# ABSTRACTS AND PROCEEDINGS

*of the*

# EIGHTH ANNUAL MEETING

*of*

# UTAH MOSQUITO ABATEMENT ASSOCIATION

*Held at*

Davis County Court House

Farmington, Utah

March 18 and 19, 1955


EDITED BY

Don M. Rees

A. W. Grundmann

James A. Giles



UTAH MOSQUITO ABATEMENT ASSOCIATION

University of Utah

Salt Lake City, Utah

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# OF THE

# Utah Mosquito Abatement Association

## A WORD OF WELCOME

By T. Amby Briggs
*County Commissioner, and*
*President of Davis County Mosquito Abatement District*

It is a pleasure to welcome you here today. Davis County is honored by your presence and we feel highly honored to have you as our guests while at this convention. We especially extend our welcome to the speakers and representatives from California. We want you to know that Utah does have some pleasant weather too, and to be sure that you will recognize our influence, we have ordered this weather especially for your convenience and pleasure while attending this convention.

I would like to compliment the program committee for preparing what I think is a splendid program. As I looked over the program I was not only pleased, but surprised that the committee had scheduled such distinguished men to participate on this program. As I noted the titles and locations I soon was convinced that we have present today some of the leading men in the field of mosquito control work. We surely appreciate the contributions that you speakers will make to the success of this convention.

Two of our representatives attended the National Convention held in Los Angeles. They gave us a rather complete report and we are certain that the information they gained will be helpful to our mosquito control work here. I can see that such meetings are needed for the purpose of cooperative thinking and acquiring up to date information for our board members.

I am rather new in mosquito control work, having only recently been appointed to our district board. This will be a new, but, I am sure, an interesting experience to me and I am looking forward to the information which we will receive at these meetings.

Flies were a great problem around our homes a few years ago. Now we see but very few of them. People now keep their home surroundings cleaner and they use more spray chemicals.

If we can control our mosquitoes in the same manner that we have controlled the flies a splendid job will have been accomplished. In this county a good job is being done on mosquito control work. The improvement has been remarkable during the last few years since our mosquito control work was started.

With good weather, this comfortable Court Room, and with a full program of such outstanding speakers, we are sure to have a good convention. We want you all to feel at home while you are with us in Davis County.

## MOSQUITOES CAN BECOME AN ANNOYANCE IN OUR COMMUNITIES

By William W. Owens
*Vice President, Utah Municipal League*
*and Mayor of Logan*

I bring you the support and good-will of the Utah Municipal League in your organized effort to control mosquitoes and other insects which are an annoyance in our communities.

I would be out of place if I tried to speak to the subject of this conference, other than as a layman, since this group contains so many trained scientists.

I remember well the time when house flies were very annoying. They would gather in such numbers on the kitchen screen door as to produce a solid black color. Enough of them would get into the house to almost make the ceiling black when they would gather indoors on frosty fall mornings. When the threshers would come around and eat with the family whose wheat they were threshing, great feasts would be prepared for them to which they would always do justice. I can remember watching the women folks wave green boughs over the table while the men were eating to keep the flies away. I think the most that was done by this procedure was to cripple a good many of the flies which fell into the food. Conditions like this are changed. The flies are now under control.

Our Utah Mosquito Abatement District law gives the people an opportunity to get together and control the mosquitoes, flies and other insects. It is not the law that produces the control but the will and action of the people to cooperate under the law. Back of the will of the people in using the law is the work of scientists in developing insect control methods.

I wish to pay tribute to the scientists. The entomologists work long years to determine the life cycle of an insect. It is this information that makes control measures possible. Scientists ascertain the facts for the "know how" of the programs in America which have given us such a high standard of living. The present leaders in Russia think they can increase the yield of corn from 15 to 45 bushels per acre by government edict. It cannot be done in that manner. In fact it cannot be done at all on the scale which has been proposed. Honest scientists have not had a voice in this project.

As a city official, I have had requests to control insects. Authority for organized control measures rests with the county commissioners under our Utah Mosquito Abatement law. Ten percent of the voters may request the county to form a control district and levy a tax for its operation. I think the Legislature used good psychology in requiring the voters to ask the county commissioners to raise their taxes. The people will be vitally interested in work for which they request a tax increase.

*Papers presented at the Eighth Annual Meeting of the Utah Mosquito Abatement Association 1955 by Members of the Logan Field Station, U. S. Public Health Service.*

# THE WORK OF THE LOGAN FIELD STATION IN RELATION TO WATER RESOURCES DEVELOPMENT[1]

By A. D. Hess, Senior Scientist

Logan, Utah is the headquarters for two important activities of the Department of Health, Education, and Welfare's Public Health Service. The newly organized Logan Field Station Section of the Technology Branch, Communicable Disease Center, is responsible for research on: (1) the distribution, ecology, and control of plague, and (2) the natural history and control of encephalitis mosquitoes and other blood-sucking arthropods associated with the development of water resources.

The plague work is carried out at San Francisco, where the Public Health Service has maintained a surveillance and research center for many years. The research on arthropods associated with water resources development is centered at Logan, Utah, with temporary field units located at Salt Lake City, Utah; Chinook, Montana; Plainview, Texas; and Bakersfield, California.

The major objective of the Logan Field Station at the present time is to obtain detailed information on the natural history of encephalitis and from this to develop the most practicable control measures. This involves extensive investigations of *Culex tarsalis,* the common encephalitis mosquito, and various other pest mosquitoes associated with it in the vast irrigated areas of the Western States.

The virus encephalitides (western equine encephalitis and St. Louis encephalitis) are the most important mosquito-borne diseases in the western part of the United States where they are endemic in many irrigated and some non-irrigated sections. Epidemics, such as that which occurred in the northern tier of Central States in 1941 and those which occurred in California and Texas in 1952, are common and unpredictable. With the expansion of irrigation farming in the West and a concomitant increase in mosquito vectors, the encephalitides are becoming increasingly serious problems in rural areas.

Cache Valley, surrounding Logan, is an ideal location for the encephalitis natural history studies. It is an irrigated area in which encephalitis has long been endemic and in which there is prolific production of C. *tarsalis* and other irrigation mosquitoes. There is, however, relatively little use of insecticides in the valley. Thus, it provides an excellent situation for studies on the summer and winter ecology of irrigation mosquitoes and the natural history of the encephalitis virus. In nearby Box Elder County and Snake River Valley of southern Idaho are comparable areas of endemic encephalitis where control studies may be carried out.

Parallel natural history studies in a highly endemic area of milder climatic conditions are carried out at the Bakersfield, California, field station in cooperation with the University of California, Hooper Foundation.

Logan is also the headquarters for biological and engineering studies on the prevention and control of C. *tarsalis* and other irrigation mosquitoes. The primary objective of this work is to develop techniques for "building mosquitoes out" of water development projects. Although primary attention is given to the permanent or "source reduction" type of control, the development of chemical and other supplementary control measures is considered important. The prevention and control studies are carried out in close cooperation with other agencies including the Agricultural Research Service, Soil Conservation Service, Bureau of Reclamation, Fish and Wildlife Service, and State and local health and agriculture groups. The following are some of the areas where this work is now being conducted:

The Weber Basin Project of the U. S. Bureau of Reclamation is only 25 miles across the Wasatch Mountains from Logan. The Weber Basin Project is designed to completely develop the agricultural area to the east of Great Salt Lake between Salt Lake City on the south and Brigham City on the north. When completed it will provide a full-season supply of irrigation for approximately 29,000 acres of now arid land, supplemental water for an additional 30,000 acres, and drainage reclamation for about 30,000 acres of water-logged land. This project thus offers an excellent opportunity for developing and incorporating mosquito prevention and control measures into the overall plans for irrigation and drainage. The location of the Bear River Migratory Bird Refuge at the north end of Weber Basin and other refuges within the Basin provide areas for studying the relation of mosquito control to wildlife management. Cooperative investigations to accomplish these various objectives are now under way as a part of the long range program of the Logan Station.

The Milk River Valley of northern Montana is one of the oldest irrigated areas in the Northern Great Plains. There tremendous numbers of encephalitis mosquitoes and other irrigation mosquitoes have plagued man and domestic animals for many years past, and encephalitis has long been endemic in the area. The Chinook unit of the Logan Field Station has completed a three-year biological and engineering study of the area and is now undertaking a cooperative experimental control demonstration. This demonstration will be carried out jointly with the Soil and Water Conservation Research Branch of the Agricultural Research Service and with the cooperation of the U.S. Soil Conservation Service, the U.S. Bureau of Reclamation, the Montana State Board of Health, and the Montana Agricultural Experiment Station. From the results of the study it is hoped to demonstrate that sound conservation irrigation practices will prevent mosquito production and increase crop production.

The Angostura Irrigation Project in southwestern South Dakota is a 12,000 acre Case-Wheeler project developed jointly by the Bureau of Reclamation and the Soil Conservation Service. It has thus offered an excellent opportunity for a cooperative demonstration that mosquito control measures can be built into irrigation

[1]From the Communicable Disease Center, Public Health Service, U.S. Department of Health, Education, and Welfare, Logan, Utah.

projects. With the successful demonstration of such measures during the past several years, attention is now being directed toward extensive and unpredicted development of seepage areas from irrigation canals and laterals. This seepage creates undesirable conditions with regard to agriculture, water conservation, and mosquito control.

In the Southern High Plains of Texas, deep well irrigation has expanded at a phenomenal rate during recent years. In the eight-county Lubbock-Plainview area alone the acres irrigated by wells increased from 135,000 in 1939 to 1,600,000 in 1952. Prodigious mosquito production accompanied this expansion of irrigation, and in 1952 an outbreak of encephalitis occurred. At the request of the State Health Department the Logan Field Station has for the past two years been conducting a study to determine the nature and extent of the problem and possible means of control. Plainview, Texas, has been the headquarters for this study. During the coming season it is hoped to initiate experimental control demonstrations in cooperation with local municipalities, water conservation districts, and other interested State and Federal groups.

Information obtained from the various field studies is utilized to develop overall vector control policies for the Public Health Service. The Logan Field Station is responsible for the proper integration of vector control into the planning, construction, and operation of water utilization projects in which the Federal Government is interested. This involves the adaptation of mosquito control and other vector control technology to the multipurpose interests of Interagency River Basins Programs and other water resource development projects. These water resource projects are being developed at a rapidly accelerated rate in order to meet the tremendous increases in demands for water, especially in the irrigable areas of the West. Approximately 26 million acres are now under irrigation, and the Bureau of Reclamation estimates that the equivalent of 100 million new acres must be developed for agriculture. In the Columbia Basin alone, more than one million acres are expected to be put under irrigation within the next few years. In order to insure that vector control technology keeps pace with this rapid expansion, the Logan Field Station participates in the planning of water resource development programs through the Federal Interagency Committees of the various River Basins. The Drainage Basins Engineers of the Division of Sanitary Engineering, who are attached to the Regional Offices of the Public Health Service, serve as members of these committees and the focal points through which the Public Health Service recommendations on vector control and environmental sanitation are coordinated. Vector control planning for individual projects is handled through memoranda of understanding with various agencies, such as the Corps of Engineers and the Bureau of Reclamation. The Logan Field Station maintains staff both at Logan and at Atlanta, Georgia, for reviewing project reports, making site surveys, and making special studies with regard to planning and integration of vector control on multipurpose water resources development projects. Similar services are provided to States on non-Federal projects through requests received through the Regional Offices of the Public Health Service.

In summary, the work of the Logan Field Station with regard to vector control on water utilization projects is an important part of the overall program for development of the Nation's water resources, particularly in the irrigated areas of the West. The proper integration of vector control into these projects will be mutually beneficial to all concerned, and requires the continued close cooperation of the various State and Federal groups who are involved in water resource development programs.

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## MAN-BITING HABITS OF *CULEX TARSALIS* AND ASSOCIATED MOSQUITOES IN NORTHERN UTAH

By Leslie D. Beadle, Senior Sanitarian
*Communicable Disease Center, Public Health Service*
*U. S. Department of Health, Education, and Welfare*
*Logan, Utah*

Studies on the anthropophilic characteristics of mosquitoes, which were initiated at Mitchell, Nebr., in 1953, were continued in Cache Valley, Utah, during 1954. Systematic biting studies were conducted for the entire season at two sites, one in the town of Logan and one on a farmstead located 1.7 miles west of town. The principal objectives of these studies were to determine (1) the relative numbers of the different man-biting species in the area, (2) the evening periods of greatest biting activity, and (3) the seasonal pattern for the major biting species. The collections were made during the 2-hour period immediately following sunset and averaged 3 collections per week at the rural site and 2 collections at the urban site. Chloroform tubes with a paper funnel in the mouth were used to collect the mosquitoes attracted to the writer's exposed legs during 15-minute intervals.

At the rural site, a total of 12,677 mosquitoes comprising 13 species was taken during 51 collections (from May 12 to Sept. 21). The five major species were: *Aedes vexans* (35%), *Culex tarsalis* (25%), *Mansonia perturbans* (24%), *Anopheles freeborni* (7%), and *Aedes nigromaculis* (4%).

At the town site, a total of 1,330 mosquitoes comprising 9 species was taken during 25 collections (from June 19 to Sept. 22). The major species were: *C. tarsalis* (50%), *A. vexans* (41%), *A. freeborni* (3%), *Culex erythrothorax* (2%), and *M. perturbans* (1%).

The highest catches of *A. freeborni* were made during the second 15-minute period after sunset; of *A. vexans,* the third period; of *C. tarsalis,* the fourth period; and of *M. perturbans,* the fifth period.

