Proceedings of the

Forty-Fifth Annual Meeting

of the

UTAH MOSQUITO ABATEMENT ASSOCIATION

Held at the

Little America Hotel
Salt Lake City, Utah

October 4-6, 1992

Edited By

SAMMIE LEE DICKSON

UTAH MOSQUITO ABATEMENT ASSOCIATION
P. O. Box 788
Grantsville, Utah 84029

TABLE OF CONTENTS

1992 OFFICERS

President . . . . John Jaussi
President-Elect . . . . Keith Wagstaff
Vice President . . . . Evan R. Lusty
Secretary-Treasurer . . . . Robert J Brand
Past-President . . . . Douglas T. Brown

DIRECTORS

Box Elder County . . . . . . J. Lawrence Nielsen
Box 566
Brigham City, UT 84302

Carbon County . . . . Mike Johnson
Route 3, Box 145 A
Price, UT 84501

Davis County . . . . Keith Ipson
85 North 600 West
Kaysville, UT 84037

Duchesne County . . . . Kay Weight
P. O. Box 1951
Roosevelt, UT 84156

Emery County . . . . E. James Nielsen
P. O. Box 72
Castle Dale, UT 84156

Grand County . . . . Art Secrest
P. O. Box 142
Moab, Utah 84532

Logan City . . . . Elmer Kingsford
255 North Main
Logan, UT 84321

Magna . . . . Evan R. Lusty
P. O. Box 40
Magna, Utah 84044

North Summit County . . . . John L. Jaussi
P. O. Box 523
Coalville, UT 84017

Salt Lake City . . . . Sammie L. Dickson
P. O. Box 16189
Salt Lake City, UT 84116

Sevier County . . . . John Johnson
230 E. 200 S.
Monroe, UT 84754

South Salt Lake County . . . . . . Keith Wagstaff
P. O. Box 367
Midvale, UT 84047

Tooele Valley . . . . Robert J Brand
P. O. Box 788
Grantsville, UT 84029

Uintah County . . . . Steven V. Romney
P. O. Box 983
Vernal, UT 84078

Utah County . . . . Lewis Marrott
2855 South State
Provo, UT 84601

Weber County . . . . Dallas Nelson
505 West 12th Street
Ogden, UT 84404

West Millard County . . . . Eldon Rowley
Route 1 Box 303
Delta, UT 84624

UMAA COMMITTEES

AUDITING
Kay Weight, Chairman
Steven Romney

AWARDS
Douglas T. Brown, Chairman
Lewis T. Nielsen
Kay Weight
Sammie Lee Dickson

ENCEPHALITIS SURVEILLANCE
Keith H. Wagstaff, Chairman
Glen Collett
Gary Hatch
James Nielsen

ENVIRONMENTAL IMPACT
Lewis Marrott, Chairman
Dallas Nelson

LEGISLATIVE & RESOLUTIONS
Kenneth Minson, Chairman
Robert J Brand
John Newman
Glen Collett

LOCAL ARRANGEMENTS
Sammie Dickson, Chairman
Gary Hatch

NEWSLETTER COMMITTEE
Glen Collett, Chairman
Lewis T. Nielsen

NOMINATING
Doug Brown, Chairman
Eldon Rowley
Evan Lusty
Sammie Dickson

PESTICIDE COMMITTEE
Sammie Dickson, Chairman
Keith Ipson
Gary King
Howard Deer

POLICY, FINANCE & BY-LAWS
Keith Wagstaff, Chairman
Robert J Brand
J. Lawrence Nielsen

PROGRAM
Glen Collett, Chairman
Bruce Bennett
Eldon Marshall

PUBLICATIONS
Sammie Dickson, Chairman
Evan Lusty
Robert J Brand
Lewis T. Nielsen

ULV TASK FORCE
Lewis Marrott, Chairman
Sammie Dickson
Steven Romney
J. Lawrence Nielsen
Robert J Brand

UTAH MOSQUITO CONTROL - FISH & WILDLIFE MANAGEMENT COORDINATING
Steven Romney, Chairman
J. Lawrence Nielsen
Randy Sessions

WORKSHOP
Lewis T. Nielsen, Chairman
Glen Collett
Sammie Dickson

UMAA SUSTAINING MEMBERS

Abbott Laboratories
Linda T. Roberts
10711 Estes Road
Yakima, WA 98908

Agricultural Aviation
Howard Harding
Roosevelt, UT 84066

Allwest Sales & Service
Bud Miller
570 W. 3710 South
S L City, UT 84115

American Cyanamid
Charles Galley
1 Cyanamid Plaza
Wayne, NJ 07470

American Mosquito Mgt. Insurance Assn.
Robert Hyde
1500 Colonial Blvd., #233
Ft. Myers, FL 33907

Beecomist Systems
Ed Kutzner
31 Meetinghouse Rd.
Telford, PA 18969

BVA Oils
David Vincent
P. O. Box 6042
Wixom, MI 48393

Clarke Mosquito Control Products
Larry Erikson
P. O. Box 72288
Roselle, IL 60172

Cornbelt Chemical
Scott Benfer
4500 Lowell Blvd.
Denver, CO 80211

Fennimore Chemical
H. B. Munns
P. O. Box 338
Pioneer, CA 95666

Intermountain Farmers Association
Ron Ellis
P. O. Box 30168
S L City, UT 84130-0168

Lowndes Engineering
Kern Walcher
P. O. Box 488
Valdosta, GA 31601

Novo Nordisk
W. Michael King
P. O. Box 1907
Danbury, CT 06810

Points West Argo, Inc.
Tom Tomlinson
730 N. Washington Blvd.
Yuba City, CA 95991

Quality Unlimited Prod.
Shelby Woodall
P. O. Box 6918
N. Little Rock, AK 72116

Reliable Labs
Reg Green
8060 Telford Way
Sandy, UT 84092

Roussell UCLAF
Doreen Weatherby
201 Route 17 North
Rutherford, NJ 07070

R V Specialists, Inc.
Kevin Smith
828 W. South Temple
S L City, UT 84104

Snake River Chemical
Steve Westover
118 East 12675 South
S L City, UT 84104

Target Specialty Products
Casey Brierley
1280 N. 10th Street
San Jose, CA 95112

Utah Local Governments Trust
Monty Eggett
560 E. 200 S. Suite 200
S L City, UT 84102

Van Waters & Rogers
Dean Hill
P. O. Box 2369
S L City, UT 84110

VecTec
Issac Dyals
6984 Venture Cir.
Orlando, FL 32807

Zanus Corporation
David Sullivan
1259 El Camino Real, #134
Menlo Park, CA 94025

Zoecon Corporation
Carl Tanner
12005 Ford Rd., Suite 800
Dallas, TX 75234

UMAA - Individual Members

Bradley Asay . . . . Evanston, WY

Merlin Ashman . . . . Richfield, UT

Scott Benfer . . . . Denver, CO

Ted Davis . . . . Denver, CO

Robert E. Elbel . . . . Salt Lake City, UT

Don Elison . . . . Sacramento, CA

Robin Gray . . . . Winnemucca, NV

Cyrus Lesser . . . . Salisbury, MD

Lewis T. Nielsen . . . . Salt Lake City, UT

Jennifer O'Brien . . . . Fallon, NV

Ron Peterson . . . . Montpelier, ID

Ron Vaugh . . . . Emmett, ID

MERITORIOUS SERVICE AWARD

The Meritorious Service Award is presented to persons who have furthered mosquito abatement efforts in Utah in a manner far exceeding what was expected of them. The Utah Mosquito Abatement Association first presented this award in 1970. The 1992 awardee and 21st recipient of this award is **Dallas Nelson.**

Dallas Nelson has been a friend and colleague of UMAA members for many years. He has served on UMAA committees ranging from Awards, Auditing, Environmental Impact, Nominating, Resolutions and Policy and Finance. **Dallas** never served as an officer of the Association despite our repeated attempts to volunteer him. Instead, he chose to offer knowledgeable counsel and wisdom in a quiet and unassuming manner.

Dallas started his mosquito abatement career with the Weber County MAD in March 1953, as a field operator. Later he became a laboratory technician identifying adult and larval mosquito collections. In 1964, **Dallas** was appointed assistant director of the Weber County MAD until 1979 when he assumed the role of District Manager where he served until his retirement earlier this year. His career has spanned more than 39 years.

The UMAA has benefited greatly by its association with **Dallas Nelson**, and it is with great pride that he is awarded with this justly deserved recognition.

ADDRESSING ENVIRONMENTAL CONCERNS IN MULTNOMAH COUNTY

PETER O. DECHANT
Multnomah County Vector Control
Portland, OR 97203

ENVIRONMENTALIST, a person who works to protect the environment from degradation for the mutual benefit of humans and other species. An environmentalist operates on the premise that humans and human activity are a natural part of the biosphere, but due to the technological prowess of humanity, the affects of human activities must be managed if the biosphere is to be preserved. Most people are environmentalists.

DEEP ECOLOGIST, a person who works to control or eliminate all technology and human advancement. A deep ecologist operates on the premise that humans and human activity are an aberration in the "natural" system and are somehow fundamentally evil. They look with nostalgia at 'the good old days' before technology was developed and believe that environmental problems can only be solved by abandoning technology. Very few people are deep ecologists. We will never have much impact on their thinking and should not be concerned with that fact.

ECO-OPPORTUNISTS, people who claim to care about the environment and play upon the legitimate concerns of environmentalists, as well as the passions of deep ecologists for the furtherance of their own personal gain. These are the people who have made an industry out of the environment. They are administrators who make lucrative salaries heading up environmental groups and lawyers who collect huge fees on toxic tort cases and other frivolous environmental suits. They thrive upon fear, half truths and public misperception.

This small group of people is a serious threat to our economy, health and social well being. They need to be exposed for what they are so that society will cease to listen to them. For those of you who have had the pleasure of hearing Lynn Lund speak about the "ducks shoot back program," these are the hunters at which the ducks should shoot back.

