PROCEEDINGS OF THE
FIFTEENTH ANNUAL MEETING

OF THE

UTAH MOSQUITO ABATEMENT ASSOCIATION

held at the

University of Utah

Union Building

Salt Lake City, Utah

March 16 and 17, 1962

edited by

LEWIS T. NIELSEN

DON M. REES

GLEN C. COLLETT

UTAH MOSQUITO ABATEMENT ASSOCIATION
463 No. Redwood Rd.
Salt Lake City, Utah

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Fifteenth Annual Meeting

PROCEEDINGS OF THE FIFTEENTH ANNUAL MEETING UTAH MOSQUITO ABATEMENT ASSOCIATION

The opening session of the Fifteenth Utah Mosquito Abatement Association convened at the Union Building, University of Utah, Salt Lake City, Utah, with President Glen C. Collett, presiding. The welcoming address was given by Dr. A. Ray Olpin, President of the University of Utah. Response for the Utah Mosquito Abatement Association was given by Dr. Carl D. Clark, President of the Magna Mosquito Abatement District.

THE DEVELOPMENT OF TECHNIQUES FOR MULTIPURPOSE MANAGEMENT OF REUSABLE WATER BEFORE IT ENTERS THE GREAT SALT LAKE

Don M. Rees, Ph.D.

Department of Zoology and Entomology

University of Utah

In 1960 representatives from eleven federal government agencies concerned with soil and water management practices were organized into a "Task Force for Cooperative Research, Field Tests, and Demonstrations on Soil and Water Management Practices." This Task Force functions under the recently established Subcommittee on Vector Control of the Interagency Committee on Water Resources. The stated objectives of this Task Force are to: (1) "develop plans for cooperative research that can be carried out with existing resources of the agencies concerned; and (2) develop plans for cooperative field tests and demonstrations which would be of mutual benefit to the various interests concerned with soil and water management."

Project V selected as one of seven projects by which the second objective could be accomplished,[1] was described as the "Development of multipurpose management techniques for waste irrigation water in the Great Salt Lake Basin." In July, 1960, I was appointed project leader for Project V to serve with representatives of the following participating federal agencies the: Public Health Service, Bureau of Reclamation; ARS Soil and Water Conservation Research Branch; and the Fish and Wildlife Service. Representatives of the following state agencies were invited and accepted the invitation to participate in this program the: Utah State Department of Health; Utah Fish and Game Department; State Engineer; and the Utah Mosquito Abatement Association.

A small grant was awarded by the Public Health Service to support this research project. These funds became available on September 1, 1961, and were approved for a four-year continuation of this study.

A meeting of representatives of the participating agencies was held in Salt Lake City on September 11, 1961. At this meeting a proposed research plan was presented, discussed and approved. It was agreed that during the first year a detailed study should be made of the nature and extent of existing water management practices as applied to available reusable water along the shores of the Great Salt Lake, in Salt Lake, Davis, and Weber counties. It was also decided the study should also attempt to determine the results, in this area, of these management practices of the reusable water as it pertains to mosquito production and other health related problems, agricultural crop yields, production of waterfowl and other wildlife, and expansion of housing and industrial development.

During the first year two locations will be selected as experimental sites. On these experimental areas intensive studies will be conducted during the first year of existing water management practices and the results produced.

During the second year at each of these sites water management practices will be altered on part of the study area by the installation and regulation of control structures. The remaining part of both study areas will not be altered and will serve as control plots for this study.

The study will continue through the third and fourth years with the introduction of modifications of water management practices that presumably will produce the greatest mutual benefit for all users of this reusable water.

If techniques are developed as a result of this study that will improve existing water management practices, for the mutual benefit of all water users in this area, it will provide a demonstration that should be convincing and helpful to other water users with similar water management interests and problems.

Mosquito abatement in most of the organized districts in Utah is based on the principle of the prevention of the production of mosquitoes rather than of their destruction after they are produced. This approach to mosquito abatement is called "source

reduction" and consists of removing the water habitat in which mosquitoes develop or in changing, through physical modifications and improvements water management, a habitat suitable for mosquito production to a habitat in which mosquitoes cannot complete their life cycle. When source reduction is impractical, other methods of biological or chemical control are necessary for mosquito abatement and are applied by the mosquito abatement district if they are feasible.

In the early beginning of mosquito abatement in Utah, it became apparent that in an effective mosquito abatement program there is no suitable substitue for source reduction. It also became evident, as the work progressed, that most of the sources of mosquito production were created by man as a result of existing water management practices. As a result of this information mosquito abatement workers have attempted to obtain the cooperation of agencies and individuals who are creating mosquito producing situations by the use, reuse or misuse of available water. In most instances these water users have been willing to assist in this cooperative mosquito abatement program if it did not seriously interfere with the purpose for which they were using the water and if it did not require additional expenditures on their part or a change in their plans. In developing this cooperative program it is obvious that it is necessary to determine the purposes for which this reusable water is being used and the requirements necessary to achieve these objectives. From existing information it seems apparent that the objectives of many water users could be more readily attained by improving existing water management practices which at the same time, would materially benefit others mutually interested in the use of this water.

Some of the mutual benefits and improvements that may be obtained by the water users through a change in existing water management practices was convincingly and forcefully established by the panel that discussed "Water Utilization Related to Mosquito Control" presented at the meeting of this association in 1961. This panel was moderated by a Wildlife Specialist and had members from the Soil Conservation Service, State Fish and Game Department, a County Agricultural Agent, and a Sanitary Engineer and an Entomologist from the University of Utah. Mr. Berryman, the moderator for the panel, aptly summarized the results of the panel discussion as follows: "There is a thread of similiarity running through the talks of each speaker. As emphasized . . . — it is the mismanagement of water that results in mosquito production . . . proper water management is compatible with organized mosquito control."

This research program, designed for the "Development of techniques for multipurpose management of reusable water before it enters the Great Salt Lake" is undertaken by a number of participating agencies in an attempt to eventually obtain the greatest mutual benefit from the multipurpose use of this water.

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THE UTAH WATER USERS ASSOCIATION AND MOSQUITO CONTROL

T. W. Jensen, Secretary-Manager

Utah Water Users Association

It is a pleasure for me to be in attendance at your Fifteenth Annual Convention representing the Utah Water Users Association.

When Mr. Jay Graham called at my office and asked me to participate in your Mosquito Abatement Program, I thought to myself, "what has water and water users got to do with the control of mosquitoes?" proving myself ignorant of some of the vital problems pertaining to the breeding and production of mosquitoes. However, knowing since a boy on my fathers' farm that water had a good deal to do with the breeding and production of mosquitoes, I decided there is quite a connection.

After Jay's visit to my office, I began to do a little research work and tried to find some information regarding some of the problems of mosquito control. I wrote to the Government Agency, Bureau

of Public Health and Welfare at Greeley, Colorado. They sent me much material, mostly of a technical nature, of which I, as a layman, was not too familiar.

So, my talk today will be from a laymans' standpoint and as a water user, leaving the technical end of the mosquito abatement to you technicians.

The No. 1 problem, as water users, will deal pretty much with the conservation and care of our water. As water users, we must consider the conservation of water by applying only the amount of water necessary to sustain plant life. We must guard against the overuse of water and not permit it to go into seep holes or into other places to accumulate where the water may become stagnant, thus making ideal breeding places for mosquitoes. Our Water Users Association has long been advocating to the grassroot irrigators to take care of their seepage water. We have advocated and are working toward the end that every feeder canal to our farms shall be lined and kept rid of undergrowth which, as I have learned in my research, is an ideal breeding place for mosquitoes. We are advocating the replacing of diversion dams, making them modern so that small pools of water will not be allowed around the headgates of our irrigation ditches and canals. We have advocated the lining of reservoirs so that they will be free from stagnant water. In all of these theories and suggestions, we did not have the idea of making them free from mosquito breeding areas, but we thought of it purely as conserving our water from seepage and evaporation, and our thinking has been in the line of true principles of water conservation. Let's team up and work together and accomplish a two-fold purpose.

In our work, we have realized that in following true conservation, it would perhaps be doing damage to some while it would be beneficial to the majority. Again in our conservation work, we never realized or never have thought of an organization such as the Utah Mosquito Abatement Association which had plans to conserve our water paralleling the thinking of our water users.

We certainly welcome your organization to give to the Water Users Association members your thinking and the results of your studies in the conservation of water obtained through control and management. In turn, our Water Users Association will cooperate with your Association in helping to carry out to successful conclusions, not only an educational program, but an activated program which eventually in the near future will have all of the swamplands and stagnant pools, the canal and ditch linings, the diversion dams, and the drainage problems properly taken care. I am sure that through the cooperation of all agencies, both federal and state, a good many of our problems will be solved within the next few years. The Soil Conservation Service's report shows that nearly ¼ of our canal lining problems have been completed as of this date. Their program to continue the land leveling and canal and ditch lining will be near 100% completed within the next 15 to 20 years if we can keep the pace going as we have been doing in the last 20 years.

The Water Users Association stands ready, through its county and state organizations, to cooperate with you, with the Soil Conservation Service, with the Utah Water & Power Board, with the State Engineer, the ASC, the Farm Home Administration, the Housing and Home Administration, the Bureau of Reclamation, the Forest Service, and the Flood Control through the Army Engineers to employ all phases of water conservation which will mean death to mosquito breeding places.

This is an ambitious program but I am satisfied that it can be accomplished. We, as water users, are willing to take hold and construct proper drainage systems which will insure complete and proper disposal of our waste irrigation water, take care of natural run-off and seepage from both irrigable and non-irrigable lands affected by the distribution of channels and insure a free flow of water at all times. This, too, is a big obligation and we are willing to work to that end. We are also desirous of having proper drainage designs made and constructed on all of our farms. We will also work to the end of preventing water from being impounded behind ditch banks and levies.

