PROCEEDINGS

The Thirty-Eighth Annual Meeting of the Utah Mosquito Abatement Association

held at the
Yarrow Hotel and Conference Center
Park City, Utah
September 30-October 1, 1985

edited by
Sammie Dickson

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RESOLUTIONS - 1985

WHEREAS, the Utah Mosquito Abatement Association has held its 38th annual meeting at the Yarrow Holiday Inn, Park City, Utah, Sept. 30-Oct. 1, 1985, and

WHEREAS, Magna Mosquito Abatement District, Evan Lusty, Manager, has served as the host organization, and,

WHEREAS, the local arrangements and program committees have done an excellent job,

THEREFORE, be it resolved that the UMAA extend sincere appreciation to the Magna Mosquito Abatement District, its manager, Board of Directors, and to all others concerned with the success of this convention.

WHEREAS, the papers presented by the speakers have been of excellent quality and highly informative to those who attended, and,

WHEREAS, many of the participants in this conference came considerable distances to take part in the conference,

THEREFORE, be it resolved that the UMAA extend its thanks and appreciation to all speakers and especially to those who came from out of state.

WHEREAS, James Nielsen has served with distinction and devotion to the UMAA as its president for 1984-85,

THEREFORE, let it be resolved that the UMAA extend appreciation for his excellent service to the Association.

WHEREAS, the Yarrow Holiday Inn, Park City, Utah, has provided nice facilities and excellent food and services, and,

WHEREAS, the banquet was of outstanding quality,

THEREFORE, let it be resolved that the UMAA express appreciation to the Yarrow Holiday Inn for contributing to the success of the 1985 meetings.

WHEREAS, the contributing members have provided financial support and information about their products as well as displays,

THEREFORE, let it be resolved that the UMAA extend its appreciation to those organizations for their support and services they have provided to further mosquito control throughout the State.

RESOLUTIONS COMMITTEE
Dallas C. Nelson, Chairman

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ETHICS, RESPONSIBILITIES AND OBLIGATIONS OF TRUSTEES

REED S. ROBERTS
Professor of Entomology, Emeritus,
Department of Biology
Utah State University, Logan, Utah

In Utah, we are very fortunate in having a long history of well organized, efficiently operated, mosquito control programs. We are also encouraged by the establishment of several new programs during the past decade.

Much of this success is due to the fact that Utah has a well written mosquito abatement law which allows for the organization, incorporation and management of mosquito abatement districts. One of the key provisions of the law is the appointment and establishment of a board of trustees for each district. This provision in the law, has proven to be very wise. It not only allows for broad political representation for the programs, it also provides an excellent base for maintaining good public relations between the taxpayers and the district employees. Thus, any meaningful discussion regarding the ethics, responsibilities and obligations of a board of trustees, needs to begin with a brief review of the Utah law as it pertains to such boards. We would hope that every Utah citizen, especially the elected officials, would be aware of the many safeguards provided to the taxpayers by having this provision in the law.

Board of Trustees - Appointment - Number - Term

(1) Within 30 days after the filing with the lieutenant governor of the certificate of incorporation, a board of trustees shall be appointed for the mosquito abatement district. The board shall consist of one trustee appointed from the district at large by the board of county commissioners, and of one trustee appointed from each municipality therein by the governing body of such municipality; provided, that if the board of trustees consists of less than five members, the board of county commissioners shall appoint from such district at large enough additional members to make a board of five trustees, provided further, that if 75% or more of the lands in the district are wholly within the boundaries of a municipality, all five members of the board of trustees shall be appointed by the governing board of such municipality. The governing board of such district shall be known as "The board of trustees of _____ mosquito abatement district."

(2) Each trustee appointed by the governing body of a municipality shall be a registered voter of the municipality and each appointee of the board of county commissioners shall be an elector of the district.

(3) All trustees shall hold office for a term of two years from the second day of January following their appointment; provided that the first board of trustees appointed shall at their first meeting classify themselves by lot so that one-half of their number, if the total membership is an even number, and if uneven, that a bare majority of their number, shall go out of office at the expiration of one year and the remainder, at the expiration of two years from the second day of January followinng their appointment.

Board of Trustees - Organization Meetings - Vacancies - Quorum

(1) The members of the board of trustees shall meet on the first Monday subsequent to 30 days after the filing with the lieutenant governor of the certifciate of corporation, and shall organized by electing one of their members as president and one as secretary. The members of the board shall serve without compensation, except that the necessary expenses of each member for actual traveling expenses for meetings or business connected with the board, shall be allowed and paid.

(2) In the event of the resignation, death, or disability of any trustee his successor shall be appointed by the board of county commissioners or governing body which originally appointed the member who resigned, died, or is disabled.

(3) The board of trustees shall provide for the time, place, and manner of calling its regular meetings, and shall establish rules for its proceedings. Special meetings may be called by three trustees, and notice thereof shall be given to each member at least three hours before the meeting. All meetings shall be open to the public, and the majority of the members of the board shall constitute a quorum for the transaction of business.

Powers of the Board of Trustees

The board of trustees may:

(1) Take all necessary and proper steps for the extermination of mosquitoes, flies, crickets, grasshoppers, and other insects within the district and to abate as nuisances, all stagnant pools of water and other breeding places for mosquitoes, flies, crickets, grasshoppers, or other insects anywhere in the state situated so that mosquitoes therefrom may migrate into the district;

(2) Enter upon territory referred to in subsection (1) to inspect and examine the same, and remove therefrom without notice, stagnant water or breeding places for mosquitoes, flies, crickets, grasshoppers, or other insects.

(3) Purchase such supplies and materials and employ labor necessary for proper furtherance of this chapter, and if necessary or proper, build, construct, repair, and maintain necessary levees, cuts, canals, or channels upon any land within the district, and acquire by purchase, condemnation, or other lawful means in the name of the district any necessary lands, right of way, easements, property, or materials requisite or necessary for any of such purposes; and

(4) Make contracts to indemnify or compensate any owner of land or other property for any injury or damage necessarily caused by the exercise of its powers arising out of the use, taking, or damage of property for any such purposes and generally to do any and all things necessary or incident to its powers and to carry out the purposes of this chapter.

Taxation - Limit of Levy

The following is to be effective January 1, 1986.

The board of trustees of each mosquito abatement district

shall;

(1) Furnish to the board of county commissioners and to the county auditor of the county in which the district is situated, in writing, an estimate of the amount of money necessary for all purposes required under this chapter during the next ensuing fiscal year. Such estimate shall be furnished at least 15 days before the first day of the month in which the board of county commissioners is required by law to levy the taxes required for county purposes.

(2) The board of county commissioners shall thereafter, at the time and in the manner of levying other county or city and county taxes, but without additional compensation for assessing and collecting, levy upon all the taxable property within the district and cause to be collected a tax, to be known as the "_____ mosquito abatement district tax." The maximum rate of the tax shall not exceed that which is sufficient to raise the amount estimated to be necessary by the board of trustees. and shall not exceed .0004 of taxable property in the district.

Taxation - Additional Levy - Election

(1) When it appears to the board of trustees that the funds required during the next ensuing fiscal year will exceed the maximum amount which the county commissioners are authorized to levy for the annual district tax, the board of trustees may call an election and submit to the electors of the district the question of whether a tax shall be voted for raising the necessary additional funds.

(2) Notice of the election, therefore, shall be published for at least four weeks prior to the election in a newspaper published in the district.

(3) No particular form of ballot shall be required, and no informalities in conducting the election shall invalidate the same, if the election is otherwise fairly conducted.

(4) At the election the ballots shall contain the words, "Shall the district vote a tax to raise the additional sum of $————"

(5) The board of trustees shall canvass the votes cast at the election, and if a majority of the votes cast are in favor of the imposition of the tax, the board of trustees shall report the same to the board of county commissioners, stating the additional amount of money required to be raised.

(6) The board of county commissioners shall at the time of levying general county taxes levy an additional tax upon all of the taxable property in the district voting such additional tax.

Collection and disbursement of taxes

All taxes levied under this chapter shall be computed and entered on the assessment roll, and collected at the same time and in the same manner as state and county taxes, and when collected shall be paid into the county treasury for the use of the district. The funds shall be withdrawn upon the warrant of the board of trustees of the mosquito abatement district, signed by the president, or acting president of the board and countersigned by its secretary.

Annexation of area into mosquito abatement district
Conditions - Procedures - Petition
Resolutions - Protests

(1) Any board of county commissioners, upon its own motion, may by resolution, declare that the public health, convenience, and necessity requires the annexation of an area into a mosquito abatement district if either:

a. there is presented to the board of county commissioners a petition setting forth the area and boundaries proposed to be annexed to the district, signed by (i) the legislative body of any city or town included or partially included within the area, or (ii) by 25% or more of the owners of real property included within the proposed area, or (iii) 10% of the registered voters of the area; or

b. the annexing district is already providing district services for the proposed area, then it is the duty of the board of county commissioners to adopt the resolution.

(2) After the resolution has been adopted, the board shall give notice of its intention to Annex the area to be specified mosquito abatement district. The notice shall define the area and the boundaries to be annexed and shall describe the services to be provided. The notice shall be published in a newspaper of general circulation for three successive weeks, and shall designate a time and place not more than 50 days nor less than 21 days after the first publication, where all interested parties may be heard in support or in opposition to the annexation. If a written protest signed by more than 25% in number of the real property owners according to the last assessment roll within the area proposed for annexation or by more than 30% of the registered voters in the area is filed with the county clerk within 30 days after the conclusion of the hearing, then the annexation shall not be completed. Upon completion, however, the county clerk shall notify the board of trustees of the district; together with any other notifications to the lieutenant governor and State Tax Commission required by law.

Dissolution - Election - Apportionment of property

(1) A mosquito abatement district may at any time be dissolved upon the votes of two-thirds of the qualified electors thereof, upon an election called by its board of trustees upon the question of dissolution.

(2) The proposition which shall be submitted to the electors shall be "Shall the ———— (naming district) mosquito abatement district be dissolved?"

(3) Notice of the election shall be published for at least four weeks prior thereto in a newspaper published in the district.

(4) If two-thirds of the votes cast at the election are in favor of dissolution, the board of trustees shall certify that fact to the lieutenant governor, who shall issue a certificate reciting that the mosquito abatement district has been dissolved.

(5) A copy of the certificate shall be transmitted to and filed with the county clerk of the county in which the mosquito abatement district is located.

(6) From the date of the certificate, the district shall be deemed disincorporated, and the property of the district shall vest in the county in which the district is located if the district comprises unincorporated and partly unincorporated territory, its property shall be ratably apportioned among the municipalities and the county in proportion to the assessed value of the property included within the district as shown upon the last

county assessment roll. However, the real property, easements or rights of way belonging to the district shall remain the property of the municipality wherein they are located; otherwise, they shall remain the property of the county.

Notices - Publication and Posting

Every notice required by this chapter to be published may be published in a daily or weekly newspaper. If there is no such newspaper published within the district or other territory wherein the notice is required to be published, the notice shall be posted in three public places therein for the length of time required for publication.

Ethics

We will now depart from our discussion concerning the law, and briefly consider the matter of ethics.

One dictionary defines ethic(s) as follows: (1) the discipline of dealing with what is good and bad, and with moral duty and obligation, (2) a set of moral principles and values, (3) a system of moral values, and (4) the principles of conduct governing an individual or a group.

Following are a few suggested statements dealing with ethics as they might apply to a board of trustees. The basis for these was derived from the Code of Ethics for Registered Professional Entomologists.

Obligations to Society -

1.1 Trustees will use their knowledge and experience for the betterment of human welfare.

1.2 Trustees will share in sustaining the laws, institutions, and burdens of the community.

Obligations to the public -

2.1 Trustees will have proper regard for the safety, health and welfare of the public in general and the district employees.

2.2 Trustees will be honest and impartial and will preface any one-sided statements, criticisms, or arguments by clearly indicating on whose behalf they are made.

2.3 Trustees will express an opinion on mosquito control matters only when it is founded on adequate knowledge and honest conviction, and will be factual in all estimates, reports and testimonies.

Obligations to employees and clients -

3.1 Trustees will act as faithful agents for the districts they represent, and will not engage in illegal work or cooperate with any person so engaged.

3.2 Trustees will indicate, if appropriate, to the district manager, alternatives to recommend courses of action and expected consequences of each recommended action and alternative.

3.3 Trustees will act fairly and justly toward vendors and contractors, selecting their products and services on the basis of merit and value.

Obligations

If ethics form the moral function for operating, then it might be said that responsibilities and obligations form the basis for a method of operating. Following are eight items related to the obligations of the trustees and administrative officers. Credit for this list goes to Mr. Jay Graham, Manager of the South Salt Lake Mosquito Abatement District.

Obligations of the members of the governing boards and administrative officers:

1. To be come cognizant of the nature, complexity, benefits and possible hazards of mosquito control operations.
2. To employ competent, properly trained professional personnel.
3. To require that professional personnel keep abreast of developing technology and provide the resources for them to do so.
4. To support and contribute their time and efforts to professional organizations that facilitate the exchange of information and promotes the welfare of mosquito control.
5. The governing board should delegate to the executive officer of their program adequate authority to organize and direct operations.
6. To evaluate the performance of the professional staff, require high levels of performance, and require necessary improvements or dismissals.
7. To provide funds through available sources, properly manage these monies and report to higher authorities and the general public on the use of these funds and the results obtained.
8. To cooperate with research organizations such as universities or government agencies and exchange data to promote the development of mosquito control technology.

Conclusions

The Utah mosquito abatement law provides for a board of trustees. It also establishes guidelines as to how such boards should function. Having a board of trustees for each mosquito abatement district has been a good thing. It has helped Utah receive national recognition for the professionalism of its personnel and for the quality of its programs. We all need to be aware of the many services the trustees provide.

The continued success of our programs may well depend, to a large extent, on how well our trustees continue to meet their responsibilties.

BASIC MOSQUITO CONTROL

J. LAWRENCE NIELSEN, Manager
Box Elder County Mosquito Abatement District
Brigham City, Utah

Mosquito control involves:

1. Public Education, Public Relations	Letting the public know.
2. Source Reduction	Eliminating or reducing mosquito-producing areas through drainage and/or good water management practices.

3. Biological Control	Planting fish or other predators into mosquito-producing areas. This is an effective and clean way to control mosquitoes in some areas.
4. Larviciding	Spraying or granulating mosquito larvae by ground or air applications, before they become flying, biting pests.
5. Adulticiding	Ultra-low volume appilcation of chemicals to suppress adult mosquito activity. Again, by ground or air application.
6. Research	Of vital importance to a progressive mosquito control program. Some MAD's have active research programs, others rely on university studies for information. The results can be most helpful in the battle against the mosquito.

Why mosquito control? The benefits of this service can be explained by enlarging on some of the above points.

Geographically, northern Utah is ideal for high mosquito production. There are many thousands of acres of wetlands and irrigated pastures, 150,000 acres in Box Elder County alone. Swamps and waterfowl areas are present. Most of these places are potentials for the enormous production of mosquitoes. And almost everyone can be affected by mosquitoes at one time or another.

Public health is the major reason for mosquito control. People are driven into their homes to escape the pest. Recreation areas suffer great financial losses when people leave because of the nuisance. Several diseases can be transmitted to man and animal by the mosquito in Utah. Encephalitis is the most critical, as a serious threat to man and animal. The potential is always present during the warm summer months. Outbreaks can occur anywhere, but the chances are greatly reduced with organized mosquito control operations. If there are indications of Encephalitis, emergency procedures are available to intensify the mosquito abatement activity. Most MAD's in Utah maintain one or two sentinel chicken flocks each year. Blood samples are taken from the birds every two weeks throughout the summer, for testing by the State Department of Health, to provide a warning of a possible Encephalitis outbreak.

Mosquitoes are also a problem for animals. Cattle and horses have been known to stampede when hit with a swarm of mosquitoes. Livestock lose weight. Cows give less milk when bothered by the mosquito.

Mosquito populations can become a nuisance, for short periods of time, when migrations occur in a populated area. These migrations can move into an area overnight. When this does occur, the MAD's work at night or early morning with ULV equipment, and generally suppress the annoyance within a few days.

All MAD's in the state carry out source reduction programs. If they do not own the appropriate equipment, the work is done by using hired equipment, or by contractors.

In Box Elder County, we have constructed over 100 miles of drains to eliminate thousands of acres of potential mosquito-breeding grounds, thus enabling the landowner to better utilize his property. All this work is done with the approval of the Army Corps of Engineers. We are grateful for their cooperation.

Public relations is the way we tell people about our work. The best form of mosquito control is the spreading of information about how NOT to raise mosquitoes. The greatest public relations we can have is the involvement of people who, thereafter, understand. When they see you and grasp the meaning of mosquito problems, I feel that the work of the inspector in the field is one of the most important parts of any mosquito abatement district's public relations.

Box Elder County's policy is:

1. Personal contact with the public when justified complaints are received by the Manager, his assistant, or the field operator.
2. The Manager should be available to speak to school audiences, civic and other organizations concerning mosquito problems and related subjects. A complete set of excellent slides is available for viewing by any age group. I do approximately 45 public presentations per year. I wish more groups would request this type of presentation. It is great for public relations.
3. ULV misting, by ground or air equipment, in populated nuisance areas. This service is generally carried out between 10 p.m. and 6 a.m., and many people do not even realize that we're working in the area. It is a most effective and safe way for reducing mosquitoes, both in rural and urban areas.
4. Free mosquito fish for planting in ponds and other mosquito breeding waters.
5. Newspaper and radio coverage of problems or accomplishments made by the District.
6. Instructing field operators to respect property owners' lands, fences, livestock, etc.
7. Keep the Board of Trustees well informed by written monthly reports so that they, in turn, can keep the people in their areas informed concerning the District's activities.
8. Genearl Board of Trustees members should attend all scheduled meetings, or send others to represent them, so that they are actively supporting the program, and know what is going on.
9. The Manager, or his assistant, will meet with people who live in high mosquito nuisance areas, explaining the program and working out mosquito related problems.
10. Projecting the proper image by hiring operators who are well trained, polite, and able to deal with the public. They represent management in the field.
11. Keep equipment in good condition and maintain a fleet of modern, well marked vehicles.
12. Invite people to inspect the District office and shop. Hold an open house!
13. All monthly Board meetings are open to the public.
14. Keep in contact with all other public and private agencies with operations located within your district.

In some parts of northern Utah, mosquito populations would be tremendous throughout most of the summer if no control program had been set up. The area would be a most difficult place in which to live without an organized mosquito control program. There are a few people who are opposed to our

programs. Some do not think the program is necessary, others think their tax monies should be spent elsewhere. These critics are certainly misinformed, and are completely uneducated about the benefits of a mosquito control program. This is unfortuante because it does make our job difficult. Mosquito control is necessary for the comfort and health of the general public. We are in operation to serve the public, reduce the chances of disease, and increase the time people can spend outdoors, enjoying summer fun without the bothersome mosquitoes. We all want to increase the number of mosquito-free days in Utah.

Why mosquito control? I've only touched on a few of the ways in which the tax dollars we spend on mosquito control is money well spent.

REPORT OF CALIFORNIA MOSQUITO CONTROL

WILLIAM C. HAZELEUR, President
California Mosquito and Vector Control Association;
Manager, Shasta Mosquito Abatement District
Redding, CA 95815

As president of the California Mosquito and Vector Control Association, I appreciate the opportunity to be here representing mosquito and vector control districts of California.

The California Mosquito and Vector Control Association is comprised of members from throughout the State. Most agencies concentrate exclusively on mosquito control. However, as our Association's name implies, some agencies also control other vectors, namely flies, gnats and rodents.