The first biting record of *C. tarsalis* was obtained on May 14 and the last on September 17. The peak of biting activity for this species occurred during the months of July and August. The maximum catch at the rural site was 287 (on Aug. 2) and at the urban site 87 (on July 29).

These biting studies confirm the finding at Mitchell that *C. tarsalis* has a strong affinity for man.

## BUILDING MOSQUITO PREVENTION INTO IRRIGATION PROJECTS

By Marshall B. Rainey, Public Health Engineer
*Communicable Disease Center, Public Health Service*
*U. S. Department of Health, Education, and Welfare*
*Logan, Utah*

In 1951, the Bureau of Reclamation, the Soil Conservation Service, the South Dakota State Department of Health, and the Public Health Service initiated a cooperative program of mosquito prevention investigations as a phase of the development of the Angostura irrigation project, a Case-Wheeler project in southwestern South Dakota. The objective of these studies was to determine if the various conditions which cause mosquito production could be eliminated during the planning, design, construction, and early operation phases of the project. The dam and storage reservoir were completed in the fall of 1949. Construction work for bringing water to the 12,000 acres of irrigable land was started during the fall of 1950 and completed in the summer of 1954.

The Bureau of Reclamation was responsible for construction of the project distribution and drainage systems. The Soil Conservation Service was responsible for subdividing the government land into farm units, developing farm irrigation plans, grading or preparing the land for irrigation, and constructing the farm distribution and drainage systems. Throughout the development period the health agencies reviewed project plans and made field investigations to detect potential mosquito problem areas. Entomological studies were conducted to obtain data on breeding areas, species, and mosquito populations within the project area before and after irrigation.

Many of the basic procedures employed by the Bureau and the SCS in developing the Angostura project were found to be of great value for mosquito prevention. Some of the most important of these were: (1) construction of project drains for removal of excess water from farm units; (2) installation of under drains where the canal and laterals crossed natural drainageways; (3) the lining of certain sections of the canal to prevent seepage; (4) location of borrow areas to prevent subsequent flooding; (5) adaptation of farm layouts to the existing topography; (6) leveling and grading of all land to be irrigated; and (7) installation of surface drains for removal of waste water from irrigated fields.

The major mosquito-producing areas associated with project development were related to incomplete project drainage and inadequate disposal of irrigation waste water on individual farm units. When such problem areas were encountered by the health agencies, they were discussed with Bureau and SCS project personnel and corrective measures were recommended to them. Almost invariably these recommendations were accepted by the Bureau and SCS and as a result many potential mosquito breeding areas were "built out" of the project.

During the pre-irrigation period (1951-1953) both larval and adult studies showed that mosquito production within the project area was relatively low. Natural seeps were the principal mosquito source; surface pools and other temporary water areas were second in importance. Many of the temporary breeding areas were eliminated by drainage and land leveling. *Culex tarsalis, Psorophora signipennis, Aedes nigromaculis,* and *Aedes vexans* were the major species in the area.

Water was diverted into the canal in 1953, and the completed farm units were irrigated for the first time. Post-irrigation studies showed that the natural seeps increased in size and many new ones appeared as a result of excessive leakage from the canal and laterals, combined with deep percolation from the irrigated lands. The total mosquito production index value for seeps increased from 1.0 in 1952 to over 85 for 1953. *Culex tarsalis,* the common encephalitis mosquito, comprised 78 percent of the larvae identified from the seeps in 1953. The increase in *tarsalis* production during the first year of irrigation was also reflected by a significant increase in adult populations of this species. Field observations indicated that further increases in *C. tarsalis* production in seeps occurred in 1954.

The measures which were built into the project during construction were effective in preventing mosquito breeding in 1953 and 1954. However, their effectiveness was largely obscured by the unexpected development of the extensive seeps which produced tremendous numbers of *C. tarsalis.* This is a special problem which remains to be solved during the early operational phase of the project. The construction agencies are making a special effort to control seepage, since it has also caused serious damage to agricultural lands and excessive loss of irrigation water.

The cooperative work at Angostura has demonstrated that many mosquito producing areas can be eliminated or minimized by planning and building mosquito prevention into irrigation projects.

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## METHODS OF SAMPLING ADULT *CULEX TARSALIS* POPULATIONS

By Richard P. Dow, Scientist
*Communicable Disease Center, Public Health Service*
*U. S. Department of Health, Education, and Welfare*
*Logan, Utah*

Efficient control of any mosquito requires some way to measure the adult population as well as the immature stages. The measurement need not be an estimate of the actual numbers of adult mosquitoes but it should bear a consistant relation to the whole population. The method should enable one to demonstrate the prevalence at various times and places, regardless of whether control measures have or have not been applied. Since a natural decrease in abundance may easily be confused with the result of spraying or other treatment, it is always desirable to have a check area where seasonal fluctuations can be observed independently. Adequate comparison of treated and check areas requires parallel population measurements in each.

Perhaps the ideal way to measure the prevalence of adult mosquitoes is to make biting collections. The number of mosquitoes of a given species which are attracted to a man in a given length of time is a figure of prime importance, no matter whether the species is a pest or whether it carries disease. The abundance of *Culex tarsalis* Coq., the principal vector of western equine encephalitis, can be successfully studied in this way. For

routine meaurements, however, this method requires too many men and too much time.

Various types of dimly lighted shelters provide daytime resting places for many kinds of mosquitoes, including *C. tarsalis*. In the early morning, these natural resting places offer a refuge from the increasing light. Holding mosquitoes throughout the day by a barrier of light, they are, in a sense, like traps. In practice, it is often difficult to find natural resting places, which are comparable and suitably located, in numbers sufficient to give a reliable picture of the adult population. Other difficulties in the use of natural resting places as regular inspection stations arise from alterations in the shelter which are made by the owner of the property and from various seasonal changes such as increased shade and reduced moisture. Attempts have been made to overcome some of these obstacles by providing artificial daytime resting places which, besides being uniform in themselves, can be placed in similar locations at more or less uniform intervals. As yet, however, no one type of artificial shelter has met with general acceptance.

At present the most successful method of measuring populations of adult *C. tarsalis* is by making collections with the New Jersey light trap. The principal objection to its use is the expense of operation, due mainly to the time required to sort the collections.

Another trap of special use and importance is the dry ice trap introduced by Bellamy and Reeves (Mosquito News 12:256-258, 1952). It captures primarily *C. tarsalis* and, as used now, is apparently useless as a device to measure any other species of mosquito. This selectivity is an important feature in connection with studies of western equine encephalitis. In work done at Logan in 1954, it was found that plasticized cartons which are manufactured to hold liquid food make excellent containers for the blocks of dry ice and permit surprisingly uniform escape of the carbon dioxide attractant. Studies of the trap entrance showed that a horizontal baffle, adapted from that of a stable trap developed in Egypt by Bates (Journ. Nat. Malaria Soc. 3:135-145, 1944), permitted the capture of many more *C. tarsalis* but also allowed greater numbers to escape, presumably after daybreak. Actually the principal difficulty with the dry ice trap is its failure to operate consistently under a variety of conditions. One cause of this trouble may be the chilling effect of the dry ice within the trap. This problem will be studied during the coming season.

Regardless of which trap is ultimately preferred for measuring a population of adult *C. tarsalis*, one problem which always remains in the correct placing of the sampling device. It is known that additions to the adult population come from aquatic areas which may be very unevenly distributed, and it is reasonable to believe that the irregular distribution of domestic animals and other hosts will result in further irregularities in the occurrence of the mosquito. Because traps placed at different locations will sample different concentrations of *C. tarsalis*, some method is necessary to make the observations comparable between different areas.

These are some of the problems which will be studied at Logan in an attempt to develop a method of measuring prevalence which can be used to compare local populations of adult *C. tarsalis* throughout its geographical range.

## THE CURRENT STATUS OF ENCEPHALITIS IN THE WEST

By Bernard Brookman, Senior Scientist

*Communicable Disease Center, Public Health Service*
*U. S. Department of Health, Education, and Welfare*
*Logan, Utah*

Interest in the arthropod-borne viral encephalitides continues to remain at a high level, particularly in the western part of the United States. This interest is due primarily to the constant threat of epidemics in this region. There have been recent recrudescences of these diseases both in horses and in man in many parts of the country, examples being: North Dakota in 1949 and 1951; California, Colorado and the High Plains of Northwest Texas in 1952; South Dakota, Nebraska, and Saskatchewan in 1953; and Florida, the Rio Grande Valley, Texas, and California in 1954.

In Utah, the problem does not appear to be acute. The most severe outbreak, affecting about 2,000 equines, occurred in 1933. Since 1935, the Bureau of Animal Industry of the U. S. Department of Agriculture has reported equine cases in Utah each year except 1951. The greatest number of cases was 837 in 1941, a case rate of 12.1 per 1,000 equines in the affected counties. The lowest case rates occurred in 1949 and 1950, when 0.5 cases per 1,000 equines at risk were reported. In 1951 no cases were reported. Encephalitis in equines has been reported from every Utah county except Wasatch and Daggett. In the period December 1940 through August 1953, 30 human cases of "epidemic encephalitis" were reported to the Utah State Department of Health. It is not known how many of these were caused by arthropod-borne viruses. In 1954 Drs. A. W. Grundmann and G. R. Leymaster reported on the testing of sera from 15 clinical cases of encephalitis of unknown etiology. Of these, one "proved to have developed neutralizing antibodies" to WEE virus. It is interesting to note that there is no indication that this case was reported to the health department as encephalitis.

Field and laboratory studies, which are continuing in various parts of the country, are attempting to further clarify the vector and reservoir aspects of encephalitis, particularly with respect to the off-season activity of the viruses. The WEE virus has been isolated during most of the winter months from wild *Culex tarsalis*, both in California and in Colorado, but the significance of these findings is not yet apparent. It is now felt by most students of the problem that wild and domestic bird mites are of no significance in the natural maintenance of the viruses. Therefore, we must still hold to the earlier concepts of a bird-mosquito-bird primary cycle, with man and horse entering the infection chain as accidental and probably dead-end hosts.

The Logan Field Station of the U. S. Public Health Service is conducting long-range investigations on the natural history of encephalitis and on the biology and control of its vectors, which it is hoped, will ultimately lead to the development of improved methods of prevention and control.

## *Additional comments upon the Appraisal of Aerosol Machines in Mosquito Control in California*[1]

*by* Thomas D. Mulhern[2]

In July of 1954, Dr. A. W. A. Brown, Head, Department of Zoology, University of Western Ontario, London, Canada, spent two weeks in California, assisted by the author and others, appraising the performance of various devices commonly used in adulticiding to control mosquitoes. The project was made possible through the sponsorship and cooperation of the California Mosquito Control Association, various individual Mosquito Abatement Districts, including particularly the Merced County Mosquito Abatement District where the work was conducted, and the Bureau of Vector Control, of the State Department of Public Health.

The results have been formally reported in "Mosquito News", for December, 1954. The present paper, of which this is an abstract, has been prepared in an attempt to further elucidate certain aspects of the study, concerning which questions have been asked from time to time.

Principal emphasis was placed on the appraisal of the physical performance of the various machines, but confirmatory checks of the biological performance were made as the situation would permit.

Aerosol samples were taken with "Casella Cascade Impactors", following the techniques described by Brown & Watson.

Two formulations were compared in each machine tested: a 5% solution of DDT in light fuel oil, and a 5% solution in diesel oil. The results obtained with these two solutions varied widely in some machines, particularly the thermal aerosol generators.

The time available was insufficient to fully explore the full potentialities of the machines tested; therefore, the appraisals were made of the various units with insecticide formulations, solvents, carriers, and dosages adjusted as nearly as possible to ordinary field treatment practice.

It appears that great changes in the physical performance of aerosol devices may be made by varying the controls of the individual machines, or by changing the viscosity or the rate of flow of the insecticide used. This was particularly well illustrated by the results obtained with the Insect-a-fog machine. A mass median diameter of seventy-five (75) microns, was obtained with a fuel oil solution of DDT when discharged at the rate of 45 gals. per hour, as compared with a mass median diameter of only three (3) microns, when a diesel oil solution was used at a rate of 35 gals. per hour. It would, therefore, appear highly desirable that each of the machines be exhaustively tested under fully controlled conditions to determine the optimum operating settings.

The following table sets forth the performance of the several units as they were tested in 1954.

TABLE I. Delivery rates of 5% solutions of DDT in oil (gallons per hour), mass median diameters (microns) of the droplet spectra, and percentages of insecticide emitted in droplets falling within an arbitrarily selected size range of 7 to 42 microns diameter.

| | Formulation | g.p.h. | m.m.d. | Percentage of insecticide in 7-42 microns particle size class |
|---|---|---|---|---|
| Venturi Exhaust Generator (Modified Venturi on Jeep) | Fuel Oil | 20 | 137 | 3.5 |
| | Diesel Oil | 18 | 16 | 86. |
| California Exhaust Generator (Plumber's nightmare on Jeep) | Fuel Oil | 12 | 4 | 20. |
| | Diesel Oil | 9 | 46 | 45. |
| California Fog Generator (Twin-headed, King size, Plumber's nightmare) | Fuel Oil | 60 | 55 | 31. |
| | Diesel Oil | 10 | 43 | 29. |
| | Diesel Oil | 60 | | 9. |
| Holmes Insect-a-Fog | Fuel Oil | 45 | 74 | 10. |
| | Diesel Oil | 35 | 3 | 5. |
| | Diesel Oil | 48 | 50 | 17. |
| Alaska Aerosol Atomizer (U.S.P.H.S., C. Wilson design) | Fuel Oil | 10 | 5 | 38. |
| | Diesel Oil | 15 | 30 | 81. |
| Small California Mist Blower (Merced M.A.D. design) | Fuel Oil | 48 | 191 | 2.5* |
| | Diesel Oil | 48 | 231 | 1.7 |
| Large California Mist Blower (Merced M.A.D. modification of "Iron-Age" Mist blower) | Fuel Oil | 33 | 70 | 21. |
| | Diesel Oil | 38 | 128 | 8. |

*Droplets impinging on air discharge shroud, producing very large secondary droplets.