As the Water Users Association has been for a number of years putting out their Utah Water Users News on a quarterly basis, we suggest to your Organization that you prepare articles from time to time to be presented through this publication to our water users on what can be accomplished through cooperation between your Association and our Association to give a better understanding and better control of our most precious asset — WATER! The future economy of our State depends on the development and saving by all methods, our precious water.

I want to say again that the Utah Water Users Association stands ready to cooperate with your Association whole-heartedly in all phases of your mosquito control.

I thank you again for this opportunity of expressing these few remarks to your Association.

THE UTAH DEPARTMENT OF FISH AND GAME — OUR TECHNIQUES AND OBJECTIVES IN MARSH DEVELOPMENT AND MANAGEMENT

Donald A. Smith
Assistant Chief, Game - Waterfowl
Utah State Department of Fish and Game

Management of waterfowl in Utah dates back to at least 1876. During that year a period of 213 days was permitted for the hunting of ducks and geese. By present day standards a 213 day season for hunting waterfowl seems rather liberal. Chances are, however, that at the time the limitation was labeled by sportsmen as entirely unjustified.

From this early beginning, Utah has become one of the outstanding States in the field of waterfowl management and marsh development. We are, at times, "hardnosed" about our management of various species of fish and game because of our legal and moral obligations. At the same time we have reconciled ourselves to the fact that other interests exist. Thus, we have made special efforts to alter our practices and "grow" with revolving times and changing needs. Our efforts in both waterfowl management and marsh development have become more intensive and more technical to gain the maximum from a limited potential.

Although there are other requirements for perpetuation of waterfowl populations I believe it appropriate here to dwell primarily on the development and management of marsh lands. Utah is a semi-arid state and natural marshes have always been limited in extent and distribution. With losses of this limited wetland habitat due to various causes came an awareness that for our people to have waterfowl to shoot and a place to do their hunting it would be necessary to create and maintain public marsh areas. This concern was climaxed in 1923 when the Utah State Department of Fish and Game created the first man-made marsh in the United States for the purpose of providing free public waterfowl hunting. This area was named "The Public Shooting Grounds" and is located in Box Elder County, west of Corrine.

Following this development came other marshes and another first for the State. Ogden Bay Refuge in Weber County was created as the first Federal Aid to Wildlife Restoration project in the United States under the provisions of the Pittman-Robertson Act of 1937. This Act provides funds for wildlife restoration projects through an excise tax imposed on sporting arms and ammunition. It has been the financial tool by which all of our succeeding waterfowl management areas have been developed and maintained. Today the Department of Fish and Game owns and operates over 62,000 acres of habitat for waterfowl and waterfowl hunters.

Populations of all game species are controlled by differing sets of what game managers term "limiting factors." These factors are simply circumstances or sets of circumstances which govern the welfare of a species to the extent that natural population limitations exist. For instance, the advantages of a large expanse of well interspersed habitat during the breeding season may be entirely offset by habitat limitations during the brooding season. Likewise, abundant food supplies at one period during the annual cycle may be completely overshadowed by shortages at another stage in the cycle. Populations of waterfowl in such areas would be commensurate with the minimum quantities of habitat and food not considering other factors. The point here is that all stages in the life cycle of the species must be considered in its management.

The relative importance of the many constituents of good waterfowl habitat were not fully understood during the time of our early developmental efforts. With a gaining of this knowledge has come a transition from the inadequate developments of the 20's and 30's to the productive marshes we now have.

Development of the Public Shooting Grounds and other of the early waterfowl areas was accomplished by standards and methods which today seem impractical to the point of being almost ridiculous. Dikes were formed by teams and slips, and backbreaking efforts by shovel brigades. Dirt erected to form the dikes was fortified by wood planking placed vertically on the water side of the impoundment to form a barrier against wave action and muskrat activity. In these early days this was much more economical than hauling large quantities of rip-rap materials for this same purpose and the vertical placing of the walls reduced the quantity of earth to be moved. The need for repairs on these structures was limited until the wood rotted and washing of the dike began; then it was almost impossible to keep up with the maintenance required.

Spillways on such areas were of wood or cobblestone construction and generally of insufficient capacity to adequately control the fluctuating water supplies. Usually there was but one or two spillways for even the largest impoundments and greatest flows of water. Large discharges of water eroded the spillway areas and washed out spillboards. In many instances our units were inadvertently drained by this action. The draining, subsequent repair of the

failure, and refilling of the unit resulted in water level changes detrimental to the welfare of ducks and geese, which were then our only concern.

At their worst, these waterfowl areas provided a greater quality habitat than many of the dwindling natural areas which also experienced ups and downs becuse of fluctuating water supplies. It was, however, becoming more and more apparent that this second rate method of management was not enough and into each successive project were incorporated new and improved techniques and facilities.

Dikes were increased in size and gradually riprapped slopes replaced the old, abrupt, wooden facings. Water control structure became more common and of more permanent and practical design. This particular feature has probably been altered more than any of the other features of a developed marsh.

Early developments were situated directly across the water source. This action, without provisions for floods, meant the entire flow of water had to be shuttled through the diked system at all times. Water level fluctuations were frequent and of disastrous magnitudes. Waterfowl nests were often times flooded at a time when renesting was impossible and complete nesting "busts" were experienced. Waterfowl food plants were also destroyed or seriously damaged by either the high flushing flows or by drouth due to impromptu drainage through dike washouts. We continue to place some of our developments across the water supply; however, provisions are now made to divert excess water around rather than through the area.

Most, but not all of our changes in marsh management have been motivated by the desire to obtain the optimum in waterfowl production and to improve the quality of our duck and goose hunting. Recognition of your mosquito abatement problems together with our own needs for greater water level stability led toward development of the prefabricated spillways we now use. Our combined needs were also instrumental in our making provisions for more spillways to further improve water control.

In addition to alterations in our designing we have initiated a study to determine the quality and quantity of waters necessary to develop and maintain a given acreage of marsh habitat. Likewise, we are investigating the feasibility of artificially hastening plant succession through erradication of competitive species. Those species we are attempting to replace are conducive to high mosquito production.

Our general objectives in waterfowl management have remained rather constant through these changes in marsh development procedures. State laws obligate us to manage and perpetuate fish and game resources in Utah and of course, this is always foremost in our programing. Waterfowl-wise, Utah is so situated that one portion of the State may be more important from a production standpoint and another portion more important from a migration and wintering point of view. This characteristic necessitates a great latitude in our management program over the State. Generally, however, we favor the creation of marshes which will produce ducks and geese and also provide a place to seat our hunters. These are multipurpose developments requiring that consideration to be given to all the varying needs of waterfowl throughout the year. An area developed and managed in this perspective requires static water levels and we have made great strides in our control over water.

In summarizing I would emphasize that we are attempting to completely and beneficially apply all our available water. From this application we expect to provide as large a marsh with the greatest distribution and interspersion of marsh types as is possible. Such an area is to be characterized by static water levels throughout the open weather period. All past and all future adjustments in our management will be toward this end and should benefit both our programs.

There is only one way we can exist and that is through coordinated efforts. I believe both our agencies have come a long way in the past few years and I propose we continue the trend.

RESEARCH ESSENTIAL TO MOSQUITO CONTROL

Jay E. Graham

Manager, South Salt Lake County MAD

Last year in Bountiful, Utah at the Annual Banquet of this association, Richard Peters, Chief of the Bureau of Vector Control of the California State Department of Health, discussed and emphasized the importance of research to mosquito control. I can not improve on what he said and do not intend to try, but a few specific examples of how research activities have resulted in increased efficiency with a substantial savings of money in the South Salt Lake MAD may be of interest to this group. I am aware that examples from other districts could be used and that other districts in the state are conducting programs of investigation that are profitable and worthwhile, but I feel better informed using examples from our district and more comfortable discussing my own mistakes.

All mosquito abatement districts sooner or later make use of the results of some research work. New insecticides or formulations and new techniques which have been produced only through intensive research eventually become used by districts a few of which may have no enthusiasm or interest in research activities. Some of these insecticides or techniques even have become obsolete by the time these districts use them.

In our district research activities are defined in the broadest possible terms so that we include all of the investigational procedures we use to learn more about the mosquitoes, their control, and the effects of control on other objects both animate and inanimate. Some of our activities are truly research activities and would satisfy a definition of research made by the most exacting scientists; other investigations and observations are not research in the strictest sense but all are valuable to the district.

The most important benefit of the activities we call research is that they help to keep us from getting in a "rut" and repeating over and over again procedures which are ineffective and inefficient. No procedure used by the district is sacred. All are subject to review and all of the basic assumptions on which procedures are based can be and are continually questioned and studied and modified or even discarded.

A good example of an inefficient procedure corrected by research activities is presented by the story of spraying activities on the south shore of the Utah Copper Gun Club when it was still in existence. Inspectors, including myself some years ago, reported larval production occurring in an area on this club of between 100 and 200 acres. When larvae were found the entire area was treated by plane and we were satisfied that we had done a good job economically.

In 1956 when detailed larval surveys were begun by our district and careful measurements were required of all larval producing area the 200 acres of mosquito production in the Utah Copper Gun Club decreased suddenly to about 15. The area thereafter was treated more effectively and more cheaply by can spraying.

I am not reluctant to report this example of previous inefficiency because it has been corrected and because I am convinced that other districts in Utah and other states may still be spraying large areas when only small parts of them are producing mosquitoes. Glen Collett of the Salt Lake City Mosquito Abatement District noted a reduction in the estimate of acres of mosquito larval production when his district joined with us in the research project involving mosquito larval surveys.

Another benefit derived from the larval survey is the mapping and location of areas that produce a particular species. In the South Salt Lake County Mosquito Abatement District *Aedes nigromaculis* larvae have been found in only a few restricted areas. Now that these areas are exactly known they are inspected and treated on a five day schedule because this species has a shorter period of development than other species in Salt Lake County. A seven day schedule is inadequate for this species and a five day schedule for the entire district would be too expensive and also unnecessary. This procedure gives excellent control of the various species but might not work under conditions that exist in other districts.