The size of agencies varies from a one-man district to an agency of fifty or more employees. Likewise, mosquito problems vary throughout the State. In Southern California, problems are predominantly metropolitan in nature. The irrigated desert in the southeast portion of the State has tremendous mosquito production; and when the Colorado River floods as it did in 1984, the problem is compounded. As one moves north of Los Angeles and over the Tehachapis, you enter the San Joaquin Valley which is agricultural in nature with pastures, row crops and some rice. Northwesterly in the Sacramento Valley rice predominates. Farther north, approximately 150 miles south of the Oregon border, where I am located, we have a variety of sources including irrigated pastures, river seepage and, just to the northeast in the Fall River Valley, the introduction of wild rice is providing a new source of *Culex* and *Anopheline* mosquitoes; and of course the coastal area has salt marsh problems. However, the situation in California is not as simple as I have made it sound. The mosquito-producing areas in California differ tremendously from intense urban and industrial sources to high mountain meadows and black-legged *Aedes.*

The methods and means of mosquito control used in California are also diversified within areas. When chemical control is used, larviciding is the predomdinate tool. Adulticiding is performed by aircraft in some areas, while in other areas ground aerosoling machines are used. A variety of biological and physical control techniques are also employed.

When State Proposition 13 was passed by the voters in June of 1978, funding of mosquito control agencies was substantially reduced. Since that time, California mosquito control agencies have placed more responsibility on the landowner to correct mosquito problems and/or pay for the costs of control.

More recently, in 1984 there were 26 confirmed human cases of St. Louis encephalitis in southern California; 16 cases in Los Angeles County with one fatality, five cases in Orange County, four cases in Riverside County, and one case in San Diego. In 1985 as of September 20, there have been three human cases; one in Los Angeles, one in Riverside and one in San Bernardino. These cases have occurred in urban-type areas. In California we would normally expect the cases in more rural, agricultural-type areas of higher endemicity.

Sentinel chicken flocks are being used throughout California to monitor the transmission of the encephalitis virus. The chickens are bled and tested monthly for SLE and WEE antibodies. As of September 13, 1985, 4,427 chicken bloods have been tested; 57 positive for SLE, 20 positive for WEE. In addition mosquitoes are tested for virus. As of September 13, 1985, there were 3,588 pools tested; 28 positive for WEE, 27 positive for SLE.

I realize this is a very simplified overview of California mosquito control. Much more in depth information will be provided at our next annual conference which will be held in Redding, California, March 16-19, 1986. On behalf of the California Association, I would like to extend an invitation to each and every one of you to attend.

PALISADES RESERVOIR - PROBLEM - CONTROL

EVERETT W. SPACKMAN
Extension Entomologist
University of Wyoming
Laramie, Wyoming

About five years ago some of the residents of Alpine, Wyoming contacted the Wyoming Agriculture Extension Service for help in developing a mosquito control program. Two representatives of the community attended our commercial pesticide applicator training for certification. I presented information of mosquito control at a public meeting in Alpine. With this information the community decided to plan to do mosquito control in the vicinity of Alpine. Alpine is not an incorporated town. There are approximately 300 people living in the town. After the public meeting, I had no further requests or contacts with them until 1984 when I received a call from the U.S. Senators' offices of Wyoming and Idaho asking what I knew about the mosquito problem in the vicinity of the Palisades Reservoir. I had little information on the actual areas in the vicinity producing mosquitoes since my trip into the area during the month of May found only a few larval mosquitoes in some pools in the U.S. Forest. At this time the reservoir was very low leaving some pools. No larvae were found. At this time I could only guess that if these pools remained as they were, they could possibly produce larvae later.

According to information received from residents of Alpine, they received a verbal directive not to do any more mosquito control on Federal lands. With this comment some

of the citizens of Alpine decided that if they could not carry on a mosquito control program with the volunteer help and monies, then it was time to see what could be done to require the Federal agencies to take care of their pesky mosquitoes. This started the letters in April 1984 to Senators, Congressman, and the EPA from citizens of Alpine. After a few months of exchanging letters, there was a slight promise that the Bureau of Reclamation and the U.S. Forest Service would be willing to sit down and discuss the situation.

Representatives of the Bureau of Reclamation, U.S. Forest Service, Alpine citizens, Extension Entomologist, University of Wyoming, and the Supervisor of the Lincoln County Weed & Pest Control District discussed and cussed the problem and then came up with a possible solution. It was proposed and agreed to that Lincoln County Weed & Pest Control District be the neutral party in which the Federal government and private landowners would funnel the necessary funds to support the mosquito study and control for 1985. The Lincoln County Weed & Pest Control District hired a retired person to do the mosquito surveillance and to do some application of mosquito insecticides.

The following mosquitoes were controlled:

Aedes vexans	*Ae. implicatus*
Ae. melanimon	*Ae. mercurator*
Ae. dorsalis	*Ae. pullatus*
Ae. campestris	*Ae. s. spencerii*
Ae. s. idahoensis	*Culiseta inornata*

Along in mid-June the surveyor found the big problem for 1985. Large numbers of larvae were found along the reservoir shoreline where there was driftwood and where the water was high enough to flood over into a greasy area near Old alpine. *Bacillus thuringiensis israelensis* (Bactimos R) granules were used to treat the water where the larvae were found.

This was a successful program where there was an advisory committee consisting of a member of the Alpine Recreation and Development Association, U.S. Forest Service, Bureau of Reclamation, Mosquito Surveyor and Supervisor, and the Lincoln County Weed & Pest Control District. This committee has met each month during the summer season. The program of 1985 will be discussed and evaluated to determine what might be planned for the future.

MOSQUITO LARVICIDING WITH A FOUR-WHEEL ATV

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Several mosquito control programs in the State of Utah have been using three- and four-wheeled All Terrain Vehicles to aid with their work in the field. The Uintah County Mosquito Abatement District recently mounted, calibrated, and adapted two Herd Model GT-77 Sure Feed Broadcasters onto the front of their two Kawasaki 185 four-wheel ATVs to assist with their granulating efforts. The following narrative includes some of the types of four-wheelers available, the uses of four-wheel ATV's in the field of mosquito control, how the Uintah County MAD has adapted the four-wheeler for granulating and a final note on safety.

There are many types of four-wheel ATVs on the market today. Mentioned here are just a few of the more popular brands. All the vehicles mentioned within have four-stroke engines, five forward gears and one reverse with automatic clutches unless otherwise stated.

Suzuki offers three models that would be suitable for use in mosquito control. The LT185 which has chain drive and recoil start as compared to the LT230GE and the LT250EF which offer electric start and shaft drive. Suzuki also offers a line of quadrunners used more for racing, sand dunes, and entertainment. These vehicles have yet to prove themselves for field use.

Kawasaki offers the KLF185 Bayou and the larger KLF300 models. Both units have shaft drive and electric start.

Yamaha sells what they call the Moto 4 which has approximately 225cc's of engine displacement. It also has electric start and shaft drive. The Moto 4 comes equipped with a high and low range transmission and a speedometer, two features which could prove to be very valuable when adapting the ATV to practical field use.

Honda has three models available at this time. The Fourtrax 125 with electric start and chain drive, the Fourtrax 250 with electric start and shaft drive, and their newly released Fourtrax 4x4. The latter is the only full time four-wheel drive available from the major manufacturers at this time. The Fourtrax 4x4 has electric start, shaft drive for both front and rear wheels and a super low range first gear. With a 350cc engine coupled with its four wheel drive ability, this machine may prove to have some definite advantages over other ATVs when it comes to adapting its use in the field of mosquito control.

There are other manufacturers of four-wheel ATVs and most dealers carry, or can get, a complete line of accessories for the vehicles they sell. For instance, one can get snowplows and snow removal equipment designed for a particular ATV that would make the machines useful during winter months. The prices of the ATVs mentioned range from $1200 to $3500 depending on model, dealer, and accessories.

These four-wheel ATVs are very versatile and valuable because of their ability to save time and take a field operator to places that a four-wheel drive truck, jeep, or person on foot cannot easily go. New areas may be discovered and otherwise inaccessible areas can be explored and inspected more carefully, and thereby achieve a higher, more cost effective control for that area. The four-wheel ATV's may not be practical for all mosquito to control programs, but for areas that are extensive, hard to get to and need something to facilitate overall cost effective control, the four-wheel ATV may be the answer.

Besides being an excellent inspection vehicle, the racks on both the front and rear permit one to carry many pounds of pesticides and equipment to areas that are otherwise inaccessible. Even the smaller units such as the Suzuki LT185 and the Kawasaki KLF185 are capable of carrying 50 to 100 pounds on both the front and rear racks. And the larger four-wheelers are capable of carrying even greater loads.

The uses of the ATVs may extend beyond the realm of mosquito control. Their uses may very well find their way into abatement procedures involving other target organisms, including flies, grasshoppers, and rodents.

Most of the ATVs mentioned require very little maintenance and are very economical to operate. Their reliability results in very little "down" time, if any, through the control season. Because of their ease to operate, most anyone can learn safe operation in just a matter of minutes and with practice can become a skilled, safe driver. The large units are better suited for larger employees and greater loads. The smaller units have the advantage of being easier to negotiate out of tight areas and bad situations if one does happen to get stuck.

Most of the ATVs are designed to fit comfortably in the bed of a standard-sized pickup truck for transporting. Lightweight portable ramps are available to make loading and unloading simple. If one prefers, or is not equipped to haul the ATV, small trailers designed to transport ATVs are available. The ATV is then secured to truck or trailer with the use of adjustable straps made for that purpose.

The Uintah County MAD has mounted and calibrated a Herd Model GT-77 Sure Feed Broadcaster onto the front for broadcasting Dursban, Baytex, BTI and other types of granules. These spreaders are designed to mount on the rear of three- and four-wheeled ATVs to spread fertilizers or seeds in agricultural applications, but we have found for our purposes that adapting the spreader to mount onto the front results in easier operation and provides a greater coverage of larvicides with better results. A local welder designed and built a specially reinforced mounting bracket for front mounting of the spreader.

The spreader will hold 50 pounds of granular material in the hopper. It has a 12-volt motor which is powered by the standard ATV battery. The motor spins a blade that broadcasts the granules and also operates an agitator inside the hopper to break up lumpy granules and maintain an even flow. The granules are fed through holes in the bottom of the hopper onto a spinning blade which dispenses them onto the source. The size of the holes is determined by a gate which is controlled by the operator. The total swath width of this spreader is 45 to 50 feet using a B size granule. By setting the ATV to travel at a designated speed one can get the rate of dispersal, travel over a given area, and thereby calibrate the spreader to the desired number of pounds per acre by adjusting that rate of dispersal.

Another reason for mounting the spreader onto the front is that one can approach the edge of a pond or source, momentarily turn on the spreader and back out again using the reverse gear and in this way treat a source that cannot be driven through.

The front-mounted spreader has saved us many hours of backbreaking work. Areas that used to require several employees to treat by hand can be done in an hour or so with the ATV and spreader. Twenty acres used to take many man-hours but can now be treated in a short period of time. Since the Uintah County MAD began using the ATV and spreader, we have saved time, labor, and become more cost effective. Our overall program has achieved a higher degree of control, and we have spent far less time adulticiding and far fewer airplane dollars as a result. Another side benefit is that we have saved wear and tear on our abatement trucks because we can use the ATVs instead of the trucks to get in and out of tough areas. This has further resulted in great fuel economy.

These machines can be very valuable tools if used properly but can result in serious injury or worse. Three-wheeled ATVs are not as stable as the four-wheelers because they roll over more easily and therefore are not recommended for use in control programs. The four-wheeled ATVs, although more stable, are not exempt from danger. It is recommended that the user wear a helmet and goggles or shield and other protective clothing such as boots and gloves, especially when using a spreader or dispersing apparatus. A respirator is also recommended.

In summary, there are many types of four-wheelers on the market to choose from. These machines can save many man-hours and taxpayer dollars if they are used correctly. The need, terrain, and expense will, in a large part, determine the purchase of a four-wheeled ATV for a pest control program. The front-mounted granular spreader makes the ATV more valuable by offering the capacity to treat large areas in a short period of time.

DERMAL VERSUS RESPIRATORY EXPOSURE OF PESTICIDE APPLICATORS

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Pesticide applicator exposure has been occurring since pesticides first came into use. Pictures of applicators taken more than fifty years ago show little regard for protection from the pesticide being applied. Similar pictures can be taken of many of today's pesticide applicators.

When mixing, loading, or applying pesticides, applicators can be affected by oral, dermal, or respiratory exposure. Oral exposure occurs when the mouth is open and pesticide enters the mouth and is swallowed. Spray droplets, mists, splashes, and ruptured hoses are examples of how this can happen. Generally under normal operating conditions this is considered the least likely route of exposure. Many pesticide applicators, myself included, thought that our greatest exposure hazard was from respiratory exposure. Recently, several research projects have shown that dermal exposure to pesticides may be of more significance than respiratory exposure.

Table 1 reports results that indicate that the dermal dose is many times greater than the respiratory dose. In fact, in most cases, the dermal dose is several hundred times larger than the respiratory dose. The only real exception to this is when 2,4-D was applied by handgun.

The dermal exposure is much greater than the respiratory, but the dermally deposited pesticide is outside of the body while the respiratory dose is inside of the body. An applicator

is partially protected from dermal dose by his skin acting as a barrier against penetration of the pesticide into the body. How much of the dermal dose is absorbed into the body? Table 2 reports results that indicate that anywhere from 1% up to 100% of the dermally applied pesticide can be absorbed into the body, but on the average about 10% of the dermal dose is absorbed. If only 10% of the dermal values in Table 1 are absorbed then the dermal dose remains many times greater than the respiratory dose.

Table 3 reports results that indicate that pesticides are absorbed at different rates for various body areas. Note that upper arm, neck and head areas are quite absorptive. Also note that the scrotal area is highly absorptive. The palm of the hand is only about 12% absorptive and because of this it can transfer considerable amounts of pesticide to other more highly absorptive areas. Good personal hygiene in using restroom facilities and in touching the head and neck area are needed.

Also note that parathion is absorbed at a rate about twice that for malathion in most body areas. Parathion and malathion are organophosphate insecticides. Carbaryl is a carbamate insecticide. Note that a much higher percent of carbaryl was absorbed than either of the organophosphates.

At the April 1984 meeting of the Division of Pesticide Chemistry of the American Chemical Society, Dr. Howard Maibach, who did the research in Table 3, discussed the dermal absorption of pesticides. He stated that the scrotal, jaw, forehead and scalp areas of the body absorb pesticides most rapidly. Damaged skin absorbs 4-10 times faster than normal skin. Occluded or covered skin also absorbed more rapidly. For malathion bare skin absorbed 9% of the applied dose after 1 hour while covered skin absorbed 12.6%. After 24 hours, covered skin absorbed 62% of the applied malathion. Washing the skin 15 minutes after application reduced absorption for parathion from 8.6% to 5%, but washing skin 8 hours after application actually increased absorption to 15%.

Utilization of protective clothing such as gloves, boots, hat, long-sleeved shirt and pants to keep pesticides off of the skin is important and can go a long way in reducing an applicator's total exposure.

Table 1. DERMAL VERSUS INHALATION EXPOSURE

Pesticide	Dermal: Inhalation*	Method of Application	Reference
Parathion	470	Ground Boom	Wolfe, 1967
Paraquat	400	Ground Boom	Staiff, 1975
EPN	227	Ground Boom	Velsicol, 1979
EPN	180	Ground Boom	Atallah, 1982
DEF	560	Ground Boom	Wilson, 1980
Dicamba	747	Ground Boom	Street, 1982
2, 4-D	869	Ground Boom	Street, 1982
2, 4-D	50	Hand Gun	Libich, 1984
2, 4, 5-T	1000	Spray Tractors	Lavy, 1980
Fenthion	500	Air Blast	Wolfe, 1974
Amitraz	421	Air Blast	USDA, 1974
Captan	618	Air Blast	Deer, 1983

*Inhalation = 1

Table 2. DERMAL ABSORPTION OF PESTICIDES*

Pesticide	%Absorbed	Test Animal	Reference
Lindane Dust	1	human	EPA 1982
Chlorpyrifos	3	human	Nolan 1983
Triadimefon	3	rat	Knaak 1984
2,4,5-T	4	human	Lavy 1980
Maleic Hydrazide	5	mouse	Grissom 1985
Cyhexatin	6	mouse	Grissom 1985
Captan	6-9	rat	Adir 1983
Captan	8	mouse	Grissom 1985
PHosalone	6	pig	Graine 1973
PHosalone	7	rat	Hiscock 1967
Paraquat	7	mouse	Grissom 1985
Fenvalerate	9	mouse	Grissom 1985
Pentachlorphenol	10	human	Nolan 1983
Trifluralin	10	human	EPA 1978
Toxaphene	10	human	EPA 1982
Lindane Liquid	10	human	EPA 1982
2,4-D	21	mouse	Grissom 1985
2,4-D	85	guinea pig	Street 1982
Parathion	8-100	human	Maibach 1971

*24 hour absorption period in most cases

Table 3. ABSORPTION OF INSECTICIDES BY BODY AREA

Body Area	% Insecticide Absorbed		
	Parathion	Malathion	Carbaryl
Palm of Hand	11.8	5.8	--
Back of Hand	21.0	12.5	--
Forearm	8.6	6.8	73.9
Elbow	28.4	--	--
Armpit	64.0	28.7	--
Jaw	33.9	--	69.9
Ear	40.3	11	--
Forehead	36.3	23.2	--
Scalp	32.2	--	--
Abdomen	18.5	9.4	--
Scrotum	101.6	--	--
Ball of Foot	13.5	6.8	--

Maibach, 1971

MOSQUITOES OF NORTH SUMMIT COUNTY, UTAH INCLUDING AN UNUSUAL OCCURRENCE OF *Aedes flavescens*

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The North Summit County Mosquito Abatement District is east of Salt Lake City in mountain valleys above 5,000 feet. In general, mosquito problems are the result of: snowmelt in early spring; flooding from river overflow in later spring followed by cultural practices of farmers and ranchers; high water tables with limited drainage. Mosquito collections have been concentrated around the populated areas of Rockport, Hoytsville, Coalville, and Echo.

Reference is made to Nielsen and Rees (1961) for a list of mosquitoes found in Summit County. A report prepared by Nielsen and Collett (1982) was preliminary to forming the North Summit County MAD. Their two-week survey in late spring indicated that, in order of importance, *Aedes dorsalis, Culex tarsalis, Ae. vexans, Ae. increpitus,* and *Ae. spencerii*; would be the primary pests to control. After organization of the North Summit MAD, more intensive larval sampling began in 1984 and continued in 1985 with the addition of regular collections by standard New Jersey light traps. In order of the number of times collected, in 1984 *Ae. dorsalis, Culiseta inornata, Ae. increpitus, Ae. vexans,* and *Ae. cinereus* were the dominant species, and in 1985 the shift was to *Cs. inornata, Ae. dorsalis, Ae.increpitus,* and *Cx. tarsalis.* New county records were established in 1984 and 1985 for *Ae. flavescens. Ae. nigromaculis, Ae. niphadopsis, Cx. pipiens,* and *Cx. minnesotae.* (Fig. 1)

Starting in early July of 1985, complaints were received from residents in and around the town of Echo about a large, yellow mosquito that was plaguing people, horses, and cattle. Although numbers of mosquitoes in light trap collections of North Summit County tended to be low, the trap near Echo had a sharp increase from 3 mosquitoes per night at the last of June, to a peak of 227 per night in mid-July. There had been an influx of *Ae. flavescens* which constituted 95% of the mosquitoes caught in that trap with a season total of 2948 mosquitoes. (Fig. 1).