Our profession needs to work with the environmentalist, pay respect to (but not heed the words of) the deep ecologist and fight the eco-opportunist.

The following words (a quote from E. S. Woolard Jr., who is chairman of the Board of Dupont) are directed to industry, but they apply directly to us as Vector Control professionals and reflect my philosophy and approach to environmental issues. The quote (with slight modification) reads as follows: "The real environmental challenge (to vector control) is not one of responding to the next regulatory proposal. Nor is it making environmentalists see things our way. Nor is it educating the public to appreciate the benefit of our services and thus tolerate their environmental impact and that of the process used to make them . . . the fundamental environmental challenge to our continued existence requires that we excel in environmental performance and that we enjoy the non-objection -- indeed the support -- of the people and governments in the societies where we operate around the world. Environmentalism is now a mode of operation for every sector of society -- vector control included. We in vector control have to develop a stronger awareness of ourselves as environmentalists."

Multnomah County Vector Control has been faced with challenges from the environmental community for several years. In the early 1980's, environmental sentiment was so strong that trying to oppose, legislate or educate these concerns away was futile, and perhaps not in our best interest. At that juncture, I decided to try to stay ahead of the issues and win the tolerance if not the support of the environmental community.

In 1982, we had a very difficult season that resulted from a heavy spring production of floodwater mosquitoes. Our attempts to control the hatch with the larvacides and adulticides available at the time were met with strong opposition from deep ecologists and concern from environmentalists. We were also made acutely aware that the level of control achieved was not satisfactory to the public.

Out of the frustration that resulted, I was willing to try new approaches to control wherever possible. One particularly productive floodwater area known as Oaks Bottom is located immediately adjacent to a residential area known as Sellwood. The area is unique in that the vast majority of flood water entering the bottom flows in through a 5-foot culvert that connects the area to the Willamette River. It occurred to me that we could prevent floodwater from entering the bottom by installing a "one way" floodgate on the river side of the culvert. Without the flood water, there would be no hatch. Since this proposal involved altering the waterway, permits were needed. I contacted the Corp of Engineers regarding the permit. The engineer with the Corp happened to be a close friend of Michael Houck who is the Urban Naturalist with the Portland Audubon Society. He had fought long and hard to make Oaks Bottom a wildlife sanctuary.

It didn't take long for Mr. Houck to find out about the proposal, and the next day I received a call from him. He was outraged that I would propose to "drain Oaks Bottom." I tried to explain that I hadn't proposed draining the area, and merely wanted to keep the floodwater out. The wetlands in the bottom that originate from springs and rainwater would remain intact. He quickly countered that the floodwater was essential for flushing the area, and remained opposed to the idea. After some discussion, we decided to meet in the bottom to discuss what options were available.

When we met, he and his associates were surprised by my knowledge of wildlife and the fact that I was open to share ideas. During our walk through the area, Mike mentioned that the Audubon Society was interested in raising the water level in the area and asked if that would help with the mosquito problem. After some thought, I said that a higher level of permanent water would prevent the *Aedes* from laying eggs, and that if the area could be planted with *Gambusia* fish, other species of mosquitoes would pose minimal problems.

We have since engaged in a series of planning sessions and an experiment with ponds installed in the bottom. These efforts have resulted in the construction of a water control structure for the area and a water management strategy that benefits both mosquito control and wildlife habitat. Perhaps more important than the control of floodwater mosquitoes that resulted from the project is the fact that our agency has won the respect and support of those who would normally oppose our very existence.

Another example of the benefits of cooperation with environmental groups is Multnomah County's experience with the Oregon Environmental Council. A study was made of pesticide use by public agencies in the Portland Area in 1982. This study was done by Maura Doherty, who is an industrial hygienist with an MPH degree. The results were published in the "Journal of Pesticide Reform" which is a publication of the Northwest Coalition for Alternatives to Pesticides. Many of you are aware of the impact that this group has had on pesticide issues in the Northwest.

The study was very critical of the lack of planning and coordination within and between public entities using pesticides in the Portland area. Jean Meddaugh of the Oregon Environmental Council initiated a follow up project aimed at improving the situation. The primary thrust of the project was to get public pesticide users to adopt integrated pest management (IPM) strategies and utilize the state's pesticide use planning process. When Jean met with me about the project, she was surprised to find that I was willing to be open with our records, was using the state's planning process and supported the concept of integrated pest management. After all, IPM has been a policy of American Mosquito Control Association for many years.

After some discussion, we agreed to establish an advisory committee of citizens, pest control specialists and environmental health professionals, who would review our operations on a regular basis. By taking the lead, we were able to obtain a very balanced committee. The committee has initiated some changes in our program, but none that really interfere with getting the job done. We have gained credibility and acceptance through the process. This credibility and acceptance have been very positive for our agency. Environmental groups have assisted us with the cost of waste tire removal for the control of container breeding mosquitoes. I have been asked to sit on advisory committees for management of natural areas, and have been able to influence the design of constructed wetlands so that mosquito production has been minimized. One of the greatest benefits has been the ability of our crews to perform control operations in an atmosphere of acceptance and trust instead of suspicion and protest.

I guess the bottom line in all this is that by working with environmentalists, and giving a little, we have gained a great deal of long-term acceptance. When you work with these people for a long period of time, it gets more and more difficult for them to consider you a malevolent ogre dead set on poisoning the environment.

THE ORANGE COUNTY VECTOR CONTROL PROGRAM

B. FRED BEAMS
Assistant Manager-Educational Coordinator
Orange County Vector Control District
Santa Ana, CA 92702

Orange County is located south of the greater Los Angeles, California area. The county seat, the city of Santa Ana, is approximately 40 miles south of the Los Angeles city limits. Just under three million people live in the county that is composed of 31 incorporated cities and a thriving unincorporated area in the southern part of the County's 782 squares miles. The county has evolved into a largely urban region from what was, as few as 20 years ago, an important agricultural area. Orange County has the dubious distinction of having among the highest priced housing in the United States with the average single family home valued at $220,000.

Organized vector control began in Orange County in 1947 when the Orange County Mosquito Abatement District was formed. In response to a countywide mosquito breeding problem, the District began operations in the agricultural areas, coastal salt marshes, and population centers, and within a few years had the mosquito problem largely under control. Up to this point, mosquito control was performed by the several large military bases, mostly on or near their properties located in the county.

In 1975, a study of the District's efficiency by the Board of Supervisors of Orange County concluded the the District could perform comprehensive vector control with a minimal addition of personnel and resources. Roof rat and fly control were added to the District's functions along with the routine bubonic plague surveillance of the county's ground squirrel population. At the same time, the District's name was officially changed to the Orange County Vector Control District.

Today's vector program in Orange County employs 33 full-time staff of which 20 are operational personnel. The remaining employees are 2 maintenance, 5 clerical, 4 technical, and 3 administrative management staff members.

The District is a unit of government formed to carry out highly specialized functions and is governed by a Board of Trustees. The Board is composed of 32 members, one appointed by each incorporated city and one member selected by the County Board of Supervisors. Each trustee serves a two-year term without pay, except for a per month in-lieu of mileage payment. The Board employs a District Manager to carry out its established policies.

The current budget of just over four million dollars has remained proportionately consistent with population over the years. As with most organizations, salaries made up the largest single expenditure.

MOSQUITO CONTROL

Orange County has changed from a largely agricultural and rural area to a prosperous urban area in just three decades. With this transition, mosquito breeding habitats have also diversified. The pastures, dairy farms, truck farms, and orchards of yesterday are now the housing developments, resorts, tourist attractions, and commercial operations for which the county has become famous. Only the coastal marshes remain as important, large rural mosquito breeding sources.

Many of the mosquito breeding sources are directly related to the county's urbanization. Flood channels, off-street drains, catch basins, ornamental fish ponds and neglected swimming pools have replaced the rural mosquito habitat of 30 years ago.

In the District's IPM approach to mosquito control four elements are used. The most widely used method is chemical control employing larvicide oils, Bti and pyrethroids. Most of these chemicals are directed toward the larval stage of the mosquito, although some selective adulticiding is done.

Biological control involves the use of mosquito fish, *Gambusia affinis*, where possible. These fish are reared at District headquarters and planted in those aquatic mosquito breeding sources where the quality of the water is sufficiently high to support them.

Source reduction, often called physical control, is the third element of mosquito control. This method involves reducing or eliminating an aquatic mosquito breeding source through drainage or other means of eliminating the water. Sometimes this is as simple an operation as emptying out a backyard wheelbarrow filled with rainwater. To accomplish this, the District may enforce the property owner responsibility laws found in the California State Health and Safety Code.

The fourth method of control is public education. The District pursues a vigorous program of public educational activities involving public and private schools, homeowners' associations, civic organizations, electronic and print media, and other avenues of information dissemination. The combination of these four elements, used where appropriate, has brought the level of mosquitoes to a very low level countywide.

Of the 21 different species of mosquitoes existing in Orange County, several are potential disease carriers or significant biting pests. The most significant potential vector species are *Culex tarsalis*, the primary encephalitis vector in the west, and *Anopheles hermsi*, the western malaria mosquito. Canine heartworm is beginning to appear in dogs in Orange County, although it is unclear at this point which species of mosquito is the vector.

The District also carries out vector-borne disease surveillance in Orange County, including detection of bubonic plague and several strains of mosquito-borne encephalitis. This is done routinely throughout the year. In late 1983, a one-year pilot program of chagas disease, transmitted by kissing bugs, detection was also begun as a result of a human case detected for the first time in California earlier in the year. In 1986-87, opossums were tested for murine typhus due to a human case in the county.