Examples of benefits to the district due to testing programs involving new insecticides and formulations are too numerous to mention all of them. The use of Heptachlor, until resistance to it developed, saved the district many dollars and was the most effective chemical used for mosquito larval control in Salt Lake County. This compound was used because of information obtained in a testing program.

The development of resistance together with restrictions on the use of D.D.T. and other compounds forced some changes in the insecticides used for mosquito control. Because of a testing program that had been in operation a number of years information was developed on the use and effectiveness of a number of other compounds in our area and also safe techniques were developed for handling toxic compounds such as parathion. The advantages of obtaining this information and developing these techniques slowly and carefully under the controlled conditions of a testing program rather than in the field under operational conditions is apparent.

The most spectacular development for our district was that of granular formulations. Tests with granules were conducted in 1951 and 1952 with the Salt Lake City district and continued in the South Salt Lake County district when it began operations in 1953. The use of granules in one part of our district in 1953 enabled a man to inspect and treat an area in one day that had taken six days in 1952 using other techniques. Not all areas were as suitable to the use of granules but the savings in labor costs were significant and obtained early because of a testing program.

The absolute need for conducting continual research projects is best shown by a study that was made of the Utah Copper Gun Club. To some, the

club was a recreational area suitable for fishing and boating. To others, it was a wildlife area. Some areas of the club produced mosquitoes, principally *Aedes dorsalis*. The club was a problem to two districts but at first not an extremely serious one. Careful studies were conducted in the area primarily to make certain that our control activities were not detrimental to wildlife on or in the lakes. These studies showed changes to be taking place rapidly in the several lakes that make up the club. These changes were the result of eutrophification, a process whereby the lakes were gradually filling with silt and organic matter and being converted from lakes to marshes. The process was well advanced in some areas and motor boats were able to operate in only a small area of the club.

Mosquito production was increasing in the area and changing from principally *Aedes dorsalis to Culex tarsalis*. The towns of Granger and Hunter were both within easy flight range of *Culex tarsalis* and were experiencing a large growth of suburban population. These changing conditions, determined by research activities, made the situation intolerable because of the increased threat of Western Equine Enchephalitis to the residents of Granger and Hunter.

A number of proposals were made to Kennecott Copper Corporation stating the problem and recommending that the lake be dredged to eliminate the mosquito problem. This would increase the water storage basin and create a better wildlife and recreational area. Officials at Kennecott recognized the problem, agreed something had to be done but felt the cost of dredging was too high. The lakes therefore were drained.

I was personally sorry to see the lakes lost to our area for a number of reasons, but the data from the research program was conclusive and some prompt action was absolutely necessary.

Had the mosquito abatement district not been aware of changing conditions on the lakes of the Utah Copper Gun Club and allowed them to go, disasterous results in the event of another outbreak of Western Equine Encephalitis such as occurred in 1958 could have occurred. Had this happened we would have been negligent and not worthy of the support and confidence of the people we serve.

MOSQUITO CONTROL IN CALIFORNIA DURING 1961

John H. Brawley, President
California Mosquito Control Association

INTRODUCTION

The year 1961 was the third season with less than normal rainfall. While greater than average precipitation adds to the mosquito control problems in California most districts agree that a dry year does not necessarily indicate fewer problems. This is probably due to the fact that our mosquito problems in the state are mostly man made.

There was considerable local pressure, in some areas, for fly control and a number of local agencies are becoming aware of gnat problems in their areas. In Ventura County a new mosquito abatement district was formed to do fly control. A new District at Borrego Springs, in Southern California, appears to have more problems with gnats than with mosquitoes. And of course Clear Lake Mosquito Abatement District and Coachella Valley Mosquito Abatement District have devoted a major part of their efforts to gnat control for a number of years.

INSECTICIDES

Parathion at 0.1 pound per acre and malathion at 0.5 pounds per acre were the most commonly used insecticides for both larviciding and adulticiding operations. Parathion is generally used in rural areas and malathion is applied only in urban areas by those districts having limited budgets. Some of the wealthy districts use malathion for all spray work.

Baytex was used experimentally by several districts. Most of the reports sound very promising. This material probably would be used in the control programs if tolerances were established by the Federal Food and Drug Administration. Gordon Smith, Ed Swift, and Richard Peters did some work at Modesto to gain information which might be used in establishing these tolerances. Gordon reports that they obtained very good results in the field at .05 pounds per acre presumably as a larvicide although his report did not indicate whether he was using it as a larvicide or an adulticide.

Kings Mosquito Abatement District is still using Methyl Parathion successfully against Ethyl Parathion resistant mosquitoes. The Delta District has encountered a low degree of resistance to Methyl Parathion.

Very little D.D.T. was used even by those districts which have not encountered resistance. A few districts made sure that they could not be held accountable for D.D.T. residues by not purhasing or having any of this material on hand.

Some granular materials were used by various districts but apparently all districts are still doing most of their work with emulsion sprays.

EQUIPMENT

District owned aircraft is on the increase. Fresno-Westside purchased a Piper Pawnee. Kings purchased a Pawnee and kept their PA-18A as a spare and Butte County purchased two (2) Snow, model S-2A. This brings the total to eight (8) districts with fifteen (15) airplanes. Merced County is the largest operator in the group with four (4) Callairs.

The California mist blower is gaining in popularity for ground application, particularly as a replacement for conventional power spraying. Hand spraying is still done on a large scale in many districts.

RESEARCH

Gnat research was continued by San Mateo Abatement District and Lake County Mosquito Abatement District. This work is financed by a subvention allocation, from the State Health Department in the amount of $10,000 to each district. This money is allocated on a matching fund basis. San Mateo is working on a biting gnat problem and Lake County is attempting to find an answer to the Clear Lake gnat problem which is becoming established in a great many reservoirs and water impoundment areas throughout Northern California.

The Riverside Campus of the University of California continued to work on granular insecticides, screening of promising new compounds, and did some work on eye gnats.

The Bureau of Vector Control of the California State Department of Public Health continued their studies on mosquito ecology, encephalitis, resistance, ovicides, and microsporidia for larval control.

The Davis Campus of the University of California was engaged in evaluating and seeking ways to improve the California Mist Blower.

Orange County Mosquito Abatement District is developing and improving a compressed air dispenser for granular insecticides.

Shasta Mosquito Abatement District has developed a technique for introducing insecticides into the sprinkler systems in use on the log ponds in that area.

SPECIAL PROJECTS

San Joaquin Mosquito Abatement District reports that an expanded program in the use of mosquito fish in rice fields proved very successful. They also had a greater use of herbicides and soil sterilant chemicals and engaged in a campaign to fill tree holes with sand and asphalt as a permanent method of eliminating the tree hole mosquito problem.

Borrego Valley Mosquito Abatement District successfully transported mosquito fish across 80 miles of desert with temperatures in excess of 120 degrees. It seems that these had to be imported from the Coachella Valley. About 300 fish were placed in a 30 gallon plastic garbage can and a large quantity of ice was placed in the container. Manager Bryan Whitworth reports that there were no losses during the journey.

Stephen Silveira, Manager of Turlock Mosquito Abatement District, has found a new approach to the problem of treating irrigation standpipes and underground pipelines. A mist blower with a special attachment is used to blow insecticide dusts into the pipe lines. He reports that a considerable length of line can be treated with a minimum of time in the operation.

OTHER EVENTS & ACTIVITIES

Manager David Reed moved from Tulare Mosquito Abatement District to the Fresno-Westside District. Dennis Ramke, Assistant Manager at Tulare, was promoted to the position of Manager of that district. Yours truly moved from Kings Mosquito Abatement District to Butte County.

The Kings and Corcoran Districts consolidated with Richard Frolli, Manager of the Corcoran District, staying on as Manager of the new organization.

The use of section maps is increasing with Steve Silveira of Turlock joining the ranks. Of coure Reed and I took this system with us when we changed districts. Even Gordon Smith, Manager of Eastside Mosquito Abatement District at Modesto is willing to admit that this system may have some merit.

SUMMARY

In general the abatement programs experienced a good control year in spite of continually growing problems due to an increasing population, increased water development, and industrial expansion throughout most of the state.

While the weather was undoubtedly favorable for mosquito control operations it does not appear to have contributed greatly to the success of the work being done.

BAYTEX

A PUBLIC HEALTH INSECTICIDE

Don G. Denning, Ph. D. Entomologist
Chemagro Corporation, San Mateo, California

BAYTEX was developed in the laboratories of Farbenfabriken Bayer A. G. of Leverkusen, Germany, by Dr. G. Schrader. It is a member of a group of low-toxic phosphoric esters which possesses, as one of its principal characteristics, a low order of mammalian toxicity, a wide spectrum of biological activity against insects and a long residual action. The toxicant is referred to in literature under a variety of names: BAYTEX, Bayer 29493, Bayer S1752, Lebaycid, ENTEX, and TIGUVON.