The testing program brought sharply into focus one fault that was common to most of the devices worked with. None of them were equipped with completely satisfactory controls and gauges. With most of them, it was impossible to duplicate precisely the machine settings for any two runs. The erratic performance of many aerosol units may very well be traced to this lack of adequate controls and gauges. With precise controls and gauges, performance could be calibrated and the operators thereafter required to maintain the optimum settings.

It has been shown by careful investigation (Latta, et al, and Yoemans) that the optimum droplet size of aerosols to kill *Aedes* mosquitoes is 13 to 16 microns diameter. However, droplets somewhat less than 10 microns penetrate dense foliage or forested areas more effectively, while somewhat larger droplets, perhaps up to 40 microns diameter are generally more effective over open areas such as irrigated pastures. No aerosol generator worked with has been able to produce a spectrum within so narrow a band as 13 to 16 microns, though a considerable percentage of the droplets in the spectrum produced by several of the machines fell within a band ranging from 7 to 42 microns diameter. This range was selected somewhat arbitrarily, as representing approximately the desirable and practicable range for an aerosol device to be used under the wide range of conditions commonly met in California. Therefore, there is included in the table herewith a column showing the percentage of the total volume of insecticide emitted by each of the machines tested which fell within this range.

The aftermath of the testing program has been the modification of several of the machines which in the test program did not produce a fully satisfactory adulticide, and it appears likely that additional appraisals will be made of several of the machines in an effort to determine the optimum operating condition for the particular devices.

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[1] An abstract of paper presented at the 1955 Annual Meeting of the Utah Mosquito Control Association.

[2] Vector Control Specialist, California State Department of Public Health.

# CHLORTHION: A NEW PROMISING MOSQUITOCIDE

By G. Edwin Washburn
*Manager, Turlock Mosquito Abatement District, Turlock, California*

When the spector of mosquito resistance to DDT became an actuality in 1950 and 1951, most of the mosquito abatement districts in the Central Valley of California began to seek insecticides which could and would control mosquito larvae. Certain of the organic phosphate materials were known to be effective; notably EPN and Parathion. These materials, however, were also highly toxic to the handlers and spray operators of the districts. In an attempt to replace EPN and Parathion with equally effective larvicides yet be relatively non-toxic to personnel, many materials were tested. One of the more promising was Chlorthion (1); a non-systemic organic phosphate, known then as Bayer 22/190.

Early in 1953, Lewis Isaak of the Kern MAD, conducted many tests with Chlorthion and other possible insecticides. Laboratory results with Chlorthion in comparison with the other insecticides commercially available were conducted. The larvae used were fourth instar, *Culex quinquefasciatus* from the laboratory colony at the Kern MAD, Bakersfield, California. Comparative data on a times basis is indicated in the following chart.

On an LD-50 and LD-90 basis, the chart would read as follows, by order of increasing toxicity. Column A is a times comparison, as Chlorthion being 13 times as effective as Malathion, which is 1.

| | LD-50 | LD-90 | A |
|---|---|---|---|
| Malathion | .14 ppm | .25 ppm | 1 |
| Diazinon | .091 " | .14 " | 1.8 |
| Dipterex | .024 " | .045 " | 5.6 |
| Chlorthion | .011 " | .019 " | 13. |
| Parathion | .005 " | .0069 " | 36. |

Because of the extremely low mammalian toxicity (common table salt is only 1/4 as toxic) and the low dosage necessary to obtain an LD-90 and better, arrangements were made in late 1953 by the California Mosquito Control Association and the California State Department of Public Health, Bureau of Vector Control with Chemagro Corporation of New York City (3) to obtain a sufficient amount of Chlorthion for extensive field testing. After some disappointments eleven mosquito abatement districts received thirty (30) gallons each of six (6) pounds per gallon. Chlorthion emulsible for testing purposes early in July of 1954.

Procedures and techniques of testing were developed and distributed to these agencies so that all the testing would follow a consistent pattern. The latter proved to be wishful thinking, for only a small percentage of the districts followed the "Standards" as set up. However, even though some of the field testing did not bring forth satisfactory results, sufficient careful measurement was done to show that Chlorthion has a real place in mosquito control in the San Joaquin Valley of California.

Failure to obtain satisfactory control in some of the tests against *Culex tarsalis* and *Aedes nigromaculis* larvae can be attributed to at least the following:

1. Rate of application was below recommended rate.
2. Insufficient agitation of mixture to insure proper break-up of emulsible Chlorthion in water. This is highly important to insure uniformity of the resultant spray material.
3. Testing areas not precisely defined, hence results were not easily determined.

Original plans called for 0.2 pounds of Chlorthion to be applied to each acre of treated area, plots of 1/8 and 1/4 acre were to be used for ease of testing. Results were highly satisfactory when this range was approached, but below 0.2 pounds per acre, results were inconclusive. Where carefully mixed samples were used and application was made in a thorough manner 95-100% kill was obtained of *Culex tarsalis* and *Aedes nigromaculis* larvae at dosages much below 0.2 pounds of Chlorthion per acre.

On August 24, 1954 in the Turlock Mosquito Abatement District, after determining that rates of application below 0.2 pounds per acre would result in satisfactory control of moderately DDT resistant *Culex tarsalis* and *Aedes nigromaculis* larvae, we confined one area, a zone of approximately ten (10) square miles, to Chlorthion alone the remainder of the season or about one month. Excellent control, (97-100%) of both *Culex tarsalis* and *Aedes nigromaculis* larvae which we had been unable to kill with 25% DDT emulsible was obtained using only 0.03 pound per acre. Under this type of testing, the Chlorthion spray was applied by two methods; i.e., hand can and a power unit by the same personnel. All types of water conditions were encountered as well as a great variety of vegetative conditions. Consistently good results were obtained.

Results of the field testing in the several mosquito abatement districts are tabulated below. The species of mosquitoes tested in the tabulation were larvae of *Culex tarsalis, Culex stigmatosoma, Culex quinquefasciatus, Aedes nigromaculis.*

| DISTRICT | AMOUNT APPLIED | WATER CONDITIONS | VEGETATION | RESULTS |
|---|---|---|---|---|
| Kern MAD | 0.2 lbs./acre | all kinds | all types | Good |
| Tulare | 0.1—0.15 lb./acre | fresh | medium | Good |
| Turlock | 0.03 lb./acre | all kinds | all types | Good |
| San Mateo | 0.2—0.6 lb./acre | all kinds | all types | Fair |
| Delta | 0.1—0.15 lb./acre | fresh | light-medium | Poor |
| Eastside | 0.1 lb./acre | fresh | medium | Poor |
| North San Joaquin | NOT MEASURED | | | |
| Fresno | 0.15 lb./acre | all types | all types | Poor |
| Butte County | 0.1—0.15 lb./acre | fresh-pasture | light | Poor |
| Sutter Yuba | NOT MEASURED | NONE USED | | |

There are at least two objections to the use of Chlorthion. Its odor is sometimes objectionable, but the primary deterent at present is its cost. Admittedly, the material reported here was of an experimental nature, however, its relative cost compared to other commonly used insecticides for mosquito control in California was very high. At 0.2 pounds per acre, cost of the material alone would be near $1.00 per acre. This is too high to be used extensively. There is a good possibility that the price will lower as demand for the material increases and the general acceptance becomes greater.

REFERENCES:


1. 50% Chlorthion — emulsible; non-systemic organic phosphate known as
   (a) 0—(3-chloro-4-nitrophenyl)—0.0 dimethyl thiophosphate
   (b) Bayer 22/190
2. Unpublished data supplied by:
   (a) Lewis W. Isaak, Entomologist Kern Mosquito Abatement District, Bakersfield, California
3. Chemagro Corporation
   350 Fifth Avenue
   New York 1, New York.


## TRIALS & TRIBULATIONS OF MOSQUITO SOURCE REDUCTION


Robert H. Peters, Manager
*Northern San Joaquin County Mosquito Abatement District*


The Northern San Joaquin County Mosquito Abatement District is starting the tenth year of a mosquito abatement program founded on the principle of mosquito source reduction. Back in 1945, however, the term "source reduction" had not come into popular usage. As a matter of fact, until the fifties, various terms were referred to regarding this approach to mosquito abatement, namely: permanent control; water elimination; minimization of sources; and source reduction.

The latter term, "source reduction," seems to best suit the general requirements of our operations which in general fall somewhat short of elimination or permanence.

Actually, in a practical way we recognize the inevitability of mosquito producing water and try therefore, to reduce the amount to the least possible degree. Our secondary objectives are to apply known engineering principles of construction to further assist our necessary spray requirements, as well as to make the resulting sources readily accessible and reasonably free from aquatic weeds.

Basically there are several means or approaches to accomplish mosquito source reduction which can be best placed in the following categories.

(1) educational
   a. corrective
   b. preventive
(2) tax supported
(3) cooperative (cost basis)
(4) legal process
(5) inter-agency participation

Undoubtedly all of these approaches have their places, depending upon the type of problem and the parties with whom it is necessary to work to accomplish a desired change. In California the two main approaches appear to be the educational and the cooperative, with some districts employing the legal process. The educational approach is based upon advisory consultation by key personnel generally referred to as source reduction specialists who analyze problems through studies and surveys and recommend corrections or prevention of mosquito sources. The cooperative procedure as applied by our district involves the complete survey and recommendations, followed by the actual accomplishment of the work requirements by district-owned equipment on a cost basis to the party responsible for the source.

It is our belief that this cooperative approach is far and away the most practical, since it does not go merely part way and point out a problem, but rather, offers a total analysis and economical solution to the problem.

Our basic concept assumes that most mosquito sources are the consequence of a failure to utilize space and that through our source reduction efforts the environment can be altered to the extent that such water areas can be reduced to the practical minimum, and the resulting land put to productive use.

Secondly, we recognize that the mosquito consideration is generally only incidentally of importance to the party with whom we are of necessity attempting to work; and that more often than not, an economic consideration of direct concern can be made the initial basis for approaching the problem. Our program over the past several years pretty well justifies our attitude when one observes the changes that have taken place as a consequence of our efforts. Of perhaps greatest importance is that we are one of the very few districts in the Central Valley operating on a lower tax rate than the initial tax rate, in spite of the increased cost of operations and material during the last decade.

However, in spite of the apparent favor with which we regard this mosquito source reduction approach there are many trials and tribulations which are encountered in setting up and carrying out such a program.

Perhaps the first "trial" in establishing a mosquito source reduction program, is the directors or trustees of a mosquito control agency, themselves. Although our own board of trustees have shown a remarkable inclination to adopt the theory that, "If you get rid of unnecessary water, it won't keep on producing mosquitoes", unfortunately I have heard of many trustees who have become so obsessed with spraying routines that any other approach or expense is regarded as impractical or improper in scope and function.

An important requirement for a successful mosquito source reduction program is the selection of high caliber personnel to approach this very important phase of activity. There is no room in this field for the untrained or unskilled. More so than in any other part of a mosquito control program, is this true, as in this work we are actually recommending changes affecting real property and there is no room for guesswork.

Proper equipment and tools to do the work required cannot be ignored in establishing a source reduction program. Naturally, these will vary depending upon the area and the types of problems encountered, but again

it can be indicated there is no substitute for the best.

Often we find that it takes time to allow other personnel of an agency to appreciate the advantages of a source reduction phase of a program. This is very necessary in order to ensure success of this activity since all employees are of use as salesmen in promoting source reduction.

Perhaps the most trying problem in mosquito source reduction is, the people themselves. Of course this suggests the extreme importance of public relations and continuous public education in order to have the objectives of this program understood. Unfortunately, in approaching source reduction problems, we are faced with many conflicting viewpoints. Usually, we find ourselves playing the role of extreme diplomats who are attempting to solve problems which in many cases have been the basis for disagreements among neighbors. It must be remembered that water problems have been the source of considerable litigation and quite often personal feuds become real obstacles to practical accomplishment.

Needless to say, time is one of the major factors in obtaining results and it is necessary to plan far in advance in order to schedule actual work programming. Since our major problems in California arise from man-made sources mainly in agriculture and industry, it is necessary to arrange our timing to coincide with the periods of the year when changes can be most satisfactorily effected.

Finally, it can be stated that a successful mosquito source reduction can only be realized through a two-fold effort of planning and *WORK*. The managerial responsibility is greatly increased as a consequence of an active program in this direction, as there is no easy way to accomplish the desired results.

In California it appears as though we have no choice but to recognize that a mosquito source reduction approach is inevitable, at least in our Central Valley. If *we are to even keep pace, let alone get ahead, of the mosquito problems which are increasing daily as a consequence of our developing water resources . . . then we must accept these trials and tribulations of mosquito source reduction as part of our future.*

* * * *

## THE ORGANIZATION AND ACCOMPLISHMENTS OF THE CMCA

C. Donald Grant, Manager-Entomologist
*San Mateo County Mosquito Abatement District*
*California*

*Summary*

In twenty-five years the California Mosquito Control Association has grown into an organization of nearly fifty agencies that receives and deserves the strong support of its component members. Through stress, compromise and success, the Association has attained a status of standardization in procedure which has been conducive to the promulgation and resolution of long range objectives in meeting our increasing needs.

