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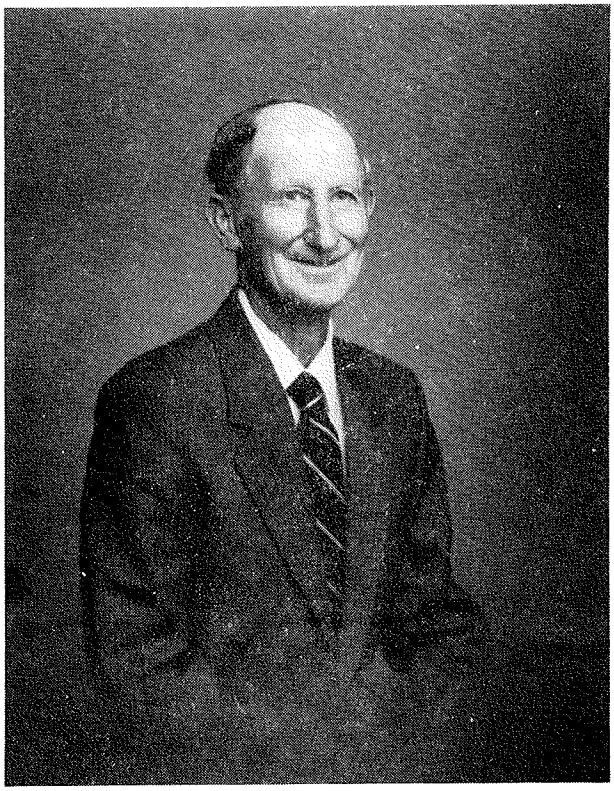

Fred C. Harmston

DR. DON MERRILL REES MEMORIAL AWARD

This award was created in 1987 by the Utah Mosquito Abatement Association to acknowledge exceptional contributions to mosquito control in Utah. The award honors **Dr. Don Merrill Rees, 1901-1976**, who was often referred to as the "Father of Mosquito Abatement in Utah."

The 1994 recipient of the fifth **Dr. Don Merrill Rees Memorial Award** is **Fred C. Harmston**. Fred was born in Roosevelt, Utah in 1911. During his youth he developed a strong interest in insects and helped his father prepare insecticides for spraying a family fruit orchard. He received his B. S. degree in entomology at Utah State University and his Masters degree on the mosquitoes of Colorado at Colorado State University. During his days at Utah State he worked with the extension service, Bureau of Entomology and Plant Quarantine, on grasshoppers and Mormon cricket control. On this project he worked with the well known entomologist, George F. Knowlton.

Fred was employed as a sanitarian with the CDC, U. S. Public Health Service for 45 years, during which time he was stationed at locations in Indiana, Texas, Utah and Colorado. During his career he worked on many vector-borne diseases, malaria, plague, dengue, typhus, Rocky Mountain spotted fever, and mosquito-borne encephalitis. His work on plague resulted in the establishment of ordinances for rodent control to prevent the disease. He also supervised rodent control in the major cities along the Wasatch Front from Provo to Logan and in other western states.

Fred also worked on water resources and irrigation projects from Kansas to the west coast to help establish mosquito abatement procedures. He was a close friend of **Don M. Rees** and spent two years at the University of Utah working with him, promoting and establishing mosquito control in Utah. He also made collecting trips with **Dr. Rees** and they published several papers together.

Fred has published more than 75 papers on vector-borne disease and other public health subjects. He is an expert on mosquito biology and taxonomy. His major publication was the 'Mosquitoes of Colorado,' which he published in 1967. He has also studied a group of flies, in the family Dolichopodidae. He has published a large number of papers on this group and described many new species.

Fred C. Harmston has been a strong supporter of mosquito control in Utah and his work with **Dr. Don M. Rees** helped in the establishment of the strong programs in the state today. The UMAA was honored to present **Fred C. Harmston** with its highest award, the **Don Merrill Rees Memorial Award**.

THE ECONOMICS OF MOSQUITO CONTROL

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Mosquitoes have been around since the beginning of time and have survived years of changing conditions that humans could never withstand. However, they have never had to be concerned with economics as humans have and in the present climate of no new taxes, mosquito control agencies have come under the gun to justify their very existence. We are a victim of our own success. It is now more important than ever to carefully consider economics of mosquito control right up there along with efficacy and environmental safety. It means the difference of survival or extinction of the species; the species being "us."

Webster defines economics as "the social science that deals with the production, distribution and consumption of goods and services and with the theory and management of economics or economic systems." It also mentions relevant financial considerations, which to those of us who manage mosquito control and abatement programs, has a special meaning.

How can we make the public aware of the importance of mosquito control? How can we run an economical program and still comply with all the regulations imposed upon us by old and recent laws? What parameters do we use to conduct an efficient but efficacious program? Do we have a mosquito problem? Are we controlling the mosquitoes for nuisance or for disease purposes or both? Can we document all these things to the satisfaction of the people paying the freight?

There are numerous questions to be asked and answered before a true evaluation of economics can be documented. I would like to give you my opinion of the process of documenting, justifying and establishing the economics of a program and a few of the cost effective ways of evaluating the results.

To begin, determine if there is truly a mosquito problem by using several different surveillance methods that are easily available. New Jersey Light traps, CDC light traps, and mosquito landing rates are but a few and are fairly reasonable even for small budgets.

With a new program, if it is politically possible, a surveillance program should be established prior to any active treatment of mosquito populations. If it is not possible, limited adulticiding, after determining the extent of the problem areas, should be conducted. Record the information and if at all possible a computer should be purchased. There are numerous programs on the market today that will provide varied types of needed information. Consult a knowledgeable computer person in the business where you plan to buy the software. They can help you get started. Lotus is basically good for simple statistics. Pie charts and bar graphs are always easier for the general public and political types to understand. Maps are another means of documentation that is eye catching and effective. After surveillance is completed and findings are documented, communicate with the people who will provide the monies or those who are supporting and encouraging you to find monies. It is important to show the cost effectiveness of a program. Show taxpayers what they will get for their monies. There must also be several alternative plans available if funding appropriation is lower than expected or needed.

It is important that a mandate is established with goals and that these goals are circulated and understood by all involved in the program. This is true for a new program or for an established one. Always be true to the goals and reassess them every 3 to 4 years.

After funding has been obtained, how do you decide which tools of mosquito control are the most useful and the most economical? by doing a cost analysis of the techniques. It is not a difficult task. A few figures are sufficient. If funds are limited, how can you best serve the public needs? Is it with larviciding, water management or adulticiding? If you adhere to an integrated approach to mosquito control, all three techniques should be used, but when reality sets in and funds are limited, a decision must be made. In my experience, I have found that adulticiding is the most economical technique for limited funds. This is not the preferred method nor is it the most environmentally sound method, but a start has to be made somewhere and the work towards an integrated approach. This is a decision based on economics. When you respond to a public need, funds will continue if the public knows you are out there performing the service they want. The secret is that you MUST let them know. Do not assume they automatically know. A very dangerous thing to do and will guarantee program extinction.

Ideally, water management should be a method of first choice because it is permanent control. Again, reality. Some states have laws that prohibit water management in any form so another choice must be made. In some areas water management is not feasible. Larviciding or source reduction is the next logical choice. This technique is very effective but not very noticeable by the public. If you wish to continue this you must again let the public know of your actions. Surveillance of course is always a must. There can be no mosquito control without surveillance.

Another must is public education. There are many methods that do not cost much, but take time. Some radio stations allow you to tape messages during the active season and give mosquito facts. Television, especially local cable channels, will give public service messages and even interview if you can interest someone in the subject. Schools are very fertile ground for absorption of information that is usually taken home to the parents, and don't forget little people become big people. Programs in the schools can be accomplished in the winter months when mosquito workers have time. Civic club members who have influence in the communities, are taxpayers. Talk to them.

I am sure that by now you are thinking "I know all of these things and I do some of them or most of them," but do you do a cost analysis of each technique? I don't mean that every time a service is performed a cost analysis must be done, but you need to have the ability to do this and to pull the figures up quickly, if asked to do so. Do you let the individual communities, townships, or towns know about the work accomplished in their area and how much it has cost each year? Have you worked out any statistics with your budget and correlated them with service calls, complaints, acres of mosquito breeding eliminated, or acres of mosquito breeding controlled with chemicals? Have you let the people in your area know how much mosquito control actually costs them per year per person?

I'll give you a for instance from the Cape May County Mosquito Commission. We are a tourist economy in Cape May County. Ninety percent of the economy is tourism. Our seasonal population is 632,600 and our off season population is 98,311 (Actually it is 98,312 because my daughter just had a baby girl.) Anyway, in 1994 our budget was 1.4 million dollars. If costs are broken down per capita seasonal population it cost taxpayers $2.24 per person for mosquito control in 1994. It is an effective method of evaluation and comparison because a can of Raid costs more than $2.24. The seasonal population numbers reflect only those who own homes and property and who are on the tax rolls. If actual numbers of people served (those in motels, transients and visitors not on tax rolls) were counted the cost per capita would be minute. If someone asks what is the cost of the off season population we also have that ready. It is $14.40 per person. In our annual report we show that mosquito control is 2.44% of the County budget and .677% of the total County, Municipal and School budgets which encompass all the property taxes they pay. The county budget is $58 million dollars, the County, Municipal, and Schools budget for 1994 is $209 million. The 1994 Net Valuation Taxable (this means the total value of all land and property in the county that is taxable) is $13,116,747,654. Does this sound like a lot of ridiculous boring figures? It will not to people who want to know where their monies were spent if you display it properly and make it easy to understand. Computer graphics are perfect for this task. Use this

on handouts, on slides, in presentation, at county fairs and in budget submissions.

Another example: Water management. Modern pressures, both economic and environmental, have caused mosquito commissions to re-evaluate their present methods of control. DeBord et al (1975) examined the economics of mosquito control techniques used from 1959-1971 by various East Coast commissions. Their study concluded that permanent control is costly and not as effective as temporary control. However, I believe there are many factors that need to be examined before such a comparison can be made of the effectiveness and economy of the permanent water management used today in New Jersey with temporary chemical control methods. Hansen et al (1976) showed that water management is very cost effective over the long term.

The major factor in New Jersey's water management for salt marsh mosquito control has been the development of open marsh water management (OMWM) techniques. OMWM is aimed at larval control by the elimination of actual breeding depressions while increasing estuarine food web components without the use of insecticides. OMWM incorporated the use of tidal ditches, ponds and pond radials. These alterations take into consideration the major features of the salt marsh tidal creeks and salt marsh ponds.