The light trap was located in a narrow valley which can be described as riparian, elevation about 5500 feet. No *Ae. flavescens* larvae were found within range of the trap during routine collecting. Echo is at a junction of two major highways with abundant lighting at the intersection which may have attracted enormous numbers of *Ae. flavescens* from a distant source and therefore to the trap. Various winds in the region may have contributed to the settling of the mosquitoes in that particular area.

Along with the natural decline of the mosquito population, malathion fogging twice a week by LECO reduced the frequency of complaints.

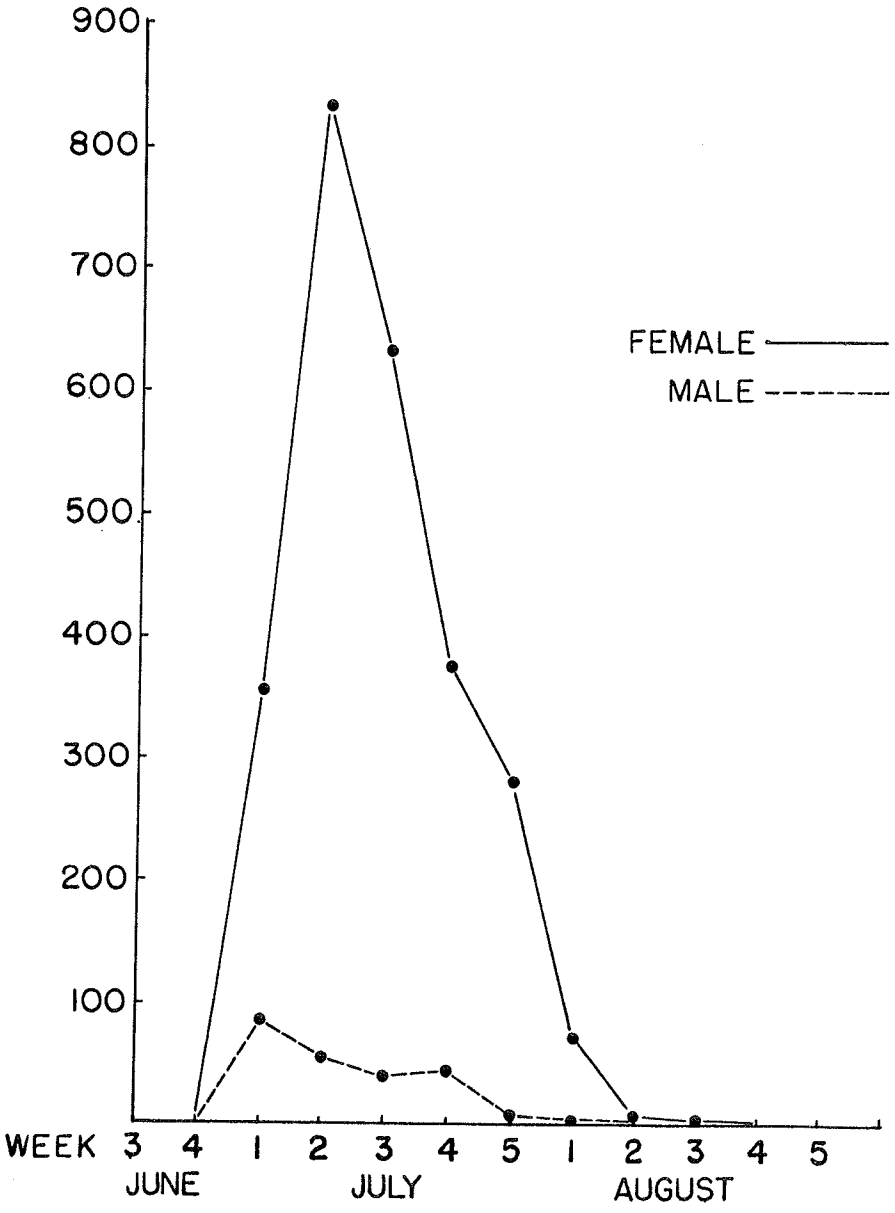
According to published accounts, *Ae. flavescens* mosquitoes seldom occur in sufficient numbers to be a serious pest and it is too rare to be an important mosquito. Except for a few studies in isolated places, little is known about its biology. In Utah, it has been previously reported from Cache, Juab, Rich, Salt Lake, and Utah counties.

Table 1. MOSQUITOES OF NORTH SUMMIT COUNTY, UTAH

	1961* Recorded Presence	1982** Larval Survey	1984*** Larvae- Number Of Times Collected	1985*** Larvae- Number Of Times Collected	1985*** Adults In Light Traps
Anopheles freeborni	X				X
Aedes campestris	X		3	4	
cataphylla	X		1		
cinereus	X	X	16	2	
dorsalis	X	X	43	43	X
fitchii	X	X	13	3	X
flavescens					X
implicatus	X	X	1		
increpitus	X	X	30	24	X
melanimon		X	1	4	X
nigromaculis			1		
niphadopsis			1	4	
pullatus	X		1		
schizopinax	X	X			
spencerii	X	X	1	8	X
sticticus	X		1		
vexans	X	X	21	38	X
Culex pipiens			2		X
tarsalis	X	X	14	23	X
Culiseta impatiens	X	X			
incidens	X			2	X
inornata	X	X	32	73	X
minnesotae			1		

* L. T. Nielsen and D. M. Rees 1961. An Identification Guide to the Mosquitoes of Utah. Univ. Utah biol. Series 12(3):1-63.
** L. T. Nielsen and G. C. Collett 1982. Report to Summit County.
*** North Summit Co. Mosquito Abatement District Records, 1984, 1985.

Figure 1. Seasonal Incidence of Aedes Flavescens: Echo, Utah, 1985



ARBOVIRUS SURVEILLANCE OF WESTERN UTAH MOSQUITOES, 1983-84

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ABSTRACT

An arbovirus survey of western Utah mosquitoes was made at Blue Lake in 1983 and at Blue Lake, Callao and Fish Springs Wildlife Refuge in 1984. *Aedes dorsalis* and *Culex tarsalis* were the most abundant species in 1983 but *Cx. erythrothorax* was more plentiful than *Ae. dorsalis* in 1984. There were 68 viruses isolated from *Ae. dorsalis,* one in 1983 and 67 in 1984. Most of the viruses, 63, were of the California serogroup, one was of the Bunyamwera serogroup, and three reacted with both California and Bunyamwera antisera.

ENCEPHALITIS SURVEILLANCE IN UTAH, 1985

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The fall of 1985 marked the end of the third year of the Utah Mosquito Abatement Association's (UMAA) expanded encephalitis surveillance program in cooperation with the Utah State Health Department (USHD). In 1985, 21 sentinel chicken flocks each of 20 white leghorn pullets were distributed in 14 of the state's 29 counties. This was an increase of ten chicken flocks from the 1983 surveillance and one more than in 1984. While the surveillance is still limited to the northern two-thirds of the state, it does encompass the majority of Utah's population.

The initial bleeding of the chicken flocks was made on May 22, followed by biweekly bleedings between June 17 and September 9. A final, ninth bleeding was made on October 7 to determine if any late season conversions had taken place.

For the second year, the Serology Laboratory of the USHD processed the blood samples. Sera were tested for antibodies to St. Louis encephalitis (SLE) and western equine encephalitis (WEE). A total of 3,390 sera were processed (Table 1). There have been no seroconversions for either SLE or WEE in the last two years.

These results may lead some to think that the surveillance program is not necessary because: (1) it has failed to detect viral activity, and (2) no viral activity may exist and therefore, why have the surveillance program. It appears that the reason no viral activity was detected in the chickens is because, if present, it is at a very low level. There have been no human or equine cases of WEE in Utah this year (personal communication, Craig Nichols, Director, Bureau of Epidemiology, USHD, and Dr. Mike Marshall, Utah State Veterinarian, Utah Department of Agriculture). However, 11 cases of SLE were confirmed in humans (with one fatality) from western Colorado this year, (interim report, Division of Vector-Borne Viral Disease, Ft. Collins, Colorado, October 9, 1985). Overall, 1985 had the fewest cases of arthropod-borne encephalitis in humans nationwide since 1955. Historically periods of low encephalitis activity are followed by outbreaks (personal communication, Chester Moore, Acting Chief Arbovirus Ecology Branch, CDC, Ft. Collins, Co.) Therefore, we believe that our sentinel chicken flock surveillance is a valuable program that must be continued. We feel that if viral activity is found, the mosquito abatement districts will be able to take the appropriate control measures before an outbreak can occur.

Table 1. Chicken flock localities and number of sera collected

FLOCK LOCALITY		
COUNTY	CITY	NO. OF SERA
Box Elder	Mantua	157
	Tremonton	133
Cache	Hyde Park	172
	Logan	173
Davis	Kaysville	177
Duchesne	Roosevelt	148
Emery	Cleveland	177
	Molen	149
	Rock Canyon	158
Grand	Moab	120
North Summit		159
Salt Lake	Draper	163
	Magna	178
	Salt Lake City	180
Sevier	Glenwood	179
Tooele	Lake Point	156
Uintah		141
Utah	Payson	179
	Spanish Fork	162
Weber	West Weber	179
West Millard		150
	Total	3,390

THE DECADE OF THE 1980's: WATER MANAGEMENT AND MOSQUITOES

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An unprecedented wet regime that Utah has experienced, which commended with a century storm in September 1982, appears to have begun to ebb. Evidence of this has evolved into a somewhat drier or more normal precipitation pattern that has prevailed during the majority of 1984.

Many precipitation records have been broken and a record amount of mountain snow has fallen in portions of Utah, especially along the Wasatch Front and through the Wasatch and Uintah Mountains. Widespread flooding occurred in the spring of 1983 with devastating mud and debris flows. 1984 spring flooding was minimal due to extensive mitigation efforts performed by city, county, and state agencies. The spring of 1985 saw ideal snowmelt conditions with the snowpack about at normal levels.

The Great Salt Lake has responded in record fashion to the awesome wet regime over the Basin. The Lake rose a phenomenal 10.15 feet in a 21-month period from the fall of 1982 to early summer of 1984. In the 1870's, it took the Lake 8 years to rise this amount. The level of the Lake in the spring of 1985 was 4209.95 feet which is the highest level the Lake has been in 108 years. The highest level the Great Salt Lake has reached in modern times is 4211.6 feet in June of 1873 and the lowest level was 4191.35 feet in October 1963.

The precipitation reported in the Salt Lake Valley, whether it be at the downtown office or the airport weather station, has proven to be an index of the Wasatch Front and the determination of what the Great Salt Lake does. Precipitation in the Salt Lake Valley averages a little over 15 inches, about 82 percent of the time the water year moisture ranges between 11 and 20 inches. Just in the past five years, the wettest water year of record was 25.15 inches in 1981-82 and the second driest of 8.19 inches was registered in 1978-79.

Precipitation is the major controlling factor on the fluctuations of the Great Salt Lake. In dry years, it falls and wet years it rises, sometimes dramatically. Several separate water budget analyses of inflow to the Great Salt Lake indicate that surface water contributes about 65-68 percent, precipitation on the lake 30-33 percent, and ground water about 1-2 percent. Normally, about 60 percent of the inflow into the Great Salt Lake comes from the Bear River, 20 percent from the Weber River, 10-15 percent from Utah Lake/Jordan River, and the remaining 5-10 percent from other sources around the Lake.

Utah Lake has also reacted dramatically to the wet pattern, being the highest level in this century at 5.43 feet above compromise in June of 1984. The latest reading, as of September 27th, Utah Lake was .69 feet above compromise. The old compromise level is still being used which is 4,489.35 feet.

The Palmer Index is a system that was developed to determine just how wet or dry a climate is in comparison to what it is normally. The values along the Wasatch Front and through the Wasatch Mountains have been in the extremely wet category or off the scale during this wet scenario. The values have decreased some this past summer.

This abnormal amount of moisture has created wet soils and a tendency to pool water. This has provided ideal areas for mosquito breeding, especially in the summers of 1983 and 1984. Drier conditions in the summer of 1985 alleviated this problem to a great extent.

Long-range weather forecasting to determine precipitation regime is not within the Science of Meteorology. Many variables make this science a difficult or almost impossible part of weather forecasting. However, a climatic regime is calculated on a number of years which are wet or dry. From indications of the past nine months, it appears that we may be heading out of the extremely wet three-year pattern. Therefore, precipitation could tend toward more normal levels or even below normal levels for the next several years. The latest 90-day forecast from the Climate Analysis Branch in Washington for Utah calls for precipitation to average above normal and temperatures to average near normal for the period October-December 1985.

With these ideas in mind, the level of the Great Salt Lake in the spring or early summer of 1986 should be slightly lower than the peak reached this past spring. The dredging of the Jordan River and the outflow from Utah Lake should continue above normal through the fall/winter/spring. This should allow Utah Lake to stay a foot or so above the compromise level.

FLOOD MITIGATION, DEBRIS BASINS, AND MOSQUITO CONTROL ALL WORK TOGETHER

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My official assignment as the Director of Protective Services for Utah County includes the charge to coordinate these services for flood control, hazard mitigation, weed and mosquito abatement. I am pleased to present to you today a few of the recent experiences I have had which will show how closely related water and flood management are with mosquito control.

Let me first offer a note of thanks to Dennis Hunter, Lewis Marrott and Dave Eagar who are the key people in Utah County managing the mosquito abatement program. In addition to supervising a large group of field inspectors, coordinating both ground and aerial spray programs, and bleeding all those poor little chickens, they have managed to contribute considerable time and expertise into flood mitigation programs.

We also need to remember and give thanks to all the taxpayers and agencies with whom we work and whose time and money make these programs possible. The last few years, in particular, have placed a heavy burden on all of us due to floods and other natural disasters. Our County Commissioners have wisely and prudently allocated funds for projects which benefit those of us from Utah County. The State and Federal agencies have been responsive, efficient, and understanding in our need for these projects of which I speak to-

day.

The onset of recent floods and landslide disasters began in 1982 with heavier than normal precipitation. Through 1983 and 1984 most areas of Utah were soaked and re-soaked with rain and snowmelt until the rivers overflowed their banks, lakes covered thousands of extra acres, and waters became artesian wells and standing pools. Many devastated areas left ideal bogs and temporary wetlands for increased sexual activity for male and female mosquitoes.

Due to the efforts, however, of efficient mosquito control personnel and extra time and dollars spent in the eradication programs, Utah County did not experience abnormally high concentrations of mosquito populations.

It is my conclusion that proper public works and hazard mitigation prograns can work hand in hand where the final result exceeds the sum of the individual efforts. We essentially have a synergistic effect where flood control and mosquito abatement can both benefit from a singular directed effort.

Debris basins have long been recognized as an effective means of collecting and holding sediments and debris flows during high spring runoff conditions. The primary function has been to provide a flood plain for an alluvian fan of sediment to form with the deposits being contained for removal at a later time when the high water flows have subsided. Most of these debris basins have a catchment area and good intentions for removal of those collected deposits. The basins soon fill and offer few, if any, benefits other than debris collection.

I want to present now to you, the debris basin design which is multi-functional, is currently complete and in use on three streams in Utah County. Each debris basin does differ in function and operation, consequently each basin also has a different operating plan. A written manual of operation defines the conditions under which the gates are controlled, the flood waters are routed and the reservoir is allowed to fill and empty. Responsible individuals are assigned to coordinate the activities which fish and wildlife agencies, cities, irrigation companies and others who would be affected or involved in the flood control operation.

Having had nearly ten years of experience in water and dam projects for the Bureau of Reclamation, I determined that our debris basin should have maximum storage to give optimum "flood routing". Flood routing is simply providing a large enough storage to accommodate those damaging peaks in stream flow which generally occur overnight and release them gradually under controlled conditions. With water storage, flow control, and debris containment we now have optimum design for flood damage mitigation.

Of the three debris basins mentioned, the Hobble Creek basin located above Springville City and just below Hobble Creek golf course, is the most comprehensive and functional structure we have. The debris basin incorporated a multistage flood control concrete spillway and gated outlet works. The system is capable of performing the following functions:

1. Gravel and sediment storage--provides an accessible location to catch and store the sediments carried by fast moving waters. As the water enters the reservoirs it slows and the particles settle to the bottom.
2. Storage of high water peaks for later release (flood routing). The more storage space we have or the lower flows we have, the more flood routing time is available. The ability to "smooth out" the downstream flows for the full 24-hour day is very desirable.
3. Storage and flow control during normal to high flows to allow for emergency operations downstream. These could include:
   a. Repair or restoration of public or private facilities. Often times we have been asked to hold and store water while an irrigation structure or stream bank is repaired.
   b. Mitigate damaging effects on fish habitat. Controlled waters are less apt to ruin those good feeding holes and spawning areas.
   c. Allow for inspection or search of person fell in the flooding stream, the water could be temporarily held back or reduced to allow for rescue efforts.
4. Has ability to catch and provide for removal of floating debris during flood stage. Large logs, trees, stumps, posts, prevented from going through the basin and plugging bridges and culverts below.
5. Has ability to reduce channel erosion and protect property. Steady uniform flows, dagain, are less damaging then fluctuating flows full of sediment and floating debris.
6. Provides a gravel borrow source as basin fills. "Washed" sand and gravel are used for roadbase and landfill. It seems to always be in demaas basin fills. "Washed" sand and gravel are used for roadbase and landfill. It seems to always be in demand.
7. Has ability to help prevent formation of downstream gravel bars and plugged conveyance structures. Gravels which are carried by the fast moving flooding streams form sandbars on the inside of downstream bends and in wider or deeper areas. These decreased the stream's capacity and cause breakouts and land flooding. Water flows below the debris basin are more uniform with no or little amounts of sediment carried.
8. Has ability to re-establish stable banks in and immediately above the reservoir area. As the reservoir water level reaches those areas, the sediment is actually dropped rather than causing additional erosion.
9. Has ability to provide winter fish habitat under ice cover. Where otherwise fish may winterkill, they now have aerated waters beneath the ice for enhanced survival.
10. Is capable of providing temporary shutoff of lower gate for recreational and fishery enhancement. Ponded water with a flow through and with adequate depth is always enticing to both the fish and fishermen.
11. Designed to allow for fish passage at low flows through the lower outlet pipe and fish ladder downstream. Our Hobble Creek basin is on a major fishing stream. During those times when water is not impounded or the stream level outlet is flowing at high velocities, the outlet pipe and adjacent fish ladder will allow for fish movement for migration and spawning.
12. Has ability to reduce downstream flows, help pre-

vent stream breakout with subsequent flooding and eventual stagnant ponds. These ponds readily form when streams break out and the flooded areas have no natural drainage. Depending on soil and subsurface water, these stagnant ponds may last days, weeks, or even months. We even have some that last years. Obviously this is a serious concern for mosquito control and another plus for debris and flood control basins.

Each of the listed items, when properly controlled, will ultimately assist in mosquito control. Perhaps the last item, which helps to prevent the formation of stagnant ponds, is most readily acknowledged here. The aftermath of flooding is always exposed wet and damp areas and in particular those lands which have inadequate or little drainage. Consequently, an ideal breeding habitat is established which must be addressed.

An example of receding waters of a large magnitude are those of Utah Lake. In 1983 the lake reached 12 feet below compromise and covered roughly 24,000 acres. In 1984 the lake peaked at nearly 6 feet above compromise and covered 110,000 acres. A simple mathematical calculation shows that the 18 feet of lake elevation change covers (or uncovers as the case may be) some 86,000 acres. This means the lake change of one foot will affect an average of over 7,000 acres. That opens up a lot of mosquito breeding territory.