Our accomplishments may be attributed to the generous services of our committee members and the cooperative efforts of outside agencies, especially the Bureau of Vector Control of the California Department of Public Health. In conjunction with the latter, the Culicidology Committee has formulated an extensive program of mosquito measurement, designed to yield reliable data on various mosquito species prevalence and the ability to predict population trends in accord with climatic and ecological variancies.

Our new Forms, Records, and Statistics Committee has gathered data throughout the year which will be coordinated and published in an annual Year Book, pertinent to the functions of the individual districts.

The efforts of our Conference Committee may have been appreciated by many of you who attended the joint American and California Associations meetings in January.

By dint of many Board and Committee meetings, an overall policy in regard to the needs and merits of state financial assistance has been congealed. Key factors in this policy are: justification for state aid in control of vector and pest mosquitoes; evaluation of the extent of need for outside aid and the consequent establishment of a formula as a basis for such continued requests; acceptance of an objective formula for the distribution of such funds; and the requests for additional funds to provide for operational investigations and studies in the amount of not less than 10% of the monies provided by the state for subvention to the districts.

Another significant achievement has been the consideration given to the establishment of a "Council of Mosquito Abatement Agencies". Although the proposal for creating such a Council was nearly introduced into the State Legislature, it has been felt prudent to await another Legislative Session and thus enable a more adequate review of the proposal by all interested parties.

Achievements yielded by our field investigations during the past year have been given in papers by the California workers at the American-California meetings in Los Angeles and will be published in the "Proceedings".

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## HOW THE WEBER BASIN PROJECT WILL AFFECT MOSQUITO CONTROL WORK

F. M. Warnick
Chief of Project Development Division
*Bureau of Reclamation*
*Weber Basin Project, Utah*

The Weber Basin Project is the first multiple-purpose project that has been planned for the State of Utah. It is intended to control and make available practically all of the water that is wasting into Great Salt Lake from the basin at this time. Not only will it capture surplus runoff from mountain streams, but by drains and wells it will convert damaging ground water in the lower areas into useful water supplies. Regulation of surplus Weber River flows will be provided by new reservoirs at Wanship, Lost Creek, and Willard sites and by enlargement of the existing Pineview and East Canyon Reservoir. The Echo Reservoir will be correlated into the project operation at its present size. All of these reservoirs are in mountain areas except the Willard Reservoir which is on

the shore of Great Salt Lake. Project water released from mountain reservoirs will be distributed to some extent by existing works, but largely through new facilities.

The Weber Basin Project as now planned will include about 80 wells in the lower areas to provide water for beneficial use and to lower the water table that is so high as to be damaging. It will also include surface and deep drains for removing standing surface water and reclaiming seeped lands. The drains will also capture some return flow from higher irrigated lands making it available for re-use. Water from wells and drains will be used for irrigation and other purposes. Additional regulated water will be provided for the Ogden Bay water fowl refuge at the shores of Great Salt Lake.

Much of the problem associated with mosquito control as it will be influenced by the Weber Basin Project has to do with drainage, and my remarks will be confined to that particular aspect of the project. While the investigations of the Weber Basin Project were being made, the Public Health Service and the Utah State Department of Health were called in to make water pollution and mosquito surveys. The results of these endeavors were gratifying. The surveys of the Public Health Service revealed that over 100,000 acres in the Weber Basin are favorable for mosquito production and that all rural areas and major communities are subject to mosquito infestations because of these mosquito producing areas. Irrigation provides more than 50% of the mosquito producing water in the area. The Public Health Service concluded that the extensive drainage system proposed as a part of the Weber Basin Project would reduce mosquito production . However, they discovered that one of the major problems associated with the mosquito abatement problem in this area was the disposal of water along the fringe area between agricultural lands and the water surface of Great Salt Lake. This problem has existed for many years and much of the area that produces mosquitoes in this fringe area is simply a waterlogged, salt grass and tule area with stagnant water which is a wonderful habitat for all kinds of mosquitoes. If the full effect of the project is to be realized it will be necessary to solve the problems associated with these fringe areas. The Public Health Service suggested the extension of all drains from the fringe areas to the water surface of Great Salt Lake.

On the other hand, sporting interest in the state, including the State Fish and Game Department, recognize the water supply from drains as potential sources of water for refuge purposes along the shores of Great Salt Lake. By centralizing these flows, they feel that a number of small refuges of considerable economic importance can be developed for the sportsmen of this locality. This can be done probably very economically, but in general it does not reduce the mosquito problem.

The people of Davis County definitely want to beneficially use as far as possible the water supplies of this basin, but at the same time they want to protect their people as far as possible from the menace of mosquitoes. Some problems will develop in connection with small refuges along the shore of Great Salt Lake. But I believe that some coordinated effort should be put forth by the mosquito abatement people and sportsmen to find the solution to this problem and thereby make maximum use of the waters of the area.

## PROGRAM CORRELATION OF FEDERAL, STATE, AND COUNTY AGENCIES

By DeLore Nichols

When state, federal, and county agencies and officials began to adjust their working programs to give consideration to the effects of an increased water supply from the Weber Basin Project, it was evident that certain phases of the planned programs overlapped with work of other departments.

When irrigation ditches need to be repaired or enlarged certain questions arise: what will be needed to provide for additional water; just where and how will this additional water flow to newly irrigated lands; will this new water increase drainage problems; will the previous more or less individual farm drainage being done provide permanent drainage on these farms; when drainage is accomplished where will the drainage water flow to prevent similar drainage problems occurring in other areas?

Are federal payments for irrigation practices on individual farms practical and justifiable unless they are tied in with more permanent, long time planned projects. What about building projects when they have failed to consider needed open channels for flood and surplus water run off?

The rapid increase in population growth has stepped up the storm sewer and sewage needs of the entire county. What effect will this have on our drainage and disposal needs?

What will be done about the increased water ponding along the entire lake shore area? Will it increase health and mosquito problems? What correlation and cooperation will be needed to solve these problems and yet give consideration to water fowl projects?

These were some of the many problems so evident that an urgent need naturally came about to consolidate the various working programs into one over-all correlated program for the entire county. All phases of all projects should be considered as they overlap or tie into projects of other departments and agencies.

After careful thought on the matter during the summer months it was decided to hold a meeting of representatives of all agencies and departments interested in water, and doing work in the county. The purpose being to set up a clearing or reviewing committee to consolidate the various programs relating to water projects.

All those present at the first meeting, held last fall, were favorable toward a united attempt on a consolidated over-all program. The committee was then named "Davis County Correlation Committee." The agencies and departments participating were then listed and are as follows:

Soil Conservation Service
Soil Conservation District
Davis Country Water Users Assn.
Extension Service
Farm Bureau & Farmers Union
County Board of Health
County Wildlife Federation
Forest Service
State Engineer

County Surveyor
City Representatives
A.S.C. Committee
Weber Basin Water Conservancy Dist.
Bureau of Reclamation
County Commissioners
U. S. A. C. Experiment Station
Mosquito Abatement District
State Fish & Game Department
County Flood Control Committee
County Planning Engineer
State Health Department

If other agencies or departments interested in water use or control have been omitted from list they will be invited to join the committee.

The general committee has been divided into four subcommittees according to direct interests in the four main projects. These are: organization and distribution Committee; Utilization of Water on the Farm Committee; Drainage Committee; and Watershed Flood Control Committee. Each of these committees will draft an outlined planned project report to be made and adopted in the next general meeting to be held April 8th. These adopted plans will then guide the future procedures and actions of the committee.

This is an entirely new procedure and we believe that much good will come from this consolidated effort.

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## WATER POLLUTION AS RELATED TO HEALTH AND MOSQUITO CONTROL

By Lynn M. Thatcher, Executive Secretary
*Utah Water Polution Control Board*

Water pollution control and mosquito abatement in one sense might be considered as parallel activities, since they both undertake to control nuisances and to protect public health. Basically, the water pollution control program seeks to preserve the usefulness of our water resources through the control of polluting materials which might deteriorate the quality of any state waters, while mosquito abatement programs seek to reduce mosquito populations by various means, among which are chemical treatment and drainage of ponded water.

Mosquito abatement activities do not necessarily take into account the quality of the waters treated or drained, and it does not appear to be an essential part of an abatement program to even seek determination of such water quality. If a body of water needs drainage or larvicidal treatment, the only question would be how best to proceed to accomplish these operations. Whether or not wastes were discharged into the body of water under consideration would not in general be an essential item of knowledge, nor would it necessarily influence the abatement action taken.

On the other hand, the water pollution control program, in attempting to accomplish its purpose of improving or preserving the quality of state waters, could not legally give any consideration to mosquito abatement problems associated with the waters being protected against pollution. For example, if waste discharges caused a mosquito breeding pond to have a lower quality of water than allowable for the established uses of that water, the water pollution control board would require treatment of those wastes to a degree which would restore the water quality, but mosquito breeding characteristics of the pond presumably would not be altered. Thus, the problem presented to mosquito abatement authorities would remain unchanged. It is conceivable that mosquito breeding problems might even be aggravated by a water pollution control board action which resulted in a change in point of discharge of some waste flow. This could happen in case a change in point of discharge might result in greater economy to a city which was obligated to build a treatment plant. The new point of discharge might result in more ponding than the old one, but the water pollution control board could not legally control such a ponding nuisance.

It certainly goes without saying that the water pollution control board is anxious to keep everyone, including mosquito abatement boards, advised of its activities, so that where mutually beneficial cooperative action is possible, it can be achieved.

A brief outline of the water pollution control board's functions and responsibilities may be of benefit in promoting a better understanding of its relationship to mosquito abatement.

The basic philosophy of the law is that no one has a right to destroy the usefulness of our waters by dumping wastes into them.

This means that one of the first responsibilities of the board is to determine what uses are made of water in Utah, and then what quality of water is necessary for each legitimate use. The board then can say to each user of water, "We will accept the responsibility of controlling all wastes which are discharged into this stream, and of requiring such treatment of them as will keep the water clean enough for your purposes." It ought to be of special interest to the association to know that the board does not recognize as legitimate a certain rather extensive use of water practiced in many areas of the state — that of mosquito breeding.

The fact should be stressed that the Water Pollution Control Board cannot control the user of water in any way. Whether the user is a farmer diverting water to his land for irrigation purposes, a municipality pumping water from a stream for filtration before delivering it through the water system, or a fisherman making recreational use of a trout stream. The board can deal only with the discharger of pollution.

The uses of water now recognized by the board for most areas of the state are irrigation and stock watering, recreation (fishing, boating, etc.), wildlife propagation, and municipal supply sources. An increasing number of surface waters are being appropriated for this latter use, but the other uses have been established pretty extensively for a long time.

It is apparent to all who have given this matter any thought that uncontrolled dumping of wastes into our streams could make the water unfit for practically all these established uses. Some waters of the state already

have been degraded to this extent. Without the control which has been set up by the law, other waters would soon follow suit, since the amount of waters to be disposed of is growing by leaps and bounds as our state grows.

Through a system of classifications and associated uses and quality requirements, the board hopes to restore all waters to full use and to preserve necessary water qualities in the future.

A brief glance at a simplified listing of the board's classifications will help to show how the board plans to achieve its purposes. The listing starts with the lowest quality and proceeds to the highest. (see table below)

The board at the present time is approaching the task of assigning one of these classifications to each stream, lake or other body of water in the state. This act will automatically define the quality requirements for each water course, which in turn will define the amount of treatment to which each entering waste flow must be subjected in order that the quality requirements can be met.

To summarize briefly, while it is sincerely the desire of the Water Pollution Control Board to cooperate closely with all agencies concerned with water in any way, it does not appear that there is a very direct relationship between the board's work and that of the various mosquito abatement districts.

## WILDLIFE AS RELATED TO MOSQUITO CONTROL

By Dr. D. Keith Barnes

Members of the Culex Fraternity:

It is a pleasure to have this opportunity to say a few words to you from the standpoint of a sportsman. Mr. Thatcher, who has just addressed you, stated he wore two hats—one as Sanitary Engineer and one as secretary of the pollution Board. I must be one of those two-headed creatures as I am not only president of the Wildlife Federation but greatly interested in mosquitoes as Director of the County Health Department. So with the latter title, you will know my intimate connection with vectors and my keen interest in mosquito eradication.

I will draw you a verbal picture of a scene which came to my view within the month. A friend of mine, a cattle feeder, called at my home and insisted that I come and see the problem which was facing him. Cattle feeders in our county are now using pit silos in preference to the vertical cement silos we have all used previously. The pit silo is an open pit affair and the one I have reference to was approximately one hundred and fifty feet long, possibly forty feet across and ten to twelve feet high, banked up on the sides as it was excavated.