DeBord et al (1975) presented data that in New Jersey, the lives of ditches are approximately five years and the average linear footage per acre is approximately 261 ft. These are two statements that have proven to be false over the years when applied to OMWM, for the following reasons:

1. OMWM is only oriented toward actual breeding sites on the marsh. Therefore, any overall average would vary greatly as large tracts of marsh are not managed at all because they have no mosquito breeding while others may have concentrated breeding.

2. OMWM incorporated ponding of areas where there is concentrated breeding.

3. OMWM methods have a long period of life and are not maintained unless breeding is found. In Cape May County on the Seaville marsh adjacent to the Atlantic Ocean we treated 548 acres with OMWM at a cost of $29.18 per acre in 1969. We have not cleaned or maintained any of the ditches as of this present date nor do they need maintenance nor do they breed mosquitoes and no pesticides have been used on the 548 acre tract. This cost us $15,990.64 to complete from 1967 to 1969. If we had not managed this area with water management at that time and had to treat the breeding acreage with a pesticide from 1969 to 1994, estimated four treatments a year (which is a very conservative number), it would have cost us $342,500 for just the cost of pesticides alone. This was aerially applied and if you add the cost of aerial application by helicopter which we use, and the surveillance necessary to find the breeding, it would more then double this figure.

I am sure you get the picture, but more importantly, you have these cost savings figures, and communicate them to the right people, you can expand and enhance your mosquito control operation with support from taxpayers and politicians alike. You will not become a political liability as far as economics are concerned. You won't be the first program cut because someone in charge perceives your value to the community as expendable, because of costs. In 1983, our Commission purchased two Hiller helicopters for larviciding, adulticiding and inspection on the salt marshes of the county. Prior to that time we rented contract helicopters and took whatever pilots came with them that met our requirements. We did a cost analysis and found that we could be more efficient and it would cost us less money in the long run if we purchased our own ships and hired our own pilot. I won't go into the actual figures, but I did the original coast analysis and our entomologist did a recent update that proved conclusively that we made the right decision. I used these originally to convince our governing body to fund the helicopters and update to show them that we made the right decision. I have copies of the publications with me if anyone would like them.

Another expense, and a hidden one at that, is regulations. In New Jersey politicians and taxpayers

alike are beginning to recognize the costs to themselves and any taxpayer funded program. There is a bill that was introduced into the New Jersey Senate in June attempting to do away with repetitious and unnecessary regulations, especially environmental regulations. All mosquito control commissions and agencies were sent a letter by the president of the New Jersey Senate in March of 1994 requesting input from us as to which regulations were costing us the most and which were impeding our programs. It was part of a cost saving program that has been endorsed by taxpayers associations all over the state. Things are looking up. In Cape May County, it costs us $1,080 per year just to pay the license fees for our Certified Pesticide Applicators. We must also, under the relatively new state Uniform Fire Code, pay municipal and state officials for the privilege of inspecting our premises to make sure we comply with the State Law and Municipal Ordinances. We have sixteen municipalities in Cape May County and we operate in each one of them. These are but a few of the fees we pay. We own helicopters so there are many fees from the State DOT Division of Aeronautics. New emissions control on the new vehicles have raised the costs of trucks (of which we have 35 and replace at least three to five each year). Permit fees are astronomical. The Freshwater Wetland Act require a charge of as much as five to ten percent of the cost of the project as a permit fee. The Stream Encroachment Act tries to keep up with them, and on and on. The American for Disabilities Act has required us to make major accommodations for the disabled and redo all our job descriptions to comply with the act. Enough said about regulations. My blood pressure rises just thinking about compliance and costs.

So what have I said in this long discourse? If you stopped listening a while ago and if you remember nothing else I have said, remember three things, Justify, Document and Communicate. Make decisions on all the professional and scientific facts that you have as experts in your field but remember the people you will be talking to are not experts. They care about how effective your program is. Does it contribute to their comfort, health and welfare, and how much of their money are you spending to do the job? Are you as careful of their money as they would be and are you letting them know how careful you are? You should. It literally guarantees longevity. We have done this over the years in Cape May County and have been there since 1915. It has paid off. It's not only good business but it is an obligation to the public that has funded us for almost eighty years.

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TAKE ME OUT TO THE BALL GAME

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The ball park on the corner of 1300 South and West Temple in Salt Lake City has been a landmark for 68 years. It has been the home to a number of minor league baseball teams including the Salt Lake Bees, Salt Lake Gulls, Salt Lake Trappers and most recently the Salt Lake Buzz. Over the years guest appearances from such baseball heroes as Babe Ruth (1940's), Ernie Banks, Stan Musial and Tim McCarver (1960), and Willie McCovey and Willie Mays (1961) kept the crowds coming. Its history begins in 1926, when a grandstand was moved to the lot and became known as Community Ball Park. By May of 1928 the city purchased five more acres for $15,000. The ball park was officially renamed in 1946 to "Derks Field" in honor of J. C. Derks, who was instrumental in obtaining the original Community Ball Park, as well as, being a long time Sports Editor for the Salt Lake Tribune. On September 24, 1946, the wooden bleachers burned to the ground, after a disgruntled Salt Lake Bees fan set a fire following a loss to Twin Falls in the playoffs. Reconstruction began in 1947 at a cost of $159,000. In 1958, work was begun on additions, remodeling of the grandstands and lighting at a cost of $280,000, bringing the seating capacity to 9,308.

In 1993, due to numerous conditions associated with weathering and age, portions of the spectator bleachers were condemned. It was determined that the existing stadium could not be cost effectively remodeled to conform to current building, health and life safety codes, of the Professional Baseball Agreement which west into effect in 1994, and the provisions of the American with Disabilities Act. In early 1993, Salt Lake City Mayor Deedee Corradini made the decision to raze Derks Field and build a new stadium at the same location. Salt Lake City successfully obtained a commitment of an AAA baseball team as a tenant, provided the new stadium was constructed and ready for play by April, 1994. That left less than one year to build the stadium even though funding had not yet been obtained.

Funding became a political issue with the Mayor vowing that taxes would not be raised to finance the stadium. In March, 1993, Derks Field, parking lot and surrounding area was determined to be a blighted area. With the designation as a blighted area, Derks Field filled the requirements to be taken over by the Salt Lake City Redevelopment Agency (RDA). In April, 1993, Derks Field became part of the 'Salt Lake City Baseball Stadium Neighborhood Development Plan' administered by RDA. Normally the RDA receives most of its funding by tax increment financing. Under increment financing, the assessed value of all personal and real property within a redevelopment area in the year prior to the adoption of the redevelopment plan becomes the base year. In all years following the base year (generally 22 years), local taxing units receive the taxes generated by applying the current year tax levy to the base year assessed valuation. The RDA may receive any taxes collected due to an increase in the assessed value of a redevelopment area over that of the base year.

The RDA will collect no tax increment from this project since all of the property is already publicly owned by Salt Lake City and not in the tax roles. To remedy this situation the Utah State Legislature passed new legislation in the spring of 1993 that allows RDA to use tax increment collected in another project area such as the Delta Center for other projects (such as the baseball park) if substantially all of the land in the new project (baseball park) are publicly owned.

The initial cost estimates for a new ballpark were around $12,000,000. The project was began in April 1993, and by April 11, 1994, the Salt Lake Buzz held its first home game against the Edmonton Trappers, both triple A teams of the Pacific coast Minor League. The final cost of the new stadium was $22,294,277.21. The funding came from the following sources:

Private	$4,947,293
State	1,824,333
S.L.C.	4,647,000
RDA	7,771,969
County	3,000,000

Of the private contributions Franklin Quest donated $1.4 million and thus the new name, Franklin Quest Field. The Salt Lake City Mosquito Abatement District (SLCMAD) became involved when it was informed that the RDA would withhold $111,539 of property tax over a 22 year period. This is the amount of property tax money generated from the Delta Center RDA project that would have gone into the SLCMAD. The SLCMAD portion was a mandate not an option. Thus, even though individual property taxes of home owners was not raised directly for the building of the new stadium, they will undoubtedly be raised by the special districts (including Salt Lake City School District) to off set the $7,771,969 over the next 22 years.

The next involvement of the SLCMAD with the Franklin Quest Field came on July 5, 1994 following a complaint from a lady whose house borders on the south side of the ballpark. The complainant explained that she had seen standing water on ballpark property. The new stadium was designed to seat 12,000 fans in permanent seats and an additional 2,000 on a 'berm' surrounding the outfield. The berm is outside and higher than the home run wall. It is covered with grass on sloping sides both facing the outfield and toward the outside of the ballpark.

At the bottom of both sides of the 'berm' are trough like areas leading to catchbasins. However, over-watering of the berm has resulted in standing water in the trough that can't drain because of a lack of slope towards the catch-basins. Several areas along these troughs had large numbers of *Culex pipiens* within a few feet of the complaint.

Adjacent to the outside of the berm the ball park was landscaped with small shrubs and trees. Bark used as a ground cover under the trees and shrubs was floating from over-watering and also contained many larvae. In addition to these sources, run-off from the landscaping had gone into a parking lot of a bank creating another source. All larval sources were treated with Golden Bear 1111, to kill any larvae and pupae that were present. Altosid pellets were also used to provide some residual treatment. The ground crew was asked to reduce watering and fill in low areas.

The ball park ground crew was asked if they were aware of any additional standing water on the property. We were told that the only other water was in two ponds under the stadium that held water used to hose down the bleacher area after games. The holding ponds are located in a large poorly lighted tunnel formed by the bleachers overhead and on one side, and the locker rooms and commissary on the other. The ponds are approximately twelve feet wide, sixty feet long and up to six feet in depth. The ponds are made entirely of concrete with a floor sloping towards a sump area. Water from these ponds is recycled, being used repeatedly to hose down the bleacher area. A fence and locked gate prevented an initial inspection of these ponds.

Two weeks after the first visit to the ballpark the SLCMAD received a call from Mike Runyan, Franklin Quest Field Supervisor. He said that the Marriott food services personnel located under the stadium, across the tunnel from one of the holding ponds was complaining of a mosquito problem. I went to the stadium that afternoon. A chef from the food services approached me upon entering the tunnel. It was quite a sight to see him standing there with a white uniform and tall chef hat swatting mosquitoes on himself. Even though it was the middle of the afternoon, *Culex pipiens* were biting in large numbers. Numerous adult mosquitoes were seen on the walls and ceiling of the tunnel. The tunnel effectively lengthened the life of the mosquitoes creating a cave-like atmosphere of cool constant temperature, high humidity and low light. There was little question as to where the mosquitoes were coming from. The ponds at this time were smelling much like a sewage lagoon and had a thick mat of algae over about half of the pond. Since our last visit to the ballpark there had not been another home game and the water in the ponds had been left to stagnate. The gates into the ponds were unlocked and I was able to collect over 100 larvae per dip. Pyrenone Tossits were used to get immediate

control and Altosid XR Briquettes were placed in the water to give a residual control.