The proficiency of BAYTEX as a mosquito larvicide is well known among those mosquito abatement districts that have used the toxicant. Many examples of its culicine larval activity may be selected from the literature, the following are a few examples:

1. LC_{90} *Culex quinquefasciatus,* 4th instar (suseptible (Mulla, 1961a)

BAYTEX E. C.	0.014 ppm
Parathion	0.008 ppm

2. LC_{50} *Anopheles albimanus* (Dieldrin resistant) (Georghiou and Metcalf, 1961)

BAYTEX E. C.	0.017 ppm
DDT E. C.	0.015 ppm

3. LC_{90} *Culex quinquefasciatus* (susceptible), activity on instars (Mulla, 1961b)

	1st instar	2nd & 3rd instar	4th instar
BAYTEX E.C.	.0026 ppm	.0015 ppm	.015 ppm
Malathion E. C.	.027	.11	.12

4. Action in irrigated pastures, 4th instar (Lewallen and Gjullin, 1960)

	Rate Active Pounds/acre	24-hour % kill *Aedes nigromaculis*	24-hour % kill *Culex tarsalis*
BAYTEX E. C.	0.05	100%	100%
	0.025	99.2%	100%
Methyl Parathion E. C.	0.1	100%	100%
	0.05	99.9%	97%

5. Action in irrigated pasture against *Culex tarsalis,* 4th instar (Mulla, et al., 1960)

	Rate Active Pounds/acre	24-hour % kill
BAYTEX E. C.	0.025	79%
	0.05	100%
Malathion E. C.	0.2	96%

Not as well known, however, is the activity of BAYTEX against adult mosquitoes. The following examples have been selected from the literature.

1. Georghiou and Metcalf (*op. cit.*)

Culex quinquefasciatus (adults susceptible)		*Anopheles albimanus* (adults Dieldrin/resistant)	
BAYTEX	1.1 LC_{50} in ug/cm²	BAYTEX	0.32 ug/cm²
Bayer 39007	1.02 in ug/cm²	Bayer 39007	1.2 ug/cm²

2. Percent mortality to *Anopheles quadrimaculatus adults* (LaBrecque, et al., 1960)

Toxicant at 100 mg active per sq. ft.	Min. Exposed	1 Wk	2 Wk	4 Wk	8 Wk	12 Wk	16 Wk	20 Wk
BAYTEX	5	100	100	100	100	50	50	4
	15	100	100	100	100	97	84	8
	30					100	100	65
DDT	5				78	93	63	40
	30	86	43	78	100	100	100	97

BAYTEX is registered for use by Mosquito Abatement Districts, Public Health officials and other trained personnel in mosquito control programs. It is registered on a no tolerance, no residue basis at 0.05 pounds active per 1 1/2 U.S. gallons for larval control and 0.1 pounds active per 18 U.S. gallons for adult control.

The versatility of BAYTEX and its interesting chemical, physical and biological features are worthy of comment.

1. *Solubility* — in its pure state BAYTEX is a colorless liquid, very slightly soluble in water.

2. *Stability* — in alkaline media it is about four times more stable than Ethyl Parathion. Because it is resistant to lime it can be sprayed on fresh whitewash. Lewallen[1] found that good Culex larval control occurred in water with pH 8.8 at 0.025 to 0.05 pounds actual/acre (personal communication). Mulla found that the breakdown of the emulsion concentrate is only slight at 100°F.

3. *Volatility* — BAYTEX is about three times more volatile than Parathion.

4. *Ultraviolet spectrum* — BAYTEX is reported to be largely resistant to the entire spectrum of sunlight.

5. *Mammalian toxicity* — the acute LD_{50} is as follows:

310 mg/kg	female rats
190 mg/kg	male rats
260 mg/kg	male guinea pigs

The acute dermal toxicity to rats is reported from 330 to 500 mg/kg. The acute interperitoneal LD_{50} to female rats is 325 mg/kg. Given a daily injection for 60 days, the highest rate a rat could tolerate was 10 mg/kg.

6. *Bird toxicity* — a pecularity of BAYTEX is its relatively higher toxicity to birds — the acute LD_{50} is 15 mg/kg for ducks and 30 mg/kg for chickens.

7. *Fish toxicity* — tests on *Gambusia affinis* showed no mortality at rates above those required for larval control. Against rainbow trout "sac fry" 1 week of age, tested in 48°F. water, Lewallen obtained complete kill of *Culex quinquefasciatus* at 0.1 pound/acre (=0.2 ppm), and no effect on the after 24 and 48 hours (personal communication).

8. *Insect toxicity* — there are several reports in the literature attesting to the fact that a most striking property of BAYTEX is its action against adult Diptera. Because of this action and its effectiveness against other household pests, Chemagro has registered BAYTEX for fly control, as a long term residual in barns at a rate of 2-4 ounces spray concentrate per gallon; residual control should persist for about 7 weeks. The product is also registered for use by Pest Control Operators (as ENTEX) for insect control in homes, commercial establishments and food preparation areas.

9. *Use on animals* — Bayer 29493 is also an animal systemic, a feature that is of considerable interest to the animal entomologist, public health entomologist, and the parasitologist. An over-all spray applied at 0.1% to 0.25% has given excellent control of the cattle grub before encystment. Similar rates gave effective control of such ectoparasites as lice, and ticks. Currently Chemagro is developing TIGUVON (Bayer 29493) for use on animals, pets and poultry.

1. California Bureau of Vector Control, Fresno, California

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THE AGRICULTURAL APPROACH TO SOURCE REDUCTION THROUGH ACTIVE PARTICIPATION

George R. Whitten, Agricultural Engineer
Delta Mosquito Abatement District
Visalia, California

The Delta Mosquito Abatement District encompasses 712 square miles in the northern half of Tulare County, California. We have 21 permanent employees, and increase our total force to about 42 during the summer months by hiring high school and college students. Our budget for 1961-62 is about $200,000.

Our approach to source reduction is, of necessity, an agricultural one because eighty five percent of our control work can be directly attributed to agricultural activities. We have taken a very specialized approach to our source reduction problems that wouldn't be applicable in many districts.

This district has a capital investment of about $30,000 in source reduction equipment which includes a TD 9 tracklayer with dozer, ripper and carryall scraper, a motor grader, a wheel tractor with backhoe and loader attachments, a two ton flatbed truck with a tiltbed trailer to service and move the equipment, a station wagon, a pickup truck, a Jeep pickup with a hydraulic pump mounted on it, an engineers level, a cement mixer and various miscellaneous tools.

We have three full time source reduction employees including myself. Our services include surveying the problem area, recommending changes necessary to improve efficiency and production in the problem area and, to complete the picture, we provide the men and equipment to get the job done.

As you can see we are serious about this source reduction program. I would suggest to any district starting on a source reduction program be prepared to follow through on a long term basis. Source reduction is not a quick way to eliminate the spray program and I don't think any miraculous new farming methods will be discovered in our lifetime which will eliminate our mosquito problem. It will take a well organized program at least two or three years to show any signs of progress.

All of the equipment which I mentioned previously is available to farmers in our district for any problem concerned with water management, such as irrigation, drainage, dairy drains and any other agricultural problem which is a direct, or indirect, source of mosquito production. To give you a comparative example of the rates we charge — our TD 9 tracklayer with dozer and scraper rents to the farmer for $6.00 per hour, with our operator. A commercial contractor would rent out the same unit for $9.00 per hour. We do not make a profit on our work, but we do endeavor to break even financially.

The only work which we do at no charge is on natural problems in our river bottom and overflow areas. This, we feel, is justified because these areas have no economic value and they do produce a large *Aedes vexans* problem for us.

Let's take a quick look at the philosophy behind mosquito abatement programs. Are we to become police agencies, which some districts in heavily populated areas find their only solution, or are we service organizations? The Delta M.A.D. is at the present time a service organization. Our policy is to provide technical assistance in solving irrigation and drainage problems and our whole source reduction program is focused on improving the farmers production while we are solving our mosquito problems.

Any improvement in farming methods or planning we can help sponsor will, in the long run, help us. We are attempting to solve problems which have plagued civilization for thousands of years. The answers will be accepted and used by agriculture only as soon as they become economically feasible.

THE UTAH MOSQUITO ABATEMENT ASSOCIATION—A BRIEF HISTORY OF MOSQUITO CONTROL IN UTAH

Lewis T. Nielsen, Ph. D.
Department of Zoology and Entomolgy
University of Utah

Historical Background: In Bulletin No. 4 of the American Mosquito Control Association "Organization for Mosquito Control" 33 states in the United States are listed as having some type of law enabling organization for mosquito control. Only 5 states, Alabama, California, Connecticut, New Jersey and New York enacted legislation prior to 1923, the year in which the Utah law became effective.

Don M. Rees (1948) discussed the Utah law and the role of the County Commissioners. The following information is quoted from Dr. Rees' paper

> "The state law making it possible to organize Mosquito Abatement Districts in Utah was passed in 1923, amended in 1931 and 1937. The drafting of this law was largely the work of Col. J. A. LePrince of the U. S. Public Health Service, at the request of Dr. T. B. Beatty who was then head of Utah State Department of Health. This law has since been cited throughout the United States as an excellent example of good legislation.
>
> The Utah state law on the forming of mosquito abatement districts provides in Section 2; that any city, county or portion thereof with a population of more than 100 may create an abatement district. To do so at least 10 per cent of the qualified voters within the area must petition for the district and the governing body of each municipality must, by resolution, request the inclusion within the district of such incorporated trerritory. This section of the law insures that an abatement district can originate only at the request of the people living within the proposed district.
>
> The petition for the creation of the said district must be published at least two weeks in advance of its hearing before the county commission. This insures that all inhabitants of the area are made aware of the proposal to create the district and provides an opportunity to oppose its creation, if they so desire, at the public hearing before the county commission. After the county commission has considered the petition and heard all protests and objections to the same the board of county commissioners may approve the petition, with any changes in boundaries they deem necessary, or deny the petition if they think the creation of such a district inadvisable. If the county commission accepts the petition the district is established at their order. The county commission then appoints a board of trustees for the said district consisting of at least five members. Each municipality within the district is entitled to one member on the board, the same to be appointed by the county commission. The board of trustees serve without salaries or pay for a period of two years.
>
> According to this law the final approval for the creation of a mosquito abatement district rests with the county commission. The appointment of the board of trustees, its governing body, is entirely in the hands of the county commission with an opportunity to make any changes necessary at the expiration of each two year term.
>
> The board of trustees after their appointment have the power to take all necessary steps for the extermination of mosquitoes, flies or other insects within the district. It is the duty of the board of trustees to estimate the amount of money needed to carry out the abatement program within the district for the coming year and notify the board of county commissioners, and the auditor, of the required amount. The board of county commissioners shall thereafter levy all taxable property within the district a tav levy sufficient to provide this amount of money. This tax to be collected by the county treasurer along with other tax levies on property within the county. This system permits the board of trustees of the abatement district to carry out the necessary control program as they consider it advisable. There is, however, this important limitation, the tax levy by law cannot exceed one mill."