In November 1982, plague antibodies were discovered in 4 ground squirrels in a residential area of Orange County, requiring immediate ground squirrel flea eradication and subsequent ground squirrel population reduction in the area. Since the cessation of statewide funding for ground squirrel control in the early 70's, ground squirrel populations have risen significantly within California, increasing the risk of plague infection among humans.

In 1984, there were 5 confirmed human cases of mosquito-borne St. Louis Encephalitis in Orange County. This led to a greatly expanded encephalitis surveillance program throughout the county involving serological testing of sentinel chicken flocks, wild birds and virus determination work on adult mosquito pools.

State laws and District policy dictate that all operational and technical staff be certified by the California State Department of Health Services. Each of these employees must pass an examination that qualifies him or her in these specialties: mosquito biology and control, terrestrial invertebrate vector biology and control, and vertebrate vector biology and control.

The backbone of the vector control district is its operational staff. Each vector control technician is chosen on the basis of his or her ability to relate well to the public, make sound and effective operational field decisions, and be willing to go the extra mile to get the job done. Many of the technicians had previous backgrounds in pest control technology or agricultural biology before joining the District. The District uses an operational vector control zone concept where a vector control technician is assigned a specific geographical area and is responsible for vector surveillance, routine control, and response to service requests for residents in his or her zone.

The technical staff is composed of professional biologists and entomologists, each assigned a specific area of responsibility such as invertebrate vectors, vertebrate vectors, or biological control agent production. The public education program is conducted by an educational coordinator who works closely with the large public school system in Orange County, civic groups, homeowners' associations, print and electronic media and other avenues of providing public information on vector control. In 1991, over 12,000 public school students were exposed to the District's public education program of vector prevention.

The District Manager conducts regular biweekly staff meetings at which time the employees are brought up-to-date on new developments and operational problems are discussed. These meetings are also used as training sessions so that the staff can stay current in vector control technology.

Future vector management problems anticipated by the District include the expected arrival of the Africanized honey bee in early 1994. Plans and training are already being formulated and conducted in order to minimize the bees impact on the public as well as calm the expected hysteria that will undoubtedly accompany the initial africanized honey bee swarms.

EVALUATION OF Bti SAND GRANULES AGAINST *Aedes sollicitans* IN MARYLAND

CYRUS R. LESSER

Maryland Dept. of Agriculture
Salisbury, MD 21801

The use of *Bacillus thuringiensis* var. *israelensis* as a mosquito larvicide is desirable because of its wide margin of environmental safety, hence its acceptance by environmentalists. For ten years the Maryland Mosquito Control Program has evaluated several Bti formulations to determine efficacy against our primary pest and vector species, *Aedes sollicitans*. All tested products failed to provide consistent, satisfactory control. Typically, the level of control achieved ranged from 25% to 80% for aerial and ground applications at maximum label rates. The reasons for this failure were thought to be the food rich environment in which *Ae. solicitans* larvae were found and the large larval aggregations typical of the species. It was speculated that these factors prevented a high percentage of larvae from ingesting a lethal dose of Bti spores. During the winter of 1992, Dr. Dickson of the Salt Lake City Mosquito Abatement District informed me of his trials of "home made" Bti sand granules and his success in using these granules to effectively control *Aedes dorsalis*, a species exploiting a larval habitat similar to that used by *Ae. sollicitans*. The remainder of this paper will examine the results of our efforts to apply knowledge gleaned from Utah and applied in Maryland.

MATERIALS AND METHODS

Granules were prepared according to the procedure detailed in Hatch and Dickson, 1989. In April 1992, 400 pounds of granules were formulated following the delivery of a sample of Vectobac™ technical powder provided by Abbott Laboratories.

Initial field applications were made at the rates of 8 to 10 pounds of granules per acre, using a Stihl ™ power backpack sprayer with an effective swath width of 20 feet. These applications were made in April and were directed against light to moderate populations of *Ae. sollicitans* and heavy populations of *Aedes vexans*.

Subsequent applications, predominantly against *Ae. sollicitans*, were made throughout the summer of 1992, using backpack sprayers and a Herd™ spreader mounted on an Argo™ ATV. A total of 2500 pounds of Bti sand granules was formulated and applied in Maryland during the 1992 mosquito season. A total of 250 acres were treated at the rate of 10 pounds per acre. In addition to *Ae. sollicitans, Aedes taeniorhynchus, Aedes vexans* and *Aedes atlanticus* were treated.

RESULTS and DISCUSSIONS

The results of field trials for 5 applications of Bti 4% sand granules are presented in Table 1. These data show that an exceptionally high level of control of *Aedes* larvae was achieved over a broad range of habitat types. The results of these trials far surpassed the efficacy of any commercial formulation of Bti evaluated in our program over the past decade.

In addition to efficacy, other advantages were realized by formulating our own granules. A finished price of ca. $1.00 per pound for our sand granules was nearly 33% less than the cost of commercially available granules. The sand carrier is preferred over the commercially available corn cob carrier because of its more uniform size, more even distribution by application equipment and ability to penetrate dense vegetation canopy.

REFERENCE CITED

Hatch, G. L. and S. L. Dickson. 1989. Bti Sand Granules. Proc. Utah Mosq. Abate. Assn. 42:20-24.

Table 1. Results of Field Trials of 4% Vectosand Against *Aedes* Species in Maryland During 1992.

DATE	HABITAT	% MORTALITY
April 23	Salt Marsh	100
May 11	Retention Pond	100
May 12	Woodland Pool	100
July 22	Salt Marsh	98
July 28	Dredge Spoil	100

EVALUATION OF AN EXPERIMENTAL FORMULATION OF METHOPRENE AGAINST SALT MARSH *Aedes* IN MARYLAND

CYRUS R. LESSER
Maryland Dept. of Agriculture
Salisbury, MD 21801

ABSTRACT

Small plot field tests of SAN S10 I 1.3 GR, a candidate formulation of methoprene, produced by Zoecon Corp., were conducted in Maryland during 1992. Three treatment rates were evaluated (2.5, 5.0 and 10.0 lb./acre), plus an untreated control. Each dosage was replicated three times. Application sites included a dredged material disposal site and a natural salt marsh. Test mosquito species were *Aedes sollicitans* and *Aedes taeniorhynchus*. Applications were made with a Cyclone™ hand seeder to 0.10 acre treatment plots. Application was made on all plots on August 20. Larvae were present at the time of application on all plots. Larval populations were high, averaging over 25 per dip at all sites. Water quality data (pH, salinity and temp.) were collected at all sites prior to treatment and at all subsequent visits. Values of pH ranged from 4.1 to 6.8; salinity varied from 5 ppt to 19 ppt; and water temperature ranged from 18° C. to 35° C. Pupae were collected from all plots 4 and 5 days post treatment and returned to the laboratory. From the control plots successful adult mosquito emergence averaged 96% in the lab. Of those pupae collected from the treated sites there was 0% successful emergence of adult mosquitoes. Similar results were observed in the field where adult emergence was highly successful in the control sites, but not detected in the treatment sites. There was no difference observed in efficacy between the treatment plots.

The residual activity of SAN S10 I 1.3 GR could not be evaluated because the study plots failed to produce a subsequent mosquito brood due to unusually high tides and frequent rainfall which maintained the sites in a flooded condition.

DROPLET TECHNOLOGY REGARDING GROUND ADULTICIDING

CARL L. SCHAAF
Beecomist Systems, Inc.
Telford, PA 18969

For optimum efficiency during ultra low volume (ULV) adulticide applications, it is important to understand the complete droplet size distribution and mass median diameter (MMD) of the droplet cloud produced by the ULV atomizer. This enables droplet sizes to be maintained within the optimum range. This range has been shown to be from 6μm to 30μm for effective control of adult mosquitoes. <u>Accurate</u> measurement of droplets in the ULV cloud is necessary, and beyond the capabilities of hand slung slides. Many alternate methods of sampling airborne droplets have been carefully evaluated. Beecomist selected the laser diffraction spectrometer. The laser gives the highest level of accuracy in repeatable measurements which are traceable to NIST (National Institute of Standards in Technology) standards.

Detailed evaluation of droplet spectra produced by two methods of ULV atomization revealed significantly different results. The rotary atomizers consistently produced at least 90% of the total volume within the 6μm to 30μm range. Two-fluid (air-blast) nozzles produced 50% to 70% of the total volume within this optimum range (Fig. 1). Professional mosquito control programs desire the most efficient operations possible. The ability to generate 90% or more of ULV droplets in the 6μm to 30μm range will provide optimum adulticide efficiency. Droplets below 5μm are considered ineffective and wasted due to their lack of velocity, which limits their ability to impinge onto a mosquito. These droplets easily follow the air "cushion" around the mosquito or are quickly separated and dispersed from the main cloud. Droplets larger than 30μm readily fall to the ground.

Laser diffraction measurements assure highly accurate analyses of ULV droplet atomizers and the materials atomized. With proven laser technology, equipment and insecticide manufacturers can certify the performance of every sprayer and insecticide label they provide. Certification assures that the user is in compliance with insecticide label droplet requirements. Working together, our industry can apply the science of "Droplet Technology Regarding Ground Adulticiding." Greater effectiveness and resulting cost savings will be some of the rewards.

Acknowledgements: research material compiled by staff members P. Rudolph, P. Phillips and E. Kutzner. For more information on the above subject request our new video entitled "Aerosol Technology Related to Adult Mosquito and Flying Insect Control," by Staff Physicist Perry Phillips, Ph.D. Expected release, January 1993. All proceeds will go to the American Mosquito Control Association.