Weekly follow-up visits were made to the ball park. The larval sources in the berm area continue to be a problem. The ground crew put sand in some low areas that actually caused an increase in the source size. Watering continues to be excessive requiring treatments for larvae throughout the summer.

The holding ponds have also required repeated treatments. Altosid XR Briquettes are filtered out of the ponds as water is recycled. The design of the ponds does not allow them to ever completely dry up. During periods when there are several home games played in a row the water is disturbed enough that no larvae are produced. However, when the team goes on the road for a week or more the water in the ponds stagnates and produces larvae.

It is hoped that as the baseball season ends, the SLCMAD can sit down with the SLC Parks Department and discuss options for correcting the design shortcoming in both the berm and the holding ponds!

ENCEPHALITIS SURVEILLANCE

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Utah has a long history of sporadic outbreaks of primarily Western Equine Encephalitis (WEE). The first recorded outbreak of WEE in Utah occurred in 1933 involving 3,958 horses. The outbreak was centered along the Wasatch Front in Utah and extended north to Franklin County, Idaho. Equine cases were reported every year from 1935 until 1951 with the high occurring in 1941 involving 837 horses (Brookman 1955). The number of human cases prior to 1957 is not known because WEE cases were not separated from other forms of encephalitis. In 1957, two human cases were reported. 1958 brought the largest outbreak in human cases involving 48 with one fatality, and 224 horses were also infected. Only two human cases of WEE have been reported since 1958; one occurred in 1963 and one in 1966 (Wagstaff et al. 1986). WEE was relatively quiet from 1958 until in 1978 when sixty horses in the Uintah Basin were diagnosed with WEE (Romney et al. 1980).

In recent years five horse cases of WEE have been reported (Table 1). The first confirmed cases occurring in 1992 in Duchesne County. Two horse cases and four chickens in the sentinel flock sero-converted to WEE about the same time.

Grand County recorded their first ever WEE cases in 1993. One horse was confirmed with WEE and one horse died before the second blood sample could be taken. However, due to the high titer count in the first sample it is considered to have died from WEE. Two chickens sero-converted in the Moab Mosquito Abatement District's sentinel flock, also a first. Uintah County reported one confirmed horse case with forty percent of the sentinel flock in Jensen sero-converting.

With the outbreak in 1958, surveillance was started with the Center for Disease Control (CDC) using *Culex tarsalis* pools and a sentinel chicken flock. Thirty-four pools of *Cx. tarsalis* females were tested with six being positive for WEE. A flock was maintained at the Salt Lake City Mosquito Abatement District from 1963 until 1974 and tested each fall. There were no sero-conversions recorded during this time.

The current surveillance program began in 1983. The program has grown from a beginning of eleven flocks to 20-21 chicken flocks of twenty birds each, stationed in locations throughout Utah. Individual mosquito abatement district's (MAD's) attempt to place the birds in strategic locations in their areas. The same flock locations are used every year to improve data results and monitoring virus activity in selected areas. The sentinel flocks have experienced sero-conversions to WEE and St. Louis Encephalitis (SLE) in eight of the last twelve years (Table 1). The majority of the virus activity has occurred in the Uintah Basin. The Basin has recorded 39 of the 47 or 83% of the chicken sero-conversions for both WEE and SLE. The cause of the epizootic in the Basin is unknown.

A new technique for sampling blood from the sentinel flocks was started in 1993 and perfected for full operation in 1994. The new sampling technique involves collecting the blood sample on #2 filter paper from a pin prick in the comb of the chicken. The blood samples are labeled and allowed to dry and mailed into the Utah State Health Department Laboratory for processing. The laboratory processes the blood by rehydrating the samples and running an ELISA test on all the samples. All tentatively positive samples are confirmed with an IFA test. The validity of the test is based on using a good sampling technique. Because such a small amount of blood is used, care must be used to ensure that good quality samples are being taken. The new technique appears to be working well and was confirmed to be effective with the finding of the two sero-conversions reported this year. The MAD's reported good success in taking blood samples and consider it to be a much easier process. The Utah Sate Health Department Laboratory (Division of

Immunology) and the Utah Mosquito Abatement Association (UMAA) has worked very hard in making the new sampling technique effective.

In 1994, twenty sentinel flocks were placed throughout the state. The participating MAD's are listed in Table 2 with the location of their flocks. Because the filter paper sampling is so much easier some MAD's have split their flocks into groups of ten birds each and spread them across their districts to increase their surveillance.

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Table 1. History of encephalitis sero-conversions in sentinel chicken flocks and western equine encephalitis in horses, 1983-1994.

ENCEPHALITIS SURVEILLANCE								
Year	# of Flocks	WEE		SLE		EQUINE		TOTAL
		Location	#	Location	#	Location	#	
1983	11	So. Salt Lake Co. Utah County	1 2					3
1984	20							0
1985	21							0
1986	21	Duchesne County Uintah County	3 2	Emery County Uintah County	2 3			10
1987	21	Uintah County	5					5
1988	20							0
1989	21							0
1990	21	Uintah County	3	Duchesne County	3			6
1991	21	Uintah County	4	Uintah County Box Elder County	1 1			6
1992	20	Uintah County Duchesne County	4 4			Duchesne County	*2	8
1993	20	Moab Uintah County Duchesne County	2 3 2			Moab Uintah	*2 *1	7
1994	20	Utah County Carbon County	1 1					2
TOTAL			37		10		(5)	47

*Equine cases are not added into total sero-conversions for each year.

Table 2. Location of sentinel chicken flocks in 1994.

District	# Bird	Flock #	Flock Location	Flock Manager
Box Elder	10	321-330	309 W Center, Mantua	Ralph Wyatt
	10	331-340	9139 N 11600 W, Thatcher	
	10	341-350	15505 N 4400 W, Fielding	Brian Shaffer
	10	351-360	2505 S 1200 W, Perry	Robert Conlon
Carbon County	20	381-400	E side Coal Creek Rd. Price	Matt Wise
Davis County	20	41-60	2759 W 700 S, Syracuse	Keith Ipsom
Duchesne County	10	61-70	S of Myton, Pleasant Valley	Kurk Larsen
	10	71-80	1/2 mile W Myton, Myton	Kim Harding
	10	81-90	15 miles W Roosevelt	Jarad Dye
	10	91-100	W of Myton, Bridgeland	Kristina Nation
Emery County	20	101-120	1/2 mile N of Elmo, UT	Richard Snowball
	20	121-140	3 miles E of Ferron	Ray Wareham
Logan City	20	141-160	449 Center Ave	Steve Larson
Magna	20	21-40	6940 W 2820 S, West Valley	Larry Newman
Moab	20	361-380	675 N 500 W, Moab	James Walker
North Summit	20	161-180	2150 N Echo Dam Rd	Water District
Salt Lake City	20	1-20	1800 N Redwood Rd, SLC	Lewis Rock Shop
So Salt Lake Co	20	181-200	1755 W Moyal Circle	Kelvin Brown
Tooele Valley	20	201-220	1535 Sunset Rd, Lake Point	District Office
Uintah County	20	241-260	4981 S 9500 E, Jensen	Wade Slaugh
	20	221-240	3086 S Vernal Ave, Vernal	Wayne Gurney
Utah County	20	281-300	12225 S 5200 W, Springlake	Bob Strebil
	20	301-320	615 Lake View Dr., Lindon	Jim Jensen
Weber County	20	261-280	1569 S 4700 W, West Weber	Glenn Morgan

K. F. MEYER ON THE ISOLATION OF WESTERN EQUINE ENCEPHALITIS VIRUS

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At the 1956 International Northwestern Conference on Diseases in Nature Communicable to Man held at the University of Utah, William C. Reeves, University of California, was moderator of the symposium on encephalitis. During the discussion, Stanley Marcus, University of Utah, reminded Reeves of his initial promise that K. F. Meyer, University of California, might be persuaded to tell his story of the isolation of Western equine encephalitis virus. Meyer said that when an old man reminisces, he becomes definitely senile to which Reeves replied, "No Sir!", so Meyer agreed to tell the story which has been told many times but never published. However, it has been documented on film by the U. S. Public Health Service Centers for Disease Control. It is an older story than you might suspect. Meyer had the Eastern virus in his fingers in 1911 when he was given two horse brains from Cape Cod, MA. Microscopic examination showed that the disease was similar to the encephalitis that he had studied in Europe but he could not find inclusion bodies. Therefore, he made two successful passages of the virus in rabbit which was the most susceptible animal known in 1911 for border virus isolation. Unfortunately, the strain was put into glycerin and left on the laboratory bench rather than being put into the ice box so Meyer said, "That encephalitis went up in smoke; if you don't do everything yourself, a laboratory technician will always bungle it."

In California during August, veterinarians reported that horses were dying of botulism so in 1930 Meyer sent his epidemiologist to a ranch of 670 horses where they had already lost 63 horses. He returned to report that in looking over the fence, he was convinced that the deaths probably were due to botulism but for confirmation he brought back two horse heads which he put in a bucket of ice. By the time he got to San Francisco, the ice, of course, had melted and wash water from the surface of the skin had penetrated the brains which were a mess of contaminating organisms. Meyer made some frozen sections and was satisfied again that he was dealing with a definite and striking inflammatory process with marked cuffing in the Wirkov space so he visited the ranch and promptly saw that the disease was not botulism. Nervous movements of all the horses suggested very definite central nervous system disease and one horse had trigeminal paralysis on one side. The rancher had already lost 63 horses and was not willing to sacrifice more so Meyer took movies which were included in the Centers for Disease Control film as the first clinical record of horses with encephalitis.

Two days later, Meyer did an autopsy on a Kern county horse with a striking liver complication that caused an odd jaundice. The brain was brought to the laboratory but by using rabbits, he was not successful in isolating the virus. This was repeated for more brains from horses that had died and were lying around for a considerable period so that much virus had been lost. Meyer said, "If you don't use a very sensi-tive indicator animal, you cannot isolate the virus. Today in 1956, you know that the best indicator animal is the mouse which was not used very extensively in 1930."