### SIMPLIFIED LISTING OF WATER POLLUTION CONTROL BOARD'S CLASSIFICATIONS

| Water Classification | Water Use | Quality Requirements |
|---|---|---|
| E | None | No nuisance |
| D | Some types of irrigation — (Not lawns, dairy pastures or row crops) Source for Industrial Supplies | Chemical constituents not objectionable for irrigation, stock watering, or municipal supplies. Coliform bacteria not above 5000 per 100 ml. B O D not above 25 p.p.m. No objectionable physical characteristics such as floating oil, suspended solids, etc. |
| C | All types of irrigation—Stock watering — municipal use after complete treatment — Fish and wildlife propagation — Recreation (except swimming)— Source for industrial supplies | Same as for Class "D," except B O D not above 5 p.p.m. |
| B | Same as for Class "C" except that only chlorination is required for municipal use. | Same as for Class "C" except coliform bacteria not above 50 per 100 ml. and must meet physical characteristics required of drinking water. |
| A | Same as for Class "B" except that no treatment of any kind required for municipal use. | Same as for Class "B" except coliform bacteria not to exceed limits specified in U. S. Public Health Service Drinking Water Standards |

I think all of us at some time or another has over-turned a rotting log, a dung hill or something similar and uncovered a nest of wiggling maggots. The silo in question reminded me of just such a wiggling mass of life. Literally, not another duck could get on it, and sitting off in the snow, covering several acres, were thousands more waiting their turn to dine. I mention this to show that Utah, and especially the area in which we are located, is rapidly becoming a nesting and hatching area as well as year-round living quarters for thousands of migratory fowl.

From the standpoint of a sportsman and conservationist, I fail to see a conflict between adequate mosquito abatement and waterfowl protection. Our private duck clubs are doing a far better job in this regard than the State Fish and Game Department on their preserves, Farmington Bay, Ogden Bay and the public shooting grounds. I am certain that many of these privately organized clubs irrigate their impounded areas and, as in the past, mow the grass or hay for sale as excellsior.

When one man is placed in charge of these preserves, and they include Clear Lake, miles to the south of us, as well as Locomotive Springs one hundred miles northwest, it is impossible for him to do the job intended. The local Wildlife boys should be called in and their services utilized.

Now, I am sure Mr. Egan who follows me on the platform will tell you that the services of a biologist are used at each of these areas. No one knows the value of research in any endeavor better than I. But one—possibly two—biologists could cover this whole state and the findings of studies made elsewhere could be utilized here. What we need is more of the common labor variety who will pull out the headgates, replace them and divert the water from one area to another rather than maintaining a constant water level in any particular part of the lake.

I am sure my ideas may be at some divergence with the Fish and Game Department but nevertheless I am sure Mr. Egan will vouch assurance that other than at a period of nesting there should be no conflict between proper mosquito control and waterfowl management.

Thank you.

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## HOW THE STATE GAME PROGRAM CAN BE CORRELATED WITH MOSQUITO CONTROL WORK

By J. Perry Egan, Director
*Utah State Department of Fish and Game*

The Fish and Game Department is primarily interested in the protection of wildlife, whereas the mosquito abatement people are charged with the destruction of mosquitoes. Both of these programs are dependent upon water manipulation and control. In order to prevent a conflict of interests, we wish to indicate a willingness to cooperate with those charged with mosquito abatement.

The Department is aware that the mosquito is a serious pest and a vector of many diseases. We are in complete agreement that mosquito control is necessary.

However, we also wish to point out the importance of Utah's marshes as waterfowl habitat. Drainage, water diversion, and other factors have reduced this continent's waterfowl habitat to a critical level. Those interested in the conservation of waterfowl are making every effort to preserve the remaining marshlands and restore many of those destroyed. Utah has done an outstanding job of marsh restoration. Ducks reared on Utah's marshes have been recovered in thirty-eight states and three foreign nations. Waterfowl hunting provides recreation for over thirty thousand sportsmen in Utah and affects our entire economy. It is evident, therefore, that caution and intelligence must be exercised before any programs are initiated that affect our waterfowl populations.

In some sections of the nation there have been disagreements with some portions of mosquito abatement drainage programs. The Fish and Game Department feels that such disagreements can be avoided through careful planning and cooperation, and that well-planned and executed mosquito control and wildlife management practices are not incompatible. We wish to take this opportunity to present our views on the matter and make specific recommendations.

The Department has no objection to drainage of semi-permanent or fluctuating bodies of water which are generally poor producers of waterfowl. However, whenever it is necessary to subject any area to drainage for mosquito control, we would like to be called in to evaluate the area and present our case. Whenever we plan new impoundments, we shall also invite mosquito control agencies in to offer advice that may reduce mosquito production on these areas.

Nonvolatile oils can destroy wildlife food, reduce hatching success, or destroy the wildlife itself. We recommend that other control measures be substituted for nonvolatile oils in areas where wild life may be affected.

DDT and some newer chemicals may be used in sufficient quantities to kill mosquito larvae, and yet have relatively no affect on wildlife populations. However, their use must be carefully supervised to avoid accumulations from repeated spraying.

Water is controlled on Utah's man-made marshes to limit mosquito production, although we realize that we do produce mosquitoes. However, we do not want to be credited with the production of mosquitoes on the seepage and pasture lands in the vicinity of the refuges, and recommend that these areas be investigated before control measures are needlessly initiated on the refuge. In event aircraft are used to spray State waterfowl refuges, the Department should be consulted so that spray dates can be arranged to avoid nest desertion damage.

## THE FEDERAL WATERFOWL PROGRAM AS RELATED TO MOSQUITO CONTROL WORK

Farmington, Utah. March 19, 1955

Floyd A. Thompson
*U.S. Game Management Agent*

It is gratifying to observe the interest expressed by the members at this conference in recognizing the related aspects of wildlife to mosquito abatement control.

Both have an important role in our domestic life: wildlife as a recreational, food, and esthetic resource, and mosquito abatement control as a nuisance and health condition. These two faces of civilization are tremendously different, nearing the direct opposite, basically, but where physical conditions overlap along the fringe of populated areas, both must be treated with a high degree of concern for the general welfare of the populace.

It is a well recognized fact by conservationists that the health and comfort of mankind supercedes wildlife needs. Yet relaxation through the recreational and the esthetic values supplied by many of these dual problem marshes provide both. It is therefor obvious that unlimited planning and efforts for the good of either mosquito abatement control or wildlife conservation on these areas by one without due regard for the other may seriously affect the human population. The good done for one cause may well be greatly offset by the harm done the other.

We of the U.S. Fish and Wildlife Service are charged with the management and protection of the migratory birds. This responsibility was initiated in 1916 with the signing of the Migratory Birds Convention between Great Britain and the United States of America. The Convention was ratified by our U.S. Congress in 1918 by passage of the Migratory Bird Treaty Act. Since then our lawmakers have charged us with additional responsibility, none of which supercedes this act and none of which charges us with the management of a resource which so completely affects the lives of each person in our entire citizenry. However, each of us has an additional interest in all species of wildlife through a private estate vested by our founding fathers. A natural resource legacy, valued as a most priceless heritage.

A large percentage of the area embodied in the mosquito abatement control programs in which this conference group has its first interest lies along the vast shoreline of Great Salt Lake. It includes four of Utah's finest waterfowl marshes, The Public Shooting Grounds, Ogden Bay, and Farmington Bay refuges owned and managed by the Utah Fish and Game Commission, and the Bear River National Wildlife Refuge owned and managed by the U.S. Fish and Wildlife Service. The combined total area of these refuges is near 100,000 acres and comprise some of the finest waterfowl marshes in all of the world. All of this vast marshland area has been acquired, developed and maintained with large expenditures of public funds under explicit directions from public representatives. It was undoubtedly obvious to those initiating movements which eventually set up those refuges, that a tremendous increase of marshland produced insects would result. It is only reasonable to assume that these men anticipated cooperative planning and methods of operation which would produce the most good for all.

This area also comprises some of the finest waterfowl breeding and hunting grounds in all of North America. Its productivity is consistently among the highest on the continent considered on an acre for acre basis. These refuges, and the additional marsh lands immediately adjoining them, including the private hunting clubs, produces, feeds and maintains an important segment of our continental waterfowl supply and is classed in a general category with the very finest hunting areas of our nation.

Such a nationally important wildlife production area demands consideration in any program involving the region and should be second only to the health and general welfare of our people.

As for planning to gain the optimum correlation of activities a review of bird populations, nesting density, and breeding conditions in their peak curve, might well be discussed with refuge managers. Such cooperation might very well obtain a near maximum of insect control while causing negligible wildlife destruction. Suitable dates when the least birdlife disturbance would occur could be set for aerosol spraying, if such control measures were needed. Also larvicidal mixtures could be determined which would create a desirable mosquito kill and yet be practically harmless to nesting and or brooding birds.

Data on relative effects of larvicidal sprays on birds and animals and their reproductive cycles are quite meager. Additional research might well be instituted which would supply data from which to base planning of future operations. These data could conceivably eliminate any conflict between mosquito abatment control and wildlife management. Exploration on shallow water management or control for reducing mosquito breeding areas could possibly assist in control of waterfowl botulism which normally intensifies in areas of very shallow water.

Marsh management for wildlife and mosquito abatement control for mankind must be carried on concurrently on many of our finest marshlands if neither are to suffer from neglect. Cooperative planning and collection of data for use in this dual problem will go far toward creating desirable communities maintaining a maximum wildlife population.

* * * *

## UTAH'S FISH AND WATERFOWL IN MOSQUITO CONTROL AREAS

Oliver B. Cope
*Chief, Rocky Mountain Investigations*
*U.S. Fish and Wildlife Service, Logan, Utah*

It would be a pleasure to stand here and report to this group on some new advances in the field of mosquito-wildlife relationships. Many facts are needed before we can fully understand these relationships and put them to use in the management of our water and our wildlife. Unfortunately, not enough work is being done in the areas of bioassay or wildlife engineering for me to be able to give an account of many new discoveries. It is true, however, that some new information has come to light in the last few years. The recent increase in the use of dieldrin for mosquito control operations has given im-

petus to studies on this toxicant, and we now have some appreciation of its toxicity to fish.

The U.S. Fish and Wildlife Service has recently completed preliminary work on an extensive program of testing chemicals against fish. The program involved the testing of more than 4,500 chemicals (many of which are commonly used in mosquito abatement work) against one species of fish. One concentration, 5 ppm., was used for the initial testing, and for chemicals demonstrating great toxicities other tests were performed at greater dilutions and different temperatures. This program is a basic study which can serve as a starting place for more intensive investigations on the toxicities of chemicals to fish.

The fish and the game animals of Utah can be considered separately in their relations to mosquito control in the state. Practically all of the mosquito abatement work performed in Utah takes place in areas harboring either no fish or fish of only negligible value. It is even likely that in some instances larvaciding performs a service by killing trash fish. One example of damage to a Utah fish population through the application of larvacides involves a small group of catfish in the lower Bear River. This has probably been the most serious recent loss of fish due to mosquito abatement operations in Utah.

The Utah game animals most susceptible to the influence of control practices are the waterfowl. Utah and its people are justly proud of their waterfowl, which represent one of the valuable resources of the state. A hazard to this resource in a state whose people are tremendously enthusiastic about fish and game matters, is something to be reckoned with. Several refuges devoted to the nesting, feeding, and resting of waterfowl are located along the eastern margins of the Great Salt Lake, and several duck clubs are found in adjacent areas. The existence of mosquito breeding in and near these waterfowl waters presents a complicated problem.

Of all the tools and methods available to the mosquito control operator, the two that most threaten waterfowl populations are drainage and larvacidal spraying. The resolution of the problem of drainage in mosquito control, and providing water for waterfowl in the same areas will not be easy, and I propose no solution here today. The control of mortality to waterfowl from toxicants is certainly more feasible.

Death of waterfowl from the action of insecticides can be of two kinds. There may be a direct poisoning from the toxicant and its solvent through the skin of immature birds. Young waterfowl in the nest, especially before feathers are formed, are sensitive to poisoning by many chlorinated hydrocarbons, as well as by other toxicants. The second effect of mosquito sprays on waterfowl is indirect, through the destruction of the invertebrate food supply. Here, again, the young birds with their high protein requirements are the more susceptible ones. If mosquito toxicants are lethal to the aquatic animals necessary in the diet of immature waterfowl, the indirect effect may be serious.

While the problem of drainage may be nearly insoluble from the standpoint of both waterfowl and mosquito abatement, larvaciding operations can often be planned to achieve effective control with a minimum of damage to waterfowl. By using our available knowledge about the kind of toxicant, the formulation, the optimum time of application, and kind of apparatus, and by using extreme care during the application to avoid depositions heavier than necessary, much of the danger to immature waterfowl can be minimized or eliminated. This is good mosquito abatement practice.

It has been a pleasure to speak to the Utah Mosquito Abatement Association. I regret that I have not been able to report on something new in the way of important findings. However, this reiteration of some fundamentals of the relationships between mosquitoes and fish and game may help us all to do a good job in the field.

* * * *

## AIRPLANE OPERATIONS IN THE SALT LAKE CITY MOSQUITO ABATEMENT DISTRICT

By Glen C. Collett
*Field Supervisor, Salt Lake City, M. A. D.*

The first use of the airplane for mosquito control in the Salt Lake City District was undertaken in June, 1949. This was on an experimental basis during which approximately 310 acres were treated. The results obtained during this test proved that this method of treating certain areas in the district with an airplane was both practical and economical.

From 1950 through 1953 a total of 10,680 acres were treated by airplane with satisfactory results. During this period, extensive areas outside the district which were not treated produced numerous large broods of *Aedes dorsalis* and some of these broods migrated into the city.

During 1954, the large mosquito producing areas in the district were controlled with satisfactory results by the application of insecticides by airplane spraying. More extensive use of aircraft was made during the season than during the combined years in which aerial treatment has previously been used by the district. In the 1954 season a total of 12,128 acres was treated by airplane. Of this amount 2,286 acres were treated in cooperation with Davis County Mosquito Abatement District in which the two districts shared the cost of airplane time and materials used.