It is obvious that nature still plays the greatest role in the never ending contest between man and his adversaries. We must constantly direct effort and dollars to maintain the environment to those levels of health, safety, and comfort which society requires. Only through never ending study, research, and application can we progress. I believe that the marriage of water management and mosquito control is a good marriage, and I am glad and proud to be a part of that institution.

BLACK FLY CONTROL IN SALT LAKE COUNTY--1985

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Black flies in Salt Lake County have been a serious nuisance for many years, plaguing humans and animals such as horses, cows, sheep, and dogs. Outdoor activities in August and September were hampered by increasing numbers of black flies prompting the South Salt Lake County Mosquito Abatement District to organize a control program in 1980. Though the program has enjoyed success as evidenced by a reduction in the number of flies and complaints phoned into the District, the flood years of 1983-84 created several problems. Minson and Bowlden (1984) reported on these frustrations listing changes in water usage, quality and quantity, and the effects the changes had on control measures.

In 1985, most of the black fly producing habitat, i.e., the Jordan River, major canals, irrigation laterals, small ditches, and mountain streams, returned to a preflood mode, with fewer uncontrolled times but more use of irrigation systems. A very dry August caused most farmers to fill irrigation ditches previously used on a cyclic basis and leave them running through the month. This provided miles of new habitat for the black fly larvae. The major water source in the County, the Jordan River, which had been at or above flood stage for the past two seasons returned to a more normal flow. An all time high flow of 2600 cfs in June of 1984 was reduced to 1500 cfs in May of 1985. This figure is still higher than the previous all time high prior to the flood years of 1983-84 but much reduced from the past two seasons.

In order to provide a more sophisticated, functional program, a detailed protocol was established under the direction of the district manager. With added personnel in 1985, different techniques of monitoring and inspection were implemented. To give a more detailed reading of larvae in the Jordan River, 10 sites were selected, each approximately 2.5 miles apart beginning at the Jordan Narrows and ending at 2100 South. The monitors were made up of a threaded 3/8" three foot bar on which two styrofoam balls were spaced 1' apart and held in place with nuts and lock washers. Between the two styrofoam balls, two pieces of 1/2" plastic strapping 18" long were stapled equidistant to trail in the water. Walsh, et.al. (1981) had recommended the styrofoam balls which provided a very stable, constant surface in a turbulent environment. The majority of black fly habitats in Salt Lake County are slow moving irrigation streams, heavily laden with silt and algae. The styrofoam with its rough surface silted over quickly providing poor attachment. Muskrats also found them appetizing and many were chewed to the point of being non-recognizable. They were used now only for aid in spotting the monitors in the water. The monitors were read every working day when feasible, giving growth, efficacy of treatment and populations of black flies in the River.

The South Jordan Canal, a canal moving through the Riverton, South Jordan, and West Jordan area carrying approximately 90-100 cfs was selected for an experimental treatment with *B.t.i.* Monitors were established at 100, 500, 1000, and 5000 meters and read periodically. Treatment was facilitated when the monitors showed black fly larval populations in excess of 100 larvae/strap.

An adult sampling device was developed in 1984 but was not used in 1985. Dr. Mary Galloway (1983) suggested a 5-gallon can painted a medium shade of blue and hung in suspect environments. Painted cans had Velcro pads glued equidistant around the can and 1" Velcro pads glued to 6" sq. .015 acetate sheets to match those on the cans. The sheets were then covered with a very thin layer of a sticky substance called "Stickum", a material developed by Michel and Pelton Company, Emeryville, CA. to act as a trap for insects. The pads were cleaned and replaced twice a week. In 1984, after the initial trap week when some 50 flies became attached to the trap set out in the Jordan Narrows, all other trap sites showed little or no fly activity though placed in areas where previous complaints had come from. It is felt that a restructuring of the trap to provide CO_2 would

greatly enhance its effectiveness. Budget constraints and time precluded completion of this project in 1985. Insect sweep nets were purchased in 1985 for use in sampling but inconsistent appearances of black fly populations at preselected sites rendered this sampling method ineffective this year.

When complaints warranted some measure of the black fly populations, individual inspectors conducted surveys at complaint sites counting the number of flies circling the head area. This was quite difficult at best but did give a limited idea as to numbers for a period of days as better control was being sought. Flies were also noted around the head and ears of horses found in the complaint area. This sampling provided a very good measure of the fluctuations of the fly populations over a longer period of time as the horses were always there and the flies were definitely attracted to the inside portion of the ear, sometimes in numbers greater than 50 per ear. An effort was made also to correlate heavy fly activity with atmospheric conditions.

Alverson and Noblet (1976) reported responses of the female black fly to selected meteorological factors and as storm fronts came into the valley black fly activity seemed to increase dramatically. Correlations with barometric pressure charts will be carried out to verify this phenomenon.

The success of the program is ultimately dependent on a successful treatment program where all sources of black flies are sought out and treated on a regular basis or as populations dictate. Problems in the past in achieving this goal have centered around the ability of the pesticide to be dispensed throughout the total mass of water and to be carried sufficient distances at a sufficient dosage to provide adequate control along the whole waterway. Slow moving waters and large quantities of silt plus areas along the Jordan River where the water ponds allowing the pesticide to settle out created control failures all too often.

This year the River is back in its channel but is heavily burdened with silt and debris as a result of extensive dredging both with barges and drag lines. The actual dynamics of water in a channel severely inhibits actual pesticide mixing as noted when the pesticide is introduced at a given site in a slow moving canal. If there is no source of agitation of the water, i.e., a headgate or some other obstruction which stirs the water, the pesticide will move to the center of the water flow and remain there for hundreds of yards. Tests have been conducted to determine how long and/or how far a pesticide dose has to travel before complete mixing takes place which will be sufficiently strong to affect the black fly larvae attached to the trailing vegetation along the sides of the waterways. Haufe (1980) has stressed the need to achieve rapid mixing in order to reduce nontarget damage as well as insure an efficient dosage throughout the body of water. The District has developed and field-tested a pump injection system that can be used in the larger canals that has had limited success. Work needs to be done to make the system more mobile and diverse to handle all sized water systems, excluding perhaps the small irrigation ditches.

The black fly program in Salt Lake County is in a state of flux due to several factors:

1. Severe flooding which has changed dramatically the habitat potential for flies as well as the sheer volume of water that needs treatment.
2. Sampling devices need modification to give effective readings and meaningful data. The color can traps were not as efficient as had been hoped for after the initial settings. Though many different insects were attracted, black flies were very sparse on the trap pads while still bothersome to humans and other animals on the immediate vicinity of the trap. Addition of dry ice may help. Netting techniques need to be modified as a backup to the traps.
3. Silt in connection with the flooding might be a legitimate problem in realizing effective treatment, however, continuing studies need to be made on hatching patterns, timing and location of treatment on any given water source, i.e., does the whole length have sufficient populations to justify treatment of the entire stream every time.
4. Lack of turbulence in conjunction with type of pesticide used needs to be carefully studied to provide more effective carry as well as better methods of injection into the streams.

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GENERALIZED EQUINE DERMATITUS ASSOCIATED WITH BLACK FLY (SIMULIIDAE) INFESTATION

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ABSTRACT

In mid-April 1985 a severe case of generalized dermatitis (intense itching, some bleeding of scratched areas, loss of hair, and some encrustation) was observed in 14-year old Tennessee Walker gelding located in a small grass pasture in east-central Orem, Utah, approximately 1 km west of the Provo River. The animal had been in a general unthrifty condition during the winter months, had

lost considerable weight, and had developed an unusually heavy coat of matted hair. The onset of dermatitis coincided with a marked increase in numbers of "black flies" (Family = Simuliidae) in the area, and numerous flies could be easily collected from the animal -- especially from regions where matted hair existed. Throughout the winter months, the owner of the horse had attempted to improve its physical condition through the use of numerous feed additives, vitamin supplements, and several broad-spectrum antihelminthics, including one purported to eliminate neck threadworms (microfilariae) alleged to cause dermatitis in horses. Although we did not complete any testing for the possible presence of filarial worms, we did determine that no eggs of any gastrointestinal helminths were present. We then recommended that the animal be treated with a suitable insecticide to assist in the control of black flies. After 3 weeks of treatment, and coincidental with the time of the natural decline of the black fly population in the area, all symptoms abated. This is the first case of which we are aware in which generalized dermititis in horses has been associated with black fly infestation.

AN OVERVIEW OF A MORMON CRICKET INFESTATION IN NORTHEASTERN UTAH

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A great infestation of the mormon cricket, *Anabrus simplex* Haldeman (Tettigoniidae) was recorded during the spring and summer of 1985, encompassing a geographic region inclusive of federal, state and private lands in extreme northeastern Utah (Uintah and Daggett counties) and northwestern Colorado (Moffat County). A total surface area inclusive of at least 150 square miles was so affected.

Historically, a long standing endemic mormon cricket population has been maintained in varying degree on a cyclic seasonal basis upon the mountain slopes and higher rangelands (typically, about 5,500-6,500 Ft. in elevation) within, as well as adjacent to, Dinosaur National Monument (Utah and Colorado). The 1985 season was characterized by a cricket population far in excess of those having occurred in the recent past, resulting in extensive increases in the local "normal" range and density of that organism. Migrations of selected cricket bands from higher mountain elevations to lower rangelands and isolated domestic crops extended in some instances as many as 15-20 miles from their probable hatching sites. Adult densities of as high as 100 per square yard were not uncommon within those extensive areas displaying greater degrees of summer infestation.

Developmental observations would indicate that nymphal eclosion (a single brood per season) commenced in remote areas in late March and early April and progressed diferentially with varying environmental conditions through that month to completion by early May. Seven distinct developmental instars occur in *Anabrus simplex*. The sexually mature adults do not possess functional wings, with the tegmina being totally concealed by the pronotum in females and extending a short distance beyond that structure in males. The reduced tegmina are employed by males in the production of an intermittent and very distinctive sexual "chirp" which might easily be perceived by the pure naturalist as soothingly melodic rather than maddening as described by local personnel responsible for the control of an overwhelming biomass of the organism. The migratory behavior of the resultant massive cricket populations proved to be essentially random, though unidirectional for any given moving band of crickets, with no observed solar orientation or other directional response to local environmental factors. Overall geographic displacement was observed to be strongly influenced by diurnal temperatures with maximal migratory activity occurring with warmer afternoon temperatures. Thermal extremes (air temperatures less than about 60 F. or greater than 90 F.) evoked a shelter-seeking or "roosting" response (as commonly described in the literature) with corresponding reductions in geographic displacement and trophic activity.

The preponderance of the geographic region which hosts the current cricket infestation is typified by sagebrush as the dominant vegetational type in common association with stands of cedar as an occasional or even extensive canopy at higher elevations. Numerous species of valuable rangeland forage grasses and flowering plants occur on a graded basis on more gentle slopes and flatlands, again in association with the more dominant sagebrush. Although no regular feeding preference for or aversion to a given plant species was observed, cricket swarms displayed a distinct affinity for the more succulent vegetational groups including young, green grasses in addition to moisture-bearing broadleaf plants. Immediate physical damage to rangeland flora varied from severe in isolated instances to slight. Of perhaps greater long-range importance is the subtle, yet extensive destruction of tender developing seed heads and blossoming reproductive tissues which may exact a more profound and inimical influence upon future vegetational patterns and commercial grazing potential. Field observations would indicate that the more extensive damage to local rangeland was accomplished in many instances by the large, late nymphal instars rather than the reproductively active adult crickets.

The author, a culicidologist, did note that *Anabrus simplex* is sufficiently possessed of those enzymes, metabolic pathways, etc. requisite for the full enjoyment of domestic winter wheat, corn and alfalfa. Severe and lasting damage to large, early stands of those commercial flora by cricket populations having migrated the furthest from their hatching sites was narrowly averted by chemical ground control procedures.

In addition to feeding upon a very wide spectrum of local host plants, a strong propensity for cannibalism was regularly demonstrated by the cricket populations observed. Any individual cricket displaying initial motor debilitation from pesticide exposure, or other weakness or mechanical injury was immediately attacked and devoured by stronger associates. Though numerous vertebrates are cited in the literature as regular, or at least casual predators of mormon crickets, no such feeding behavior by local vertebrate associates was observed. Throughout the duration of the 1985 infestation, no evidence of cricket pathology from microbial infection, fungal

disease or other parasites was noted.

By early May, it had become very apparent to local ranchers, farmers and Bureau of Land Management (BLM) personnel that a major entomological emergency was rapidly evolving within the aforementioned geographic region and that extensive control measures were indicated. In the recent past, atypically large cricket populations occurring within that area disposed to cyclic infestation were subject to aerial chemical control measures as supplementally sponsored by th, federal Animal and Plant Health Inspection Service (APHIS) in cooperative agreement with and by request of those states so affected. Such measures were necessitated in 1981 (2,200 acres total, for Utah and Colorado) and 1982 (27,992 acres, both states). A similar though far more extensive program was urgently requested and subsequently implemented for 1985. In addition to the primary source of funding via the federal APHIS, substantial state, county, and private funds were also utilized in the overall control effort.

Past as well as current federal regulations disallow the chemical control of mormon crickets or other pestiferous organisms within the boundaries of Dinosaur National Monument. Those regulations were therefore strictly observed by all participants in the control effort.

Those regulations were therefore strictly observed by all participants in the control effort.

The cooperative planning and logistics common to cricket control were exceptionally challenging and regularly involved APHIS and BLM personnel, local ranchers, farmers, Uintah County Mosquito Abatement District employees and others. With those enormous surface areas involved, larger, more threatening cricket bands were, earlier in the season, often first discovered by ranchers in more remote areas or by patrolling BLM personnel. Prior to the aerial application of pesticides to any given cricket population, those potential targets were evaluated and prioritized in regular planning conferences as per the relative abundance and developmental stage of the organism, apparent direction of migration with proximities to and potential for destruction of rangeland forage and agricultural crops, general topography, percent of vegetative (and physically occlusive) canopy, feasibility for adherence to federal guidelines for pesticide application, etc.

Any heavily infested area designated for the aerial application of pesticides was, after initial evaluation, carefully but quickly surveyed and flagged to insure the precise placement of chemical agent. Professional and private citizen alike shared in those efforts which all too often involved rugged terrain, difficult weather and modes of transportation ranging from horseback to foot or 4-wheel drive. A single engine fixed-wing 665 horsepower Marsh Turbothrush was employed, by federal contract, for aerial cricket control. The aircraft was periodically based and serviced in both Utah and Colorado, depending upon the location of those sites to be treated. The chemical formulation of choice for all aerial applications was "Sevin-4-Oil" at the uniform rate of 20 ounces (16 Oz. 4 Lb. carbaryl and 4 Oz. diesel oil) per acre. In addition to meeting legal and label guidelines and specifications for the intended application, a projected 21-day lethal residual was anticipated for that formulation when deposited, as a stomach poison, on vegetation to be ingested by crickets. In some instances involving smaller cricket instars and ideal meteorology and vegetative patterns that expected residual was achieved.

The first aerial application of pesticide to migrating, feeding cricket swarms was accomplished on June 4th of 1985. Each load and application treated a surface area of slightly less than three sections (square miles). Difficult terrain, thermals and other time-consuming safety and operational requisites rarely allowed for more than a single early morning application per day. Successive applications were coordinated and accomplished at critical sites and times throughout the entire region of infestation, excluding Dinosaur National Monument. Post application surveys were regularly made for those infested sites treated, with evaluations of kill efficacies upon target populations having received direct applications as well as those having moved into treated areas subsequent to application.

In addition to aiding in the planning and coordination of APHIS aerial operations, Uintah County MAD personnel made regular and very extensive season-long truck-mounted power spray applications of water emulsions of baited carbaryl (Sevimol 4, - sevin and molasses). That action proved to be an essential supplement to aerial work, especially in instances involving smaller though heavily infested acreages and private properties not included in APHIS aerial contracts. The Abatement District ground spray operations were concentrated on the protection of domestic crops which in many instances were threatened by substantial cricket bands. Effective ground control was achieved via direct application to cricket bands as well as the placement of the baited carbaryl emulsions as chemical barriers on vegetation in the line of march of feeding populations and along the peripheries of those crops to be so preserved. Those ground control procedures were continued, as needed, through the first week of August.

The last APHIS aerial application of carbaryl was made on July 11th of 1985 and roughly coincided with the beginning of the gradual and natural reduction in numbers and migratory activity of those remaining, reproductively active crickets which had not been subjected to control procedures. Overall, the aerial cricket control program proved extremely successful in the selective prevention of widespread damage to valuable rangeland land domestic crops. That favorable result is of special note when viewed with respect to those numerous and difficult conditions common to the project, including long-range planning, spray contract negotiations, surveillance, logistics, geography, legal considerations and finite project funding.

For northeastern Utah in 1985, the cricket-infested surface area treated by APHIS aircraft totaled 34,128 acres. Of that acreage, 25,153 were inclusive of federal land and were treated at federal expense, 2,475 acres included state lands and were treated at equally shared state and federal expense with the remaining 6,500 acres being privately owned and treated at equally shared private, state and federal expense. For the same period in adjoining northwestern Colorado, a proportionately greater area received aerial applications, resulting in a two state total of 78,000 infested areas treated. The final combined federal expense for the 1985 mormon cricket con-

trol program, exclusive of those state and private monies so committed totaled in slight excess of $217,000.00. There is no guarantee or promise that comparable or greater funding will be made available from the same source for follow-up use in 1986.

The 1986 season will no doubt be remembered locally as the critical or pivotal year for mormon cricket control in northeastern Utah and northwestern Colorado. Although a great deal of very beneficial cricket control was achieved in the spring and summer of 1985, vast numbers of reproductive females survived aerial and ground control measures and have oviposited extensively, over an area which in many instances represents a new and great extension of their recent geographic distribution and traditional habitat. If the winter and spring of 1986 should provide environmental conditions, conducive to the favorable eclosion and development of *Anabrus simplex,* a migratory brood of staggering proportions could well result.

Some of many Uintah County Mosquito Abatement District plans and goals for the 1986 season include the urgent solicitation of substantial state and federal financing in support and expansion of the current aerial program as implemented, the procurement of additional ground control equipment and supplies, specialized cricket control training for selected personnel and the thorough mapping of the area of projected infestation. Every effort will be made to achieve the earliest possible spring commencement of control operations. In addition, all possible avenues of approach will be examined for the future implementation of at least limited cricket control procedures in those heavily infested regions (via perhaps, the use of biological control agents) within the boundaries of Dinosaur National Monument.

ROLE OF THE STATE DEPARTMENT OF AGRICULTURE- 1985 GRASSHOPPER CONTROL PROGRAM

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Utah's 1985 Grasshopper Control Program was a cooperative effort of the Utah Department of Agriculture, the USDA's Animal and Plant Health Inspection Service (APHIS), and private landowners.

The program began in the fall of 1984, when legislative support was requested and a fall survey of critical areas were surveyed. Through this effort and supportive organizations, the Utah Legislature appropriated $1 million for the Utah Department of Agriculture to use in the Grasshopper Control program. The Bill (SB171) which had to do with the funding, established a Decision and Action Committee (ad hoc) which was selected by the Commissioner of Agriculture. Plans were set up in early April for the 1985 program and funds were requested from the Federal Government to help in a united effort to control grasshoppers. These monies from the federal government were approved on May 9 which made it possible for the largest control program in the state's history to be carried out.

The federal government through APHIS provided 100 percent of the funding on federal lands, shared 50/50 with the State on state rangeland and provided 1/3 of the funding on private rangeland with the state paying 1/3 of the cost and the remainding 1/3 by the landowner.

