Aerial insecticide dispersal by present Navy technique costs less than \$.25 per acre but this is almost impossible outside the Military. Therefore, the airplane which looked so good as a tool for our mosquito control workers is rapidly losing its importance.

Large pieces of ground equipment are available from many manufacturers. Unfortunately, these companies are not able to keep up with the developments of the chemist. So today we have many chemicals of great value but no means for accurate and efficient dispersal. Numerous scientific tests of these large machines are biased in their results or the machine is still not so good as its operator. Many operators are heard to say "I bought that machine for its psychological effect, I doubt if it kills anything." And so we are warned, that the "psychological effect"

will not remain efficient and we must, sooner than we think, control mosquitoes.

In some reports it seems apparent that the operator is desperate. His disrespect for complaints is a sure sign of coming failure. Too often some operators point with pride at the low incidence of diseases related to insect vectors as evidence of his efficiency. Or as a last resort the operator procures a machine with a thunderous roaring engine to prove to his constituents "you heard the crew spraying last night."

What may be our plan for 1952?

1. *Don't experiment in the field.* There are too many "researchers" now. Use what you know to be good which is in keeping with your means. Accept what has been proven by responsible persons who are devoted to your problems through their affiliation with responsible agencies. If five percent is good, seven and one-half percent may be no better but the addition of a synergist may be the answer. But let someone else do the experimenting.
2. *Survey your area again.* Even if we have been working in the same area for many years we must recognize the changing environment. Excellent controls in a familiar area were completely upset last year by the sudden appearance of *Psorophora discolor*. The broods were so great that they constituted 84 percent of the mosquito index for the year. They were found to be breeding in an area under construction which, due to unusual weather, became a perfect breeding medium. Alert surveying might have allowed the operator an opportunity to avoid this upset or establish a more efficient control.
3. *Study your profession.* For your personal safety, the protection of the health of others, the preservation of wildlife, scientific mosquito control requires constant study. Oiling of stand-

ing water may have been satisfactory and was accomplished by the untrained. But the use of chemical controls must be under the careful supervision of the specialist.

4. *Don't put all your eggs in one basket.* One county goes bankrupt because it owns so many spray planes. Another fails because it expects chemical control to be the only answer. Where successful programs are in operation, about 55 percent of all labor and money is expended for permanent control measures. Larviciding and adulticiding are coordinated to reduce the mosquito population from areas which continue to produce. But these good operators are sure that a fill is used where a fill should be, drainage is planned where drainage can be accomplished, and flushing is developed where it can be dependable. And thus resistance is being prevented.
5. Finally, *don't give up.* Some mosquito control commissioners have been swayed to reduce operations on the basis that "you can't kill them any more." Excellent results are being produced by the alert and ambitious mosquito control worker. Those who are willing to accept defeat are not prepared to do mosquito control.

SUMMARY

The "magic mile" and the "barrier" technique have never been completely successful. The limitation of the control area is determined mainly by the mosquito but the limitation of the area controlled is dependent on Man. Extensive techniques are required in some locations but should be coordinated with intensive techniques. "If an ounce is good a pound is better," can not be a rule for insect control workers. Where an operator knows his problem, intensive techniques may more likely succeed.