The cost for aerial treatment during 1954 was much lower than any previous year as a result of contracting the pilot and plane on an hourly basis of $20.00 per hour. The cost per acre ranged from $.26 to $.74 per acre, with the season's average acreage cost of $.35. The cost prior to 1954 was on an acreage basis with prices varying from $.50 to $1.00 per acre. The hourly basis proved to be not only more economical, but better results were obtained. The pilot on an hourly basis was not interested in just getting as many acres covered as possible, but was also concerned with doing a better job.

The insecticides used during 1954 were DDT in No. 2 fuel oil, DDT and water emulsion, and heptachlor emulsion in water. DDT was applied at the rate of 2 gal. per acre, containing .4 lbs. of DDT. At times DDT-oil and DDT water emulsion failed to give satisfactory results. The DDT and oil spray was more unpredictable than the DDT-water.

The heptachlor-water emulsion proved to be consistently effective at low concentrations and to be more economical to use than DDT. The cost to treat an acre with heptachlor was approximately $.12 as compared with $.19 for DDT-water emulsion and $.40 for DDT and oil spray. Heptachlor was effective and gave good larval control when applied at the rate of .06 lbs. per acre. For the control of adults this was increased to .08 per acre. With the use of this material, larval reduction rates were generally above 95% except when excessive vegetation covered the water.

The principle species involved were *Aedes dorsalis* and *Culex tarsalis.*

Along with the use of the airplane, sound, fundamental principles of mosquito control must be applied. A prerequisite to airplane spraying is the need for a good job of inspection. The importance of inspection before and after spraying cannot be over emphasized. Larviciding a large area without knowing the extent of the larvae present may promote good public relations, but will prove to be costly and impractical. The mere fact that control measures have been applied does not necessarily mean that control measures have been accomplished.

Adequate records should be kept of both adult and larval populations by field observations and light trap collections for adults. An appraisal also has to be made in determining if airplane spraying has been done as economical as possible. All these factors are necessary and must be considered in the use of the airplane in a mosquito control program.

* * * *

## GRANULAR INSECTICIDE CARRIERS USED IN SALT LAKE COUNTY IN MOSQUITO ABATEMENT OPERATIONS

By Jay E. Graham
*South Salt Lake County M.A.D.*

Granular materials have been in use for several years as carriers for mosquito larvicides. The use of these granular larvicides in the United States prior to 1954 was adequately summarized last year at the New Jersey meetings by R. L. Vannote and G. E. Washburn.

Rees, Edmunds and Nielsen (1953) reported the advantages of using granular insecticides for treating small mosquito producing water by hand application at the time of inspection. These advantages were further confirmed by the continued use of granular larvicides in Utah during 1954.

Granular formulations first were used in Utah for mosquito larviciding in 1951 when the Salt Lake City Mosquito Abatement District received, through the efforts of Robert L. Vannote, 500 pounds of granulated tobacco stems impregnated with 10% DDT, from the Tobacco By-Products and Chemical Corporation of Richmond, Virginia. Since that time the Salt Lake City, South Salt Lake County and the Weber County Mosquito Abatement Districts have used other granular carriers on an experimental basis in both hand and airplane applications.

In an attempt to obtain the most suitable granular larviciding material for hand application, a number of granular carriers were investigated during 1954. The granules used were impregnated with different concentations of aldrin, dieldrin and heptachlor. This investigation was not exhaustive but some of the results obtained seemed to be significant and are herein presented for consideration.

The first granules used in 1954 were bentonite of 30-60 mesh containing 2-1/2% heptachlor which had been stored during the winter. These granules were not lethal when applied to first instar larvae of *Aedes dorsalis* but appeared to act as a growth inhibitor on the larvae. The supply of these granules was exhausted before this could be further investigated.

Bentonite granules containing 5% dieldrin and 5% urea as deactivator were used as a pre-hatch treatment in several areas. The granules were applied at the rate of approximately 10 pounds per acre. When applied to areas that were intermittently flooded during the year, this material apparently was effective for the entire season but when applied to an area of permanent water, it was effective for less than two months.

Throughout the summer several granular formulations were tested in the field by hand application using regular control procedures. The carriers used were granulated tobacco stems, bentonite, attapulgus, vermiculite, celite and panacalite. At the dosages normally used all of these granules produced satisfactory results but the granules were not equal in all respects. An attempt was made to evaluate the carriers on the basis of the following factors: effective coverage, penetration of vegetation, visibility of dispersed granules, acceptability for handling, the need for deactivators and the cost per acre of the material used. Included in effective coverage were the distance the granules were dispersed when thrown and the manner in which they spread over the area treated. Acceptability for handling included the ease with which the granules can be transported in the field by the inspector and any unpleasantness experienced when applied by hand.

The following is a chart showing the results of this evaluation:

COMPARISON OF GRANULAR CARRIERS

| Granules | Effective Coverage | Penetration of Vegetation | Visibility of Applied Granules | Acceptability for Handling | Deactivator Required | Cost Per Acre* |
|---|---|---|---|---|---|---|
| TOBACCO STEMS 30-50 Mesh | Good | Good | Poor | Poor | No | ? |
| BENTONITE 36-60 Mesh | Good | Good | Good | Good | Yes | $1.00-2.00 |
| ATTAPULGUS 20-40 Mesh | Good | Good | Fair | Good | Yes | $1.00-2.00 |
| VERMICULITE 30-60 Mesh | Fair | Good | Fair | Good | Yes | ? |
| CELITE 30-60 Mesh | Fair | Good | Fair | Good | Yes | ? |
| PANACALITE Approximately 60 Mesh | Good | Good | Good | Good | No | $0.25-0.40 |

*Cost is based on price of Granules delivered at Salt Lake City.

From the above scoring panacalite granules are apparently the most satisfactory of those tested. As prepared for mosquito larviciding panacalite is a white floating granule readily visible when applied. It is light in weight, 8 lbs. per cubic foot, it absorbs some moisture without clumping, and is not offensive for handling in the field. It was also found that water can be added to panacalite granules in the field to make a heavier granule for casting into the wind when necessary. In addition, one pound of panacalite granules can be used to treat an area eight times the size of that which can be effectively treated by one pound of bentonite.

## SUMMARY AND CONCLUSIONS

Granular formulations are the most satisfactory type of larvicide that have been used in Utah to treat mosquito producing waters by hand application at the time of inspection.

Granular formulations are very effective when used under conditions where the larvicide must pass through dense vegetation to arrive on the surface of the water.

All of the materials investigated as granular carriers of larvicides were effective as carriers but panacalite was superior to the others as determined by the characteristics considered in making the comparison and the conditions under which the granules were used.

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## REPORT FROM THE SOUTH SALT LAKE COUNTY MOSQUITO ABATEMENT DISTRICT

By Orlon Newbold, Secretary

I feel it an honor to be asked by my fellow board members to make a report and to give you a few of the highlights of the South Salt Lake County Mosquito Abatement District. As many of you know, we are one of the baby districts, having been organized as of June 1952 and having completed only two years of control work.

I have attended the last two state conventions and have been very interested in the topics discussed by men who understand mosquitoes better than I. I was not truly aware of the many diseases carried by mosquitoes until I attended the convention at Brigham City two years ago and listened to Dr. George A. Spendlove, Utah State Health commissioner, who told of a heart breaking experience that had happened in his own family in which one of his children was afflicted with a dreadful disease carried by mosquitoes. He also stated that many cases of polio are misdiagnosed and may be diseases in which mosquitoes may be involved. Since that time I have become very mosquito minded.

Our board has worked in close cooperation with the Salt Lake City District. Dr. Don M. Rees and Robert Wilkins have assisted us greatly in our program since our organization for which we are very appreciative.

Our board has set up the policy, along with our manager Jay Graham, that where it is possible, that we attempt to eliminate or to reduce the source of mosquito production. In the past two years this policy has involved primarily drainage, done by dragline, tractor and by hand.

The dragline work completed in 1954 can be divided into 3 parts. The first segment of this work was accomplished in cooperation with the Salt Lake City Mosquito Abatement District and eliminated practically all of the mosquito-producing water in the low areas on either side of the Jordan River from 5200 South to 6000 South. A total of almost 10,000 feet of ditch was dug by drag line in this area.

The second part of the drag line work was accomplished by the Salt Lake County Flood Control, which drained several hundred acres of mosquito-producing land east of the Jordan River between 11500 South and 12000 South. This work was planned and requested by the South Salt Lake County Mosquito Abatement District and property owners in the area.

The third part of the drag line work was performed by the United States Smelter which operated a drag line to drain about 75 acres south of the smelter in Midvale. This work was requested by Mayor Henry Beckstead of Midvale, and with the cooperation of the officials at the smelter the mosquito nuisance on this portion of their property was eliminated. This means that approximately 27,800 feet or 5.3 miles of drains have been constructed by drag line at the present time.

Extensive hand drainage work has reduced or eliminated many mosquito breeding areas throughout the country. This work has been accomplished by employees of our district with some help being given by employees of the Salt Lake City Mosquito Abatement District. Approximately 34 miles of ditches have been constructed or cleaned between 2100 South and 14700 South in this manner.

Through this drainage program, plane spraying has been reduced 75% in the last year and if our drainage program is completed this year there is a possibility that plane spraying may be eliminated.

In our district last year, 5000 acres were also treated for control of mosquito larvae and adults.

We are at the present time concerned with impaundments of stagnant water produced by the activities of man, such as the stagnant water in old barrels, beer cans, automobile tires, water filled cellars, cesspools and irrigation practices, such as excessive flooding of pastures in low areas. Our board feels that we must institute an education program with the people of our district so they will cooperate and help rid us of these nuisance breeding containers and practices.

Our board feels that much has been accomplished for the money spent and also our men have done splendid work. We hope the City and County can continue to work in close cooperation in the future as we have in the past, also that all Districts in the State may work together to the end, that we may all enjoy a better control program.

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## MOSQUITO ACTIVITIES FOR 1954 OF THE BOX ELDER MOSQUITO AND FLY ABATEMENT DISTRICT

By Karl L. Josephson, Supervisor

During the first part of the year we completed the addition to the warehouse that we started in November of last year. We have also received delivery on 10,000 lbs. DDT and two Jeeps.

We started spraying cattle in the last part of January and sprayed several thousand head before the season was over.

In the first part of March we started work on our air boat. Fred Bradford and myself put in most of the work. Soon after, we started repairing and building the pumps and sprayers for the new Jeeps. This activity put the boat building into second place so that the boat didn't get finished until late summer.

We purchased another large aerosal fogger and a small portable fogger. By using the small fogger in small areas we did not need to tie up the large foggers that were so badly needed in the populated areas near the mosquito producing sloughs and swamps. We also sprayed some five thousand acres with an airplane. This, coupled with our fogging and ground spraying activities, gave us better mosquito control than we have ever received before. Many favorable comments have come to us and are still coming to us concerning excellent work done last year. I believe the foundation of this success was laid in the careful inspection both before and after each treatment, whether airplane or ground treatment, and because of the addition of two extra inspectors. We started our inspection work the first part of April and this year we used three inspector-sprayers instead of one as in former years. This has made it possible to locate breeding areas

so much better and made control more substantial.

We ran out of money about the first of October and found a few mosquitoes after that. Most of this breeding activity was in the marsh areas themselves, and not in the towns.

Our Gambusia fish planting program has been quite successful, and as we have planted barrels of these mosquito larva eaters every year, there is a continuous stream of them running into both Bear River and Malad River. We also furnish the Weber District with their fish.

## REPORT OF THE FLY AND EARWIG CONTROL 1954

This year, again, the cost of our fly and earwig spray was all taken from taxes. This, to the delight and satisfaction of most people, gave us the chance to treat all properties involved without too much difficulty. Of course there were one or two cases where people did not cooperate mostly because they felt they didn't have pests to kill, no flies, no earwigs, etc. We also had some that wanted at least 100 gallons used on the premises. This is in contrast to the years in which we charged for the spray when these same persons would take some two or three gal. All in all we treated about 95% of the improved property in Box Elder County for flies and earwigs.

We used 23,545 lbs. of 50% DDTW and 2,700 lbs. of Lindane 25G for our earwig and fly spraying. Of course this included livestock and other special spraying we did. We collected about $3,000.00 for the special spray.

This year we did some experimentation with Malathion, a chemical that was thought to replace DDT, but we found that it had a residual effect for only ten days so we returned to the use of DDT and Lindane which produced good results. We tried Diaznon as a bait against earwigs and received good results. Next year we intend to try a wettable spray of Diaznon and compare results. If in the future we have to change from the chlorinated hydrocarbons to other insecticides we will have some first hand information to fall back on.

As was the case in past years, our degree of control of flies and earwigs had a direct relationship to conditions of sanitation. Where sanitation was poor, we had many flies to kill, while in areas of better sanitation, some people didn't want the service as no flies were present.

We find that in all parts of the district, our sprayers are more than welcome to call and treat the property. In one vicinity, one spray crew found the following note;

"Dear Fly Sprayers, We can't be home but please go in and spray everything in-side, out-side, down-side, up-side, round-side, his-side, her-side, my-side or any other dam-side where a fly might land."

## REPORT OF SALT LAKE CITY MOSQUITO ABATEMENT DISTRICT TO UTAH MOSQUITO ABATEMENT ASSOCIATION CONVENTION, FARMINGTON, UTAH, MAR. 18-19, 1955

By Karl D. Hardy, President

The year 1954 was most successful for mosquito control in this District as evidenced by the few complaints received. In September, a migration developed in the northwest section of the city. This was quickly eliminated by aersol application.