The Utah law was amended again in 1959. This amendment further broadened the power of the district board of trustees in abating a mosquito nuisance.

Present Status of Mosquito Control Organization: Utah now has nine organized mosquito abatement districts. They are listed below according to year of organization and followed by the name of the present manager:

Salt Lake City. MAD, 1924. Glen C. Collett
Box Elder Co. MAD, 1945. Karl C. Josephson
Magna MAD, 1946. J. Larry Nielsen
Weber Co. MAD, 1947. Lewis E. Fronk
Davis Co. MAD, 1951. Morris Swapp
South Salt Lake MAD, 1952. Jay E. Graham
Elgin MAD, Greenriver, 1953. County Agent or appointed representative

Moab MAD No. 1, 1953. County Agent or ap pointed representative

West Millard Co. MAD, 1961. Howard Johnson

In addition to these districts three other counties have mosquito control operations on a more limited scale. Utah County has appointed Ted Davis as an agent for the Utah County Health Department to conduct mosquito control operations. A mosquito survey of this county has been completed and mosquito control work is expanding. Personnel of the U.S. Public Health Service have conducted a mosquito survey in Cache County and since 1959 the Cache County Commissioners have budgeted funds yearly for limited mosquito control work which is conducted by members of the Noxious Weed Control Department. The organization of a mosquito abatement district in Cache County will probably occur in the near future. Duchesne County also has carried on some mosquito abatement activities.

Despite what appears to be a relatively small number of organized districts Utah's accomplishments are impressive when compared to the rest of the United States. Only five states, California, Florida, Illinois, New Jersey and Virginia have more organized mosquito abatement districts. Over 7,000 square miles of the state of Utah are covered by some type of mosquito control operation and at least 3/5 of the states population, a number in excess of 500,000, are receiving the benefits afforded by the protection.

The Utah Mosquito Abatement Association: The original establishment of the UMAA was almost entirely due to the foresight and efforts of Don M. Rees, presently Chairman of the Division of Biology and head of the Department of Zoology and Entomology. Dr. Rees saw the need for greater organization, coordination and the dissemination of ideas among the mosquito control agencies of the state. He was aware that the establishment of a state association would make it possible to participate in mosquito control activities on a national level and attract outstanding leaders in the field to attend the annual meetings to contribute their knowledge and experience to the mosquito control workers in Utah.

These objectives have proved to be eminently successful. To Dr. Rees belongs great credit for bringing mosquito abatement practices in Utah on a par with any in the nation, and for imbueing students, abatement district workers, supervisors and board members with the need and desire for maintaining that excellence by keeping informed of the most economical and efficient mosquito control practices currently available.

The first meeting of the UMAA was held on Saturday, March 20, 1948, in the Salt Lake City Tribune Auditorium. The first meeting was attended by a small number of local abatement representatives and interested people in public health. Five papers were presented in addition to reports by the MAD districts organized at that time, Box Elder County, Magna, Salt Lake City and Weber County. Don M. Rees was elected the first president by acclamation, a position he held during the first four years of the organization of the UMAA.

The value of the organization became apparent at the second annual meeting, held in Salt Lake City, March 18-19, 1949. At these meetings 23 papers were presented, five of which were given by managers of California mosquito abatement districts. Two of these managers, Harold Gray and G. E. Washburn, also held important administrative offices as a result of their eminence in mosquito control work. Mr. Gray was then president of the American Mosquito Control Association and Mr. Washburn president of the California Mosquito Control Association.

Including the 1962 meetings a total of 15 annual meetings have been held. An indication of the regard in which the UMAA has been held can be noted by the fact that in 1952 and 1959, the Utah Association held joint meetings with the National organization, the AMCA, in Salt Lake City. Don M. Rees served as president of the AMCA at the 1952 meetings.

A list of all meetings held by the UMAA with dates, localities and president is listed below:

1. 1948. Salt Lake City, Salt Lake Tribune Auditorium. March 20. Don M. Rees, President.

2. 1949. Salt Lake City, University of Utah Union Building. March 18-19. Don M. Rees, President.

3. 1950. Ogden, Weber College. February 17-18. Don M. Rees, President.

4. 1951. Salt Lake City, University of Utah Union Building. March 19-20. Don M. Rees, President.

5. 1952. (Joint meeting with AMCA) Salt Lake City, Hotel Utah. March 24-27. O. Whitney Young, President.

6. 1953. Brigham City, High School. February 21. T. A. Schoenfeld, President.

7. 1954. Magna, Fireman's Hall. March 19-20. O. C. Finley, President.

8. 1955. Farmington, County Court House. March 18-19. Howard Widdison, President.

9. 1956. Midvale, City Hall and County Library. March 16-17. De Lore Nichols, President.

10. 1957. Salt Lake City, University of Utah Union Building. March 8-9. Jay E. Graham, President.

11. 1958 Ogden, Utah, Weber College, Moench Building. March 14-15. Lewis T. Nielsen, President.

12. 1959. (Joint meeting with AMCA) Salt Lake City, Hotel Utah. April 12-15. Lewis E. Fronk, President.

13. 1960. Brigham City, Box Elder High School. March 18-10. Karl L. Josephson, President.

14. 1961. Farmington, County Court House. March 17-19. Morris Swapp, President.

15. 1962. Salt Lake City, University of Utah Union Building. March 16-17. Glen C. Collett, President.

Papers and Publications:

During the fifteen year history of the UMAA a total of 364 papers have been presented at the annual meetings. Of this number 158 have been given by specialists from various state and federal agencies outside of the state. These speakers have represented 17 states as well as Canada and the Canal Zone.

The first publication of the UMAA was the mimeographed proceedings of the third annual meeting. The proceedings of the sixth and seventh annual meetings were also mimeographed. The first printed proceeding were those of the eight annual meeting. Since that time, all of the proceedings of UMAA meetings have been published with the exception of the twelfth annual meeting in 1958. The proceedings of the 1958 meetings as well as those of the 1952 meetings, both of which were joint meetings with the AMCA, were published in "Mosquito News," the official journal of the national organization. The proceedings of the papers given at all of these meetings represent more than 300 pages of printed material representing virtually all aspects of mosquito control.

Value of the Association: Most of the values of an association such as the UMAA are obvious, but it would not be amiss to mention these values again, lest we forget the importance of these meetings to the success of good mosquito control in Utah.

The revised Constitution and By-Laws of the Utah Association are printed in the Proceedings of the Eight Annual Meetings of the UMAA (1955). Article II. "Objects" states:

> 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.

The active members of the association are to be congratulated for the successful manner in which these objectives have been achieved. A spirit of cooperation has pervaded all of the meetings of the association, a spirit which remains in evidence throughout the entire year. The cooperation has extended beyond the districts themselves. These meetings have afforded the opportunity for representatives of other water using agencies such as the Utah Fish and Game Department, the State Engineers office and the Waters Users Association to present their side of water management problems. A greater respect and appreciation of mutual problems and greater desire for cooperation has resulted. Many other state agencies have contributed participants to these meetings, the state and city health departments, Brigham Young, Utah State and Utah Universities, Weber College, the Utah Municipal League, and others.

Several mayors and commissioners have spoken to these gatherings.

Federal agencies that have participated in UMAA meetings include the Bureau of Reclamation, the U. S. Department of Agriculture, the U. S. Public Health Service and the U. S. Army, Navy and Air Forces.

The major insecticide producing companies in America have had agents here to present information on the latest developments in chemicals used in insect control.

When the registration roles from the joint meetings in Salt Lake with the AMCA are checked one finds that people from every state in the United

States have been in attendance. These include representatives from the government agencies noted above as well as virtually all the active mosquito control districts and many of the states and federal health organizations in the United States. Mosquito specialists from Canada, Mexico, South America and other countries also have been present.

The accomplishments of the Utah Mosquito Abatement Association and resulting benefits afforded to the people of Utah are truly impressive.

It is hoped that none of us will lose sight of these values in the future.

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A PROPOSED VECTOR CONTROL PROJECT FOR UTAH COUNTY

Ted Davis

Entomologist, City-County Health Department of Utah County, Provo, Utah

The City-County Health Department of Utah County has desired for several years to participate in the vector control demonstration project sponsored by the CDC Branch of the U. S. Public Health Service. Since there is only one such unit in the Western United States, the demand for its services is great.

In November of 1961 a meeting was held in Provo to discuss the needs of Utah County in regard to vector control and other phases of environmental health. Those attending this meeting were Mr. Ralph Barnes, Director of CDC Region VIII, Denver, Colorado; Mr. Paul Meier, Sanitary Engineer of the U. S. Public Health Service, Phoenix Field Station, Phoenix, Arizona; Mr. Ellis R. Shields of the Utah State Department of Health; Dr. C. M. Smith, Sr., Director of the City-County Health Department of Utah County; and this writer. It was suggested by Mr. Barnes, Mr. Meier, and Mr. Shields that the City-County Health Department carry out an independent vector control survey. It was also suggested that this writer be sent to Casa Grande, Arizona, for a two-week training period in vector control survey methods with the CDC demonstration unit located there. Under this program, advisory aid is available to the local health department through CDC upon request of the local and state health departments. This plan was approved by the Utah County Board of Health.

The two-week training period was completed in late January and early February under the direction of Joseph W. Hunt who is in charge of the CDC demonstration unit in Casa Grande, Arizona. Local plans have progressed to the point that survey operations are ready to begin.