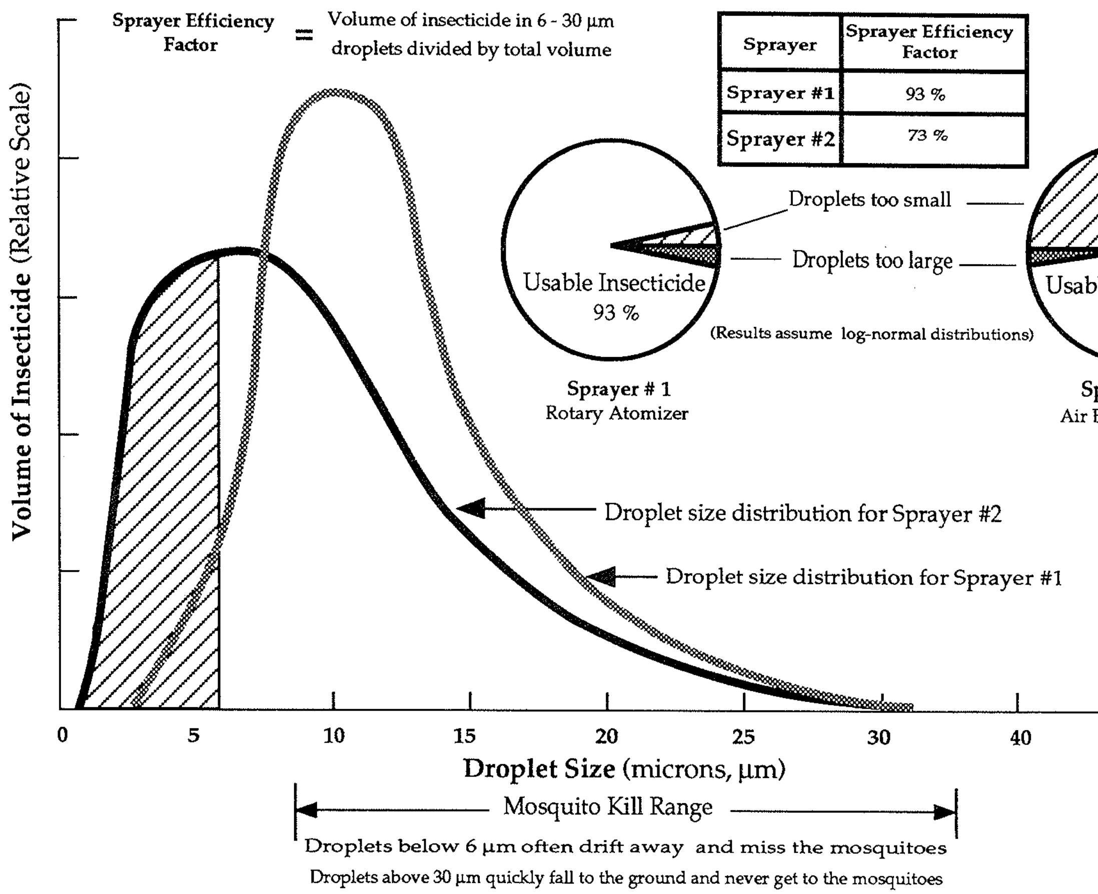


Fig. 1. Sprayer Efficiency Factors for Two ULV Space Sprayers

MOSQUITO RESISTANCE TO THE LARVICIDE MALATHION IN TREATED AREAS OF DAVIS AND WEBER COUNTIES

STEPHEN M. FOOTE[1] and **DAVID HAVERTZ**[2]
Weber State University
Ogden, Utah

ABSTRACT

Resistance was measured for the mosquitoes *Aedes dorsalis, Aedes nigromaculis, Culex pipiens, Culex tarsalis* and *Culiseta inornata* to the chemical malathion during the summer of 1991 in Davis and Weber Counties of Utah. Larvae were collected from three sites and then subjected to standard test procedures of the World Health Organization (W.H.O.). LC_{50} values were compared among species, areas and past studies.

Findings revealed resistance to malathion appears to have increased since 1970. The resistance increased over the summer months, and a dramatic difference in resistance was found between Davis and Weber Counties.

INTRODUCTION

Mosquito resistance to the insecticides used against them was first observed in 1947 with the chemical DDT (Brown 1986). Since then, resistance factors and the formation and use of effective chemicals has become a key focus of mosquito control.

The development of resistant populations is observed as a progressive decrease in the control obtained by the dosage recommended on the basis of its effectiveness when the insecticide was first introduced (Brown 1986). This resistance is found to be inherited through genetic factors (gene alleles) with mutant enzymes (isozymes) engineered for the detoxification of selective insecticides. These factors are not general but usually specific to the insecticide (Brown 1986).

In Utah, organophosphate larvicides were introduced in 1956 (Graham and Rees 1956, 1958) and remain the chief agents used in Davis and Weber Counties (Fink and Thompson 1987). In past studies, low resistance was found in 1970 to malathion in untreated (Shiozawa and Havertz 1971) and treated areas (Shinney and Havertz 1971). In 1977, Hart and Womeldorf classified very few of their 1976 samples resistant to parathion, fenthion and malathion. Tests run in 1977 (Merrell and Wagstaff 1978), 1978 (Wagstaff and Merrell 1979) and 1979 (Merrell and Rosay 1980) indicated slightly increased levels of resistance to parathion, fenthion and malathion (Merrell and Rosay 1980).

This study originated with a personal observation and concern about the mosquito population inherent to Davis and Weber Counties. This region is a perfect environment for mosquitoes as it contains a large acreage of the Great Salt Lake shoreline and many low-lying wetlands. In the June 10, 1991 edition of the Ogden Standard Examiner, Dallas Nelson, director of the Weber County Mosquito Abatement District, was quoted as saying, "Spraying this year has been the heaviest in over 13 years." Thus, we feel it is important to present a recent study on one of the insecticides presently in use.

The objectives for this research are to determine the degree of resistance to the organophosphorus larvicide malathion in five common mosquito species found in Davis and Weber Counties using the LC_{50} (lethal concentration which kills 50% of a sample population) value as criteria. These species include *Aedes dorsales, Aedes nigromaculis, Culex pipiens, Culex tarsalis* and *Culiseta inornata*. We will also compare the LC_{50} values of species found in Weber and Davis Counties to the values found by Shinney and Havertz in 1970. Although their studies were completed only in Weber County, our comparison will include Weber and adjacent Davis County. Finally, we

[1]Student, Weber State University

[2]Professor of Zoology, Weber State University

will compare the mean LC_{50} values between Davis and Weber Counties.

It is our feeling that when completed, this study will be beneficial in determining the correct concentration for the effective use of malathion and reveal a fluctuation in the resistance levels to malathion in Davis and Weber Counties, thus contributing to better control of the mosquito populations of northern Utah.

COLLECTION SITES

Farmington

This collection site is a 5 hectare horse pasture located at 1200 North Highway 89 in Davis County. The pasture borders additional fields to the south, highway 89 to the east and residential areas to the north and west. A ditch lines the outer rim and runs directly through the pasture. Four wells are present, 2 contain standing water, the other 2 contain water that is free flowing into the pasture. Vegetation includes a few trees, cattails on the outer edges and a variety of grasses. Samples were collected from the wells, ditches and depressions where water pools from irrigation and spring run-off.

Spaulding Farm

This collection site is a one hectare cow pasture located at 545 East 6600 South in South Weber, Davis County. It borders additional fields to the south, east and west with the Spaulding residence to the north. Approximately 20 cattle reside here year round and the pasture is irrigated on a weekly basis during the summer months. A variety of grasses are present. Samples were collected in depressions, ditches and from a cattle watering trough.

Sportsman Club

This site is located at the end of 2550 South 5100 West in Taylorsville. It is a 2 hectare region that is divided by a dirt road. The east side is a grass covered field in which water pools in low spots from irrigation of adjacent fields. To the south is an open field where water collects from spring run-off but dries up in early summer. The west contains a 10 x 20 meter pond with cattails and grass growing around and through the pond. To the north is a dry grassy field. Samples were collected east of the dirt road in the standing water, west of the dirt road in the pond and behind the pond where water pooled from spring run-off.

METHODS

Each collection site was inspected weekly. When sufficient third and fourth instar larvae were located for a test, the larvae were collected with a soup ladle and transported back to the laboratory in 3.8 liter thermos jugs. The larvae were transported in water gathered from each site to maintain constant temperature and environmental conditions. Upon arrival to the lab, the larvae were transferred to white 8 x 11 x 2 cm. pans for easy selection of third and fourth instars.

We conducted tests using a standard malathion larval test kit acquired from W.H.O. Strict W.H.O. procedures (Anonymous 1963) were followed throughout the experiment. Tests began by filling 5 test vessels with 250ml of dechlorinated water. Test solutions of 3.125, 0.625, 0.125 and 0.025 parts per million (ppm) of malathion were added to separate vessels. The fifth vessel was utilized as a control containing ethanol which is the malathion carrier.

Testing was started on the day of collection and lasted for a 24-hour period. Thirty to 40 larvae were transferred from separation pans into each of five 50 ml beakers. Each beakers content was dumped into one of the separate test vessels. Lighting was controlled to mimic natural conditions. Upon completion of the test period, larvae were removed from the various test concentrations with a glass pipette and classified as either dead, moribund (still able to move but unable to rise to the surface) or alive. The dead and moribund were combined for analysis. The two groups were stored separately in 70% ethanol. Larvae were later identified to species using a dissecting microscope and key to mosquitoes of Utah (Nielsen and Rees 1961). Species and area specific data were graphed using logarithmic probability paper to determine the LC_{50} values. A one-way analysis of variance was calculated using the Least Significant Difference (LSD) test.

RESULTS

Farmington

Mosquito larvae were obtained from this area from June 10 to August 12, 1991 (Fig. 1). The area yielded *Cx. tarsalis* from early June to late July, *Cx. pipiens* in June and *Cs. inornata* from early June to mid August.

Area and individual species LC_{50} values varied considerably throughout the summer (Table 1).

Spaulding Farm

Mosquito larvae were obtained from this area between June 25 and August 3, 1991 (Fig. 2). The site contained *Ae. nigromaculis* and *Cx. tarsalis* from mid July to early August, *Ae. dorsalis* throughout the collection period and *Cx. pipiens* during mid and late July. LC_{50} values varied throughout the summer (Table 2).