The Davis County District is given commendation for their cooperation in conducting a very effective airplane spraying program. A total of 12,534 acres were covered with 25,865 gallons of insecticide at a cost of $7,140.39, or $.57 per acre. Other coordinated effort was maintained with the So. Salt Lake County and Magna Districts.

A highly successful program of Cooperative Drainage was followed in conjunction with Salt Lake City and Salt Lake County. The representation of the three agencies participating constitute the Cooperative Drainage Committee who authorized the dredging and cleaning of 30 miles of drains by dragline, tractor, and hand work at a total expenditure of $29,254.61.

A total of 26,196 mosquito fish were planted in drains and ornamental pools at a cost of $862.40.

The regular field work of the Salt Lake City Mosquito Abatement District included the operation of a D4 tractor by which 35 miles of drains were cleaned at a cost of $4,616.53. In addition, a total of 11 miles of hand work on various drains was completed at a cost of $9,462.23. A total of 13,964 inspections were made and 12,315 gallons of larvicide were applied where needed.

The financial report on Dec. 31, 1955 showed capital assets as follows: Land $1,000.00, Buildings $16,305.64, Tractor $3,000.000, Trucks $20,130.41 and Equipment $4,009.65.

The success of this District lies in the fact that the Board of Trustees are successful business and professional executives who exercise their expert administrative judgment for the most effective functioning of this District.

Since I have been a member of the Salt Lake Mosquito Abatement Board almost since its inception, I have been in a position to follow its growth and development. And one of the most outstanding features is in the work of Dr. Don M. Rees, who commenced working for the board when he was a young man and a student at the University of Utah, where his studies qualified him as an expert in the proper treatment of the mosquito nuisance. He was made supervisor of the Salt Lake District and soon had in operation entirely new and modern methods of treatment which he has continued to put into effect with gratifying results. Dr. Rees soon became a member of the Salt Lake Mosquito Abatement Board.

I know Dr. Rees has been a great help to all the districts, which have been organized since the Salt Lake City District was formed and I am certain the help Dr. Rees has given has saved the various new districts a great deal of money and he has given the residents much comfort by the elemination of the mosquito nuisance.

It is my opinion we will owe Dr. Rees a debt of appreciation for his generous and able help in keeping us up to date with the best modern and effective treatment of the mosquito nuisance.

# HIGHLIGHTS OF THE WEBER COUNTY MOSQUITO ABATEMENT DISTRICT FOR THE YEAR 1954

LEWIS E. FRONK, *Director*
EARL A. JENNE, *Supervisor*

## INTRODUCTION

The 1954 mosquito control season was by far the most successful experienced by the Weber County Mosquito Abatement District. This can be attributed to a very dry season, and a well organized mosquito abatement program. The cost of this program last year was $62,544.46.

## BRIEF SUMMARY OF MOSQUITO ABATEMENT ACTIVITIES DURING THE YEAR 1954

Table I

DRAINAGE:

| Area | Ft. Dug | Ft. Cleaned | Equip. |
|---|---|---|---|
| N. Ogden | 210 | | Dragline |
| Plain City | 6,871 | 11,248 | " |
| Far West | 2,483 | 6,306 | " |
| Marriott | 633 | 363 | " |
| Slaterville | 500 | 3,443 | " |
| Warren | 1,974 | 5,773 | " |
| W. Weber | 1,813 | 447 | " |
| P. View | 1,241 | 39 | " |
| County general | | 364 | Hand |

Total Feet dug ..... 15,725 ft.
Total Feet cleaned ..... 27,619 ft.
Total by hand ..... 364 ft.
Other work:
a. four (4) new culverts
b. cleaned (11) culverts
c. lowered (8) culverts
d. layed 144′ tile
e. leveled spoil dikes

### TABLE II

AERIAL APPLICATION OF INSECTICIDE:

| Total Acres | Insecticide | Lbs. per acres | Gals. per acre | Carriers | Results |
|---|---|---|---|---|---|
| 13,300 | DDT | .1 to .4 DDT | 2 to 4 | #3 oil H20 | 60% to 95% |
| 124 | Heptachor | .083 to .1 | | 20-40 Panacalite | 30-60% kill |
| 100 | Dieldrin 5% | 5% 1 lb./acre | | Bentonite | poor 10% |

Total Acres ..... 13,574
Application Cost ..... $.38 per acre
Overall cost ..... $.77 per acre

### TABLE III

GROUND APPLICATION OF INSECTICIDE:
(Aera Mist, Hand & Power Sprays)

| Total Acres | Insecticide | lbs./acre | Gals./acre | Carrier | Results |
|---|---|---|---|---|---|
| 2,384 | DDT & Oil | .2 — .6 | 2 — 10 | Oil | Excellent 98% |
| 1,073 | DDT & H20 | .2 — .6 | 2 — 10 | Water | Very good 90% |
| 870 | Heptachlor Water or Oil | .1 | 5 — 10 | Water Oil Panacalite | Excellent 98% |

Total Acres — 4,327

### TABLE IV

FISH CULTURE:

| Area | Type Condition | No. Fish | Kind | |
|---|---|---|---|---|
| Ogden City | Ornamental ponds | 2,326 | gambusia | Very good |
| Weber County | Ornamental ponds | 1,750 | gambusia | Very good |
| Weber County | Drain ditches | 5,400 | gambusia | Very good |
| Weber County | Swampy Areas | 15,000 | gambusia | Survival relatively poor because of the natural enemies. |

Total fish planted — 24,476

TABLE V

FOGGING:

| Area | No. Gals. | Insecticide | Carrier | Equipment | Miles Fogged | Results |
|---|---|---|---|---|---|---|
| Weber County General Especially Areas in or about duck clubs etc. | 10,850 | 5-8% DDT .05% pyrethrum 1% Heptachlor | #3 fuel oil #3 fuel oil | 3 liquified gas machines | 2,874 lineal miles | fair to good |

## THE EFFECT OF MOSQUITO ABATEMENT FOGGING ON VARIOUS INSECTS

EARL A. JENNE, *Supervisor*

It is apparent that fogging for mosquitoes is apt to have an effect on beneficial insects or other destructive insects. It is also apparent that one insecticide may be better suited for some phases of the work than other insecticides. It was in an effort to help evaluate the fogging operation on the basis of the two foregoing statements that this investigation was initiated. The results so far obtained are not to be taken as conclusive, and next year the project will be continued and improved.

## EQUIPMENT AND METHODS

Two types of cages were made of screen wire. One type has a screen lid, and the other has an open end which can be plugged with a piece of cloth. Canvass straps were attached end to end for twenty feet and were used to measure the distance the traps were placed from the fogger.

The insects were caught and caged, and the cages were suspended from a wire ring, so they would hang free in the fog. This wire ring was attached to a fence or other object down wind from the fogger. The fog was then turned on for a period of from one minute to one and one half minutes, and then the specimens were quickly removed from the fogging area. The physical condition of the specimens were determined prior to the test and at various intervals after the test. The weather conditions, insecticides used, height of the insect above the ground, and length of exposure were recorded. The same cages were used repeatedly, and after exposure each cage was washed in gasoline followed by a water bath before the next use. Fresh string or cloth was used to close the cages for each test. A few insects were confined in the cages and not fogged to help determine the effect of mechanical injurys on the insects used in the tests.

The following chart will give some examples of the results obtained thus far in the study, but it should be kept in mind that these results in some cases are based on a single insect.

| | Heptachlor 1% | | 6% DDT & .05% Pyreth. | | |
|---|---|---|---|---|---|
| Insect | Exposed | Effect | Exposed | Effect | No Insecticide |
| Various Mosquitoes | 1 Min. 1 Min. | Dead in 3 Hours | 1 Min. 1 Min. | Dead in 2 hours | Effect of Confinement |
| House Fly | 1½ Min. | Dead in | 1 Min. | Alive | Dead within |
| Bumble Bee | 1 min. | 12 hours | 1 Min. | 40 hrs. | 20 hours |
| Syraphid fly | | Alive after 12 hours | | Alive 12 hours | Still alive after 43 hours |
| | | Alive after 9 hours | | Dead 1 hour | Still alive after 43 hours |
| | | | | | Still alive after 28 hours |

## TENTATIVE CONCLUSIONS

1. The open ended cages proved to be better with respect to the ease of confining the insects without injury.
2. The cages are apparetntly not seriously contaminated by residual insecticides when treated as they were.
3. Honey bees are quite delicate and their hives should be avoided when fogging.
4. Heptachlor and DDT are both effective against mosquitoes.
5. DDT fog is deadly to mscid flies and heptachlor is not.
6. Noctuid moths are resistant to both DDT fog and heptachlor fog.
7. Syrphid flies are killed by either DDT fog or heptachlor fog.
8. Bumble bees are quite resistant to either DDT fog or heptachlor fog.

## HIGHLIGHTS OF THE DAVIS COUNTY DISTRICT

By Ward Warnock, Director

Davis County Mosquito Abatement District has operated the past 4 years on a contribution basis with each city as well as the County contributing to the support of the project. This year we are officially organized and operating on a ½ mill basis. We are now aware of most of our problems.

1. The most serious control problem in Davis County is our long lake shore. Our County extends 24 air line miles, but we have 55 miles of shore line along great Salt Lake, having duck clubs, swamp areas and natural stream outlets. The problem is, as more irrigation water is placed on the upper land, (Weber Basin Project), and additional drains are installed for collection of waste water, water will be discharged on the mud flats before reaching the salt water thus spreading out and creating greater mosquito breeding problems.

2. The problem will be greatly minimized if drains are installed and maintained to carry all waste water out to the salt. The lake level has varied in the past 50 years from 4211 to 4193 (18 ft.) which on the lake shore means a difference of up to 5 miles. Most of the area exposed during low water level constitutes our mosquito breeding area.

The district has purchased a small John Deere Tractor, equipped with Ditcher, which we have used to drain some of the swamp area nearer to the lake. We have succeeded in educating some of our farmers to the value of draining pastures. We are also ditching the lake shore so that some areas that have not received irrigation water in the past, are now getting it, and areas which had water standing on them, are now drained. Many farmers are asking for this work to be done.

However, we believe we have had a successful year during 1954. This year we will operate with 7 full time men and 3 trucks equipped with Beam Power Sprayers. Also, one Jeep and the John Deere Tractor and ditcher.

In closing, we do want to express our thanks to our neighbors to the South and North of us. The assistance given us in airplane spraying the lake shore was invaluable.

March 19th, 1955

## AUDIT OF UTAH MOSQUITO ABATEMENT ASSOCIATION

By ROBERT A. WILKINS, *Chairman*

JAY GRAHAM JAMES A. GILES

| | | | |
|---|---|---|---|
| Balance on hand 1st March, 1954 | | | $355.29 |
| | Debits | Credits | |
| March 15th dues 1954 Magna | | $ 25.00 | |
| March 24th, 1954 Salt Lake County Mosquito Abatement District | | 25.00 | |
| March 24th, 1954 Weber County Mosquito Abatement District | | 25.00 | $430.29 |
| April 1st Box Elder | | 25.00 | 455.29 |
| June 22 Davis County | | 25.00 | 480.29 |
| September checks authorized | $96.33 | | 483.96 |
| A. M. C. Assn. Advertising | 20.00 | | 363.96 |
| October 30 South Salt Lake County Mosquito Abatement District | | 25.00 | 388.96 |
| January, 1955 Salt Lake County Mosquito Abatement District | | 25.00 | |
| Refund to Utah Association | | 6.87 | 420.83 |
| February 24 Weber County | | 25.00 | 445.83 |
| March 10, Salt Lake County '54-'55 dues | | 50.00 | 495.83 |
| March 10, stamps, L. Fonk | 7.55 | | 488.28 |
| Checks on hand as follows: | | | |
| ANNUAL DUES 1955 | | | |
| Davis County | | 25.00 | |
| 12 March, 1955, Magna | | 25.00 | |
| 15 March, Box Elder, 1955 | | 25.00 | |
| South Salt Lake County Mosquito Abatement District, 8 March, 1955 | | 25.00 | |
| 19 March, on hand | | $100.00 | $588.28 |

Very truly,

Robert A. Wilkins, *Chairman*
Jay Graham
James A. Giles

## REPORT OF LEGISLATIVE COMMITTEE UTAH MOSQUITO ABATEMENT ASSOCIATION

By Lynn M. Thatcher, Chairman

*Presented at Eighth Annual Meeting, Farmington, Utah Friday and Saturday, March 18th and 19th, 1955*

At the Seventh Annual Meeting of the Utah Mosquito Abatement Association held in Magna, Utah, March 19th and 20th, 1954, the Legislative Committee presented a number of recommendations relating to changes in Utah's present mosquito abatement law. Official action by the association at that meeting resulted in the following recommendations, with the understanding that final approval of the Executive Committee would be obtained:

1. That the present law be amended to require that a County Commissioner be made a member of each mosquito abatement district board of trustees, in addition to members already specified.

2. That if the present law does not permit the board of trustees to name an executive committee to conduct the bulk of its business, an amendment be made to permit this, with the stipulation that such committee shall consist of at least five members.

3. That the law be amended to simplify the procedure of annexing new territory to a mosquito abatement district. This procedure should be more in harmony with that specified for initial creation of a district.

4. That the law be amended to permit consolidation of adjacent districts with full consent of each board involved.

5. That the law be amended to require at least 24 hours notice of special board meetings instead of the present three hours.

6. That the law be amended to exercise the type of control over mosquito breeding nuisances that is exemplified by the California law.