Prior to spraying an area, several criteria have to be met. The first is called "survey and detection" which determines if an economic infestation exists. Eight grasshoppers per square yard are considered an economic infestation. The treatment areas in Utah this year were well over this count and in some cases as high as 200/square yard. Other requirements were: a spray block had to be at least 10,000 acres of "flyable" rangeland with no more than 20 percent of the total block being cropland; treatment must be made before the majority of the grasshoppers reach maturity and egg laying begins; all the landowners have to have their money in escrow accounts before a contract will be issued.

Other agencies providing assistance with the 1985 program were Utah State University Extension Service, Bureau of Land Management, Forest Service, Utah Division of Wildlife Resources, State Lands, Park and Recreation, Forestry and Fire Control, Water Rights and Water Resources, and the Utah Mosquito Abatement Association.

Farmer/rancher meetings were held prior to the creation of any spray block and all details outlined well ahead of the spray program. Local county agents arranged for these meetings. An APHIS representative attended and explained the requirements of the program and answered questions.

This year (1985) landowners were asked to put $1.34 an acre of rangeland to be sprayed in an escrow account. This was their share of the projected cost of $4.00 per acre. The program was carried out at a total cost of $3.36 million. The cost per acre for the control program was $2.58. The landowners' share was .86 per acre not $1.34, so .48 per acre was returned to the rancher.

There were ten spray blocks in the State located in nine counties selected and approved for spraying. These were Tooele, Millard, Box Elder, Juab, Sevier, Sanpete, Beaver, Summit, and Morgan counties. In these counties there were 1,406,368.7 acres sprayed for grasshoppers by the cooperative program and over 700,000 by private landowners. On top of this amount, there were 32,268 acres sprayed for mormon crickets in the Uinta Basin area. The most the state had done in any previous year was 72,000 acres.

This year the aerial spraying began in Tooele County (Skull Valley), on June 5th and was completed on August 4th in Summit and Morgan counties. Chemicals used were Sevin-4-Oil and malathion. Sevin-4-Oil was used early in the spray program because of the erratic hatches. Some hoppers were hatching while others were in the 4th and 5th instars. In July and later, malathion was the primary spray.

The spray blocks were delimited using topographic maps of the areas. Boundary markers and flags were used as well as visual reference. Spray cards are used during the aerial application to insure uniformity of spray. This enabled the ground crews to detect any problems such as a plugged spray nozzle. Surveys conducted after the treatment showed 90-95 percent control of grasshoppers on treated range land.

Working with limitations of both time and money, a very

effective and economical program was carried out in those areas sprayed. Because of careful "survey and detection" work, the timing of the insecticide application was done in such a manner that only one application was needed for optimum control. This saved not only labor and chemical costs, it protected the environment from unnecessary chemicals.

Beekeepers were informed early in the spray program so they could remove their bees from the spray block and were very cooperative in doing so.

GRASSHOPPER CONTROL IN SALT LAKE COUNTY, 1985

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Introduction

For the past several years Salt Lake County, Utah has experienced unusually large populations of grasshoppers. Traditionally grasshopper infestations have been a problem for farmers, ranchers, and rural communities. However, during the last decade a rapidly expanding human population coupled with a limited area for expansion in the valley has necessitated the building of subdivisions within areas that are ideal habitats for grasshoppers. The residents of these newer subdivisions have had large numbers of grasshoppers move onto their property from the undeveloped surrounding land. The insects have damaged much of the vegetation around these homes and many property owners have approached local government officials asking for help to control these pests.

In response, the Salt Lake County Commision requested that the three Mosquito Abatement Districts of the county work with the property owners to provide some relief from grasshoppers. Preliminary studies indicated that the cost of a complete grasshopper control program would be two to three million dollars, and that financial resources of that magnitude were not available. An alternative program was developed that would select areas for treatment of heavy infestation adjacent to subdivisions. The primary goals of this pilot program were to: (1) minimize the grasshopper damage in 1985 and (2) gather data for establishing a more cost effective grasshopper control program in the future.

Materials and Methods

Since the Mosquito Abatement Districts had neither the proper equipment nor the liability insurance, bids were solicited from private pest control operators to do the actual control work. Each firm selected was required to demonstrate liability insurance of one million dollars which included the abatement districts. The price of treatment for areas less than 5 acres was $22.50 per acre and those greater than 5 acres in size was $17.50 per acre with the private pest control operators supplying the insecticide. The insecticide of choice was chlorpyrifos. Small areas were treated with a Myers Sprayer mounted in the back of a pickup truck, and larger areas with a Myers mist blower mounted on a large all-terrain truck. Areas too large for ground application and removed from housing areas were sprayed by aircraft. Cost of aerial treatment was $0.56 per acre with the Mosquito Abatement Districts supplying the insecticide.

Grasshopper sources were identified by field inspectors and from complaints of the property owners. Probable sources were inspected to determine the approximate density and nymphal stages of the grasshoppers, the size and accessability of the area, and potential of the grasshoppers for causing economical damage. For an area to be eligible for spraying it had to: (1) have more than eight grasshoppers per square yard in nymphal stages one through five, (2) be larger than one and preferably greater than five acres in size, (3) be accessable to spray equipment, without a spray hazard to adjacent properties, and (4) be in proximity of lawns, trees, gardens, etc. that might be damaged by the grasshoppers. On no occasion were the yards of private residences treated.

After meeting eligibility requirements, areas were assigned to the private pest control operators. Prior to application, a grasshopper fact sheet was distributed supplying necessary information and suggestions to the private residents adjacent to the surrounding fields.

A post-application inspection was made 24 hours after treatment by a Mosquito Abatement District field inspector. A determination was made of the percentage kill, as well as observations of the effects on non-target organisms. If control was not achieved, the area was treated, followed with another 24 hour post-application inspection. Results were recorded when control was achieved.

Results

Spraying for the grasshoppers began in late May and continued through July, with most of the identified sources being sprayed while the grasshoppers were in the nymphal stages. The best control, usually 95-99%, was achieved when treating nymphal stages. However, spraying was effective against adult grasshoppers. While a good short-term control was obtained from the majority of the treated areas, the long-term results varied greatly. Some areas once sprayed remained free of grasshoppers for the remainder of the year, others had subsequent hatches, and still others became reinfested as grasshoppers moved in from untreated areas.

The total cost of spraying areas for grasshoppers in Salt Lake County for 1985 was $33,432.27. This amount does not include the costs of the field inspectors salaries, transportation and secretarial help. A total of 1451 acres were sprayed by ground application and 1440 acres of aerial application.

Discussion and Recommendations

Generally the pilot program was successful. The numbers of grasshoppers were reduced in critical areas and the residents were appreciative of the results obtained. Because of the public relations program, people understood that the program was limited due to financial constraints.

However, as with all programs, some property owners were not pleased. These ranged from people who wanted their individual yards treated and those who had properties adjacent to problem areas that did not meet spraying eligibility requirements, to those people who object to the use of any insecticides.

The second goal of the pilot program was to gather data for establishing a cost-effective program for the future. Many grasshopper sources have now been identified. It is expected that many new sources will be found if the program continues. With the number of areas that need to be sprayed increasing the budget for spraying must also be increased and/or greater selectivity must be used in the spraying eligibility requirement. Greater selectivity of areas to be treated can be obtained by (1) identification of grasshoppers from each source, spraying only those areas with species known to be destructive, and (2) learning more about the behavior and life history, so as to be able to better delineate the amount of area away from a subdivision and the time that spraying should be done.

At present it is not feasible for the Mosquito Abatement Districts to spray for grasshoppers. The cost of proper equipment for the Mosquito Abatement Districts would be excessive. The need for the special equipment is limited to about 3 months.

The future of the grasshopper control program rests in both its need and the ability to obtain the necessary monies. As mentioned earlier, during the past few years the grasshopper population has been unusually large in Salt Lake County. However, since grasshopper populations tend to be unpredictably cyclic, there is no guarantee that there will be a pest problem. If a problem does exist in the future, trained personnel and monies need to be quickly available.

It is recommended that a permanent employee of each Mosquito Abatement District be trained further in the control practices, behavior, life history, and identification of grasshoppers. This person should be available each spring to evaluate the potential of a grasshopper problem. In the event of a large population of grasshoppers this person should be able to train the appropriate number of field inspectors. Private pest control operators should be contacted for bids for spraying. A portion of each Mosquito Abatement Districts budget should be kept in a special fund for the purpose of grasshopper control.

Thirty-Eighth Annual Meeting

"Arbovirus Activities in the U.S. during 1985."
Chester G. Moore, Acting Chief Arbovirus Ecology Branch,
Vector-borne Disease Section, C.D.C., Fort Collins, Colorado

"Status of the University of California Mosquito Research Program."
Russell E. Fontaine, Extension Entomologist, Coordinator of Mosquito Research,
University of California, Berkeley, California

"Identification and Distribution of Grasshoppers in Utah."
James McMahon, Department of Biology,
Utah State University, Logan, Utah

"Water Management." Panel:
Terry Holsworth, Director, Salt Lake County Flood Control,
Salt Lake City, Utah

"Preliminary Report on Mermithid Nematode Worm Parasitism and Mosquitoes in the Western U.S."
Mark Blackmore and L. T. Nielsen, University of Utah
Salt Lake City, Utah

"Liability Insurance and Public Entity Risk Management."
Pete Andersen, Marketing Director, Casualty Division,
Utah Local Government Insurance, Salt Lake City, Utah

"Aids and Mosquitoes." Craig Nichols, Director, Bureau of Epidemiology,
Division of Community Health Services,
Utah Department of Health, Salt Lake City, Utah

"Vector-borne Animal Diseases in Utah."
Mike Marshall, Utah State Veterinarian, Department of Agriculture,
Salt Lake City, Utah

"The Role of Bacterial Larvicides in Integrated Management of Mosquitoes."
Mir S. Mulla, Department of Entomology,
University of California, Riverside, California

PROCEEDINGS

of Thirty-Ninth Annual Meeting

of the

Utah Mosquito Abatement Association

held at the
Hilton Hotel
Ogden, Utah
September 29-30, 1986

edited by
Sammie Dickson
Robert E. Elbel

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RESOLUTIONS 1986

WHEREAS, Dr. Lewis T. Nielsen has organized and conducted an annual workshop for all employees of the mosquito abatement districts of the State of Utah every Spring.

THEREFORE, be it resolved that the Utah Mosquito Abatement Association extends its appreciation to Dr. Nielsen for this service and his support of the organization in numerous ways.

WHEREAS, the Utah Mosquito Abatement Association has held its 39th Annual Meeting at the Hilton Hotel, September 29-30, 1986, and,

WHEREAS, Box Elder County Mosquito and Fly Abatement District, J. Lawrence Nielsen, Manager, has served as the host organization, and,

WHEREAS, the Arrangements and Program Committees have done an outstanding job,

THEREFORE, be it resolved that members of the UMAA extends sincere appreciation to the Box Elder County Mosquito and Fly Abatement District and all others concerned with the preparation and arrangements for this excellent convention.

WHEREAS, the papers presented by the speakers have been of high quality with much valuable information for those in attendance, and,

WHEREAS, many of the speakers came considerable distances to participate in these meetings,

THEREFORE, be it resolved that the Association extends its appreciation to all speakers and give special thanks to those who came from out of state including Donald J. Sutherland, President, American Mosquito Control Association.

WHEREAS, Hilton Hotel has provided excellent facilities and services, and,

WHEREAS, the banquet was of excellent quality,

THEREFORE, be it resolved that the Utah Association expresses appreciation to the personnel of Hilton Hotel who contributed greatly to the success of these meetings.

WHEREAS, the Contributing Members have provided contributions and interesting displays of their products,

THEREFORE, be it resolved that the Utah Association extends its appreciation to these organizations for the support and services they have provided to further mosquito control throughout the State.

RESOLUTIONS COMMITTEE
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Verl Peterson
Dennis Hunter

CHANGES IN AMCA
CURRENT PROBLEMS IN NEW JERSEY

DONALD J. SUTHERLAND
Mosquito Research and Control,
Rutgers University, New Brunswick, N.J.

It was almost 2 months ago that I gladly accepted the invitation to attend and participate in these meetings. At that time I suggested the title "Changes in AMCA and Problems in New Jersey", because (1) they were 2 subject areas in which I was knowledgeable and (2) they would be of interest to you: AMCA, since many of you are active members, and problems in New Jersey, since the problems of the most populated state of New Jersey may eventually be the problems of other states.

However, as I was preparing my remarks, I concluded that my title, if given to a book or a movie, would not "sell". Likewise, I suddenly felt that the words "changes" and "problems" were somewhat negative terms. My thoughts were interrupted when I had to make a phone call. A recorded message said "the number has been 'changed' ", I jotted the new number down, redialed and completed my phone call. My secretary then came into my office and said, 'we have a "problem"; there's a roof leak in the conference room'. With a few more telephone calls to the University's physical plant, a custodian's mop and two well-placed buckets, the problem was at least temporarily solved. Returning to my thoughts for this meeting, I felt I had real evidence that the words "change" and "problem" are not negative but indeed part of our every day personal and professional lives. There are certainly more negative terms such as "obstacle, crisis and catastrophe". Indeed, if we list all five terms together, we see an array of levels at which we interpret the various challenges we face. As we are confronted with any challenge, such as a new regulation, initially we may consider it an obstacle or a crisis but with reasoning and analysis of the situation as a series of problems, we evolve solutions which generally incorporate change. It is in this concept that I wish to talk about AMCA and New Jersey.

In 1985 AMCA held its 51st annual meeting in New Jersey. It marked a milestone for AMCA, 50 years of service to mosquito control workers in the United States and to the development of a nationwide profession. It was also a significant meeting for the New Jersey Mosquito Control Association which helped to spawn AMCA in 1935. At the 1985 meeting, significant financial and staff problems in AMCA were discussed. Initially, to some, such problems seemed to be of a crisis dimension. But within one year, by April 1986, the AMCA Board of Directors and various committees made remarkable progress in solving problems and instituting changes in AMCA as it has entered its second 50 years in very good shape.

This progress was marked by 2 great changes. Firstly with the retirement of Tommy Mulhern as Executive Director, a search was conducted to find a new Executive Director. Under the very capable committee leadership of Utah's Lew Nielsen, nominations were received and the final candidate chosen. The new Executive Director is Dr. Harold Chapman, who with over 20 years experience with mosquitoes, particularly in their biological control, and with federal and international experience, is a great resource for the growth of AMCA. He was appointed in February 1986. The second great AMCA change is that Central Offices are now located in Lake Charles, Louisiana. For over 20 years, Central Offices were located in Fresno, California and received much aid from California AMCA members, such as James Caton. For this AMCA will always be very grateful. But with Harold Chapman in Louisiana, with recognition of the benefits of having Central Offices more centrally located in the country, and with two invitations to relocate to Louisiana, the decision to relocate was made at the New Orleans meetings last April.

The facility for the Central Offices was offered by the Calcasieu Parish Police Jury, the Parish governmental agency. The one story facility with seven rooms is adjacent to a similar structure housing the Parish Health Agency and is located on a main street in Lake Charles about 3 miles away from the Parish Mosquito Control Unit. The Calcasieu Parish funded repairs and renovations with significant assistance from the Parish Mosquito Control Unit. Within 2 months, most large repairs were completed and AMCA moved into the sizeable building.

With the space available, rooms were designated for the central reception-office area, Dr. Chapman's office, an area for the computer terminal, an area for xeroxing and the addressograph, a room for library holdings and periodical storage, and space for storage of past business files. And in early August, Central Offices held an open-house, attended by over 60 representatives from Louisiana and Texas. All attending were impressed with the new offices and shared in the pride of the changes and accomplishments at Central Offices. There are other changes in AMCA forthcoming; one in particular I welcome are the changes in the AMCA Newsletter to serve its members better. Preparation for some changes was made by the previous editor, John Combs, in California. With the new editor, Jimmy Long, of Texas, members will be seeing these changes take effect.

Coincident with AMCA changes is the change in significance of mosquitoes to the public. The Asian Tiger Mosquito, *Aedes albopictus,* and its incidence in Texas and Louisiana was a major topic of conversation at last April's AMCA meeting in New Orleans. Since that time, the news media has certainly made the most of it. The species has also; it now has been found in a total of 12 states. The views about the species vary among mosquito control workers; some say "It's change - it's just another mosquito". Others say "it's a crisis" or even a catastrophe". One thing I do believe: this species has shown how dynamic the mosquito situation is and how dynamic our profession has to be. I characterize it as exciting and certainly a stimulus for our profession.

The species has not yet been detected in New Jersey. Most New Jersey agencies have alerted their surveillance and inspection programs. Such agencies are somewhat variable in their view towards the possible future of the species in New Jersey. Part of the variation in attitude is due to the isolated and limited appearance of *Culex tarsalis* in our state several years ago. Part is also due to other significant problems in mosquito control in New Jersey. I wish to briefly mention them, as a possible future concern in other states.

I. Public toxiphobia

Mainly due to toxic waste and toxic spills and its coverage

by the news media, the public is becoming more concerned about any chemical, including insecticides, and wants to be educated and protected. The concern goes beyond just environmental safety to the individual citizen and his or her concern about their own health. Terms like "chemical trespass" are being used by some public speakers. Mosquito control agencies must respond to these public concerns. In order to defend programs, the New Jersey agencies generally are increasing their usage of *B.t.i.* whenever possible and efficient. However, this is in spite of proven performance of other materials.

II. Pesticide regulations

The public's toxiphobia and the concerns of environmentalists have already influenced New Jersey's pesticide regulations. For several years now, mosquito control agencies have had to provide advanced notification of aerial and ground adulticiding. Such notification, in two newspapers, must appear 7-60 days before the adulticide application and covers a period of 60 days. Our county programs have contended with this obstacle by automatically publishing this notification every 60 days. This is interpreted as a slight change in operation. Certainly, it's not as bad as it might be. Some legislative efforts tried to make such notification by first-class mail and even include larviciding applications. Such rules, of course, if adopted could be termed a catastrophe for practical mosquito control.

III. Water management

There are other potential state regulations which will influence New Jersey's use of water management. The current political sentiment in New Jersey is to protect upland wetlands as a valuable resource of wildlife and water. This means countering any alteration of such wetlands, be it for urban development or for water management for mosquito control. The definition of such wetlands will depend greatly on the types of vegetation present. Such potential regulations will magnify the permit process and in turn interfere with water management practices which for so long have been a basic method for mosquito control in New Jersey. Of course, less water management may mean greater pesticide usage. But proposers of this legislation are not considering this.

IV. State legislation

There is related state legislation already in effect, the Natural Area Systems Act, which deals with State lands and their protection as recreational and game areas. Already, this act is forcing increased documentation of a mosquito problem before any type of control measure is taken.

V. Right to know

State legislation even covers the individual employee of a mosquito control agency. New Jersey now has a State law, called the Right-to-Know Act, which insures that each employee has the right to know about the presence of chemicals in the work place and be educated about such materials. This extends, beyond pesticides, to fuel and even acetone used in the laboratory. This means the expenditure of monies for inventory, training, and administration.

VI. OSHA

Some newer state legislation has gone beyond federal legislation, such as the Federal OSHA, Occupational Safety and Health Act. New Jersey has expanded it to State government employees, with PEOSHA. Conformance to these types of legislation obviously requires changes in operation.