Sportsman Club

Mosquito larvae were obtained from this site during the period of June 10, 1991 to August 12, 1991 (Fig. 3). The area contained *Cx. pipiens* and *Cx. tarsalis* from early June to mid August, *Ae. dorsalis* from early June to late July and *Cx. inornata* also from early June to late July. LC_{50} values were found to be the highest in this area (Table 3).

As shown by the results, *Cx. pipiens* is the most resistant with a combined LC_{50} mean value of 0.397, followed by *Cx. tarsalis* at 0.209, *Cs. inornata* at 0.135, *Ae. nigromaculis* at 0.128 and *Ae. dorsalis* which showed the lowest resistance with a combined mean of 0.117.

The one-way analysis of variance comparing the 3 sampling sites revealed significant differences ($P = 0.014$). Pairwise comparisons of the means indicated no difference ($P > 0.05$) between Farmington and the Spaulding Farm (Davis County areas), which both differed from the Sportsman Club ($P < 0.05$) (Fig. 4).

DISCUSSION AND CONCLUSIONS

Utah area resistance levels to malathion have increased since 1970, also noted by Fink and Thompson in 1987. In 1970 (Shinney and Havertz 1971), *Cs. inornata* showed a mean seasonal value of 0.063 whileour study revealed a 1991 seasonal mean of 0.135. *Ae. dorsalis* had a 1970 seasonal mean of 0.048. In 1991 it was 0.117. *Cx. tarsalis* showed a LC_{50} value of 0.020 in 1970. Today it is 0.209. *Cx. pipiens* showed the most dramatic change in LC_{50} values with a 1970 seasonal mean of 0.058 and a 1991 mean of 0.397.

Fluctuations in resistance values were also noted throughout the summer months (Fig. 1, 2 and 3), an overall increase in resistance to malathion from June to the highest levels occurring in August. These results contradict the work of Carter in 1971 (Unpub. data) who found a general trend of increased susceptibility to malathion over the summer for all species of mosquitoes in Weber County. The most striking result of this study was the significant difference in resistance between mosquitoes in Davis and Weber Counties. The Sportsman Club (Weber County) showed a seasonal mean over 2 times the resistance levels of Farmington and Spaulding Farm (Davis County areas). This may be the result of: 1) abatement district usage of malathion (as many districts are phasing out the use of organophosphate insecticides (Dickson 1988), 2) abatement spraying practices, 3) food availability or inherent attributes of insecticide resistance (Perry 1966) and 4) Davis County habitats may have been under less selective pressure (i.e. fewer insecticide applications) than those in Weber County. Any one of these factors may contribute to this phenomena or perhaps none. We suggest further experimentation and research for a more conclusive explanation.

ACKNOWLEDGEMENTS

I would like to thank Dr. David Havertz of Weber State University for his invaluable assistance in overseeing conceptualizing and guiding this thesis. Also, for his expertise and hours of field work assistance, I would also like to thank Mr. Earl Jenne and Dr. Bret Harvey for their assistance in overseeing this thesis. Lastly, I would like to thank my wife, Rita Foote, for her continued help and support throughout this project.

REFERENCES CITED

Anonymous. 1991. Wet weather helps hatch big batch of mosquitoes. Ogden Standard Examiner, June 10, p. B1.

Anonymous. 1963. Instructions for determining the susceptibility or resistance of mosquito larvae to insecticide. Reprinted for W. H. O. Technical Report Series No. 265, pp. 51-54.

Brown, A. W. A. 1986. Insecticide resistance in mosquitoes: a pragmatic review. J. Amer. Mosq. Control Assoc. 2:123-140.

Carter, S. J. 1971. Population and susceptibility of mosquitoes under mosquito abatement control in Weber County. Weber State College, 8pp.

Dickson, S. L. 1988. Message from the president. Utah Mosq. Abate. Assoc. News and Views. 1(2):1.

Fink, T. J. and M. A. Thompson. 1987. Resistance of Utah larval mosquitoes to chlorpyrifos, fenthion, and malathion. Proc. Utah Mosq. Abate. Assoc., 40:42-45.

Graham, J. E. and D. M. Rees. 1956. Progress report on the field testing in Utah of some organic phosphorus insecticides for mosquito control. Proc. Calif. Mosq. Vector Contr. Assoc. 9:23-25.

Graham, J. E. and D. M. Rees. 1958. Chemical control of mosquitoes in Utah. Proc. Calif. Mosq. Vector Contr. Assoc. 26:16-19.

Hart, N. R. and D. J. Womeldorf. 1977. Insecticide susceptibility of mosquitoes in Utah: status of organophosphorus larvicide resistance through 1976. Proc. Utah Mosq. Abate. Assoc. 29:23-28.

Merrell, C. and B. Rosay. 1980. Changes in resistance of Utah mosquitoes to organophosphorus larvicides. Proc. Utah Mosq. Abate. Assoc. 32:44-45.

Merrell, R. and K. Wagstaff. 1978. Status of organophosphorus mosquito larvicide resistance in Utah: 1977. Proc. Utah Mosq. Abate. Assoc. 30:10-12.

Nielsen, L. T. and D. M. Rees. 1961. An identification guide to the mosquitoes of Utah. University of Utah Biological Series 7(3):1-57.

Perry, A. S. 1966. Biochemistry of insecticide resistance in mosquitoes. Mosq. News. 26(3):301.

Shinney, C. L. and D. S. Havertz. 1971. Comparison of susceptibility of *Culex tarsalis, Culex pipiens* and *Anopheles freeborni* to malathion in areas under control within Weber County, Utah. Utah Academy Proceedings. 48(1):1-37.

Shiozawa, D. K. and D. S. Havertz. 1971. Susceptibility trends to malathion in fluctuating mosquito populations not under abatement management. Utah Academy Proc. 48(1):1-40.

Wagstaff, K. and R. Merrell. 1979. Status of organophosphorus mosquito larvicide resistance in Utah, 1978. Proc. Utah Mosq. Abate. Assoc. 31:21-27.

Table 1. Mosquito LC_{50} levels for the Farmington area, 1991.

SPECIES	DATE	LC_{50}	MEAN
Combined Species	10 June	0.102	0.124
	18 June	0.102	
	25 June	0.112	
	4 July	0.119	
	17 July	0.050	
	22 July	0.179	
	30 July	0.152	
	5 Aug.	0.160	
	12 Aug.	0.148	
Culex tarsalis	10 June	0.058	0.100
	18 June	0.133	
	25 June	0.102	
	4 July	0.107	
Culiseta inornata	10 June	0.105	0.139
	18 June	0.125	
	4 July	0.190	
	17 July	0.051	
	22 July	0.179	
	30 July	0.152	
	5 Aug.	0.160	
	12 Aug.	0.148	
Culex pipiens	18 June	0.058	0.058
Anopheles freeborni	24 June	0.264	0.264

Table 2. Mosquito LC_{50} levels for the Spaulding Farm area, 1991.

SPECIES	DATE	LC_{50}	MEAN
Combined Species	25 June 4 July 17 July 26 July 3 Aug.	0.100 XXXX 0.152 0.107 0.160	0.130
Aedes dorsalis	25 June 26 July 3 Aug.	0.100 0.066 0.167	0.111
Culex tarsalis	17 July 26 July 3 Aug.	0.156 0.148 0.291	0.198
Aedes nigromaculis	25 June 26 July 3 Aug.	0.058 0.175 0.152	0.128
Culex pipiens	17 July 26 July	0.144 0.556	0.350

Table 3. Mosquito LC_{50} levels for the Sportsmans Club area, 1991.

SPECIES	DATE	LC_{50}	MEAN
Combined Species	10 June	0.099	0.300
	17 June	0.164	
	24 June	0.248	
	1 July	0.264	
	8 July	0.164	
	17 July	0.456	
	22 July	0.167	
	30 July	0.568	
	12 Aug.	0.575	
Culex pipiens	10 June	0.156	0.446
	17 June	0.241	
	24 June	0.625	
	1 July	0.425	
	8 July	0.229	
	17 July	0.579	
	22 July	0.506	
	30 July	0.625	
	12 Aug.	0.625	
Culex tarsalis	10 June	0.140	0.267
	17 June	0.156	
	24 June	0.248	
	1 July	0.125	
	8 July	0.179	
	17 July	0.475	
	30 July	0.291	
	12 Aug.	0.525	
Aedes dorsalis	10 June	0.088	0.126
	22 July	0.164	
Culiseta inornata	10 June	0.059	0.129
	24 June	0.164	
	1 July	0.164	
	8 July	0.111	
	17 July	0.113	
	30 July	0.164	

Fig. 1. Farmington graphical LC_{50} values for Malathion resistance.