7. That no amendment of the law be made with respect to the type of insects controlled.

8. That no amendment be made with respect to technical guidance of districts by a state organization, or with respect to representation of health departments or county agents on boards.

9. That no amendment be made with respect to payment by the district of costs of assessment and collection of taxes.

10. That an investigation be made into the legality of acceptance by districts of contributions from persons, firms, or corporations and that if such acceptance of contributions is found to be illegal, the law be amended to make this practice legal.

It was anticipated that the various approved changes would be incorporated into a bill for presentation to the 1955 Legislative Session. However, due to various circumstances it was found impossible to submit such a bill. It is anticipated that legal help can be obtained to prepare a suitable bill during the next few months, so that it will be available for submission to the next Legislative Session.

Legal opinions have been obtained from the Attorney General in connection with items 2 and 10 as adopted at last year's meeting. The Attorney General has ruled that the present law does not permit the Board of Trustees of a district to name an executive committee to conduct the bulk of its business, but that the law could be amended to allow this procedure. The Attorney General has ruled also that it is legal for districts to accept contributions from firms, persons, or corporations.

At a recent meeting, the Legislative Committee felt it advisable to reconsider item No. 1 adopted at last year's meeting. It was agreed that it would be better to allow a county commissioner to name someone to represent him on a board if he so desired, rather than making it mandatory that the county commissioner himself be a member.

The committee recommends:

1. That delegates to this 8th Annual Meeting reconsider the action taken last year on the question of County Commissioner membership on Mosquito Abatement District Boards, and authorize a change in the law which will specify that a county commissioner or someone designated by him be an ex-officio board member.

2. That the legislative committee be authorized to proceed with preparation of a bill embodying the approved changes to the law, subject to Executive Committee approval.

* * * *

## REPORT OF THE RESOLUTIONS COMMITTEE

for the
Utah Mosquito Abatement Association's
Eighth Annual Meeting
Farmington, Utah

March 19, 1955

RESOLUTIONS COMMITTEE MEMBERS:
Glen C. Collett
Lewis E. Fronk
Karl Josephson
Dr. George Knowlton, Chairman

WHEREAS the program committee and officers have provided us with an excellent program of outstanding speakers, and

WHEREAS the speakers have gone to much effort to bring us inspiring, helpful, and up-to-date information; and in many cases, have come long distances to participate on our program, and

WHEREAS the Davis County Commissioners and mosquito control personnel have provided us with the places of meeting, eating. and arranged for other necessary facilities, and

WHEREAS the members of the various committees have performed their duties well with regard to this, our Eighth Annual Meeting and

WHEREAS the press and radio have aided this endeavor with publicity whenever such was made available to them, and

WHEREAS the officers of the association have performed their duties well and faithfully throughout the year, and for this meeting,

THEREFORE, it is resolved that we extend to every who has aided in any way to make this Eighth Annual who had aided in any way to make this Eighth Annual Meeting of the Utah Mosquito Abatement Association a success, this March 18th and 19th of the year 1955.

DR. GEORGE KNOWLTON, Chairman

Glen C. Collett

Lewis E. Fronk

Karl Josephson

* * * *

## REVISED CONSTITUTION AND BY-LAWS OF THE UTAH MOSQUITO ABATEMENT ASSN.

Adopted at the 8th Annual Meeting of the Association

### CONSTITUTION

#### ARTICLE I. NAME

The Name of this organization, an unincorporated association, shall be "UTAH MOSQUITO ABATEMENT ASSOCIATION."

#### ARTICLE II. OBJECTS

The objects and purposes of the association shall be to promote close cooperation among those directly and indirectly concerned with, or interested in, mosquito control and related work, to increase the knowledge of mosquito abatement, and the advancement of the cause of mosquito abatement and extermination in the State of Utah and elsewhere. The Association may also encourage and undertake such other insect control problems as the Association may determine.

#### ARTICLE III. MEMBERSHIP

*Section A.* The membership of the Association shall consists of three classes: Active members, Contributing Members, and Honorary Members.

*Section B.* Active members shall consist of three categories: District Members, Associate Members and Individual Members.

1. District Members shall be any duly constituted mosquito abatement district created under the provisions of the laws of the State of Utah. Each such member shall have five votes to be cast in person by five Trustees present at the time of voting. District Members shall constitute the majority of votes eligible to be cast at any voting.

2. Associate Members shall be agencies, departments, institutions, commissions, civic organizations and other nonprofit groups interested in or concerned with mosquito abatement. Each such member shall have five votes to be cast in person by five designated representatives present at the time of voting.

3. Individual Members shall be any person interested in or concerned with mosquito abatement who desires affiliation with the Association. Each such member shall have one vote to be cast in person at the time of voting.

*Section C.* Contributing Members shall be any commercial or profit-making organization which desires affiliation with the Association. Each such member shall have no vote in the Association.

*Section D.* Honorary Members shall be any individual who has performed outstanding service in the interest of mosquito abatement and who has been elected to honorary membership for life by a two-thirds majority vote of active members present at the time of voting. Each such member shall have no vote in the Association.

*Section E.* All applications for membership shall be subject to approval by the Board of Directors.

#### ARTICLE IV. REVENUES

*Section A.* The revenue of the Association will be derived from dues paid by members from the sale of publications, from donations and contributions and from such other sources as may be approved by the Board of Directors.

*Section B.* The dues for members shall be as follows:

1. District Members

| Local budgeted Funds for Mosquito Abatement | | Annual Dues |
|---|---|---|
| From | To | |
| 0 | $ 5,000 | $10.00 |
| $ 5,000 | $10,000 | $15.00 |
| $10,000 | $20,000 | $20.00 |
| $20,000 and over | | $25.00 |
| 2. Associate Members | | $10.00 |
| 3. Individual Members | | $ 2.00 |
| 4. Contributing Members | | Minimum $10.00 |
| 5. Honorary Members | | None |

#### ARTICLE V. OFFICERS

*Section A.* The elective officers of the Association shall be a President, Vice President and a Secretary-Treasurer. A Director will be appointed by the Board of Trustees of each District Member not represented by an elective officer. The elective officers and the duly appointed directors shall constitute the Board of Directors. Only Active Members shall hold office.

## Article VI. Duties of Officers

*Section A.* The President shall preside at all meetings of the Association, annual and special, and at all meetings of the Board of Directors. He shall maintain and exercise general supervision over the affairs of the Association, subject to the authority of the Board of Directors, and shall discharge such other duties as usually pertain to the office of President.

*Section B.* The Vice-President shall exercise the powers and perform the duties of the President in the absence or disability of the President or in case of a vacancy in the office of the President. He shall also perform such duties as may be assigned to him by the Board of Directors.

*Section C.* The Secretary-Treasurer shall keep full and correct minutes of all meetings of this Association and of the Board of Directors. He shall be responsible for the maintenance of all membership records, conduct the correspondence of this Association, and issue all notices of meetings. He shall collect and receipt for all dues, assessments and other income. He shall deposit promptly all funds of this Association in such depositaries as shall be approved and designated by the Board of Directors. Checks in payment of obligations of this Association shall be signed by the Secretary-Treasurer. He shall, under the direction of the Board of Directors, pay all bills of this Association and make such other disbursements as are necessary and incidental to the operations of the Association. He shall, at the annual meeting of this Association, and if directed by the Board of Directors at special meetings, make full and true report of the financial condition of this Association. He shall perform such other duties as are usually incident to the office of Secretary-Treasurer and as may be assigned to him by the Board of Directors. The Secretary-Treasurer, with the approval of the Board of Directors and with the assistance of the Publications Committee, shall publish and distribute the proceedings and other publications of this Association.

*Section D.* The Board of Directors shall meet upon the call of the President, or upon the request of three (3) or more members of the Board of Directors directed in writing to the Secretary-Treasurer. At least five (5) days prior notice in writing shall be given by the Secretary-Treasurer to all members of the Board of Directors as to any meetings of the Board of Directors: the time and place of such meetings shall be designated by the President. A majority of the members of the Board of Directors shall constitute a quorum for the transaction of business, and action by the Board of Directors shall be upon the vote of a majority of those members present at any meeting of the Board of Directors at which a quorum is present.

Section 2. The Board of Directors shall manage the affairs of this Association and shall have power:

(a) to fill any vacancy among the officers of this Association, including the membership of the Board of Directors;

(b) to appoint a Publications Committee of not more than five (5) to assemble, edit and cause to be published the proceedings of the annual meeting of this Association, and of such special meetings as the Board of Directors shall direct;

(c) to appoint an Auditing Committee of three (3) who shall audit the accounts of this Association and report thereon at the annual meeting of this Association;

(d) to appoint a Program Committee of not less than three (3) for each annual meeting and for any special meeting. The Secretary-Treasurer shall be ex-officio a member of any Program Committee;

(e) to appoint such other committees as it may deem to be necessary or useful in conducting the business of the Association;

(f) to prescribe the duties of officers of this Association not otherwise prescribed in the By-laws of this Association;

(g) to prescribe rules and regulations for the conduct of the affairs of this Association, as are not inconsistent with the provisions of the By-laws of this Association;

(h) to determine the number and price of each publication which shall be distributed to the various members of this Association, and to others; to approve lists of non-members who may receive publications without charge;

(i) to accept or reject applications for membership in this Association, except Honorary Membership, and to prescribe rules and procedure in relation thereto.

## Article VII. Nominating and Election of Officers

*Section A.* At least 15 days prior to the annual meeting of the Association the President shall appoint, subject to approval by the Board of Directors, a Nominating Committee consisting of five Active Members.

*Section B.* The Nominating Committee shall determine its nominees for the elective officers of the Association. It shall, ten days prior to the annual meeting, send to each active member the names of the nominees selected. It shall also receive prior to the time of voting, nominations made in writing and signed by not less than three Active Members for any elective office in the Association. Nominations may be made from the floor at the time of election of officers.

*Section C.* Officers of the Association shall be elected by majority vote at the annual meeting of the Association, and shall serve until the next annual meeting following their election or until the election of their successors.

## Article VIII. Meetings

*Section A.* There shall be an annual meeting of the Association, for the election of officers, the presentation of papers and discussions on mosquito abatement and related subjects, and such other business as may properly be brought before it. Such meetings shall be held at such times and places as the Board of Directors shall prescribe.

At least 7 days prior notice shall be given to all members as to the time and place of the annual meeting.

*Section B.* Special meeting of the Association may be held whenever the Board of Directors deems such meetings ncessary, or whenever ten or more Active Members shall make a written request thereof, presented to the Secretary-Treasurer. Such request shall be presented to the Board of Directors, which shall designate a time and place for such special meeting. The Secretary-Treasurer shall give written notice of all special meetings of the Association to all members, at least seven days prior to the date of such special meeting. With the approval of the Board of Directors, special meetings of limited membership in the Association, for consideration of technical or administrative matters, may be held at times and places to be determined by the Board of Directors.

*Section C.* A simple majority of Active Members of this Association shall constitute a quorum for the transaction of business at any annual or special meeting and any actions taken at such meetings shall be by majority vote.

### Article IX. Reports and Publications

*Section A.* The annual report of the Association shall be published each year. The report may contain the proceedings, papers, and business transacted at the annual meeting. It may include any other matter deemed by the Board of Directors to be essential to the general welfare.

### Article X. Parliamentary Practices

In the absence of rules in this Constitution or in the By-laws of the Association the proceedings of the Board of Directors' meetings, as well as the Association meetings shall be conducted in accordance with established parliamentary procedure.

### Article XI. Amendments

This Constitution may be amended at any regular business meeting of the Association at which there is a quorum, by a two-thirds vote of the members present, provided the Board of Directors has previously considered the merits of the amendment.

## BY-LAWS

### No. I Dues

Dues for all classes of membership in the Association shall be payable on or before the date of the annual meeting or at such time as the Board of Directors may determine.

### No. II Committees

*Section A.* The following standing committees will be appointed each year by the President subject to the approval of the Board of Directors.

1. The Membership Committee shall consist of not less than three Active Members. This committee shall investigate and promote membership in the Association.
2. Education and Publicity Committee shall consist of not less than three Active Members. The duties of this committee shall be such as assigned by the Board of Directors.
3. Legislative Committee shall consist of not less than three Active Members whose duties shall be such as assigned by the Board of Directors.
4. Program Committee shall consist of not less than three Active Members. Their duties shall be to provide programs and direct events at each annual and special meeting.
5. Publication Committee shall consist of not less than five Active Members whose duties shall include organizing, editing and publication of the proceedings of the annual meeting and such other matters as the Board of Directors may determine.

*Section B.* The following special committees may be appointed by the President subject to the approval of the Board of Directors.

1. Nominating Committee shall consist of not less than five Active Members who shall recommend to the Association candidates for election to the several offices.
2. Auditing Committee shall consist of three Active Members whose duties shall be to examine and audit the books of the Association and report their findings at the annual meeting.
3. Resolutions Committee shall consist of not less than three Active Members.

### No. III Commercial Exhibits

All commercial and other exhibits to be displayed at the various meetings of the Association shall be approved by the Board of Directors. The Board shall also determine the fee to be charged such exhibits.

### No. IV Financial Responsibility

Except by specific direction of the Active Members at an annual or special meeting no debt or other financial obligation shall be incurred beyond the amounts of the funds (over and above all liabilities) then in the hand of the Secretary-Treasurer.

### No. V. Amendments

The By-Laws may be amended at any regular business meeting of the Association at which there is a quorum of Active Members, by a two-thirds vote of the members present, provided the Board of Directors has previously considered the merits of the amendment.