VII. Another problem, I term it almost a crisis, concerns the federal registration of insecticides. For over 15 years our major larvicide has been the organophosphate Abate because of its efficiency, economy, and in-state impact studies. In 1988 this insecticide will be considered for re-registration. EPA has reported data gaps which have to be filled by the registrant, American Cyanamid, before re-registration is allowed. Since this insecticide is not a broad-sale item, American Cyanamid is contesting the requirement to fill the data gaps. Related to the possible loss of Abate as a larvicide, is the Federal Fish, and Wildlife's concern about materials such as Abate and its labeling and use on federal lands. Such federal agencies are favoring the expanded use of *B.t.i.* although many find that *B.t.i.* aircraft larviciding is not economical and not efficient. Federal favoring of B.t.i. usage is also partly due to intensive lobbying by manufacturers of *B.t.i.* proclaiming its absolute safety to the environment.

Of course, biopesticides, i.e. pesticides from biological entities such as bacteria to control various types of pests, are the coming thing. Already, *B.t.i.* is being used as a larvicide. There is a second bacterial larvicide, *B. sphaericus,* which may soon be commercially available. Research articles on this bacterium have appeared in the AMCA Journal.

In 1985 and 1986, we have been evaluating it in New Jersey. The results have been so promising that I want to briefly discuss them. *B. sphaericus* was first identified as having larvicidal activity in 1965. In contrast to the discovery of *B.T.I.* in 1977 and its full EPA registration in 1981, the experimental use permit for *B. sphaericus* was only issued in 1985. There are over 40 strains; the Biochem Experimental Use Permit is for one of the highly toxic strains #2362. Like *B.T.I., B. sphaericus* has a toxin associated with crystal inclusions and possibly cell wall material which, when ingested by larvae, affects the mid-gut epithelium. Larval death is slower than with *B.T.I.* requiring 24-48 hours for mortality. Unlike *B.T.I. B. sphaericus* is specifically toxic to mosquitos and not Black flies. Various other differences between *B.T.I.* and *B. sphaericus* exist, e.g. differences in species susceptibility and residual effectiveness. *B. sphaericus* has been reported to be effective for up to 9 months and is effective even in polluted water.

In New Jersey we are faced with problems of *Culex pipiens* in polluted and brackish waters associated with leachate waters and waste treatment plants. Various superintendents have been cooperating in the evaluation. In some areas, and with probable recycling of the bacterium, a single application has been effective for about 30 days. Based upon the results in New Jersey, we look forward to the commercial availability of this product since it represents a solution to some of our so-called problems I have discussed.

I am sure that mosquito control agencies in Utah are confronted with problems also which are being solved. We all interpret this as progress. There is one additional problem that I believe we all have, not just regionally, but nationally; it's the public's perception of the mosquito, as fostered by the communication media in all its forms. The media tends to make light of the mosquito, often makes it an object of fun, while we in the mosquito control profession take the mosqui-

to deadly serious. Media coverage does not really nurture public concerns about mosquitoes and their control. I am sure that your association and its members are making every effort to educate the public about mosquitoes and about our profession whose objective, simply put, is to control mosquitoes. There are over 20 regional and state mosquito control associations in the United States trying to do the same thing. Actually, we are a national profession with a national association, AMCA, pulling us all together. Membership in AMCA does not make anyone a certified professional but it provides the opportunity to nationally identify with mosquito control workers across the country. I believe that AMCA will more and more represent our profession nationally and internationally.

On behalf of AMCA, I extend best wishes to your organization for a successful meeting and for continued service in the future to your members and to the public they serve.

New Jersey Agricultural Experiment Station Publication No. E-40400-02-86 supported by State funds.

ESTIMATING LARVAL POPULATIONS BY POOL GRADING

ROBERT J BRAND

Tooele Valley Mosquito Abatement District
Lake Point, Utah

In 1983 Utah received national exposure due to unusual spring flooding. Because flooding occurred state wide the Center for Disease Control in Ft. Collins, CO. asked Dr. Bruce Francy and Dr. Donald Eliason to visit Utah and ascertain possibilities for Western equine encephalitis transmission. The habitats for *Culex tarsalis* were in place and the possibility for an epidemic depended on continued weather factors. As part of the surveillance of encephalitis, each mosquito abatement district was asked to submit a weekly total of *Cx. tarsalis* pools and light trap records to Dr. Lewis T. Nielsen, University of Utah, who worked with the Utah Mosquito Abatement Association as consultant.

One of the problems of using the number of pools as a basis for larval population comparisons assumes that pools of mosquitoes have a consistent population or else they will tend to average out over a long period of time. It has been our experience, however, that this is rarely, if ever, the case. Because of this problem, we found it very difficult to understand actual larval numbers. Did we have more mosquitoes because we had more pools, or did we have less mosquitoes because we had less pools? In 1983 because of the increase in water, we had a tendency to see fewer but larger pools with relative dip counts being lower. Our challenge, then, was to see if a better system could be used in estimating mosquito populations.

Various methods have been used to estimate mosquito populations at the pool. One method is described by Cyrus R. Lesser (1977). This method involves setting out area samplers, such as an open ended coffee can, then using removal sampling techniques to plot a periodic catch against a cumulative catch. A line of regression can then be plotted to give an estimate of a pool with known dimensions. The major problem with this approach is that it is limited to small pools with shallow enough water to use the area sampler. Another approach, using a Giemsa marking, was developed by Fish and Joslyn (1984) that improves the accuracy of the estimate. The basis of taking a known amount of larvae, staining them, and then placing them in the original habitat to mingle with unmarked larvae affords an excellent measure when recapturing the larvae 18 hours or so later. The ratio of unmarked to marked larvae is the tool for making this estimate but in situations where control is paramount, we do not have the time to adopt this method of larval estimation.

What we wanted was a system that gave us enough information, based on the pool, to make an estimate as to whether we had more or less mosquitoes from a given time or place. We required that we gain this information as part of normal inspection. We also wanted to use our common sampling methods of using the standard dipper and estimations of pool size without spending time in measuring area size of the pool. We recognized that such an approach would cause the standard deviation to be extreme. Our reasoning here was to make comparisons on levels of magnitude rather than in actual numbers. If we could compare levels of magnitude, the standard deviation, hopefully, would be minimal.

In setting up our levels of magnitude, we wanted to correlate our pool sizes with some relative larval dip count. We had already expressed our pool sizes on the logarithmic scale with pools from 1-10 square feet being assigned the magnitude of 1. A pool 10 x larger was given a magnitude of 2, etc. So, a pool with a magnitude of 5 represented a pool size of approximately 10,000-100,000 sq. ft. of surface area, or from 0.22 acres - 2.22 acres. It was natural enough to continue with this logarithmic scale with our average number of dips to estimate larval populations. Any pool with dips less than 1 per dip was assigned the magnitude of 1. The dip range of 1-10/dip was a level 2, 10-100/dip was a 3, and anything over 100/dip average was a level 4. These numbers represent the factor of the pool and the dip. By adding the two numbers of magnitude together we arrived at a pool grade. This grade, then represented our population index of a particular pool. A pool with an area size 4, coupled with a dip level of 2 would constitute a grade 6. With this system, we have created 9 levels of magnitude, each one 10 x that of its neighbor. Another way to view this is to realize that it takes 10 of any level to equal the next higher degree. We have determined that the most common level is at 6, therefore, we have assigned this level to represent a population index of 1. This means that, for our purposes, a population index of 1 represents a pool approximately 1,000-10,000 sq. ft. of surface area with a relative average larval dip count from 1-10. In 1986 this grade applied to 29% of all pools collected and of those pools, 64% existed in the rage of 1,000-10,000 sq. ft. of surface area with 1-10 larvae per dip.

Another problem in estimating mosquito populations is the species found. Some species are far more important than other species so we must focus on one species at a time. In our program, we are more concerned about *Ae. dorsalis* and *Cx. tarsalis.* So, before we estimate our population index, we use only those pools that produce these species. Our popula-

TABLE 1. Lake Point and Erda comparison for *Culex tarsalis* for June and July, 1985.

Lake Point					Erda				
Date	No. of Pools	Dip	Size	Grade	Date	No. of Pools	Dip	Size	Grade
06/03	0				6/06	1	1	4	5
06/10	0				06/12	2	1	4	5
							4	5	9
06/17	3	3	6	9	06/18	4	3	5	8
		3	6	9			2	5	7
		3	4	7			2	6	8
							3	5	8
06/24	4	3	6	9	06/24	1	1	3	4
		3	6	9					
		2	6	8					
		1	6	7					
06/29	2	1	6	7	07/02	6	1	4	5
		3	5	8			1	4	5
							1	4	5
							1	5	6
							1	4	5
							1	4	5
07/08	2	2	6	8	07/09	3	1	4	5
		1	6	7			2	4	6
							1	4	5
07/15	3	1	6	7	07/16	1	2	4	6
		2	5	7					
		2	6	8					
07/22	4	2	4	6	07/23	6	1	4	5
		2	5	7			1	6	7
		2	6	8			1	4	5
		1	4	5			1	4	5
							2	4	6
							1	3	4
07/29	2	1	6	7	07/30	1	1	4	5
		2	5	7					

tion index is based, not only on area size and relative dip counts, but also on species.

The application of this system can be demonstrated in Table 1 by comparing 2 dissimilar areas during the months of June and July, 1985, for *Cx. tarsalis.* The numbers entered in the Dip column and Size column represent the logarithmic step. The Grade is created by adding these 2 numbers together. The number of pools represent the actual number of pools collected.

From Table 1 we find that each area was inspected 9 times: Lake Point had 20 actual pools and Erda had 25. A careful look will show that the pools in Erda did not have as high dip counts as did Lake Point. Also, the area sizes found in Lake Point were consistently larger. If we relied only on the number of pools of *Cx. tarsalis* found in these 2 areas, we would erroneously assume that Erda had the higher population. If we create a population index by adding together all like grades beginning with grade 6, we see Lake Point with an index of 4590 compared with 1324 for Erda. Another way to understand this population index is to read it by saying that from June 3rd to July 30th, Lake Point had 4 pools of *Cx. tarsalis* of grade 9, 5 pools of grade 8, 9 pools of grade 7, and 0 pools at grade 6 while Erda had 1 pool at grade 9, 3 pools at grade 8, 2 pools at grade 7, and 4 pools at grade 6. These numbers then can be significant in quickly comparing populations between areas. The conclusion now would show Lake Point with a population of *Cx. tarsalis* 3 $^1/_2$x greater than Erda.

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C. R. Lesser. 1977. A method to estimate populations of larvae in shallow water. Mosq. News 37:517-519.

TRACKING MOSQUITO POPULATIONS USING AN IBM PC

LARRY E. LOWDER
Tailor Made Software
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About seven years ago Robert Brand came to visit me with an interesting problem. He is Manager of the Tooele Valley Mosquito Abatement District. Most of his time was spent in gathering data from pools and areas within his district as they were inspected. Maintaining thousands of records manually had become a nearly impossible part of his job. So much of his time was taken up in mosquito control that he scarecely had any time left to analyze his data.

Data analysis of this type is essential to any abatement program. Analyzing your records will tell you nearly everything about your district. "Where is the greatest population growth and movement of mosquitoes within a specific area? What caused growth and movement? How do pool conditions effect the population for a specific species? What chemicals work best for certain species under certain pool conditions during a specific time period? What inspector sprayed a specific pool on a given date? What did he use when he sprayed it? What is the productivity level of a given inspector?" The answers to all these questions and many, many more are essential to someone who is trying to manage a district. Without proper analysis of this pool data, how could anyone ever be able to tell if progress was being made? Mr. Brand realized that when you can't tell exactly what is going on, you are operating at a disadvantage.

When he needed information for a given pool within a given area he found himself spending hours simply trying to locate all the necessary records. Then he spent more time extracting the information he needed and compiling it into a meaningful report. And many times, even after he located the needed records, he found that the records generated by his inspectors were incomplete. He didn't have time to be tied down to his desk and the filing cabinets extracting and generating this information. He wanted, instead, to be doing the more important work of running the abatement. He wanted to work smarter, not harder. He wanted to find a new way of analyzing this data by using a computer. "Let the computer spend its time searching for this needed information. Let the computer generate these reports." All this was on his mind when he first came to see me.

Mr. Brand had some interesting requirements drawn up for this new automated system. Just a few of which were:

--The ability to retain a minimum of 5 year's information on the computer at any given time.

--An easy, user friendly, system which required little more than a warm body to run it. (Mr. Brand is no jet fuel genius when it comes to computers)

--The ability to extract any information about any given mosquito pool within a given area for any given time span.

--The ability to generate reports on any of the following:

a. Species population and locations within the district
b. Historical reporting on population movement and growth
c. Seasonal and periodical reporting for given pools for a given species
d. Population growth under different pool conditions
e. The effectiveness of specific chemicals when used on a given species under different pool conditions.
f. Where and when a given chemical had been used.
g. Where and when a given employee had worked for both productivity and reporting purposes.
h. Generate reports on a daily basis which would help sprayers know, from a historical viewpoint, where to spray, when to spray, what chemical to spray, what species to spray, etc.

--Generate a population index by area.

--The system had to be affordable. So as not to cause any of his board members an aneurysm when it was presented to them for funding.

--The ability to communicate with other mosquito abatement computers to access their data with his programs.

This is where the plot thickened. At that time, I was a programmer analyst. I worked for a company which used several large main frame computers to perform its data processing functions. Micro and personal computers had not, as of yet, arrived on the scene. Those computers which were available were very expensive and required a great deal of attention and maintenance to perform their operations. Mr. Brand had a terrific idea, but unfortunately, at the time, there wasn't a machine available which would fit his storage and budget needs. Another problem was an access method by which the computer could extract information from it's database. Mr. Brand wanted to get at his data from so many angles that, at the time, there wasn't an access method available, on a small machine, that would feed the bulldog. I turned Mr. Brand away. I told him that he would have to wait a few years for technology and small machine database software to catch up with his idea. So with a dejected look he walked out.

6 YEARS LATER

A lot can happen in six years, especially in the computer industry. There has actually been a personal computer revolution. Personal computers have become very powerful. A machine that used to fill a room the size of a football field can now sit on your desk. The speed and capacity of retaining data now exceeds even that of large machines from just a few short years ago. The cost of personal computers is so low that nearly anyone can afford one. Life is now beginning to structure itself in such a fashion that to own a computer is no more unique than owning an automobile.

Relational databases have appeared on the scene. These databases allow data to be accessed in any way imaginable. Compilers have been developed which generate linked binary execution modules. These modules allow the system designer to join several programs into one large software system. Because these systems are binary they can run with the same speed that they would on a large main frame computer.

Like a bad penny, Robert Brand returned. This time, however, I was ready for him. I was now working for a new company as a Senior Programmer Analyst/Project Leader. I was working with a bigger, faster computer. Using bigger and better databases, languages and methodologies. I also had my own I.B.M. PC consulting company. Mr. Brand and I sat down, rolled up our sleeves and began to work.

Being a student of both Yourdon and McDonald Douglas Automation structured analysis and design technologies, I

used a combination of the 2 to generate a paper model of the way Mr. Brand ran his abatement. This paper model included a data dictionary including all terms and data elements used by the abatement, data flow diagrams which are a graphic depiction of processes and functions within any business or agency and mini specifications explaining all processes and functions which were found on the data flow diagrams. It was only by having a complete understanding of the way Mr. Brand ran his abatement without a computer that I could comprehend the way he wanted to run it with a computer. While I built my model, Mr. Brand finalized his first draft requirements for the new system.

When we had both finished our tasks, I merged the new requirements with the paper model I had built. Thereby creating a new paper model of what Mr. Brand's abatement would look like after the computer system was in place. After carefully walking through the new paper model and making all adjustments and changes which Mr. Brand saw fit, I began to design my databases. By using a process called 'Normalization', I separated the data elements into 7 individual, non-redundant files. At this point I began to design programs, 117 programs in all.

Just because a person owns a medical journal, does not make him a brain surgeon. The same holds true for computers. Just because a person has a home computer does not make him a programmer analyst. Any baboon can slap a computer system together so that the end user will have to have a pilots license to run it. That's simple. The person using it has to know everything while the computer can get by without knowing anything. The systems that a 'hacker' will build, will be nearly impossible to run and in the end will always end up in the trash can.

The true, trained, quality systems designer will build a system so that the end user can run the system while knowing very little about the way the software really works. Why should you have to know how the system works! You should know mosquitoes, not computers. A good designer should make the system smart enough to run with only minimal input from the user. This is the way I designed 'Mosquito Byte'. The user can run all 117 programs by simply using one finger. In fact, the user doesn't even realize there are 117 programs within the system.

I realized that each abatement would probably want to run things a little differently (or a lot differently) than another. So I designed 'Mosquito Byte' to run from tables. The tables are set up completely by each abatement. Therefore, they are set up in the manner in which each abatement sees fit.

As each phase of the system was completed, it was turned over to Mr. Brand for testing. There was a long period of time in which the system was tested and modified. But at long last, the system reached a plateau in which Mr. Brand's first 'live' records could be entered.

The system was designed to have data entered from area inspection sheets as the inspectors returned from their daily rounds. These inspection sheets may also be collected during the summer and the data may be entered during the winter when time permits. The following items of information are gathered and entered from each pool:

a. Area Number
b. Inspection Date
c. Pool Number
d. Inspection Time
e. Pool Size
f. Larval Count per Sample (Identified as Dip Count)
g. Chemical Used
h. Inspector (Up to 3 may be entered per pool, per inspection)
i. Species found (Up to 3 may be entered per pool, per inspection)
j. Pool Condition (at time of inspection)

Each item above is identified and entered by using a 1 or 2 digit code. These codes are defined by the individual abatement. One or 2 digits were used to allow for speedy entry. The data for each pool may be entered in a matter of seconds. An entire area may be entered within just a few minutes. When pool information is printed, the computer performs a lookup for these codes, within the tables mentioned above, and prints the actual description of each item. That is, Inspector Number '1' may print out as Mornimer Snurd. That is, if you set your Inspector Number '1' as Mornimer Snurd. Chemical Number '1' could be Dursban. Species Number '34' could be low flying Bassett Hounds if you decided to set your tables with low flying Bassett Hounds as number 34, etc. Once again, the way in which your tables are set up are entirely up to you.

Once your Area data has been entered, you can ask the computer to analyze the data. The Machine will produce the following reports:

1. Area Analysis by Pool . . . This report allows the user to request a pool analysis for any area within any period range, for up to any 4 species that are greater than or equal to a population specified, from any given year through any given year. In other words,I want a report for area # 4, beginning on May 1 through July 31, selecting only pools having *Ae. dorsalis, Cx. tarsalis, Ae. vexans and Cs. inornata,* with a population greater than or equal to 10 per dip, from 1971 through 1986. This report can be printed and sorted by either population or pool number. This report must be printed in hardcopy.
2. Pool Condition Report. . . This report allows the user to request a pool analysis for any area within any period range, checking for a specific pool condition, from any given year through any given year. In other words, I want a report for area # 43, beginning on September 16 through September 21, selecting only pools which were in a dried up condition, between 1984 and 1985. This report can be printed and sorted by either population or by pool number. This report must be printed in hardcopy.
3. Pool Report. . . This report allows the user to request a pool analysis for a specific pool, within a specific area, within a given period range, for a given year. In other words, I want a report for pool # 3a, within area # 4, beginning on January 1 through March 31, for the year 1984. This report can be displayed on the screen or printed in hardcopy.
4. Sprayer Report. . . This report allows the user to request a report on a particular sprayer when spraying a given area, within a given period range, for a given year. In other words, I want to know what Earnie Smutz inspected in area # 65, beginning on April 1 through September

31, for the year 1986.