By the end of October, the epizootic was terminating so Meyer put in the field a few people to search for a horse with early signs still running a fever that could be sacrificed. In the early days of the depression, a horse could be bought for relatively little money. After four days in the Merced area, the investigator called to report that he had located a horse with very early signs: tremulous, flabby lower

lip and a temperature of 102°F. Meyer arrived in four hours and the investigator said very dejectedly, "You can't get the horse. It's the only horse the old man has and he will kill you if you kill his horse." The investigator had not talked to the old man's wife so Meyer said he would try some diplomatic shenanigans. As he talked to her, he fingered a $20 bill. He told her that the horse was going to die anyway and she would get nothing but if she gave the horse to him, the $20 was hers. "The old man will kill you but he doesn't have to know so we can have the following plan: I'll be behind some bushes on the corner of the field at 9 pm; when the old man is in bed and asleep, lift the shade in the room and when I see the light, I'll know the territory is clear. Now that we are good friends, I trust you implicitly so here is the $20." Meyer went to the place at 9 pm and the shade went up at 9:05 pm. He said he was still very agile and was over the fence in no time, the syringe with strychnine was in hand, the horse was down and the head severed within eight minutes. They put the head in the car and drove to the other end of Merced; in an old chicken coop with flashlights, the brain was removed, wrapped in cheese cloth, returned to the car and they drove back to San Francisco while Meyer was figuring where and in what series of animals the brain would be injected. They reached the laboratory at 5 am and by 10 am, practically all species of animals from the horse to the mouse were injected. "That's how the virus of Western equine encephalitis was isolated." Reeves said that he would really like to know how that Merced lady explained the headless horse to her husband.

In telling the story, Meyer always emphasized that you have to go to the field yourself. In the field, you look and listen and a lot of things come to light. In 1930 there were 4,000-5,000 horse deaths and he counted the deaths by going to the rendering plants or he stood on the street corners and counted the horse legs standing upright in the carts on the way to the rendering plants. Astonishingly, about two weeks after the first horse deaths, a large number of atypical poliomyelitis cases came into the Kern County General Hospital. When Meyer investigated, he saw that the disease was not poliomyelitis but typical encephalitis. One case in late 1930 was a Sacramento man who tended horses. Meyer told the pathologist, "If the man dies, put the brain in ice and send it to me." The brain was fixed in formalin instead so that all Meyer found was histological evidence of encephalitis similar to that in horses. Thus, there was evidence in 1930 of what in subsequent years become a typical pattern, first the horse cases and then the human cases.

Field observations also showed that horse infections were most commonly found along irrigation ditches; there were never any cases where horses were kept in the barn. Therefore, Meyer suspected an arthropod-borne infection but in 1930 the virus was never found in the blood. Later in systematic studies when horses were infected and bled daily, viremia was found to precede neurological manifestations.

In 1931 Meyer wanted to produce immune serum but it was obvious that in California few horses could be found that were still susceptible to intracerebral inoculation of encephalitis virus so horses were obtained from Nevada where they were uniformly susceptible. Horses were immunized with heavy suspensions of virus and their immune serum was produced in quantity by a biological house. About 1933 or 1934, the serum was used in Utah to abort an epizootic of Western equine encephalitis and further cases ceased but 90 days later the disease reappeared on the same premises. Meyer was at a loss to explain so he went to Utah and performed two autopsies. Both horses had extensive liver lesions and all the horses had jaundice so the horse immune serum contained hepatitis virus which was surprising as the serum was heated for an hour in preparation.

Meyer said that these things had never been published. There were about 12 huge filing cases with incomplete work and he asked, "Why fill the literature with that kind of tripe?" However, he concluded that the story was a very interesting and important part of the history of encephalitis.

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PRELIMINARY REPORT OF FINDINGS OF SURVEYS TO DETECT HANTAVIRUS IN RODENTS IN COLORADO ECOSYSTEMS

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A grant (U50/CCU 809862-01) was received from the Centers for Disease Control and Prevention to conduct surveys of rodent populations in Colorado in 1994 as a follow-up to the outbreak of Hantavirus Pulmonary syndrome (HPS) that occurred in 1993. The 1993 outbreak of HPS was centered in the Four Corners area. The purpose of the surveys was to determine which rodent species might harbor the virus.

For the purposes of these surveys, ecosystem designation follows the terminology of the Denver Museum of Natural History which is modified from that used by David M. Armstrong in his Distribution of Mammals in Colorado, Monograph of the museum of Natural History, University of Kansas, No. 3, 1972. Those are Grassland, Pinon-Juniper, Semi Desert Shrub, Montane Shrub, Mountain Meadow, Montane Forest, Subalpine Forest and Alpine Tundra. Twelve surveys were conducted in these eight ecosystems.

Surveys were conducted by a team of four people working three days as follows: Day 1; Travel, select trap sites, set 250 Sherman and 20-25 Tomahawk live traps. Day 2; Collect trapped animals by wearing gloves and putting the trap with animal in a plastic bag, process the animals at a field laboratory established in close proximity to the trapping area, check and reset traps where needed depending on number of captures. Day 3; Repeat day 2 except that all traps are recovered and returned home.

Animal processing involved anesthetizing with Metofane® or occasionally chloroform. Blood samples were taken by heart puncture or from the retro-orbital sinus using a capillary tube. Lung, liver, spleen, kidney and heart tissues were also collected. All specimens were stored in dry ice and later shipped to The Museum of Southwestern Biology at the University of New Mexico. Animal carcasses were stored in 10% buffered formalin for five days, drained and shipped to The Museum of Southwestern Biology as voucher specimens.

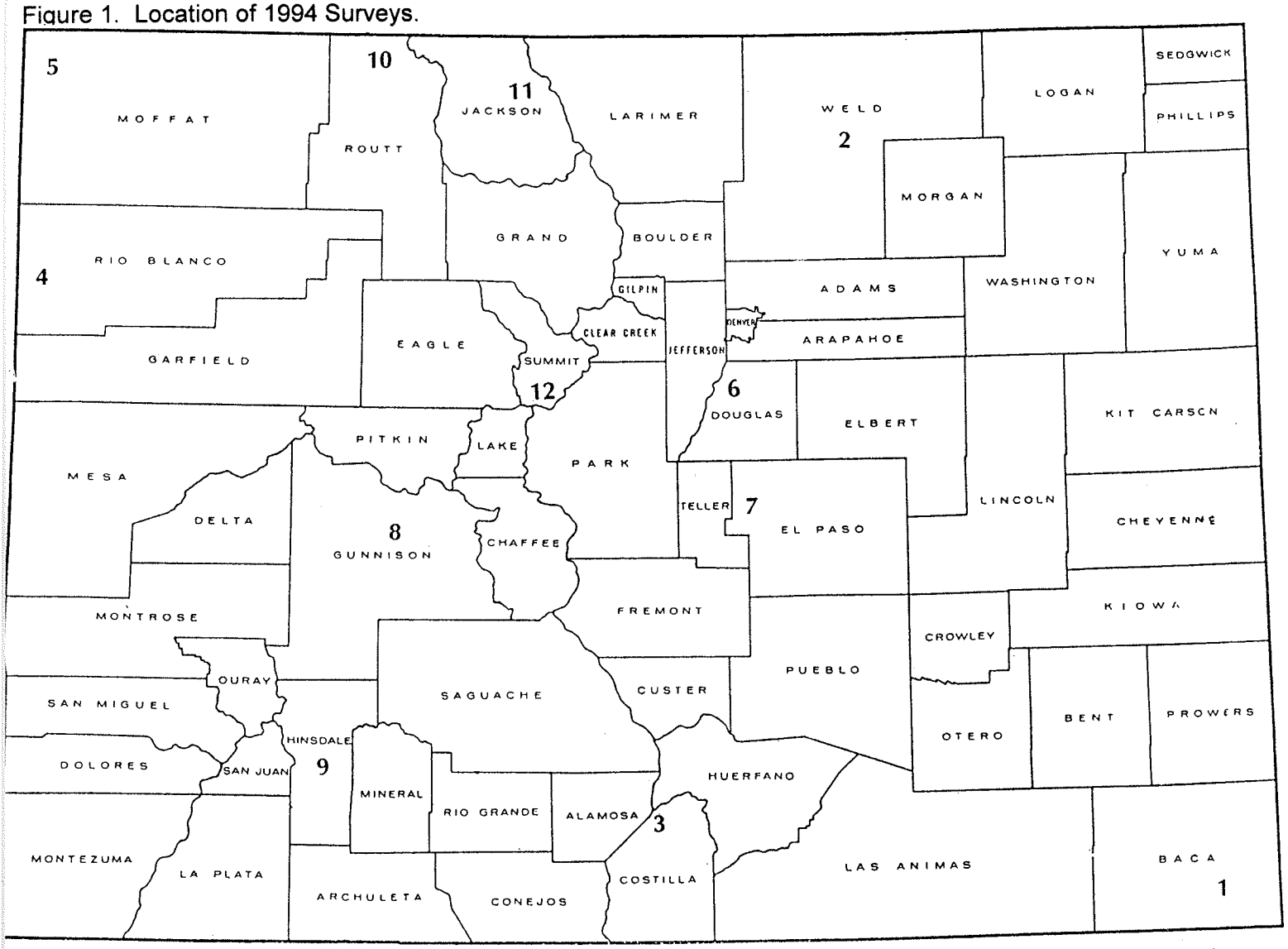
All positive traps were soaked in a disinfectant solution of household bleach, washed, rinsed and air dried as a part of the processing operation each day. Personal protection involved wearing gloves to retrieve positive traps, double gloves while processing, tyvek gowns, half or full face respirators equipped with high efficiency particulate air (HEPA) filters and goggles.

At the end of each day all gowns, gloves, plastic bags and anything coming in contact with the animals or processing were double bagged in hazard bags to be autoclaved. All capillary tubes, syringes and needles were put in heavy plastic sharps containers.

The accompanying map (figure 1) shows the locations of the surveys and is numbered chronologically. Table 1 lists the species and numbers collected in each ecosystem. This list will change some as mammologists at The Museum of Southwestern Biology review our identifications using the voucher specimens. Laboratory data is not available at this time.

There has been one case of HPS confirmed in Colorado in 1994. It was in Garfield County near Glenwood Springs. The patient died leaving only one survivor out of six cases. An environmental assessment has been made to determine risk to others and rodents have been collected. Laboratory results are not available at this time.

Figure 1. Location of 1994 Surveys.