The vector control project is planned around the concept that education and citizen participation are the primary essentials in obtaining improvements in environmental health. For this reason, the survey is aimed at the individual city block and the environmental deficiencies are rated on this basis.

The survey is of a reconnaissance type where all possible information is gathered from a slow moving automobile. This requires a driver and surveyor. If the desired information cannot be obtained by driving around the block, it becomes necessary to survey the area on foot.

Several items are listed on a survey form and each is carefully checked. A sketch of each block appears on the survey form and each feature is plotted on the sketch for future evaluation surveys.

Structural conditions of residences, business and public buildings are rated good, fair, poor, or dilapidated. The cost of the building is not considered in this classification. A good house is one that appears to meet health and safety standards. It has adequate lighting, ventilation, is not crowded and has a readily accessible entrance to the street.

A building is considered fair when it shows signs of deterioration and extensive neglect. It is feasible to remodel such a building and restore it to a good classification.

A poor building is one where attempted remodeling would not be feasible. These structures have none or few of the qualifications listed under the good classification.

When a building is rated as dilapidated, it would be advisable from the standpoint of health, safety and aesthetics to demolish it.

Outstructures will be rated in the same manner as the residences and business buildings. These are important because of safety and rate harborage.

Vacant ground will also be included in the survey and its condition will be rated as good, fair or poor.

Most of the survey will be concerned with sanitation deficiencies. These will be in regard to refuse storage, rubble, construction materials, large and small animals, poultry, drainage ditches, street gutters, ornamental pools, fish ponds, or privies. In determining deficiencies, public health standards will be used and not local ordinances.

Refuse storage will be considered on the basis of proper containers with tight-fitting lids. Refuse refers to all solid waste except body waste and includes garbage, tin cans, bottles, paper, and similar materials.

Rubble means any material either wanted or unwanted that is piled instead of stacked. This may include wood piles, certain types of construction materials and heavy yard trimmings.

Most of these deficiencies are considered as providing food and breeding places for flies and rats. The drainage ditches, street gutters, ornamental pools and fish ponds will be recorded as mosquito-breeding habitats.

When the survey data is recorded on the block survey forms, it will then be tabulated and each block will be rated as to its structures, refuse storage, rubble, animals, rats, and mosquito breeding. These ratings will then be transferred to maps. Good structural blocks will be blue, fair will be gray, poor will show yellow and dilapidated or very poor blocks will be red.

Sanitation deficiencies are shown in blue for good, yellow for fair and red for poor.

The sewage and water systems will be shown by different colored tapes representing different pipe sizes.

Once the survey of a city is completed, maps will be prepared and the educational part of this program will be implemented. Recommendations will be made at this time in regard to corrective procedures. A review of pertinent ordinances will be made to determine if revisions or more strict enforcement are required to correct the deficiencies.

The program as outlined here is of a general nature. When the data is compiled, many ramifications are possible. The full potential of this program is not known. Each survey that has been conducted in various parts of the country brings to light different uses of the basic information. However, the end result has been the same in each instance and that is a more healthful environment.

MOSQUITO PROBLEMS OUTSIDE OF ORGANIZED CONTROL DISTRICTS

George F. Knowlton Ph. D.

Extension Entomologist
Utah State University

Mosquito outbreaks are like grass fires, which flare up and cause trouble from time to time. Wherever an efficient mosquito abatement district is organized it is equivalent to an efficient fire department. It attempts not only to put out the trouble, but even more important to prevent its recurrence.

Mosquito outbreaks have occurred in parts of every one of the 29 counties in Utah. Until the Salt Lake City Mosquito Abatement District was organized, all of Utah was outside organized districts. This district set a fine example, so that in time it was joined by the Magna, Weber, Box Elder, Salt Lake County, and Davis County Districts. In Grand County, Moab, and Elgin have recently organized districts, and the West Millard District was organized during 1961. Also Cache and Carbon Counties have seriously considered the need and advisability of setting up abatement districts.

Farms create many of their own problems through water wastage. Seepage from canals and irrigation ditches, and shallow water in grassy areas along streams add to this situation. Over-watering of pastures and grass-haylands is a common source of

mosquitoes in farming and ranching areas. Lack of drainage for wet lands near farms and communities complicates this problem in dozens of Utah areas.

Areas about homes and farm buildings are commonly affected by these same mosquito conditions. Reduced milk and beef production from the herds, difficulty of keeping hired help, and people moving away, reducing income from the tax rolls, are common conditions encountered in areas seriously troubled by mosquitoes.

Serious range mosquito problems are common about Utah. Locomotive Springs and other waters between Penrose and Lucin in Box Elder County have been examples of prolific mosquito breeding areas. Similarly favorable mosquito breeding waters also are present over thousands of acres of Tooele, Millard, Beaver, Rich, Piute, Carbon, Uintah, Duchesne, Cache, Sanpete, Wayne, Grand, Washington, Garfield, Morgan, and other counties. I will never forget the tremendous mosquito populations we sometimes encountered in the canyon and mountains south of Woodruff in Rich County, near Locomotive Springs, along parts of the Duchesne River, and in many other local and larger areas. Serious mosquito infestations interfere with recreation in our canyons, about lakes and on other fishing, camping and boating waters. Golfing is seriously discouraged in the Helper-Price area when mosquitoes are numerous. Similar complaints have been received from other golf courses. Tourist business also is discouraged from some of our canyon, resort and lake areas during the worst of our mosquito breeding seasons.

Problems dealing with pesticide residues and pesticide applications often are complex. Occasional aircraft applications have helped make life livable in the Green River area, the Helper-Price-Wellington area, and at Moab. Malathion, parathion and other phosphate insecticides have been used to avoid leaving DDT, dieldrin, heptachlor, toxaphene, chlordane, or lindane residuse on food and forage crops. Such changes may result in shorter residual intervals, create toxicity problems, etc. It is not easy nor economical to carry out programs so that no objectionable chemicals will reach drinking water, hay crops, or pastures used by livestock. The situation is most objectionable when chemical residues appear in the milk as a result of milk cows consuming hay, pasture forage, or drinking water containing objectionable chlorinated hydrocarbon pesticides. Occasionally bees come into the picture, particularly if an area in blossom is treated with parathion, dieldrin, malathion, or other materials highly poisonous to bees.

Areas not included in mosquito abatement districts get their mosquito control advice from various places. Some of it comes from qualified mosquito control supervisors of organized districts, some of it comes from federal, state or county health departments. Often the county agricultural agent is called in and he in turn calls upon the extension entomologist, and upon other resource people with whom he is acquainted or to whom he is referred. Often one or two "shotgun" efforts at control are the most that can be mustered. Shoestring control programs usually have been disappointing. Such makeshift programs often prejudice people against organizing an M.A.D. Without adequate funds, effective mosquito control rarely is possible, especially on a continuing basis.

Communities outside organized mosquito control districts commonly have more disappointments than successes in attempts to accomplish mosquito control. If problems of financing can be worked out, and if supporters remain as stalwart as the opposition, parts or all of Utah and Cache Counties, and one section of Carbon County soon might organize.

The likelihood that encephalitis may recur is sure to stimulate interest and encourage organization, particularly among the more informed and thoughtful leadership of mosquito infested communities and counties. It is unfortunate that the persons opposed to such a project more consistently turn out at meetings to fight against a program that costs money but means progress, than those desiring and supporting programs such as organized mosquito abatement.

PROGRESS TOWARDS MOSQUITO ABATEMENT IN CACHE COUNTY[1]

Reed S. Roberts

Department of Bacteriology and Public Health
Utah State University

On different occasions during the past several years, small groups of people have met with the members of the Cache County Commission to request a mosquito control program. However, as yet, the Commission has not been presented with a formal petition which would enable it to set up a conventional abatement program. Such a petition would of necessity carry the names of ten per cent of the

1. This paper originally appeared in the April 26, 1962 edition of the Logan Herald Journal and is reprinted here for the information of UMAA members and others who are interested in the progress of mosquito control in Utah.

registered voters who owned property in each of the incorporated areas as well as in the unincorporated area of the county. Likewise, the petition would need to define the boundaries of the proposed mosquito abatement district. In lieu of the petition, the Commission has considered the requests of the various groups and has made some effort to provide mosquito control in those areas of the county where the problem was most acute.

There has been some mosquito control in Cache County during the past four years. In 1959 the Commission set aside $2,550.24 for the purpose of learning more about the mosquito problem in the county and doing some control work. A student-entomologist was hired to survey for mosquitoes and he was provided with a sprayer and some helpers on a part-time basis. The sprayer and the spray crew were borrowed from the noxious weed control program. As mosquito breeding areas were located, they were treated. At the conclusion of the summer season a report was submitted to the Commissioners relative to the work done.

In 1960 and 1961 some mosquito control work was carried out by members of the Noxious Weed Control Department. The programs for the two years were comparable. In 1961, for example, 38 gallons of Hepthachlor and 71 gallons of DDT were mixed with water to make up 64 tanks of spray at 200 gallons of spray per tankful. The costs were estimated as follows: two men and a sprayer for 8.5 hours a day for 21 days at $5.50 per hour, $467.50; and $463.25 for the cost of the insecticide for a total cost of $930.75 for the year.

Most of the spraying for mosquito control in 1960 and 1961 was in the following areas. The borrow pits and sloughs just West and North West of Logan City, the area between Logan City and the Logan-Cache Airport, the area from the airport into Benson, the Cache County Fair Grounds, Willow Park and several low areas around Wellsville. It should be mentioned that in addition to these programs, members of the weed spraying crews frequently sprayed small suspected mosquito breeding areas with insecticide while traveling to and from their regular work areas.

For the year 1962, the County Commission has budgeted $2,000.00 for mosquito control purposes.