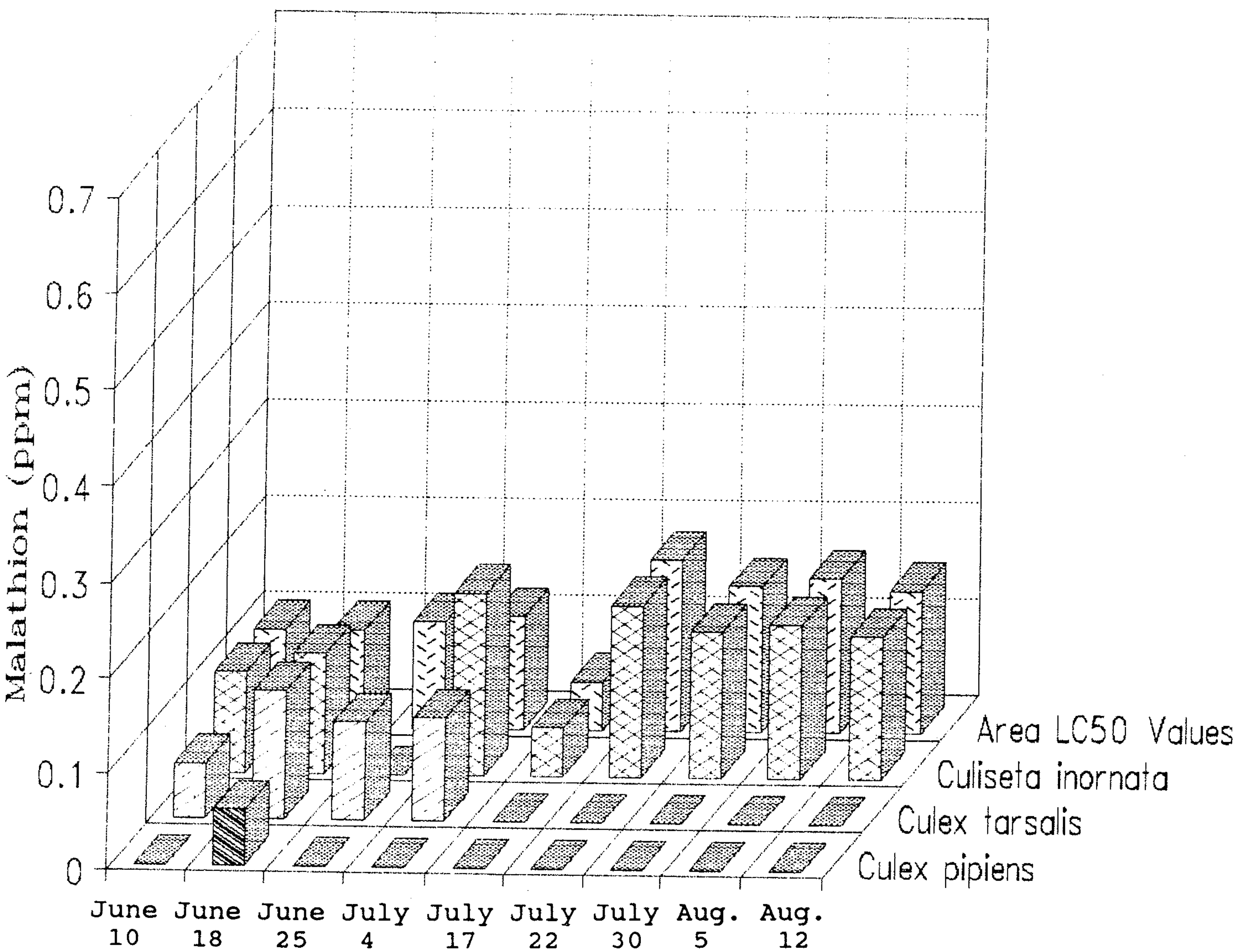


Fig. 2. Spaulding Farm graphical LC_{50} values for Malathion resistance.

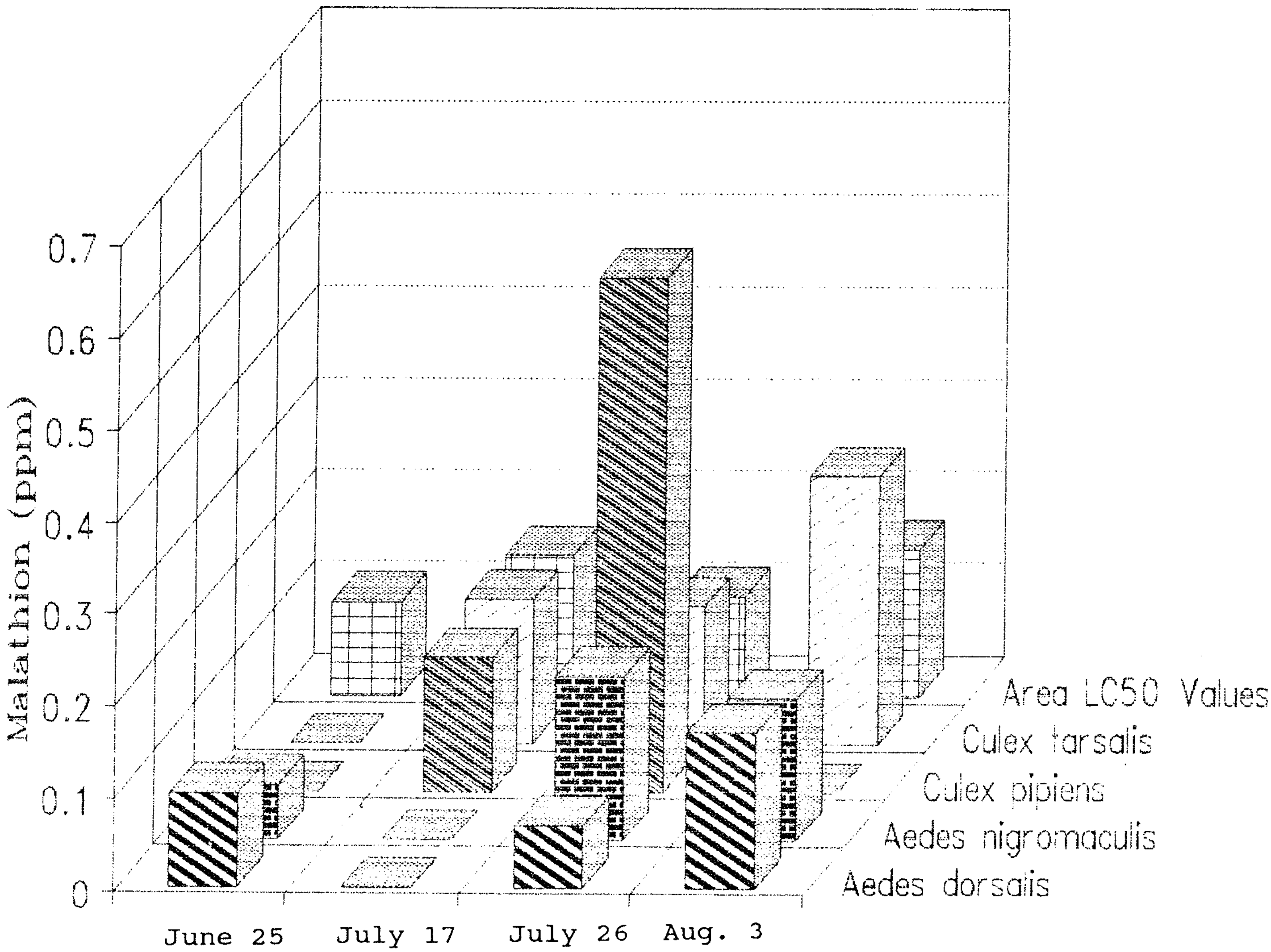


Fig. 3 Sportsman Club graphical LC_{50} values for Malathion resistance.