ECOSYSTEM SURVEYS - 1994

Week Conducted		Ecosystem
1)	May 9	Grassland, South
2)	May 16	Grassland, North
3)	May 23	Pinon Juniper Woodland, South
4)	May 31	Semi Desert Shrub
5)	June 6	Pinon Juniper Woodland, North
6)	June 13	Montane Shrub
7)	June 20	Montane Forest, South
8)	June 27	Mountain Meadow
9)	July 5	Sub Alpine Forest, South
10)	July 11	Montane Forest, North
11)	July 18	Sub Alpine Forest, North
12)	July 25	Alpine

Table 1. Ecosystem surveys for Hantavirus in Colorado, 1994, with associated number of rodent species captured.

Rodent Species	Grassland So.	Grassland No.	Pinon-Juniper So.	Pinon-Juniper No.	Semi Desert Shrub	Montane Shrub	Montane Forest So.	Montane Forest No.	Mountain Meadow	Sub Alpine Forest So.	Sub Alpine Forest No.	Alpine	Total
Mus musculus		1				3							4
Onychomys leucogaster	5	1											6
Perognathus fasciatus				2									2
P. flavescens	2	1											3
Peromyscus leucopus	1					3							4
P. maniculatus	19	41	41	65	43	37	15	12	67	2		2	344
P. truei			5		7		1						13
Reithrodontomys megalotis	5												5
Zapus princeps							1	20	6		3		30
Clethrionomys gapperi							1			5	5		11
Microtus montanus				1					7	1	2		11
M. pennsylvanicus	1	2	1		6	17							27
Phenacomys intermedius								1					1
Thomomys talpoides								1					1
Tamius minimus				4	1			2		12	5	16	40
T. quadrivittatus			7		3		2		2				14
Dipodomys ordii	8		5	2									15
Spermophilus lateralis			2						2	7			11
S. spilosoma	3												3
S. variegatus							1						1
Tamiasciurus hudsonicus											1		1
Neotoma cinerea						4	1						5
N. mexicana						21	2						5
N. micropus	3												3
Sorex nanus										1			1
S. vagrans											1		1
Sigmodon hispidus	2												2
Unknown	6												8
TOTAL	**57**	**46**	**61**	**78**	**63**	**61**	**23**	**36**	**84**	**28**	**17**	**18**	**572**

HANTAVIRUS

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With 50.8% of the deer mice tested in Vya (in northern Washoe County, Nevada) positive for Hantavirus (Table 1), a proactive approach to control a possible outbreak of the virus in employees was accomplished in the summer of 1994. The location is a Road Department substation and residence for employees. The liability to Washoe County was felt to be great, so many hundreds of hours and many thousands of dollars were spent in refurbishing the site and in rodent control.

Table 1. Hantavirus (Muerto Canyon) Serosurvey Washoe County, Nevada

1993		Peromyscus Tested	Peromyscus Positive	% Positive
10/14	Lemmon Valley	13	0	0
10/15	Caughlin Ranch	12	2	16.7
10/19	Verdi Elem.	17	0	0
10/20	Spanish Sprs.	19	4	21.1
10/21	Davis Creek	14	0	0
10/22	Golden Valley	1	0	0
10/26	Bella Vista	7	0	0
10/27	Damonte Ranch	23	0	0
Totals		**106**	**6**	**5.7%**
1994				
1/19	UNR Dairy	20	0	0
1/25	Misc.	3	0	0
3/18	Lakeridge	8	0	0
4/27	Panther Dr.	3	0	0
UNR	San Raphael	33	0	0
7/19	Vya	59	30	50.8
UNR	Lemmon Valley	32	0	0
Totals		**158**	**30**	**19%**

Although serious, the incident has a humorous side as evidenced by the following poem written by Gary Minto, a Road Department employee.

VYA ON MY MIND

I have a few good reasons for drinking
And one just entered my head,
I could be thinking about Vya
Where Mickey Mouse sleeps in your bed.

Please take no offense to my little rhyme
It was written at home on my own time
One little poem--A minute of verse
It may not be funny--but it could be worse.

Written all in the hopes of people who hear it
Will lighten their mood and lift up their spirit
Enough of the banter and wasting your time,
Jump to the next page--let's start the rhyme.

Two years ago when the snow was so high
Stolpas wandering around and trying to die
Freezing their toes and also their can
According to Ariaz, the mouse bloom began.

With all of the weeds, and now not much snow
The mice were all breeding; but where could they go?
"Northern Nevada!" One of them said
My cousin Mickey says there's a breakfast and bed.

But it got crowded out in the brush
So into the bunkhouse, they went in a rush
Nice place to stay so cozy and warm
Moving into mouse condo, soon was the norm.

Their whiskers and paws they clean with a lick
But before long most mice were all sick
Hantavirus it is the Health Department said
Won't bother the mice; but breathe it, your dead.

The mice were not worried--not even Big Rat
'Cause they all could outrun the three-legged cat.
Other than him only two runaway dogs
One makes love to your leg, the other eats logs.

Then the eviction, with steamcleaner and bleach
Out went every mouse the clean team could reach
Mosquito Dan was leading the plan,
Rubber gloves, masks and sprayer for each and every man.

The tension is high from low to the Brass
Moving out Mickey Mouse is a chore, but alas
When asking a question to the chiefs you will find
Don't ask me now--I've got Vya on my Mind.

The cleaning is done. The mice are moved out.
The trap lines are set--it's over, let's shout!
Let's have a toast to the cleaning team
They did a good job and made Vya gleam.

But one thing you missed, for goodness sake
To keep mice down--better buy a snake.
Not one that rattles--get one that's nice
One big hungry snake--that loves to eat mice.

They won't have to feed it--it's easy to keep
Won't get in your bed when your trying to sleep
When it's winter, he goes underground,
Then when spring comes--no mice can be found.

You might bring this up next time you meet
As for a plan, they will think it is sweet
You won't pay insurance--retirement--and more
He's happy eating mice and sleeps on the floor.

If this plan fails don't have any fear
We have guys in Gerlach who will volunteer
Four guys in a jeep, all with forty fives
Ariaz's sprayers--mounted on C-J Fives
I think this will work--I took a poll
We'll wipe them out with one Rat Patrol!

BEAUTIFUL BEAST, *Lythrum salicaria*

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Harvey K. Nelson, Regional Director of U. S. Fish and Wildlife Services Minneapolis, Minnesota, in a Department of Interior Wildlife bulletin said, "After more than fifty years of study and debate, purple loosestrife (*Lythrum salicaria*) an emergent aquatic plant has come to the forefront in marsh management discussions in the eastern and midwestern United States. The relatively recent and rapid westward expansion of the plant and its rise to dominance in many inland marshes and river systems are causes for alarm among botanists, wetland ecologists, and water fowl managers" (Thompson et al, 1987). And I hope to add to the list mosquito abatement districts.

In the last two or three years it has been brought to our attention through our association with people like Dr. Steve Dewey, USU Extension Weed Specialist and others, that this beautiful plant, purple loosestrife, has proven in other areas to be a serious threat to the health of wetlands. As we started looking at our infestation of the plant, how it was affecting us and what we could do about it, we soon found that there were many other individuals and agencies with grave concerns as well. In fact, concerns over the threat of purple loosestrife has created some new alliances; forces not previously enjoyed. The common enemy has brought and is bringing groups together in our area which here-to-fore worked strictly from their own agendas.

As it was discovered that we had the only known infestation on the Colorado River drainage, many other people became concerned and offered assistance, some from as far away as New York. This was the help of the New York Cooperative Fish and Wildlife Research Unit of Cornell University, Ithaca, New York. Of course, this kind of concern from others helped our county commissioners realize the importance of funding control efforts. Although I supervise both weed and mosquito control programs in the county, and our initial concern was from a weed point of view, as we began to focus on what the plant was doing, we could see that it was having an impact on our mosquito control as well. Since the plant is exotic and has no natural controls and since it has the propensity to invade every mosquito producing habitat we have in the county, this plant is a concern for both areas of responsibility.

Purple loosestrife is an emergent aquatic plant of Eurasian origin. Its perennial root stalks produce stout erect annual stems. The flowers are bisexual; however, cross-pollination prevails because of the plant's attractiveness to insects, especially bees, and its long bloom period from June through September. A mature plant will produce 2.7 million seeds annually with a longevity of at least three years with greater than 80% viability (Thompson et al, 1987). These seeds are so small they are of no value to wildlife. The plant employs several methods to survive adverse conditions: nutrient deficiency is negated by changing the root-to-shoot ratio; flooding is counteracted by the production of aerenchyma tissue; damage to the root or shoot causes the development of new buds. The literature describes the plant as being "more successful on acid or neutral soils" however it is very healthy and robust on alkaline Emery County soils. All of these capabilities have allowed this plant to claim 469,490 acres of wetlands annually in the US and southern Canada (Thompson et al, 1987).

Although the plant is marginally palatable to cow and deer when it is young and tender, it soon outgrows this stage. Its fast, dense, aggressive growth has an adverse impact on the ecology of the wetland, eventually forming a monospecific stand so dense that even access is extremely limited.

One of our big concerns is that, in our mosquito abating efforts, we don't become a spreading agent for the weed. The great number of seeds and their

small size make it easy to transport them from one area to another in equipment, on shoes and clothing.

Although it seems that we have had good success this year in spraying mature plants with 1 1/2% Rodeo and 1/2% non-ionic surfactant, we don't know what our long term chances are of controlling the plant considering it prodigious seed production and our almost inaccessible drainages which pass into wilderness study areas; but considering we have the only known infestation n the Colorado River drainage, we are working for eradication, realizing that it is very seldom possible.

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NOXIOUS WEEDS AND WILD FIRES MANAGEMENT COMPARISONS

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The spread of invasive noxious weeds on public lands in the West has been described as a biological wildfire raging out of control. This analogy extends from aspects of spread and impact, to principles and strategies of effective control. Wildfires and noxious weed infestation both usually begin as a small incident\infestation which spread slowly at first, then increases exponentially in size. Spread of fire is compounded as embers are dispersed by wind, water, or animals. Embers create spot fires which enlarge and merge with each other and the main fire. A similar phenomenon occurs as weed seeds are dispersed by wind, water or animals and create 'spot' patches which grow and merge with the main infestation.

Wildfires and noxious weeds both dramatically change plant communities, which can adversely impact wildlife, domestic livestock, food and fiber production, soil erosion, water quality, or recreational opportunities. A key difference is the fact that plant and animal communities and ecosystems extensively invaded by non-indigenous noxious weeds will remain permanently altered.