The commissioners are well aware of the fact that for a comprehensive mosquito control program, more money would have to be spent. If the people should petition for such a program, it would be given every consideration. In the meantime, the Commissioners are going to go ahead with their plans for a limited control program.

Cache County has a population of approximately 35,788 people with about 18,731 of the total living in Logan City. The assessed valuation of the County is $33,000,000.00. The present mill levy is 56.47 for the County and 81.40 for Logan City. A one mill levy would raise approximately $33,000.00 in revenue.

There is reason to believe that the public will continue to support the Commission in its present efforts to control mosquitoes.

A REPORT FROM THE WEST MILLARD MOSQUITO ABATEMENT DISTRICT

Howard Johnson, Manager

West Millard MAD, Millard County, Utah

The West Millard Mosquito Abatement District consists of mostly farm land with several communities and towns throughout the area. It contains 213 1/2 square miles or 136,640 acres, with many mosquito producing waters both inside and outside the district boundaries. From the Northeast, the Sevier River, which is the main source of irrigation water for the area enters the district. It is a slow running river with many places along its banks capable of producing mosquitoes.

As the river comes into the area it is distributed through large and small canals and ditches to the land where it is to be used. This land is irrigated periodically and this practice leaves many breeding places over the entire area.

The drainage waters accumulated in a network of deep drains and are directed by the gradual slope of the land to the West where the water runs into a large area of ponds and gradually sinks into the ground. These drains at times have been neglected and have become blocked by weeds and trash allowing water to stand for very long periods of time. These drains and ponds are undoubtedly the main source of our mosquito problem.

There also are many livestock watering wells both inside and adjacent to the district that produce many breeding places.

I was asked to be the manager of the West Millard abatement district in May of 1961 by the board of directors.

For several years prior to this time attempts were made by groups of people from the small communities in the area to organize a district. Their efforts were without results in many cases but with each attempt more people became in favor of it.

After the organizing of the district became a reality we were restricted in our activities until we received money from the county taxes in November of 1961. We did, however, set up some light traps and did some spraying in parts of the district prior to this time. The people in the areas where we sprayed reported a big reduction in the number of adults. We also tried to familiarize ourselves with the area and our local problems and a map of the trouble spots was started.

Because of lack of funds our efforts were mostly directed toward planning for the summer of 1962. We hope to get started this year in controlling the mosquitoes of West Millard County. Compared with many districts we are still very limited financially. Our plans for this year include establishing a headquarters from which to work and purchasing a limited amount of equipment.

We would like to express our thanks to those who have helped us, especially Glen Collett and the Salt Lake City Mosquito Abatement District.

PROBLEMS OF MOSQUITO CONTROL IN FROG PONDS IN THE MOSQUITO ABATEMENT DISTRICT, MAGNA, UTAH

Jay H. Linan[1]

Department Zoology & Entomology
University of Utah

To accomplish mosquito control in frog ponds, a mosquito abatement district is faced with three problems: (1) What methods of control are most effective; (2) Obtaining property owner's confidence and consent; (3) What are tht immediate and long-term effects of insecticides on tadpoles and adult frogs?

The Magna MAD district has been faced with these problems for a number of years and has yet to find an entirely satisfactory solution.

1. Former manager of the Magna Mosquito Abatement District.

Frog ponds in the Magna district are all under the same ownership and are located on the same piece of property. Ponds range in size from 25 x 20 ft. to two acres in area. These ponds are generally shallow near the margins but may be 4 feet or more in depth in the central portions. Water comes from uncapped and unregulated flowing wells. However, the flow is not always constant and pond levels fluctuate considerably. Portions of the ponds contain rushes and other emergent aquatic plants. These ponds have been stocked by the owners with the bullfrog, *Rana catesbeiana.* Mosquito fish, *Gambusia affinis* have been introduced by the Magna MAD as a control measure.

These ponds are not well suited to control by aerial spray by fixed-wing aircraft. Their size and irregular shape make this an expensive and wasteful procedure. The tall plant growth prohibits the spray from reaching the water in certain areas. Control by helicopter may prove more feasible.

Pond fluctuations may sometimes provide conditions that produce *Aedes dorsalis* (Meigen). These larvae are generally located around the margins and may be controlled by vehicle mounted spray equipment. *Culex tarsalis* Coq., the principal mosquito species produced in these ponds, sometimes occurs in the central portions of the ponds. To secure control with regular spray equipment is difficult.

It has been difficult to secure the owner's consent to attempt mosquito control in these frog ponds. This reluctance to cooperate fully has often been justified. Often unsightly ruts and tire tracks have been left by vehicles; dikes have been rutted and caved; and oil has killed vegetation and tadpoles. The owners have contended that insecticides, even when properly applied, have resulted in tadpole mortality. This later objection is not easy to overcome. The frog population has not increased as the owners think it should. Low pond levels, predaceous birds such as herons and egrets, disease and other unknown factors undoubtedly account for considerable tadpole loss, but it is difficult to convince the owners that these may be important.

Laboratory tests to test tolerance to insecticides by tadpoles of *Rana catesbeiana* have been initiated. Nothing in the current literature is known to the author which deals with tadpole tolerance to chemicals applied in water. Laboratory tests have been of little value to date. Size of the aquarium, type of substrate, amount of vegetation, water depth, and water flow all affect results. It has not been possible to obtain enough *Rana catesbeiana* to run proper controls and a sufficient number of tests.

A field test, using tadpoles of *Rana pipiens* has produced results that may be of some significance. A pond approximately 200 ft. long, 50 ft. wide, and 3 ft. deep in the center and containing several hundred tadpoles of various sizes was sprayed with parathion. This insecticide was applied at the approximate rate of 0.25 lb. per acre. Regular spray equipment was used during the application. After application of the insecticide, the pond was checked daily for three days. Only one dead tadpole was found.

The mixing of the insecticide, application of it, and the daily checks were performed in the presence of one of the owners of the frog ponds. This procedure did much to convince him that the mosquito abatement activities were not responsible for the lack of increase in the frog population and that the district was genuinely anxious to avoid damage to the tadpoles.

While this procedure helped us gain time, many questions remain to be answered. Are tadpoles of *R. pipiens* and *R. catesbeiana* similar in parathion tolerance? Is there a better insecticide to use? Will DDT accumulate as a residual in the silt on pond bottoms and subsequently produce a tadpole kill? Will insecticide residues be found in frog tissue? These problems are unanswered as yet. Lack of facilities and the limited budget of the Magna MAD have prevented a controlled experimental program that could answer many of these questions. It is hoped that eventually such tests will be possible. Aid also is solicited from other districts that may have encountered this problem.

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FLUCTUATIONS OF ANOPHELES FREEBORNI POPULATIONS IN SALT LAKE COUNTY, UTAH

by

David S. Havertz and Kenneth L. Minson

South Salt Lake Mosquito Abatement District

Anderson (1957) reported that populations of *Anopheles freeborni* Aitken were reduced in Salt Lake County by both mosquito abatement practices and increased pollution of the habitat. For the past four years, 1957-1961, each known pool of water in the South Salt Lake County MAD was inspected once each seven days for mosquito larvae. Data collected during these inspections concerning larval mosquito communities show that the number of pools which produced *A. freeborni* increased from 13 in 1957 to 71 in 1961.

Nielsen and Rees (1961) reported that the preferred habitat of *A. freeborni* is clear fresh water pools exposed to sunlight. Aitken (1945), in reporting on *A. freeborni* in the western United States, stated that the species preferred clear, fresh, seepage water in pools sunlit for a part of the day, but may be found in deep shade. Data gathered during this study seem to indicate that the degree of shading does not appear to be an important factor in limiting populations of this species.

We have found that the fresh water habitat has been altered by water source reduction and by increased pollution. The lack of precipitation during the 1960-61 period also contributed to the reduction of typically suitable larval habitat for *A. freeborni.*

The greatest increase in number of *A. freeborni* producing pools occurred from 1960 (30) to 1961 (71). This period, 1960-61 is of significance, not only because of the increase in number of pools producing *A. freeborni,* but because 1961 was the driest year of this study. Specimens of *A. freeborni* larvae collected during 1961 were found in a wider variety of habitats than in previous years. Such habitats ranged from the margins of deep, shaded trout ponds to shallow (less than 6 inches) warm pools in unshaded pastures.

One clear fresh water pond in Salt Lake County, which had been inspected regularly since 1956 had not produced mosquitoes until 1961. The first mosquito larvae to be collected here were found during the last half of June, 1961. These were second instar larvae of *A. freeborni* and represented the only species of mosquito collected. During the last half of July, 1961, a small section of this pond produced *Culex tarsalis Coq.* as well as *Anopheles freeborni. Culex tarsalis* larvae were present for seven days, after which only larvae of *A. freeborni* were collected.

Anopheles freeborni larvae also were collected from pools which contained varying amounts of observed organic matter. One area from which fourth instar *A. freeborni* were collected was fed by water which ran through a barnyard and contained varying amounts of fecal matter. This particular pool was the most highly polluted of the habitats which produced *A. freeborni* larvae.

Data collected from mosquito larva surveys indicate that *A. freeborni* has increased its range within Salt Lake County since Anderson's report of 1957. From these data it appears that the *A. freeborni* present in the southeast part of Salt Lake County occur in a wider range of ecological situations than previously suspected.

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REPORT OF THE NATIONAL MOSQUITO CONTROL-FISH AND WILDLIFE MANAGEMENT COORDINATION COMMITTEE FOR 1961[1/2]

The National Mosquito Control-Fish and Wildlife Management Coordination Committee has been in existence 2 years. As its name implies, it is a group formed to stimulate and facilitate the coordination of mosquito control and fish and wildlife management programs in the United States wherever there is a need. An account of its activities during 1960 is contained in *Mosquito News* for June 1961. Following is a brief report of its work in 1961.

1. Prepared by Committee members: Paul F. Springer, Secretary; Robert L. Vannote, Chairman; A. W. Lindquist; K. D. Quarterman; E. A. Seaman, and Ira N. Gabrielson.