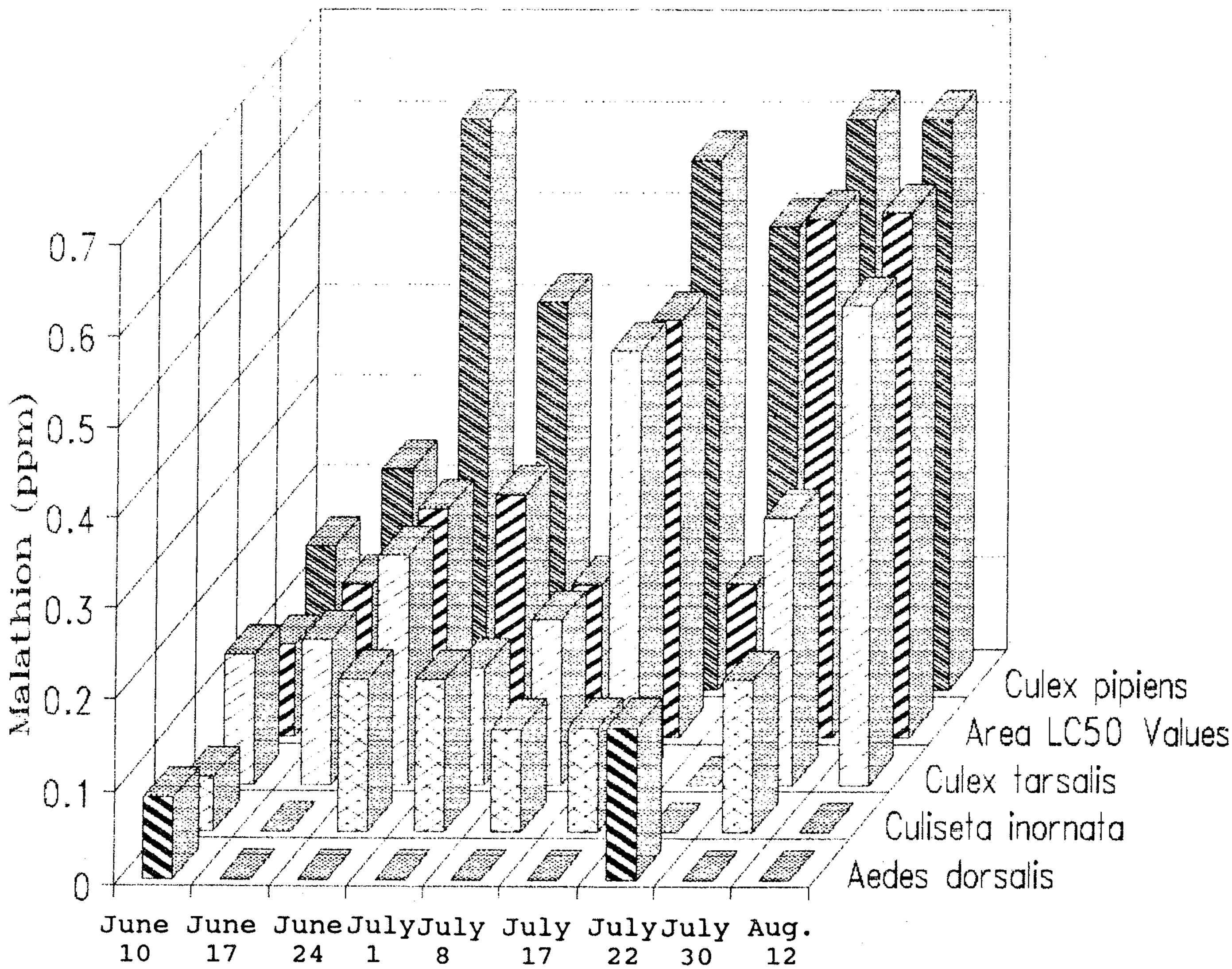
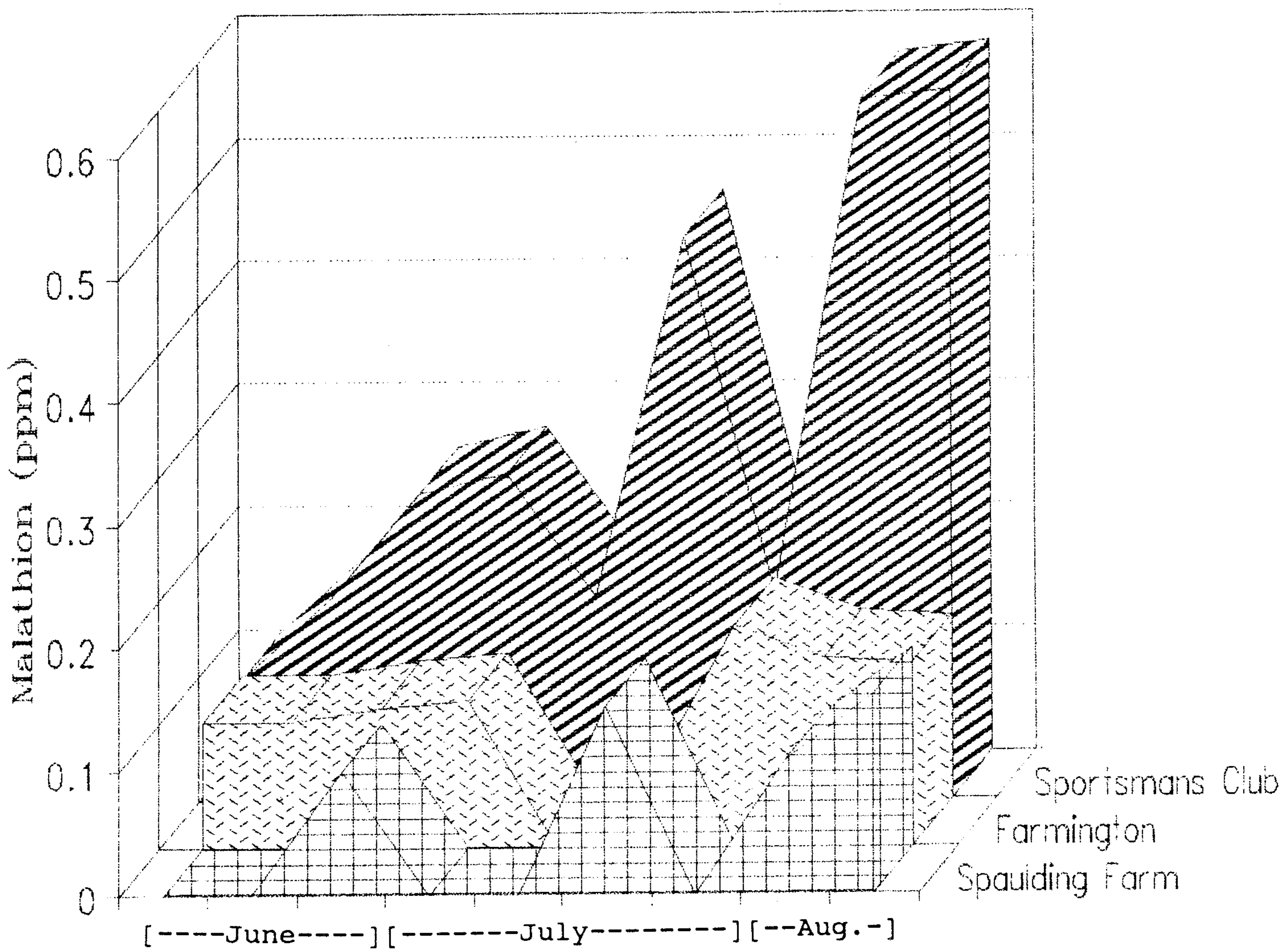


Fig. 4 Combined area LC_{50} resistance values to Malathion. Sportsman Club (Weber County); Farmington and Spaulding Farm (Davis County).



WIND, DROUGHT AND BLACK FLIES

KENNETH MINSON
SOUTH SALT LAKE COUNTY MAD
MIDVALE, UT 84047

An area of concern in the ongoing effort to improve overall black fly control is to try to understand what influence meteorological changes may have on black fly behavior. Wellington (1974), Johnson (1969), Fallis (1964), and Freedeen (1969) have discussed various aspects of dispersal and migration. Most suggest that black flies are strong fliers but due to very small size can be carried great distances with wind assistance.

Garms and Walsh (1987) identify two different types of movement made by adult black flies: those that are immediately goal-oriented and those that are not. Goal-oriented or "appetive" flights (Johnson 1969) include movement to find a mate, oviposition sites, and food (either sugar or a blood meal). There are still arguments about how much influence weather changes have in hampering "appetive" movement of questing flies.

Garms and Walsh state further that although some insects may migrate without the aid of the wind, present evidence suggests that they are the exception. One flaw may be pointed out when predicting increased black fly activity being the result of windcarried adults into a given region. It is very difficult to associate entomological data concerning increased peak activity of the black flies with a particular meteorological event, because it is not always possible to determine the exact arrival of the flies.

Magor and Walsh (1980) did indicate that days in which flies are caught biting man are not necessarily the day on which flies arrived in the vicinity. Along with these comments, it might be noted that much of the activity of many species of black flies occurs at dawn and dusk (Williams and Davies 1957, Walsh 1978, Service 1979).

Flies will move considerable distances as reported by Thompson (1976). He captured, released, and recaptured black flies some 56 and 79 kilometers, respectively, in less than 48 hours. Although linear movements are not considered to be wind-assisted, it is difficult to imagine that these two flights could have been achieved without the aid of wind.

Black fly control in Salt Lake County has been in effect for 13 years. Success has been achieved by creating a detailed and careful inspection schedule with treatment designed to overlap marginal carry limits of the pesticide. Post inspection is done judiciously in areas where effective carry of the pesticide may be suspect and larval populations may be dense enough to create problems if high control numbers are not achieved. With a successful program in place, sudden appearances of black fly adults in areas where control failures are not likely are exasperating to say the least.

Populations of the adults seemed to appear in numbers that were noticeable and irritating to the public after changes in the weather i.e., impending storms with their corresponding fronts moving through the area. To help answer these questions and monitor weather changes in the south part of the Salt Lake Valley, the South Salt Lake County Mosquito Abatement installed a Digitar PCW Computer weather station that provides continuous weather information. Functions included are measurements of wind speed, high wind gusts, wind direction, and barometric pressure. Memory recall and storage of data in graph form is available. A supplemental, small handheld computer, a Weather Pro by Digitar was purchased to be used in the Narrows located in the south end of the valley.

As inspections took place during the 1991 and 1992 seasons, weather data was observed and recorded by the inspectors when increased, agitated black fly activity was noted. Dates, weather patterns and specific black fly activity around one's head were recorded. At seasons end, these data were correlated with data gathered by the computer programs detailing barometric pressure on half-hour basis, wind and wind gust speeds. The days showing the most fly activity were then charted with the wind patterns and gusts (speeds of each) against the barometric pressure.

Climatologically, the Salt Lake Valley is a difficult read. With the surrounding mountains, the configuration of the valley and its effect on wind patterns and the ever present Great Salt Lake provide many different possibilities in any given 24 hours. The Oquirrh

Mountains bordering the west side of the valley are cause for severe microbursts during certain frontal passages which have caused wind gusts to 60 mph in the Kearns area.

High level winds are measured standardly at 20 feet and measurements there are often 50% higher than at eye level. Barometric pressure has a diurnal pattern with the lows recorded in the 5 to 6 o'clock time frame and the highs are recorded in the 10 to 11 o'clock period. Temperature also influences barometric pressure. Normal vacillation of mercury can be as much as 0.10 inches.

Data gathered at the District office and at the station in the Narrows reflects their placement in the valley, too. The wind gauge at the Narrows station is located in the gorge of the neck of the "Point-of-the-Mountain," a deep cut formed by the eroding actions of the Jordan River. This monitoring device is located some 200-250 feet below the two surrounding bluffs. Jack Rindlesback, a resident in the Narrows (personal communication), indicates the daily wind patterns are less formidable at River level compared to speeds at the top of the bluffs. The weather station at the M.A.D. is setting on an area that is open and exposed to unobstructed gusts of wind. Therefore, the wind speeds recorded at the Narrows is not as representative as it might be at 200 feet higher in elevation. This does not take away the fact that the "historical" wind patterns attributed to the "Point-of-the-Mountain" are not sufficient to cause movement in black flies migrating up from the breeding sites of the Jordan River and surrounding canals.