5. Population Index. . . 'Mosquito Byte' will compute a population index for each area within your abatement. This index is defined by Robert Brand's article in this same publication. The Index is computed for a specific area, within a given period range, for any given species, for a given year. In other words, I want a population index for area # 5, beginning on January 1 through December 31, for *Ae. dorsalis,* for the year 1982. This index is displayed on the screen after its calculation has been completed.
6. Area History Report. . . This report will list all historical records for any given area within any given date range. In other words, I want a report listing all inspection activity for area # 5, beginning February 12, 1984 through May 1, 1984. This report may be viewed either on screen or on hardcopy listing.
7. Individual Table Listings. . . The tables set up by each individual abatement are: Species, Sprayer (Inspector), Areas, Chemicals, Dip Count, Pool Size, Periods, Pool Conditions. Listings of each table can be printed as a hardcopy report or displayed on the screen. These are very helpful when entering area historical records.
8. Individual Pool Report Screen. . . This report will list all historical records for your entire abatement within a given date range. In other words, I want a report listing all inspection activity beginning January 15, 1986 through May 18, 1986. This report may be viewed on the screen or on hardcopy listing.

By reviewing his newly computer generated report, Mr. Brand began noticing population trends within his abatement. Now, instead of just sending his inspectors into an area, he can tell them to look for specific things within specific pools. He can tell them to use a specific chemical because for the past 5 years the one they were using wasn't as cost effective as another. He can tell very accurately, hundreds of things that he couldn't tell before. He has been able to identify specific areas that need more attention. He can now tell how a species will do under all types of pool conditions at all different times of the year. He can evaluate, at a glance, one years productivity against another. He is able to tell how effective a specific inspector is. He can tell if one inspector is faster or more efficient than another. He can now tell, on a historically documented basis, the order in which his areas need to be worked. He can tell what day of the year a specific pool will begin to produce and what species it will produce. He can tell how a specific chemical works on a given species. Truly, with this information, he can develop a better integrated pest management program.

It is one thing to try to envision how and what a computer system will do for you. It is quite another to actually begin using that system. Mr. Brand has happily announced that this software has shown him many things about his abatement that he never expected. Over the next few years he is going to use this new information to bring his district into better shape than it has ever been before. "Best of all," says Mr. Brand, "the computer does all the mundane work while I take the credit at board meetings."

Some of you may be asking "Why I.B.M.?" Well, the world is blue, "I.B.M. Blue". I.B.M. has 93% of the world's computer market. The majority of published computer software is written for the I.B.M. PC or other machines that are I.B.M. compatible. Not only will Mr. Brand be using his I.B.M. compatible machine to run 'Mosquito Byte', he will also be using it as a word processor, he will be using it for accounting purposes, he will be using it to generate spread sheets, he can use it as a desk top manager, he can use it to communicate with other mosquito abatement computers and he can use it to perform a thousand other functions that an I.B.M. computer is capable of doing. I.B.M. compatible software is the most readily available and is certainly among the most affordable.

I am glad Robert Brand thought enough of his idea to wait 6 years to see it through. It was an enjoyable project. As a Senior Analyst, it is always nice to see the artificial intelligence of a computer helping someone realize their dream.

BLACK FLY (DIPTERA: SIMULIIDAE) DISTRIBUTION IN SOUTH SALT LAKE COUNTY

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ABSTRACT: *Simulium* populations have been monitored for the past five years in South Salt Lake County. Efforts have been made to key ultimate instars and pupae to species. Techniques of dissecting and mounting respiratory histoblasts from the ultimate instars were developed. Black fly distribution can be divided into two major categories: the Jordan River and its attendant canals, irrigation streams and ditches, and all other clear, clean mountain streams and springs. *Simulium vittatum* Zetterstedt is the primary species in the Jordan River complex. The following species are currently found in the second category: *Prosimulium exigens* Dyar and Shannon, *S. arcticum* Malloch, *S. argus* Williston, *S. bivittatum* Malloch, *S. canadense* Hearle, *S. hunteri* Malloch, *S. venustrum* Say and *S. tuberosum* Lundstrom.

More work will be required to further understand each unique species along the Wasatch Front bench area and studies need to be expanded to include the anthropophilic nature and biology of these second category species.

UMAA CO-OPERATIVE ENCEPHALITIS SURVEILLANCE IN UTAH, 1986

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Utah has had a long history of encephalitis surveillance (Wagstaff et al. 1986). However, the Utah Mosquito Abatement Association (UMAA) believes that the co-operative encephalitis surveillance program with the Utah State Department of Health (USDH) and the Utah State Department of Agriculture (USDA), which began in 1983, has a greater alerting potential than it's predecessors. Confidence grew in the program in 1985 when no human or equines developed vector-borne encephalitis and there were no Western equine encephalitis (WEE) or St. Louis encephalitis (SLE) antibody isolations from the sentinel chicken flocks, yet western Colorado had an outbreak of SLE.

Expansion of the surveillance program in 1986 was only partially successful. A new sentinel flock was placed at Price in Carbon Co. and Duchesne Co. added a second flock. However, west Millard Co., which had had a flock in 1984 and 1985 dropped out of the surveillance program, and Emery Co. went from three flocks to two. This left the 1986 program with 21 sentinel chicken flocks dispersed among 14 of 29 counties. This is the same number of flocks and counties as in 1985 although distribution was slightly different.

The initial bleedings of the approximately 16-week-old, white, leghorn pullets took place on May 21 at the Utah Co. Public Works complex. Numbered wing tags were placed on all chickens to allow the rechecking of individuals with questionable results. The chickens were then taken to the predetermined locations (Table 1). Subsequent bleedings of the flocks were made biweekly between June 16 and September 8. A final, ninth, bleeding to check on late seasonal viral activity was made on October 6. Blood samples were examined as in previous years by the USDH Serology Laboratory for antibodies to both WEE and SLE (Wagstaff et al. 1986).

Ten chickens were found with encephalitis antibodies in 1986. The only previous antibody isolations in this program were made on September 6, 1983, when 2 chickens from South Salt Lake Co., and 1 from Utah Co. showed antibodies to WEE (Mason 1983). Half of the positives in 1986 were for WEE and the other half for SLE (Table 1). This is believed to be the first SLE antibody isolations from chickens in Utah. Prior to the 1986 mosquito season, SLE antibodies were expected from the Grand Co. flock at Moab since that flock is a short geographical distance and on the same Colorado River drainage as Mesa Co., Colorado where an SLE outbreak occurred in humans in 1985.

The first viral antibody isolations were made from the September 8, 1986 bleedings. There were 2 positive for WEE and 1 for SLE from Uintah Co., and 1 positive for WEE from Duchesne Co. The final bleeding on October 6, showed an additional 6 chickens with encephalitis antibodies: Uintah Co. with 1 SLE and 1 WEE, Duchesne Co. with 2 SLE and Emery Co. with 2 WEE. Eight of the 10 isolations were from Duchesne and Uintah County flocks both within the Uintah Basin.

Fortunately, all of the antibody isolations were late in the mosquito season and no human cases of vector-borne encephalitis were reported. Cool temperatures predominated over the state after the first week of September, thus, no control measures were necessary. If encephalitis antibodies had been found earlier in the mosquito season, the mosquito abatement districts would have taken appropriate control measures to further reduce the *Culex tarsalis* population.

The UMAA, USDH, and the USDA co-operative encephalitis surveillance program will continue in 1987. The same sentinel chicken flock locations will be used next year with the possible addition of one flock in Uintah Co. and the resumming of surveillance in west Millard Co.

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TABLE 1. Chicken flock localities and number with encephalitis antibodies.

County	City	#of chickens w/antibodies WEE	SLE
Box Elder	Mantua	0	0
	Tremonton	0	0
Cache	Hyde Park	0	0
	Logan	0	0
Davis	Kaysville	0	0
Duchesne	Arcadia	0	0
	Ioka	0	3
Emery	Cleveland	2	0
	Molen	0	0
Grand	Moab	0	0
Summit		0	0
Salt Lake	Draper	0	0
	Magna	0	0
	Salt Lake City	0	0
Sevier	Glenwood	0	0
Tooele	Lake Point	0	0
Uintah	Vernal	3	2
Utah	Payson	0	0
	Spanish Fork	0	0
Weber	West Weber	0	0
	TOTAL	5	5

TWENTY YEARS OF ARBOVIRUS STUDIES IN WESTERN UTAH

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The purpose of this paper is to summarize published data that George T. Crane and I have presented previously at Utah Mosquito Abatement Meetings.

Insects were collected each year, 1965-1976 and 1983-1985, with CDC miniature light traps and dry ice attratant. Specimens were sealed in vials, frozen on dry ice and transported to the Dugway Laboratory for assay in suckling mice. Specimens were pooled visually by species, date and site. In 1965 pooling was done in the field with no verification of identifications. After 1965 pooling was done at the Dugway Laboratory on a CDC chill table on which verifications were made under a stereo microscope (Elbel 1968). Insects were pooled and assayed the year of collection except that 1970 specimens were held at -65°C for 18 months prior to processing. Freshly engorged specimens were removed from pools for precipitin studies to determine the blood-meal source. Pools were assayed by intracranial inoculation into suckling mice and isoaltes were identified by neutralization tests in suckling mice (Crane et al. 1970).

The most abundant area for *Aedes dorsalis* and California serogroup (CAL) viruses is Blue Lake, a spring-fed marsh 17 miles south of Wendover, Utah, on the western boundary of the Great Salt Lake Desert. The dominant vegetation at the lake margin is saltgrass (*Distichlis stricta*), bulrushes (*Scirpus* spp.) and pickleweed (*Allenrolfea occidentalis*) with some rabbitbrush (*Chrysothamnus* spp.) and greasewood (*Sarcobatus vermiculatus*). *Ae. dosalis* is abundant in the flooded saltgrass.

Correlation between arboviruses and climate in Utah was first noted by Graham et al. (1960); the abundance of *Culex tarsalis* and Western equine encephalitis (WEE) in horses were associated with above normal precipitation in May or June and an unusually dry July and early August. Hess et al. (1963) added a temperature factor; WEE transmission rates in avian sentinels were favored by unusually cool, wet springs. Thus, we expected more arboviruses in years with above normal precipitation and below normal average temperature in May or June or both. These years were 1965, 1967-1969, 1971 and 1975 but as indicted by values for infection ratio (IR) (mosquitoes/isolates), CAL viruses at Blue Lake are not affected by climate (Crane & Elbel 1976). The highest and lowest IR values were in 1967 and 1968, years with above normal precipitation May, June and July and below normal average temperature at least in May. The second highest IR was in 1974, a year with below normal precipitation in May and June and above normal temperature May, June and July.

Crane et al. (1977) demonstrated transovarial transmission of California encephalitis subtype (CE) virus in *Ae. dorsalis* at Blue Lake. Mosquito larvae, collected May to August 1975, were reared to adults which were assayed for arboviruses. CE virus was isolated twice from *Ae. dorsalis,* once from a pool of males and once from a pool of females that were reared from larvae collected 4 June. This is the first report of transovarial transmission of CE virus in *Ae. dorsalis* or in any aedine in western United States and may account for the abundance at Blue Lake of CAL viruses which likely are maintained by transovarial transmission in *Ae. dorsalis* regardless of climate or availability of hosts.

The first year of study was 1965 (Table 1) and collections were made at 6 areas in Western Utah (Smart et al. 1972a). *Ae. dorsalis* accounted for 97% of 228,590 mosquitoes of which 81% were at Blue Lake and 89% of the arbovirus isolations were from *Ae. dorsalis* at Blue Lake. Only 143 of 559 isolates were specifically identified. Of 107 CAL virus isolations, 94% were from *Ae. dorsalis.* There were 62 WEE virus isolations, all from *Ae. dorsalis* at Blue Lake except for 1 at Callao. Both viruses were found in each of 26 *Ae. dorsalis* pools at Blue Lake.

Surveys in 1966 and 1967 (Table1) were at Callao, a small farming community east of the Deep Creek Mountains in western Utah (Elbel et al. 1971). CAL virus isolations were 2 from 38,776 mosquitoes in 1966 and 43 from 36,972 mosquitoes in 1967 so over 20 times more CAL viruses were isolated in 1967 from slightly fewer mosquitoes than in 1966. The difference was attributed to climate since May and June 1966 were warm and dry but these months in 1967 were cool and wet. Most of the CAL viruses were isolated from *Ae. dorsalis* and *Cs. inornata* which was considered the best vector because of the larger number of high IR values. One Cache Valley (CV) virus each was isolated from *Anopheles freeborni* in 1966 and *Cs. inornata* in 1967.

In a 1967 survey (Table 1) of Cedar and Utah valleys in central Utah (Crane et al 1970), 18,878 mosquitoes yielded 23 arboviruses, 8 Hart Park from *Cx tarsalis* and 15 CAL of which 6 were from *Ae. dorsalis* and 7 were from *Cs. inornata* which was indicated as the best vector because of the highest total IR.

Additional studies in 1967-1976 (Table 1) were at 7 areas in western Utah (Crane et al. 1983). From 215,150 pooled specimens, there were 307 arboviruses, 256 CAL, 35 Main Drain (MD), 9 Lokern (LOK), 6 CV and 1 WEE which was from *Ae. dorsalis* at Fish Springs in 1968. Only 47% of the pooled insects but 91% of the CAL virus isolations were from *Ae. dorsalis,* 64% of which were at Blue Lake where *Ae. dorsalis* constituted 84% of the pooled mosquitoes. CAL viruses were isolated from *Ae. dorsalis* at each of the 7 areas. Other CAL virus isolations were 11 from *Psorophora signipennis* at Ditto Dunes and 8 from *Cs. inornata,* mostly at Ibapah west of the Deep Creek Mountains in western Utah. Ditto Dunes, vegetated sand dunes 16 km west of Dugway, accounted for 66% of the MD viruses, 20 from *Ps. signipennis* and 3 from *Ae. nigromaculis.* Most of 9 MD virus isolations from *Ae. dorsalis* were at Blue Lake. For LOK virus, which was not reported previously from Utah, 7 isolations were from the biting midge, *Culicoides variipennis,* at Fish Springs and Callao. *Cs. inornata* at Hickman Canyon, east of the Stansbury Mountains in western Utah, accounted for 5 of 6 CV virus isolations.

At Fish Springs National Wildlife Refuge on the southern boundary of the Great Salt Lake Desert, redirection of water

from a canal to a marshland apparently controlled CAL viruses by changing the mosquito dominance from *Ae. dorsalis* to *Cx. erythrothorax* from which there were no CAL virus isolations.

Precipitin tests on 347 blood-engorged insects from western Utah showed that most feedings were by *Ae. dorsalis* on rabbits at the marshes of Fish Springs and Blue Lake and on cattle at the farming community of Callao. All feedings at Ditto Dunes were on rabbits, 57% by *Ps, signipennis* and 31% by *Ae. nigromaculis.* From *Cs. inornata,* 31 feedings on cattle were mostly at Callao. *Cx. tarsalis* fed mainly on rabbits at Fish Springs and Blue Lake but on rabbits and cattle at Callao.

The 1971 epidemic of Venezuelan equine encephalitis (VEE) in Mexico and Texas (Sudia et al. 1975) prompted surveillance in 1972 to intercept VEE along the most likely path of entry into Utah. Drs. L. T. Nielsen and D. M. Rees helped select sites (Elbel et al. 1972). Insects were collected in 1972-1975 (Table 1) at Bloomington, Middleton and Washington Field near St. George, Utah and Beaver Dam Wash, Arizona (Smart, et ala. 1972b, Elbel et al. 1977). Of 22,640 insects, 61/ were collected at Bloomington and Beaver Dam Wash and 11 of 13 arbovirus isolations were at these 2 sites. There were 7 isolations of WEE virus, 1 from *Cx. tarsalis* at Washington Field and 6 at Bloomington, 5 from *Cx. tarsalis* and 1 from a pool of rubbed *Culex* abdomens which could have been either *Cx. tarsalis* or *Cx. thriambus.* One MD virus was isolated from *C. variipennis* at Middleton.

Isolations at Beaver Dam Wash in 1973 were 1 Jamestown Canyon, a CAL virus, from *Cs. inornata* and 1 St. Louis encephalitis (SLE) virus from *Cx. tarsalis.* SLE virus had not yet been isolated in Utah but was isolated in southern California, southern Arizona, New Mexico and Mexico which may suggest that Beaver Dam Wash can serve as a pathway for viruses into Utah. The presence of SLE could have been anticipated since total precipitation was below normal and average temperature was above normal each month, May to October. Hess et al. (1963) stated that SLE was favored by unusually warm, dry springs in contrast to WEE which was favored by unusually cool, wet springs as mentioned previously. In 1974 an Anopheles A Group (ANA) and 2 MD viruses were isolated from *An. freeborni.* No ANA virus had been found previously north of Guatemala so how did the virus transfer from the tropics to Beaver Dam Wash in the Lower Sonaran Life Zone? Establishment is unlikely and the ANA virus was not found again in 1975. However, if a tropical ANA virus can reach Beaver Dam Wash, why not also VEE? The ANA virus was described by Calisher et al. (1980, 1982). Viruses are named for the locality from which originally collected but Beaver Dam Wash Virus sounds blunt so, at Dr. Nielsen's suggestion, the virus was named the Virgin River Virus which is appropriate since light traps were along the Beaver Dam Wash just above the union with the Virgin River in the Virgin River Basin.

Precipitin tests on 83 blood-engorged insects from southern Utah showed that there were 34 feedings on cattle, 15 at Washington Field and 12 at Bloomington, 11 by *Ae. dorsalis,* 8 by *Cs. inornata,* 6 by *Ae. vexans* and 3 each by *Cx. tarsalis, An. franciscanus* and *An. freeborni.* There were 31 feedings on rabbits, 16 at Middleton, 9 at Bloomington and 6 at Beaver Dam Wash, 11 each by *An. franciscanus* and *An. freeborni,* 5 by *Ae. vexans* and 3 by *C. variipennis.*

The 1983-1984 survey (Table 1) was reported by (Crane et al. 1985). In 1983 at Blue Lake, 10,380 mosquitoes were collected of which 80% were *Ae. dorsalis,* 14% were *Cx. tarsalis* and there was 1 CAL virus isolation from *Ae. dorsalis.* In 1984 at Fish Springs, Callao and Blue Lake, 57,341 mosquitoes were collected, about 5 $^1/_2$ times more than in 1983. Of the total mosquitoes, 40% were *Ae. dorsalis* of which 62% were at Blue Lake and 47% were *Cx. erythrothorax* of which 66% were at Fish Springs. All 67 isolations were from *Ae. dorsalis* of which 85% were at Blue Lake. Isolations were 63 CAL viruses, 1 Bunyamwera serogroup (BUN) virus and 3 pools of mixed CAL-BUN viruses. In both 1983 and 1984 for western Utah, June was cool and wet (climatological Data, Utah 1983-1984) so virus abundance in 1984 cannot be explained by climate. In 1985 about 80,000 mosquitoes were collected at Fish Springs, Callao and Blue Lake. Nearly 800 pools of identified mosquito suspensions were sent to the Division of Vector-Borne Viral Diseases, CDC, Ft. Collins, CO., for viral assay when funds become available.