2. (Included in the Proceedings at the request of the secretary of the committee).

A leaflet entitled "Coordinated Control" was prepared and 50,000 copies were printed. Funds for this purpose were provided by contributions of various conservation and mosquito control organizations. The leaflet describes some of the mutual problems facing mosquito control and wildlife workers, the advantages of coordinated programs in dealing with these problems, and the assistance that the Committee and governmental and private organizations can provide in this regard. Copies of the leaflet have been distributed widely, and an additional supply will be provided without charge to anyone requesting them. The aim of the Committee is to distribute the leaflet to all who are faced with a mosquito control-wildlife problem.

Another publication that became available during the year is the Proceedings of the Symposium on the Coordination of Mosquito Control and Wildlife Management held in Washington, D. C., on April 1-2, 1959. Strictly speaking, this is not a product of the Committee but of the meeting that led to the formation of the Committee. The 154-page proceedings include papers on the fundamentals of mosquito biology and control and of wetland wildlife management as well as papers on chemical and environmental programs in relation to mosquito control and wildlife management. Copies are available from the Morris County Mosquito Extermination Commission, P. O. Box E, Morris Plains, New Jersey, at a cost of $2 each.

During the summer the Committee sponsored a 3-day field tour through Maryland, Delaware, and New Jersey to view water development projects designed to integrate mosquito control and wildlife management objectives. Most of the projects observed were based on the impoundment principle. One of the primary values of the tour was the opportunity it provided for workers in one state to see the new approaches being tested in the neighboring states.

The Committee is presently making a special study to determine the variation that occurs in the recommendations of mosquito control agencies for application rates of various chemicals. This subject is timely because of the increased interest in the pesticide-wildlife problem and the known sensitivity of certain fish, shellfish, and wildlife to chemical poisoning.

Through conferences, field inspections, correspondence, and literature survey the Committee has attempted to keep abreast of the latest pertinent developments in the mosquito control-wildlife field. It has continued to provide information on these and other matters to those requesting it. Where this has not been readily available, it has solicited the information from appropriate sources or has pointed out the need to those in a position to obtain it. The Committee has lent support to efforts to develop well-rounded investigational programs and, in several instances, has been instrumental in helping to develop better coordinated operational field programs.

During the year a questionnaire was prepared on problems needing research and/or demonstration in mosquito control and fish and wildlife management practices. This was sent to state, federal, and private fish and wildlife organizations, and to state and regional mosquito control associations for distribution to member districts and commissons. A total of 108 usable replies was received from some national and regional groups and from organizations in 37 of the 50 states. Fifty-six of the replies were from mosquito control organizations and 52 from fish and wildlife conservation organizations. Replies are still to be received from certain mosquito control districts.

Results of the questionnaire showed that 70 percent of the respondents believed that significant mosquito control-wildlife problems existed, 20 percent said that there were no problems, 7 percent considered the problem to be minor, and 3 percent had no knowledge of the problems. Problems dealing with environmental programs and with chemical applications were considered to be of nearly equal importance, whereas biological and miscellaneous problems ranked third and fourth, respectively.

Most of the problems in environmental programs were associated with impoundments. These problems were of two princpal kinds — construction and water management of wildlife impoundments to reduce the production of mosquitoes, and possible use of impoundments as a mosquito control measure. Related problems included determination of effects of mosquito control impoundments on fish and wildlife and development of substitute methods of mosquito control more favorable to fish and wildlife utilizing large reservoirs. The remaining environmental problems concerned ditching, principally its influence on wildlife and how ditch construction and management could be modified to lessen any detrimental effects on wildlife.

Chemical problems were concerned primarily with the effects of insecticides on fish and wildlife, and the lower animals that they eat or that are commercially important, such as crabs and shrimp. A corollary of this problem was the need for the development of new chemicals, formulations, and methods of application that cause less damage to fish and wildlife.

Biological problems included mosquito control by use of fish and other biological agents and the influence of introduced Gambusia on existing fish populations. The principal miscellaneous problem was the need for basic ecological studies of wetlands and their mosquito-wildlife problems. Also mentioned were a determination of the role that swamp-inhabiting birds play as a reservoir of the encephalitis virus and the importance of transmission of the disease by mosquitoes.

Of the 103 usable problems mentioned, 34 were said not to be the object of either study or demonstration. Individual work by either a fish and wildlife or a mosquito control organization was being done on 34 of the problems and joint work on 19. Three respondents did not know the status of work on the problem mentioned and 13 respondents did not reply to this question.

Results of this questionnare are of value in pointing up research and demonstration problems of greatest importance and will be helpful as a guide for future research and demonstration programs. It is believed that as much as possible such programs should be joint in nature in order to pool resources and to provide the best climate for mutual acceptance of the results. The Committee plans to encourage the further development of coordinated programs by bringing problems mentioned in this survey by mosquito control or fish and wildlife organizations to the attention of potential cooperating organizations in the opposite field.

RESISTANCE OF MOSQUITOES IN UTAH TO DDT

Glen C. Collett[1] and Mervin R. Reid[2]

A study to determine the present status of the susceptibility or resistance of mosquitoes in Utah to DDT was started in September 1961. Data was obtained on the susceptibility of larvae in the form of percentage mortalities to various ppm of DDT for 24 hour exposure. The percentage mortalities were then plotted on logarithmic probability paper in order to obtain the dosage-mortality regression line and the LC_{50}. This method of testing has been standardized on a global basis by the World Health Organization and test kits are available for this purpose and were used in this study.

Since 1948 DDT has been routinely used in the organized mosquito control districts in the state. In addition to DDT other chlorinated hydrocarbon insecticides such as heptachlor, dieldrin, BHC, and others in limited amounts, have been used in various formulations such as dusts, granules, and sprays. More recently, several of the organic phosphorus insecticides have also been used. Changes in the

1. Manager-Entomologist, Salt Lake City Mosquito Abatement District.

2. University of Utah.

choice of insecticides have been influenced by a variety of factors such as: suspected resistance as a result of control failures, costs of material, greater effectiveness in results obtained or ease in handling.

Tests conducted in the fall of this year are to be considered as preliminary in nature because the study was started too late in the year to obtain a sufficient number of tests on larvae of the various species of mosquitoes from both controlled and uncontrolled areas.

The following species of mosquitoes were tested: *Culex pipiens, C. tarsalis, Aedes dorsalis, A. nigromaculis, A. vexans, Culiseta inornata.*

Culex pipiens

Seven series of tests were run on *C. pipiens* larvae which were collected from six areas having a control program and from one uncontrolled area. The LC_{50} results were:

Area previously untreated:
.008 ppm DDT — Provo area.

Areas under control program:

.03 ppm DDT — Cudahy Lane.
.03 ppm DDT — 4800 West 700 South
.05 ppm DDT — 3000 West 500 South
.06 ppm DDT — Cudahy Packing Company
.06 ppm DDT — Cudahy Packing Company
.25 ppm DDT — Bountiful sewer oxidation ponds.

The tests showed a range of resistant mosquitoes from three to thirty times more resistant to DDT than larvae from a non-treated area.

Culex tarsalis

Four series of tests were run on *Culex tarsalis* mosquitoes. The larvae were collected from four different areas, all within mosquito abatement districts. The *C. tarsalis* that were tested had an LC_{50} range as follows:

.003 ppm DDT — in Weber County.
.01 ppm DDT — 1/4 mile east of Saltair, Utah.
.03 ppm DDT — Northeast side of the Kennecott Dike, Magna, Utah.
.10 ppm DDT — The L.D.S. Church stake welfare farm, 48th West and 7th South, Salt Lake City, Utah.

The larvae from the church farm tested thirty-three times more resistant to DDT than the mosquitoes that were tested from Weber County, and ten times and three times more resistant than the mosquitoes that were tested from the Magna Mosquito District.

Culiseta inornata

Three series of tests were run on *Culiseta inornata* larvae from Salt Lake County. The range of the LC_{50} was:

.003 ppm DDT — Harrison Gun Club.
.01 ppm DDT — 1/4 mile east of Saltair.
.03 ppm DDT — Northeast side of Kennecott Copper Co.'s dike, Magna, Utah.

The test results indicate that the *C. inornata* collected along the Kennecott dike in Magna, Utah, were 10 times more resistant than the larvae from the Harrison Gun club.

Aedes dorsalis

Three series of tests were run on *A. dorsalis* larvae which were collected from gun clubs in the Salt Lake City Mosquito Abatement District. The following LC_{50} were obtained from the tests.

.003 ppm DDT for larvae from the Midland Gun Club.
.007 ppm DDT for larvae from the New State Gun Club.
.01 ppm DDT for larvae from the Midland Gun Club.

In comparison with these 1961 results, *A dorsalis* larvae from duck clubs in the same area which were tested during the summers of 1956 and 1957 were found to have LC_{50} of:

.003 ppm DDT in 1956 and
.01 ppm DDT in 1957.

The results of these tests would tend to indicate that *A dorsalis* larvae are susceptible to DDT and that they have not developed any greater tolerance to the insecticide over the last five years.

Aedes nigromaculis

One series of tests were run on *A. nigromaculis* in the Salt Lake City Mosquito Abatement District. The LC_{50} obtained from the tests was:

.003 ppm DDT — Hinckley's pasture, Salt Lake City.

A. vexans

The one series of tests run on *A. vexans* was run on larvae collected near Lehi, Utah, an uncontrolled area in Utah County. The LC_{50} was .002 ppm DDT.

These preliminary findings, supported by the test results on *A. dorsalis* during 1961 as well as in 1956 and 1957 would indicate that the Aedes mosquitoes in this area are quite susceptible to DDT insecticides, while *Culiseta* and *Culex* are showing a marked resistance to chlorinated hydrocarbons in some areas.