Of greatest importance in the analogy between wildfires and noxious weeds are similarities in control stategies and principles. Fire fighting is so similar to fighting weeds, that nearly every aspect of modern wildfire management holds useful ideas on ways to improve noxious weed control programs. Fundamental elements of wildfire management are prevention (education and regulation), early detection and rapid response, containment and control, and site rehabilitation. These are the same basic elements of effective weed management. Adherence to the principle and practice which make wildfire management so successful could improve the overall effectiveness and efficiency of many noxious weed management programs.

Wildfire training and experience abundant within state and federal land management agencies could serve as an effective base upon which to build future weed management training programs. Personnel, already trained in wildfire suppression, find the analogy with weeds relevant to their background and interest, and quickly realize that they are already familiar with many key principles and practices of effective weed management.

Experience in developing and implementing effective public education programs in fire prevention could serve as a source of ideas to help increase the public's awareness, concern, and involvement in noxious weed prevention.

DISTRIBUTION AND OCCURRENCE OF THE AGGRESSIVE HOUSE SPIDER IN UTAH

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The agelenid spider *Tegenaria agrestis* (Walckenaer), commonly known as the aggressive house spider (AHS) or hobo spider, was first identified in Utah in 1990. This species has recently been recognized as a cause of necrotic spider bites (Vest 1987a, Vest 1987b, Akre and Myhre 1991). Cases of necrotic spider bite in Utah have usually been blamed on the brown recluse spider, even though it is not known to be established in the state (Gertsch and Ennik 1983) and only occurs by occasional accidental transport. The AHS is a much more likely cause of necrotic spider bites in Utah and is therefore a species of public health concern.

With AHS only being recognized in Utah recently, there is a need to determine the distribution and patterns of occurrence of this species in the state. Public concern about this species has created a demand for effective methods of dealing with AHS in private dwellings and commercial locations. Basic information about the habits of AHS in necessary as a foundation for developing these methods.

METHODS

Source of Data

The source data for this study consists of 896 records of spider specimens submitted for identification to the Plant Pest Diagnostic Lab, in the years 1990 to 1993. All specimens were submitted by the public.

The vast majority of these spider specimens were submitted in 1993, with most being submitted after August 1. This deluge of specimens was apparently due to sudden public concern about venomous spiders, resulting from various new articles and television reports about AHS and brown recluse spiders. Since most spider specimens were submitted in 1993, some analyses utilized data from 1993 alone or utilized subsets of 1993 data.

Basic information stored for all specimens included the date of collection, county, city, a general description of the collection site (indoor or outdoor), sex of the specimen, and state of maturity (whether immature or adult).

For many specimens submitted in 1993, the level of the dwelling where the spider was collected (the basement, for example) was also recorded. In some cases this information was not provided by the submitter.

Identification of Specimens

All spiders were identified to genus, with the exception of a few specimens which were too damaged to be identified beyond the family level. Spiders of the genus *Tegenaria* were identified to species.

Identifications of AHS specimens were initially made by verifying four features: 1) the presence of trichobothria on the tarsi, 2) the presence of plumose hairs on the carapace, legs, or both, 3) an eye arrangement consisting of two nearly straight rows of four eyes, and 4) the presence of six to eight teeth on the retromargin of the cheliceral fang furrow, with the two or three medial teeth of each chelicera being reduced in size. The first three features allowed identification of agelenid specimens to the genus level (Kaston 1978). The fourth feature separates AHS from the other local species of *Tegenaria* (Akre and Myhre 1991).

Identifications of mature AHS specimens also included examination of the male paplus or female epigynum. After some experience examining

specimens, it was possible to identify mature males merely by examination of the palpus. The palpus of AHS has unique two-pronged structure near its base (Akre and Myhre 1991). The presence of this structure was easily verified and allowed rapid identification of mature male AHS specimens.

Comparison of Counties

Data from all years was analyzed to determine if there were significant differences in the proportions of AHS submitted from counties where AHS was found. The proportion of AHS among all submitted spider specimens was calculated for each county. Differences among counties were examined using chi-square tests of homogeneity (2 x 2 tables).

Sexes and Chronological Distribution

The collection dates of male and female AHS adults and immatures were summarized using data from all years. For specimens submitted during 1993, the numbers of male and female adults were tabulated for each week. Date ranges and the length of collection periods for adult and immature males and females were determined for data from all years. The peak collection dates for adult males and females were determined for 1993 data.

Using data for all years, binomial confidence intervals were generated for the percentages of adult males and females. A relative ratio of males to females was calculated based on these binomial confidence intervals.

Occurrence In and Around Dwellings

The collection sites for AHS specimens were summarized using data from 1993. The relative percentages of AHS specimens were compared for specimens submitted from basement levels versus other dwelling levels.

Binomial confidence intervals and relative ratios were calculated to compare outdoor sites with indoor sites, and to compare basement sites with sites on other dwelling levels.

RESULTS

Comparison of Counties

Based on data from all years, the presence of AHS has been verified in nine Utah counties: Box Elder, Cache, Davis, Sanpete, Salt Lake, Summit, Utah, Wasatch, and Weber.

The numbers of AHS submitted, the total of spiders submitted, and the percentage of AHS are shown for each county in Table 1. The proportions of AHS among all submitted spiders varied considerably among counties, with a minimum of 2.2 percent (Box Elder County) and a maximum of 44.1 percent (Cache County). Figure 1 shows a map of Utah with the relative percentages found in each county.

Results of the chi-square test of homogeneity indicated that counties could be roughly divided into two groups: those with less than 20 percent AHS in the submitted specimens (Box Elder, Sanpete, Utah, and Davis) and those with more than 20 percent (Summit, Salt Lake, Wasatch, Weber, and Cache). Statistically, overlap between the two groups occurred for Davis and Summit Counties, but their relative percentages still fit within the respective groups.

Sexes and Chronological Distribution

Numbers of specimens, collection dates, and collection periods for mature and immature AHS specimens are summarized in Table 2. Mature males were submitted about three times as often as mature females. Adults were submitted twenty-eight times as often as immatures.

The length of the collection period was thirty-three days longer for mature females than for mature males. The earliest collection date for mature females occurred seven days later than that for mature males, and the latest collection date for mature females occurred forty days later than that for mature males. The peak collection date (1993) for mature females was twenty days later than that for mature males.

The earliest collection date for immatures occurred about fifty days before that of mature males, and the latest collection date for immatures occurred

ten days after that for mature males. The earliest collection dates, latest collection dates, and collection periods were nearly identical for immature males and females. Too few immatures were submitted to determine if there was a peak date of collection in 1993.

Results of comparisons of the numbers of mature male and female AHS specimens are shown in Table 3. The ratio of males to females was very close to 3:1, with males comprising 75.7 percent and females comprising 24.3 percent. Based on the binomial confidence interval, this 3:1 ratio could be expected to vary from 2:1 to 5:1.

Occurrence In and Around Dwellings

Results of comparisons of the numbers of AHS submitted from outdoor and indoor situations are shown in Table 4. Specimens were submitted from indoor situations about twelve times as often as from outdoor situations. Based on the binomial confidence interval, this 12:1 ratio could be expected to vary from 7:1 to 33:1.

Among specimens from indoor situations, AHS were submitted about twice as often from the basement levels of dwellings as from other dwelling levels. This ratio could be expected to vary from 1:1 to 3:1, based on the total sample size. Occurrence of the spider was rare in second-story dwelling levels or above, with about one percent of the specimens submitted from such sites.

DISCUSSION AND CONCLUSIONS

Comparison of Counties

At this writing, the known distribution of AHS in Utah is confined to counties along and adjacent to the Wasatch Front, which includes the most populous counties of the State. According to researchers in the Pacific Northwest, AHS is more abundant in urban areas.

Crawford and Vest (1988) stated that AHS "probably occurs in most cities and towns of Washington, Oregon, and Idaho, and is sometimes found in rural areas." More specifically, Akre and Myhre (1991) stated that AHS "dominates urban areas [in the towns of Moscow, ID, and Pullman, WA], shares habitats with other agelenids in rural areas just outside the towns, and is rarely seen in habitats far from the towns."

Based on the above, one would expect to find AHS about equally abundant among the most urbanized counties (Cache, Davis, Salt Lake, Utah, and Weber). Statistically, the proportion of AHS in all of these counties is equivalent, with the exception of Utah and Davis Counties.

Low proportions of AHS in Utah County (and also Sanpete County) could be interpreted as representing the current southern distribution limit of the species in Utah. In other words, proportions may be low because AHS has not been in these counties for very long and thus comprises a rather small percentage of the spider population. The writer is not aware of any collection records for AHS at more southern latitudes anywhere in the United States.

The low proportions in Box Elder and, in particular, Davis Counties are more difficult to explain. Box Elder County is located adjacent to two counties with relatively high proportions of AHS (Cache and Weber Counties), while Davis County is located between two counties with relatively high proportions (Salt Lake and Weber).

Box Elder County has a relatively low human population density per square mile, which might explain the low proportion of AHS there. However, Wasatch and Summit Counties have nearly equivalent population densities yet significantly higher proportions of AHS. Given that Davis County has the second highest population density per square mile of any Utah county, a rather high proportion of AHS would be expected to be present there, but such a proportion was not seen.

Some of the inconsistencies in the proportions of AHS could be due to the relatively small number of specimens submitted from most counties. When compared to the human population, the number of specimens is hardly representative. This is especially

true in the more urbanized Davis, Salt Lake, Utah and Weber Counties. Additional data may eventually show that proportions among these counties are more consistent than indicated by these analyses.

Other factors that are presently unrecognized may influence the abundance of AHS. Proportions may actually be low in some counties due to the effect of such factors.

Sexes and Chronological Distribution

Mature males were the most likely life stage of AHS to be found and submitted. This is consistent with the situation in the Pacific Northwest. Crawford and Vest (1988) found that once males leave their webs (upon maturity) they spend the rest of their lives wandering in search of females, and it is usually the wandering males that come into contact with people. Akre and Myhre (1991) similarly stated that "males wander in search of females in the fall of the year and this tends to bring them into contact with humans."

Male AHS were submitted from July to October and were most likely to be submitted during August and September. In the Pacific Northwest, mature males may be found from late June to October and most die before October (Akre and Myhre 1991). According to Crawford and Vest (1988) AHS are commonly seen only during August and September, in areas west of the Cascades.

Female AHS were most likely to be found later in the season than males. Akre and Myhre (1991) found that males matured from June to September, while females matured from late June to October. Crawford and Vest (1988) reported that AHS were found in dwellings as late as December.

Immatures of AHS were seldom submitted from Utah households but were submitted over a longer time period than adults. Since AHS has a two-year life cycle (Akre and Myhre 1991), immatures could theoretically be found at any time of year. However, immatures were submitted so infrequently that they can be considered rather minor in terms of the likelihood of human contact.