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TABLE 1. ARBOVIRUS ISOLATIONS FROM INSECTS COLLECTED BY LIGHT TRAPS IN WESTERN UTAH, 1965-1985.
Number of pooled insects and (virus isolations)[1]

Year (Publ.)	*Ae dorsalis*	*Ae. nigromaculis*	*Ae. vexans*	*An. freeborni*	*Cs. inornata*	*Cx.tarsalis*	*Cx.erythrothorax*	*Ps.signipennis*	*C.variipennis*	Others pooled[2]	Total
1965 Smart et.al. 1972a)	222482 (75C,36W, 26CW, 415U)	1307 (1C,1U		149	1469 (2C)	2112 (3C)	957			114	228590 *(81C,36W, 26CW,416U)*
1966	4852 (1C)			8427 (1V)	4302 (1C)	18503	2560			132	*38776 (2C1V)*
1967 (Elbel et at. 1971)	15583 (19C			2601 (1C)	5474 (22C,1V)	11307 (1C)	1232			775	*36972 (43C,1V)*
1967 (Crane et at. 1970)	9968 (6C)				1428 (7C)	5430 (1C,8H)	348 (1C)			1704	18878 (15C,8H)
1967-1976 (Crane et al. 1983)	100683 (233C,9M, 1V,1W	5380 (2C,3M)	2057 (1C)		5502 (8C,1M, 5V)	25014 (1C)	15896	15111 (11C,20M) 2L)	4635 (2M,7L)	40872	215150 *(256C,35M, 9L,6V,1W)*
1972-1975 (Elbel et al. 1977)	4998		3799	2319 (2M,1A)	520 (1J)	2733 (6W,1S)	100		1407 (1M)	6764 (1W)[3]	*22640 (7W,3M,1A, 1J,1S)*
1983	8359 (1C)	300	5	42	14	1493	3			511	10380 (1C)
1984 (Crane et al. 1985)	22911 (63C,1B, 3CB)				225	6252	27151			455	*57341 (63C,1B,3CB)*

[1] C-California serogroup, W-Western equine encephalitis, CW-mixed California serogroup-Western equine encephalitis, U-unidentified, V-Cache Valley, H-Hart Park, M-Main Drain, L-Lokern, A-Virgin River, J-Jamestown Canyon, S-St. Louis encephalitis, B-Bunyamwera serogroup, CB-mixed California serogroup Bunyamwera serogroup.

[2] Specimens with no virus isolations and insects included here that were not assayed for virus.

[3] Western eqine encephalitis from pool of 25 rubbed *Culex* abdomens.

TITLES PUBLISHED ONLY

Thirty-Ninth Annual Meeting

"Mosquito Control in Winnipeg, Canada." Roy A. Ellis,
City Entomologist, Winnipeg, Manitoba, Canada.
"*Aedes albopictus* Infections and Public Health, Implications in U.S."
Bruce Francy, Chief Arbovirus Ecology Branch, Vector-borne Diseases Section,
CDC, Fort Collins, Colorado.
"East Bay-Farmington Bay Water Quality Considerations After Great Salt Lake Inter Island Diking."
Darwin L. Sorensen, Utah Water Research Laboratory,
Utah State University, Logan, Utah.
"B.t.i. -- Where Are We?" Mitch Rohlfs, Research Specialist,
Abbott Laboratories, Yakima, Washington.
"Update of Mormon Cricket Infestation in N.E. Utah and N.W. Colorado."
Steven V. Romney, Director, and Randel M. Sessions, Assistant Director,
Uintah County M.A.D., Vernal, Utah.
"Report of Mosquito Control Experiences in Sevier County."
Earl Slack, Supervisor of Weed and Mosquito Control,
Sevier County, Richfield, Utah.
"Evaluation of Scourge Formulations for Aerial Application."
Robert Sanderson, Department of Entomology and Plant Patholody,
New Mexico State University, Las Cruces, New Mexico.
"Addresses Pertaining to Trustees Roles in Mosquito Control."
Mike Stewart, Trustee, South Salt Lake County M.A.D., Midvale, Utah.
Clifford Brown, Trustee, South Salt Lake County M.A.D., Midvale, Utah.
Lynn Thatcher, Trustee, Salt Lake City M.A.D., Salt Lake City, Utah.
Verl Peterson, Trustee, Box Elder County M.A.D., Brigham City, Utah.
"Uniform Accounting Manual for Special Districts."
MacRay Curtis, Audit Manager, Uniform Accounting Division,
State Auditors Office, Salt Lake City, Utah.
"Vector Borne Animal Diseases in 1986."
Michael R. Marshall, State Veterinarian, Director of Animal Industry,
State of Utah, Salt Lake City, Utah.
"Effects From Flooding on Mosquito Control Along the Wasatch Front 1983-86."
Panel: Glen Collett, Manager, Salt Lake City M.A.D., Salt Lake City, Utah.
Rex Passey, Manager, Davis County M.A.D., Kaysville, Utah.
Bruce Bennett, Field Supervisor, Weber County M.A.D., Ogden, Utah.
Larry Nielsen, Manager, Box Elder County M.A.D., Brigham City, Utah.
Lewis Marrott, Field Supervisor, Utah County M.A.D., Provo, Utah.

UTAH STATE HEALTH CODE
CHAPTER 27
MOSQUITO ABATEMENT DISTRICTS

Section

26-27.1 Organization authorized.
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26-27-3. Petition for -- Signers -- Contents -- Publication.
26-27-4. Petition -- Hearing -- Notice.
26-27.5. Findings -- Order thereon -- Name -- When incorporation complete.
26-27.6. Board of trustees -- Appointment --Number -- Term.
26-27.7. Board of trustees -- Organization -- Meetings -- Vacancies -- Quorum.
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26-27.9. Taxation -- Limit of levy.
26-27.10. Taxation -- Additional levy -- Election.
26-27.11. Collection and disbursement of taxes.
26-27.12. Annexation of area into mosquito abatement district -- Conditions -- Procedures -- Petition -- Resolution -- Protests.
26-27.13. Dissolution -- Election -- Apaportionment of property.
26-27.14. Notices -- Publication and posting.

26-27-1. Organization authorized. Mosquito abatement districts may be organized, incorporated, and managed as provided in this chapter and may exercise the powers herein expressly granted or necessarily implied.

History: C. 1953, 26-27-1, enacted by L. 1981, ch. 126, § 26.

Compiler's Notes. Laws 1981, ch. 126, § 1 repealed old sections 26-27-1 to 26-27-4 (L. 1969, ch. 205, §§ 1 to 4; 1973, ch. 43, § 1; 1975, ch. 65, §§ 1 to 3; 1977, ch. 108, § 1), relating to elimination of architectural barriers for handicapped. New sections 26-27-1 to 26-27-14 were enacted by § 26 of the act. For present provisions, see 26-29-1 et. seq.

26-27-2. District may include county, municipality or portion thereof -- Minimum population. Any municipality or county or portion of a municipality or county having a population of not less than 100 inhabitants, whether such portion includes incorporated territory or not, may be created a mosquito abatement district.

History: C. 1953, 26-27-2, enacted by L. 1981, ch. 126, § 26.

26-27-3. Petition for -- Signers -- Contents -- Publication. (1) A petition, which may consist of any number of separate instruments, shall be presented to the board of commissioners of the county in which the proposed mosquito abatement district is located at a regular meeting thereof, signed by registered voters within the boundaries of the proposed district, equal in number to at least 10% of the number of votes cast in the proposed district for the office of governor at the last general election prior to the presenting of the petition.

(2) Where all or part of one or more municipalities is included in the proposed district, the petition shall be signed by at least 10/ of the registered voters of such municipality, or parts thereof, and of the unincorporated territory included in the proposed district, and in addition thereto the governing body of each municipality shall by resolution request the inclusion of such municipality thereof in the proposed district.

(3) The petition shall describe the proposed boundaries of the district and pray that it be created a mosquito abatement district.

(4) The text of the petition shall be published, for at least two weeks before the time when it is to be presented, in a newspaper published in the county, and also in a newspaper published in each municipality or part thereof included in the proposed district, or if there is no such newspaper the text of the petition shall be posted for the same length of time in three public places within the county and within each municipality or part thereof included in the proposed district. When contained in more than one instrument, only one copy of the petition need be published and posted. Not more than five of the names attached to the petition need appear in the publication or posting, but the number of signers shall be stated.

History: C. 1953, 26-27-3, enacted by L. 1981, ch. 126, § 26.

26-27-4. Petition -- Hearing -- Notice. (1) With the petition there shall be published, and, if posted, there shall be posted a notice stating the time of the meeting of the board of county commissioners when the petition will be considered, and that all interested persons may appear and be heard.

(2) At that time the board shall hear the petition and all protests and objections to the same, and may adjourn such hearing from time to time, not exceeding two months in all.

(3) No defect in the contents of the petition or in the title to or form of the notice or signatures, or lack of signatures, shall vitiate any proceedings thereon, provided the petition has a sufficient number of qualified signatures attached thereto.

(4) On the final hearing the board may make changes in the proposed boundaries as it deems advisable, and shall define and establish such boundaries.

(5) If the board deems it proper to include any territory not included within the original proposed boundaries, it shall cause notice of its intention to be mailed to each owner of land within the additional territory whose name appears as such on the last completed assessment roll of the county. The notice shall be addressed to the owner at the address given on the assessment roll, or, if no address is given, then to the last known address, or, if it is not known, then to the owner at the county seat of the county in which the land lies. This notice shall describe the territory proposed to be included, and fix a time, not less than two weeks from the date of mailing, when all persons interested may appear before the board and be heard.

(6) Boundaries lying within a municipality shall not be altered under Subsection (5) unless the governing body

of the municipality shall, by resolution, assent to the alterations.

History: C. 1953, 26-27-5, enacted by L. 1981, ch. 126, § 26.

26-27-5. Findings -- Order thereon -- Name -- When incorporation complete. (1) Upon the hearing the board shall determine whether or not public necessity or welfare of the proposed territory and of the inhabitants thereof, requires the formation of the district and whether or not the petition complies with the provisions of this chapter. A finding of the board in favor of the genuineness and sufficiency of the petition and notice shall be final and conclusive against all persons except the state.

(2) If it appears to the board that public necessity or welfare requires the formation of the district, it shall, by order entered on its minutes, declare such to be its finding, and order that the territory within the boundaries so fixed be created a mosquito abatement district under an appropriate name selected by the board, which name shall contain the words "mosquito abatement district."

(3) The county clerk shall immediately cause to be filed with the lieutenant governor a certified copy of the order of the board, and thereafter the district shall be deemed incorporated as a mosquito abatement district, with all the rights, privileges, and powers set forth in this chapter and necessarily incident thereto.

History: C. 1953, 26-27-5, enacted by L. 1981, ch. 126, § 26.

26-27-6. Board of trustees -- Appointment -- Number -- Term. (1) Within 30 days after the filing with the lieutenant governor of the certificate of incorporation of trustees shall be appointed for the mosquito abatement district. The board shall consist of one trustee appointed from the district at large by the board of county commissioners, and of one trustee appointed from each municipality therein by the governing body of such municipality; provided, that if the board of trustees consists of less than five members, the board of county commissioners shall appoint from such district at large enough additional members to make a board of five trustees, provided further, that if 75% or more of the lands in the district are wholly within the boundaries of a municipality, all five members of the board of trustees shall be appointed by the governing board of such municipality. The governing board of such district shall be known as "The board of trustees of _____ mosquito abatement district."

(2) Each trustee appointed by the governing body of a municipality shall be a registered voter of the municipality and each appointee of the board of county commissioners shall be an elector of the district.

(3) All trustees shall hold office for a term of two years from the second day of January following their appointment; provided, that the first board of trustees appointed shall at their first meeting classify themselves by lot so that one half of their number, if the total membership is an even number, and if uneven, that a bare majority of their number, shall go out of office at the expiration of one year and the remainder, at the expiration of two years, from the second day of January following their appointment.

History: C. 1953, 26-27-6, enacted by L. 1981, ch. 126, § 26.

26-27-7. Board of trustees -- Organization -- Meetings -- Vacancies -- Quorum. (1) The members of the board of trustees shall meet on the first Monday subsequent to 30 days after the filing with the lieutenant governor of the certificate of incorporation, and shall organize by electing one of their members as president and one as secretary. The members of the board shall serve without compensation, except that the necessary expenses of each member for actual traveling expenses on meetings or business connected with the board shall be allowed and paid.

(2) In the event of the resignation, death, or disability of any trustee his successor shall be appointed by the board of county commissioners or governing body which originally appointed the member who resigned, died, or is disabled.

(3) The board of trustees shall provide for the time, place, and manner of calling its regular meetings, and shall establish rules for its proceedings. Special meetings may be called by three trustees, and notice thereof shall be given to each member at least three hours before the meeting. All meetings shall be open to the public, and the majority of the members of the board shall constitute a quorum for the transaction of business.

History: C. 1953, 26-27-7, enacted by L. 1981, ch. 126, § 26.

26-27-8. Powers of board of trustees. The board of trustees may:

(1) take all necessary and proper steps for the extermination of mosquitoes, flies, crickets, grasshoppers, and other insects within the district and to abate as nuisances all stagnant pools of water and other breeding places for mosquitoes, flies, crickets, grasshoppers, or other insects anywhere in the state situated so that mosquitoes therefrom may migrate into the district;

(2) enter upon territory referred to in Subsection (1) to inspect and examine the same, and remove therefrom without notice, stagnant water or other breeding places for mosquitoes, flies, crickets, grasshoppers, or other insects;

(3) purchase such supplies and materials and employ labor necessary or proper in furtherance of the purposes of this chapter, and if necessary or proper, build, construct, repair, and maintain necessary levees, cuts, canals, or channels upon any land within the district, and acquire by purchase, condemnation, or other lawful means in the name of the district any necessary lands, rights of way, easements, property, or materials requisite or necessary for any of such purposes; and

(4) make contracts to indemnify or compensate any owner of land or other property for any injury or damage necessarily caused by the exercise of its powers or arising out of the use, taking, or damage of property for any such purposes and generally to do any and all things necessary or incident to its powers and to carry out the purposes of this chapter.

History: C. 1953, 26-27-8, enacted by L. 1981, ch. 126, § 26; L. 1983, ch. 138, § 1.

Compiler's Notes: The 1983 amendment inserted "crickets, grasshoppers" throughout subsecs. (1) and (2).

Cross-References. Eminent domain, 78-34-1 et. seq.

26-27-9. Taxation -- Limit of levy. The board of trustees of each mosquito abatement district shall:

(1) Furnish to the board of county commissioners and to the county auditor of the county in which the district is situated, in writing, an estimate of the amount of money necessary for all purposes required under this chapter during the next ensuing fiscal year. Such estimate shall be furnished at least 15 days before the first day of the month in which the board of county commissioners is required by law to levy the taxes required for county purposes.

(2) The board of county commissioners shall thereafter, at the time and in the manner of levying other county or city and county taxes, but without additional compensation for assessing and collecting, levy upon all of the taxable property within the district and cause to be collected a tax, to be known as the "_____ mosquito abatement district tax." The maximum rate of the tax shall not exceed that which is sufficient to raise the amount estimated to be necessary by the board of trustees, and shall not exceed .0004 of taxable property in the district.

History: C. 1953, 26-27-9, enacted by L. 1981, ch. 126, § 26; 1985.

26-27-10. Taxation -- Additional levy -- Election. (1) When it appears to the board of trustees that the funds required during the next ensuing fiscal year will exceed the maximum amount which the county commissioners are authorized to levy for the annual district tax, the board of trustees may call an election and submit to the electors of the district the question of whether a tax shall be voted for raising the necessary additional funds.

(2) Notice of the election therefore shall be published for at least four weeks prior to the election in a newspaper published in the district.

(3) No particular form of ballot shall be required, and no informalities in conducting the election shall invalidate the same, if the election is otherwise fairly conducted.

(4) At the election the ballots shall contain the words, "Shall the district vote a tax to raise the additional sum of $_____?"

(5) The board of trustees shall canvass the votes cast at the election, and, if a majority of the votes cast are in favor of the imposition of the tax, the board of trustees shall report the same to the board of county commissioners, stating the additional amount of money required to be raised.

(6) The board of county commissioners shall at the time of levying general county taxes levy an additional tax upon all of the taxable property in the district voting such additional tax.

History: C. 1953, 26-27-10, enacted by L. 1981, ch. 126, § 26.

27-27-11. Collection and disbursement of taxes. All taxes levied under this chapter shall be computed and entered on the assessment roll, and collected at the same time and in the same menner as state and county taxes, and when collected shall be paid into the county treasury for the use of the district. The funds shall be withdrawn from the county treasury upon the warrant of the board of trustees of the mosquito abatement district, signed by the president, or acting president, of the board and countersigned by its secretary.

History: C. 1953, 26-27-11, enacted by L. 1981, ch. 126, § 26.

26-27-12. Annexation of area into mosquito abatement district - Conditions - Procedures - Petition - Resolution - Protests.

(1) Any board of county commissioners, upon its own motion, may by resolution declare that the public health, convenience, and necessity requires the annexation of an area into a mosquito abatement district either:

(a) there is presented to the board of county commissioners a petition setting forth the area and boundaries proposed to be annexed to the district, signed by (i) the legislative body of any city or town included or partially included within the area, or (ii) by 25% or more of the owners of real property included within the proposed area, or (iii) 10% of the registered voters of the area; or

(b) the annexing district is already providing district services for the proposed area, then it is the duty of the board of county commissioners to adopt the resolution.

(2) After the resolution has been adopted, the Board shall give notice of its intention to annex the area to a specified mosquito abatement district. The notice shall define the area and the boundaries to be annexed and shall describe the services to be provided. The notice shall be published in a newspaper of general circulation for three successive weeks, and shall designate a time and place not more than 40 days nor less than 21 days after the first publication, where all interested parties may be heard in support or in opposition to the annexation. If a written protest signed by more than 25% in number of the real property owners according to the last assessment roll within the area proposed for annexation or by more than 30% of the registered voters in the area is filed with the county clerk within 30 days after the conclusion of the hearing, then the annexation shall not be completed. Upon completion, however, the county clerk shall notify the board of trustees of the district, together with any other notifications to the lieutenant governor and State Tax Commission required by law.

History: C. 1953, 26-27-12, enacted by L. 1981, ch. 126, § 26, 1985.

26-27-13. Dissolution - Election - Apportionment of property.

(1) A mosquito abatement district may at any time be dissolved upon the vote of a majority of the votes cast at an election called by its board of trustees on the question of dissolution. An election on the question of dissolution shall be called by the board of trustees if a petition requesting dissolution is presented to the board of trustees, signed by registered voters within the boundaries of the district equal in number to at least 30% of the votes cast in the district for the office of governor in the last general election prior to presentation of the petition.

(2) The proposition which shall be submitted to the electors shall be "Shall the _____ (naming district) mosquito abatement district be dissolved?"

(3) The election shall be held in conjunction with the next general election following the date a petition is presented to

the board of trustees in accordance with Subsection (1). Notice of the election shall be published for at least four weeks prior thereto in a newspaper published in the district.

(4) Between the date a petition for dissolution is presented to the board of trustees and the date of the election, no capital expenditures may be made by the board of trustees.

(5) If a majority of the votes cast at the election are in favor of dissolution, the board of trustees shall certify that fact to the lieutenant governor, who shall issue a certificate reciting that the mosquito abatement district has been dissolved.

(6) A copy of the certificate shall be transmitted to and filed with the county clerk of the county in which the mosquito abatement district is located.

(7) From the date of the certificate, the district shall be deemed disincorporated, and the property of the district shall vest in the county in which the district is located if the district comprises unincorporated territory alone. If the district comprises partly incorporated and partly unincorporated territory, its property shall be ratably apportioned among the municipalities and the county in proportion to the assessed value of the property included within the district as shown upon the last county assessment role. However, any real property, easements, or rights-of-way belonging to the district shall remain the property of the municipality wherein they are located, otherwise, they shall remain the property of the county.

History: C. 1952, 26-27-13, enacted by L. 1981, ch. 126, § 26; 1987.

26-27-14. Notices -- Publication and posting. Every notice required by this chapter to be published may be published in a daily or weekly newspaper. If there is no such newspaper within the district or other territory wherein the notice is required to be published, the notice shall be posted in three public places therein for the length of time required for publication.

History: C 1953, 26-27-14, enacted by L. 1981, ch. 126, §4 26.