In 1991, black flies were observed on several occasions of 3-4 day periods in numbers that had the public complaining. During July 25 through July 27, flies were reported from the Narrows at the Turner Dam (17200 South) to 7000 South and 3200 East. The barometric pressure was 29.42 inches of mercury and the winds were gusting from 16 to 32 mph. Flies then decreased for several days as the weather cleared and the barometer went up to 30.24 inches of mercury. On August 5th through the 7th, black flies were observed in Draper, the barometer had dropped to 29.92 inches of mercury, and flies were observed in numbers of 20-30 around one's head at the Turner Dam. By the 8th of August there were flies north to Magna. The barometer was sporadic with winds gusting to 26 mph. Severe weather occurred during the last week of August, 1991, where flies were now valley wide and gusts of wind were recorded to 32 mph with the barometric pressure dropping to 29.90 inches of mercury.

In the 1992 season, black fly adults were a noticeable problem on just two occasions--July 12th through the 15th with winds gusting to 24 mph over that period and the barometric pressure dropping to 29.83 inches of mercury on the 13th. There was a terrible storm starting the 12th and on the 13th inspection of adults were horrendous in the Narrows and the larval population seemed to explode. There probably is no correlation between the weather and the larval population explosion but the presence of such large numbers of adult flies may indicate the unsuspected oviposition potential. Through the middle part of August, high winds in excess of 60 mph (weather bureau radio report) on the 5th and the 20th. The barometer dropped to 29.86 inches of mercury on the 6th. No black flies were reported by any of the usual complainants.

In comparing the information available from District weather stations, weather reports, and larval inspection data, movement of black flies should have occurred again as in 1991, throughout the Salt Lake Valley. However, this was not the case. Black fly adults were not seen in the "usual" places north of the Narrows in significant numbers. Such locations as Draper, a small city located in the southeast corner of the valley, and an area constantly harassed by black flies over the years, and several other sites along canals in Sandy City and areas along the east foothills. Two major reasons can be suggested. One is that the inspection regimen was successful in reducing larval populations to a point that didn't provide numbers of observable adults. Secondly, the drought effected available water to the canal systems because of the severe reduction of water in Utah Lake. With low water in the lake, any appreciable north wind would push the water away from the pumps on the north end of the lake making it impossible to extract water sufficient to supply the canal needs. The canal's volumes fluctuated greatly over the last two weeks of August and all of September such that larval populations were drastically reduced the last part of the season.

Conclusions can be drawn that weather conditions seem to agitate the black fly adult populations to irritating levels around humans and animals if sufficient adults are around. If black fly populations are reduced properly with a good larval reduction program, weather changes that previously stimulated adult activity won't apply.

REFERENCES CITED

Fallis, A. M. 1964. Feeding and related behaviour of female Simuliidae (Diptera). Exp. Parasitol. 15:439-470.

Freedeen, F.J.H. 1969. Outbreaks of the black fly *Simuliumm arcticum* Malloch in Alberta. Quaest. Entomol. 5:341-372.

Garms, R. and J. F. Walsh. 1987. The Migration and dispersal of black flies: *Simulium damnosum s.l.*, Onchocerciasis. Black flies Penn. State 528 pp. 201-214.

Johnson, C. G. 1969. Migration and dispersal of insects by flight. Methuen, London. 763 pp.

Magor, J. I. and L. J. Walsh. 1980. Studies of winds and weather during migrations of *Simulium damnosum* Theobold (Diptera: Simuliidae), the vector of onchocerciasis in West Africa. Bull. Entomo. Res. 70:693-716.

Service, M. W. 1979. Light trap collections of ovipositing *Simulium squamosum* in Ghana. Ann. Trop. Med. Paritol. 733:487-490.

Thompson, B. H. 1976. Studies on the flight range and dispersal of *Simulium damnosum* (Diptera: Simuliidae) in Rain-forests of Cameroon. Ann. Trop. Med. Parasitol. 70:343-354.

Walsh, J. F. 1978. Light trap collections of ovipositing *Simulium damnosum s.l.* in northern Ghana. Tropenmed. Parasitol. 29:492-496.

Wellington, W. G. 1974. Black fly activity during Cumulus-induced pressure fluctuations. Environ. Ecol. 3:351-353.

Williams, C. B. and L. Davies. 1957. Simuliidae attracted at night to a trap using ultra-violet light. Nature (London) 179:924-925.

URBAN MARSH AND MOSQUITO CONTROL

SAMMIE L. DICKSON
Salt Lake City MAD
Salt Lake City, Utah 84116

Since the discovery that mosquitoes are the vector of several diseases to both man and his domesticated animals, communities throughout the world have endeavored to drain marshy areas in close proximity of urban areas. The positive result of the drainage has been to improve the quality of life and increase the usable lands for those growing communities. Until recent wetlands legislation, the problem of mosquito control agencies has been, how to contend with communities encroachment on marshlands. Now the problem is reversed, how do we deal with marshlands invading urban areas. An example of this trend began in Salt Lake City almost 10 years ago. The Salt Lake City sewer treatment facility located on the north edge of the city was surrounded by marginal wetlands. The nearest subdivision was within 1 mile of the facility separated only by a golf course. As industry expanded much of the existing wetlands in the area was filled in and developed. However, a 30-acre plot of land belonging to the sewer treatment plant remained undeveloped and a perennial problem when each spring it became flooded producing a large brood of *Aedes dorsalis*. In 1982, the Salt Lake area began experiencing the first of several years of record breaking precipitation. Marginal wetlands became shallow lakes attracting unprecedented numbers of shore birds and other water fowl in close proximity to the populace. This phenomenon did not go unnoticed by local bird watchers and the Department of Natural Resources.

By 1988, ground water was down and the shallow lakes dried up and returned to their previous condition as marginal wetlands. In the interim years wetlands legislation had made it impossible for the sewer district to enlarge its facilities on the unused 30 acres. An idea evolved to turn the now unusable land into an 'urban marsh' as it had temporarily been during the mid--1980's. Treated water discharged from the plant would be circulated through the area to create a permanent marsh designed to attract a vast array of bird life. Walkways and viewing areas would be built so that the public could receive first hand knowledge of the wetland habitat.

An artist's drawing of the concept hanging at the sewer treatment facilities board room readily demonstrates the misconception of what a typical marsh is like in the area. Likewise some of the people involved with the project had no understanding of successional stages and the dynamics taking place within the wetland ecosystem. Some felt, as the picture portrays, that the marsh would instantly be mature with landscaping similar to a city park.

Sewer treatment personnel soon found that simulating a natural marsh was not as easy as just flooding an area. A number of agencies soon became involved, including: US Army Corp of Engineers, Federal Fish and Wildlife, Utah Department of Natural Resources, Salt Lake City-County Health Department and the Salt Lake City Mosquito Abatement District. All entities lobbied for their own interests. Mosquito control, although involved, had less influence than those agencies promoting waterfowl attraction. Initial designs of channels several feet deep with steep banks gave way to shallow channels with low slopes and plans of planting several progressive stages of emergent vegetation.

Two years after the initial construction of the urban marsh several problems have emerged. The look of the marsh is much different from what was originally planned. Viewing areas have not been built and visitors to the area are discouraged.

Although informed that few if any trees occur naturally in the marshes surrounding the Great Salt Lake, trees were planted along the entrance to the urban marsh. Most have died or are dying due to the alkaline soil conditions. Initial estimates of the flow rates for water through the urban marsh would have prevented mosquito production. However, a lack of a maintenance plan and a proliferation of aquatic vegetation has created areas along the edges of channels where water stagnates and *Culex pipiens* larvae thrive. Weirs designed to maintain a stable level of water have received a minimum of maintenance and have become overgrown and clogged with algae blooms, causing water levels to fluctuate.

During the past summer this area was treated 11 times, for predominately *Culex pipiens and Culex* *tarsalis*. This compares to pre-urban marsh years when the average was for only two treatments in the spring.

I believe that the concept of an urban marsh is a good one. The need to preserve our wetlands is real. However, a lack of acceptance of environmentally sound principles by those political bodies placed in charge of the design, construction and maintenance of urban marshes condemns them to fail.

AQUATIC VEGETATION MANAGEMENT

SCOTT BENFER
Cornbelt Chemical Company
McCook, NE 69001

I) DEFINING THE PROBLEM

- A) Sites of Concern
- B) Vegetation Concerns

II) MANAGEMENT TECHNIQUES

- A) Physical Removal
- B) Mechanical Removal
- C) Habitat Manipulation
- D) Biological Controls
- E) Chemical Control

III) PLANT IDENTIFICATION

- A) Algae
- B) Floating Plants
- C) Submersed Plants
- D) Emersed Plants
- E) Marginal Plants

IV) DETERMINE SIZE OF TREATMENT AREA

- A) Area Measurements
- B) Volume Measurements

V) PRODUCT SELECTION

- A) Products Available
- B) Formulations Available
- C) Product Positioning
- D) Water Use Restrictions

VI) EQUIPMENT SELECTION

- A) Granular Products
  - 1) Hand Application
  - 2) Spreaders
  - 3) Granular Blowers
- B) Liquid Products
  - 1) Direct Diluted
  - 2) Hand or Backpack Sprayers
  - 3) Handgun Power Sprayers
  - 4) Flowing Water Drip Systems

VII) PRODUCT APPLICATION

- A) Preliminary Considerations
- B) Re-examine Treatment Area
- C) Dilution and Calibration
- D) Properly Time the Application
- E) Review Application Techniques
- F) Make the Application

VIII) SUMMARY/CONCLUSION

- A) Evaluations
- B) Adjustments

ARBOVIRUS UPDATE FROM A VETERINARIAN PERSPECTIVE

NORMAN T. EREKSON
Assistant State Veterinarian
Salt Lake City, UT 84116

ABSTRACT

Dog heartworm was reported from 24 dogs in Utah in 1992. Thirteen of these cases were from animals brought from other states, while 11 were native Utah dogs. The native dogs were from Sandy City (1), West Valley City (1), and Hill Air Force Base (9) areas.

Three horses in the Uintah Basin (Duchesne County) were confirmed as having western equine encephalitis.

No bluetongue was discovered in flock surveillance in the Uintah Basin area.