The results here are consistent with the findings of researchers in the pacific Northwest. In Utah, maturation of male and female AHS may occur slightly later in the season, but the seasonal pattern of occurrence is very similar.

Different life stages of AHS have different implications as public health concerns. Vest (1989) found that bites occurring in July through September, when mature males are most common, were more likely to cause necrotic lesions, were often accompanied by systemic illness, but usually did not cause protracted illness. Bites in late October and November, when mature females are most common, did not usually result in necrotic lesions or systemic illness, but caused only relatively minor skin reactions at the bite site. Bites during winter months, when immatures are most common, occurred uncommonly but were more likely to result in serious poisoning.

Given the much greater change of contact with humans and the likely effects of the bite, the mature male AHS has the most significance as a public health concern. Since the mature male spiders come into contact with humans because of their wandering activity, measures to prevent the spiders from entering dwellings would seem to be the most worthwhile means of dealing with them.

Occurrence In and Around Dwellings

As with the seasonal patterns, the patterns of occurrence of AHS in and around dwellings in Utah are also similar to those reported by researchers in the Pacific Northwest. Akre and Myhre (1991) state that AHS is a poor climber and is rarely seen above ground level, and that male AHS enter basements and ground floor levels at the rate of several per day from June to September. Crawford and Vest (1988) and Akre and Myhre (1991) both mention that large populations of AHS are often found in crawl spaces under houses and mobile homes, so the lack of a basement does not necessarily reduce spider incidence.

The implication of these findings is that, as far as indoor situations, persons living or spending time in basements are most likely to encounter AHS. The likelihood is smaller but still significant for persons

inhabiting ground level dwellings, but rather insignificant for those inhabiting dwellings above ground level. However, AHS could conceivably be transported to higher floors by the movement of household objects. Since basement and ground floor levels are the most likely entrance areas for AHS, any measures taken to exclude the spiders should be concentrated on these levels.

Additional Analyses

Additional analyses of these data are currently being performed. These include regression analysis of human populations against the proportions of AHS and other spiders submitted from Cache County, comparison of proportions of AHS and other spiders submitted in 1993 versus other years, and comparison of proportions of other spiders submitted from counties where AHS is found versus counties where it is not found.

ACKNOWLEDGEMENTS

I would like to thank Dr. Jay Karren of Utah State University for his much-needed assistance in identifying the hundreds of the spider specimens that were submitted during the 1993 season. Also, thanks to our Extension Secretary, Karren Pulsipher, for her patience and assistance in dealing with the huge numbers of live specimens that were brought in by the public.

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Table 1. Percentages of AHS among all spiders submitted from Utah counties, 1990-1993.

County	# of AHS Specimens	# of Other Spider Specimens	% AHS*
Box Elder	1	45	2.2[a]
Sanpete	1	42	2.3[a]
Utah	3	105	2.8[a]
Davis	5	41	10.9[a,b]
Summit	3	11	21.4[b,c]
Salt Lake	7	21	25.0[c]
Wasatch	18	39	31.6[c]
Weber	57	85	40.1[c]
Cache	240	304	44.1[c]

* Percentages accompanied by the same letter are not significantly different at 95% confidence, using chi-square tests of homogeneity.

Table 2. Sex and maturity of AHS specimens submitted, 1990-1993.

	ADULT		IMMATURE	
	Male	Female	Male	Female
Total specimens	212	68	3	7
Earliest collection date	12 July	19 July	23 May	25 May
Latest collection date	10 Oct	19 Nov	20 Oct	20 Oct
Collection Period (days)	91	124	151	149
Peak collection date (1993)	30 Aug	19 Sept	*	*

* Insufficient data to determine peak collection dates.

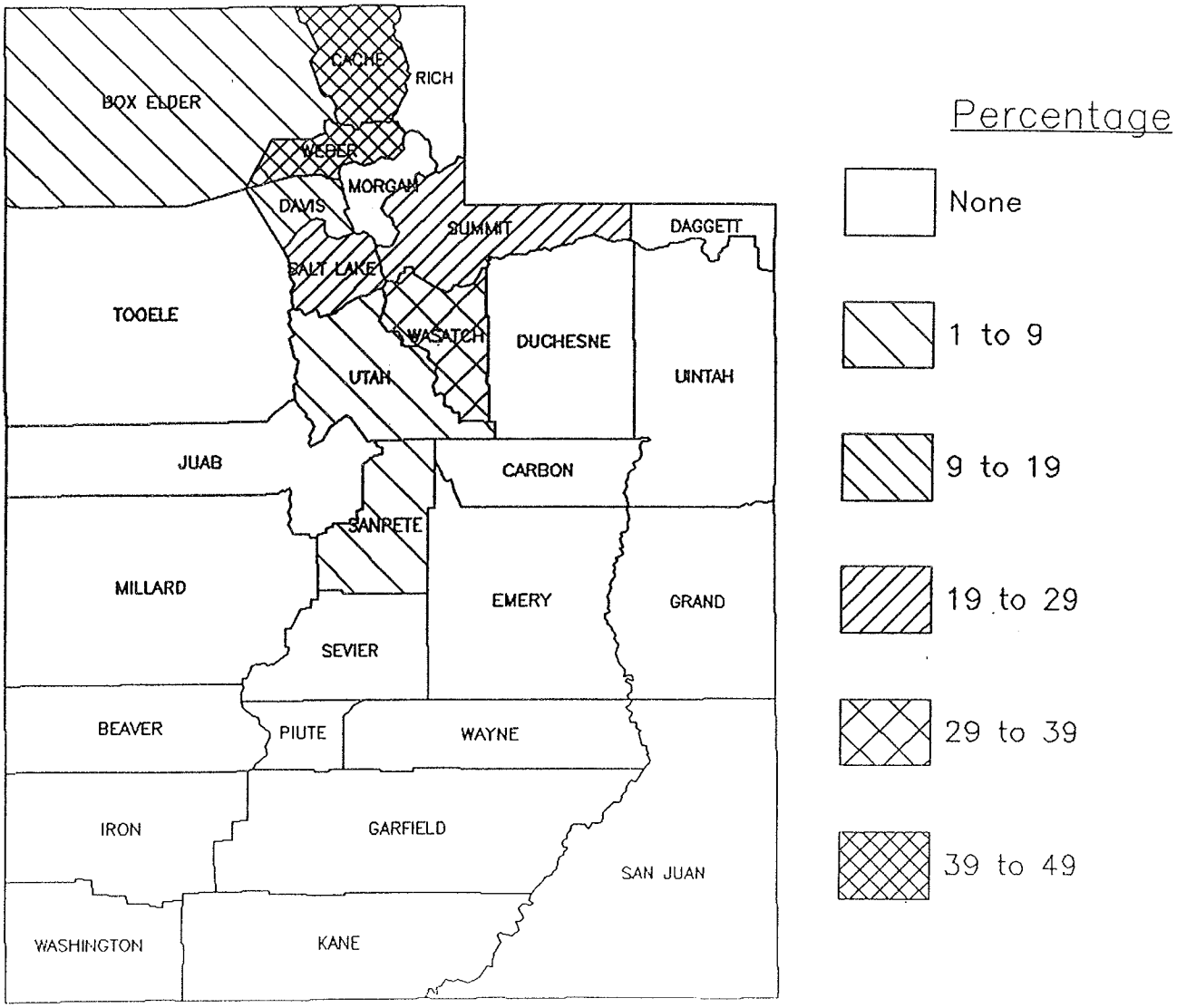
Table 3. Comparison of adult AHS specimens submitted 1990-1993.

	Male	Female
Total Specimens	212	68
Relative Percentage	75.7	24.3
Percentage Range *	68.2 - 83.2	16.8 - 31.8
Average Male:Female Ratio	3:1	
Male:Female Ratio Range	2:1 - 5:1	
* Binomial confidence intervals calculated at 99% confidence level.		

Table 4. Comparison of AHS specimens submitted from indoor and outdoor situations, 1990-1993.

Category	Number of Specimens	Relative Percentage	Percentage Range *	Ratio Range (Average Ratio)
Indoor	201	92.6	87.3 - 97.1	7:1 - 33:1
Outdoor	17	7.8	2.9 - 12.7	(12:1)
Indoor Only				
Basement Level	131	65.2	56.0 - 74.4	1:1 - 3:1
Main & Second Level	70	34.8	25.6 - 44.0	(2:1)
* Binomial confidence intervals calculated at 99% confidence level.				

Figure 1. Percentages of AHS specimens among all spiders submitted from Utah Counties, 1990-1993.



THE USE OF GIS IN UTAH COUNTY MOSQUITO CONTROL INTEGRATING DATABASE MANAGEMENT AND MAPPING

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The use of geographic information systems (GIS) is becoming increasingly important and useful as the public sector strives to attain higher levels of efficiency. As GIS systems become more user friendly and data becomes more accessible, the possibility of using GIS within individual departments to increase efficiency is becoming a reality. The results of GIS implementation include significant increases in the amount of information obtained from present and past data, the ability to illustrate that information on demand, in map form, and finally, to make more efficient and clearer decisions. Implementing GIS into the Utah County Mosquito Abatement program required the following steps:

1. Cooperating with county Mapping Division
2. Updating and reorganizing present methods
3. Coordinating historical data with new data base
4. Determining uses for newly available data.

This paper will discuss these steps, and possibilities for additional GIS use.

Obtaining help from Utah County's Mapping division was a key factor in gaining access to a GIS system. It was necessary to communicate on basic points such as the Mosquito Abatement Division's (MAD) needs and the capacities of the Mapping Division. The MAD sought a program where data could be entered onto an easily updated and accessible system. The Mapping Division had access to Arc/Info, a GIS system, on a network server and agreed to offer technical support for the project. It was determined that the MAD would need to supply one semiskilled data entry clerk to use the Mapping Division's GIS system. The MAD would then purchase a computer terminal to tie into the Mapping Division's GIS. Using this terminal, MAD personnel could then perform ongoing data entry and updating of maps.

Upon completion of the breeding site coverage, it was necessary to convert from the former system by redesigning map components and reorganizing the breeding site tracking system. Arc/Info offered the advantage of creating maps that showed only those map features important to MAD functions. County, city, and state roads, railroads, street addresses, and city boundaries were chosen. Arc/Info also made it possible to fit a breeding site map and the inspection information on one side of a sheet of paper (see figure 1). The numbering system was changed from individual air photo maps of small areas with their own numbers, some of which overlapped and created duplicate data in many instances, to a uniform numbering system that gave each breeding site a unique number throughout the system.

Another step in the update phase was to define and create the new database. The data entry system being used previously was compared to other MAD's systems. The database was then updated to meet the level of uniformity with neighboring divisions and discontinue any clutter from irrelevant data. It was necessary to make the new data collection system readable to the computer. This was done by taking each component of the newly derived data entry form, or code guide (figure 2), and defining it. An example of the definition form is shown in figure 3. The attribute being entered on the form is Wind Direction and correlates with the first attribute on the code guide. Numeric codes are used to eliminate extensive character entry for field inspectors and data entry personnel. In cases where a more exact numeric count is required, the field type listed at the bottom of

figure 3 is entered as an integer. A character field type was not used by the Utah county MAD, but some divisions may find it useful in their data collection systems. Width defines how many characters wide the field will need to be. The description fields were for defining use to the database programmer.

After the redesigning and update phases were completed, the data entry screens were designed. The new screen is illustrated in figures 4 and 5.

Using this system, data is entered using the keyboard, the mouse, or both. Each of the numbers on the menu correlates to a component of the code guide used by each inspector (figure 2). The inspector reports his/her findings in the correlating column on the inspection map (figure 1). This data entry system is easily corrected, and much clearer than the former system. This step completed the preparatory stages of the Utah County GIS conversion. The next step, and the concluding paragraphs will discuss the uses of the newly acquired GIS capabilities.

The foremost reasons for obtaining a GIS were to improve decision making abilities and efficiency through an increase in the availability of stored data. The greatest addition through the GIS system was the use of data sets compatible with the Arc/Info system. The following is a list of several data sets available to the Utah County MAD.

1. Data on groundwater elevations, for use in predicting mosquito populations in areas of high ground water during different seasons.

2. Zoning maps and census data, for determining and targeting high resident population areas for higher concentration of efforts. (i.e., Much of south Utah County has recently been rezoned from 20 acre to 5 acre lot requirements. The south end of Utah Lake is part of this area and contains some of Utah County's highest producing breeding sites. The increased population density from smaller lot requirements will put more residents at risk for mosquito-borne diseases.)

3. Weather station data, also for prediction of mosquito populations. Immediate weather reporting can produce short term predictions or forecasts for mosquito control.

4. Utah lake Water Surface Elevation data, for use in determining amount of exposed marshlands, in map form, for increased breeding site awareness.

Other counties and/or government entities will have various other data layers with potential to enhance an MAD. The uses for data gathered by field inspectors are also greatly increased by a GIS conversion. The Utah County MAD data collection consists of time of inspection, wind direction, wind velocity, sample number, spot ID number, species, percent of species, instar, average dip, water source, vegetation type, water characteristics, depth, dry or wet state, water temperature, chemical type, treatment method, fish present, spot status, areas checked, and acres treated (figure 1). These components can be used in any combination, at any point in time to discover new correlations in mosquito population differences. This may include a map of a certain species found during one week in a year or throughout the entire season, or monitoring of one specific breeding site (or specified area with no otherwise known previous boundary) throughout one or many seasons.

One example of the use of field data in mosquito abatement is the monitoring and tracing of *Culex tarsalis*, the species known to carry western equine encephalitis (WEE). With the GIS system, a map of all areas producing *Culex tarsalis* could be generated. That information could be used for determining where the two sentinel chicken flocks used for monitoring for WEE should be located. This small change could greatly increase the efficiency of the WEE Surveillance program.

Other uses for GIS in a mosquito abatement program are the tracking of resident complaints to target areas that may not be aware of the abatement program, and to monitor the number of complaints coming from a consistent high complaint area (figure 6). Another use would be to generate spring and fall maps for those areas producing more mosquitoes in

the off season. Hazardous spray, or "Call Before Spraying," areas that require notification prior to spraying, are also useful as an overlay on a spray request form (figure 7). It is also important to note that the "Info" portion of Arc/Info is a database which can easily be converted for use on a spreadsheet program such as Quattro Pro or Excel. This maintains the ability to chart and graph data in an already familiar data analyzing environment.

The addition of GIS to any data collection and information intensive program is a great leap forward toward increased efficiency and knowledge. The addition of GIS to the Utah County MAD has made data collection easier for both those collecting the data and those analyzing it. Special thanks to Mark Quilter, Utah State Department of Agriculture, for additional support and services rendered in the GIS conversion process at Utah County MAD.

Figure 1. Revised mosquito breeding site map and data entry form.

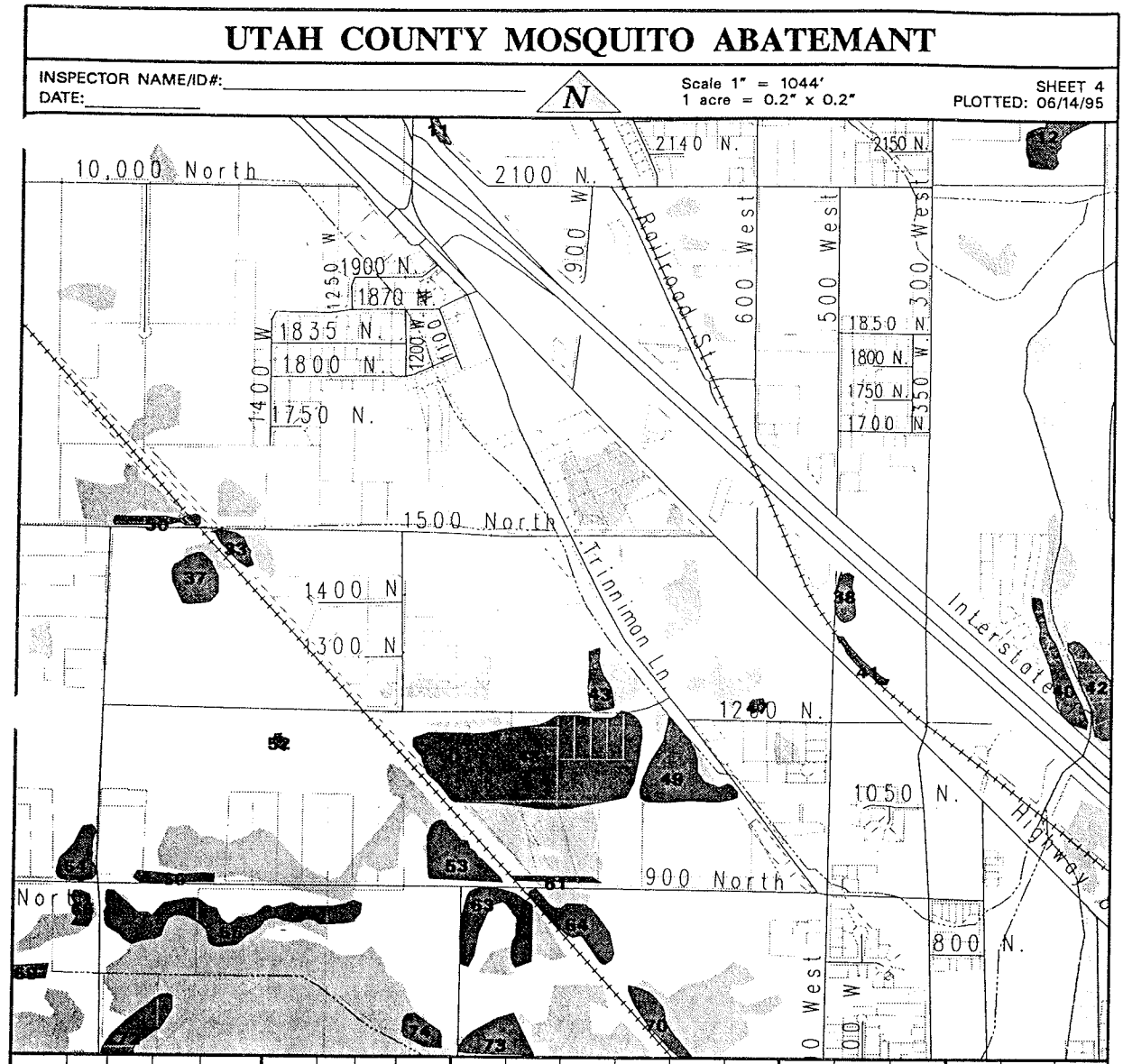


Figure 2. Code Guide for use by field inspectors in conjunction with inspection map.

CODE GUIDE

Wind Direction:
Direction wind is coming from
0. None
1. North
2. Northeast
3. Northwest
4. South
5. Southeast
6. Southwest
7. East
8. West

Wind Velocity:
1. 0-5 mph (calm to breezy)
2. 5-15 mph (windy)
3. 15-30 mph (very windy)
4. 30+ (gales)

Instar:
1. First
2. Second
3. Third
4. Fourth
5. Pupa
6. Adult

Water Source:
1. Precipitation
2. Irrigation
3. Seepage
4. Well water
5. Sewage associated water
6. Spring
7. Pond
8. Edges of canal, river, etc.

Water Characteristics:
1. Permanent (exists throughout season)
2. Temporary (alternating dry periods)
3. Permanent but fluctuating
4. Fresh (recently flooded)
5. Clear
6. Turbid
7. Treehole

Vegetation Type:
1. No apparent vegetation
2. Salt grass
3. Cattails, bulrushes, sedges
4. Pasture type grasses and clovers (other than salt grass)
5. Algal masses
6. Willows and other shrubbery
7. Trees
8. Cultivated areas (grain fields, etc.)

Depth:
1. 0-3 inches
2. 1-6 inches
3. 1-9 inches
4. 1-12+ inches

Dry or Wet:
1. Dry
2. Soil moist (muddy, etc.)
3. Water level decreasing (drying up)
4. No obvious change in water level
5. Water level increasing

Chemical:
1. Bti sand
2. MLO Flit
3. Dursban granules
4. ULV
5. Altosid
6. MLO + Dursban

Treatment Method:
1. Hand
2. ATV
3. Ground (ULV)
4. Air
5. Drained
6. Not treated

Fish:
1. Gambusia
2. Other fish present
3. Gambusia planted
4. None

Spot Status:
1. Permanently eliminated
2. New spot
3. Temporary spot
4. Near permanent spot

Figure 3. Database definition form.

UTAH COUNTY MOSQUITO ABATEMENT DATABASE

Attribute Item Name: Wind Direction

Description: Direction wind is coming from

Data Coding

CODE VALUE	WIDTH	TYPE	DESCRIPTION
0	1	N	None
1	1	N	North
2	1	N	Northeast

Field Types:
I = Integer N = Numeric C = Character

Figure 4. Menu 1 of the data entry screen.

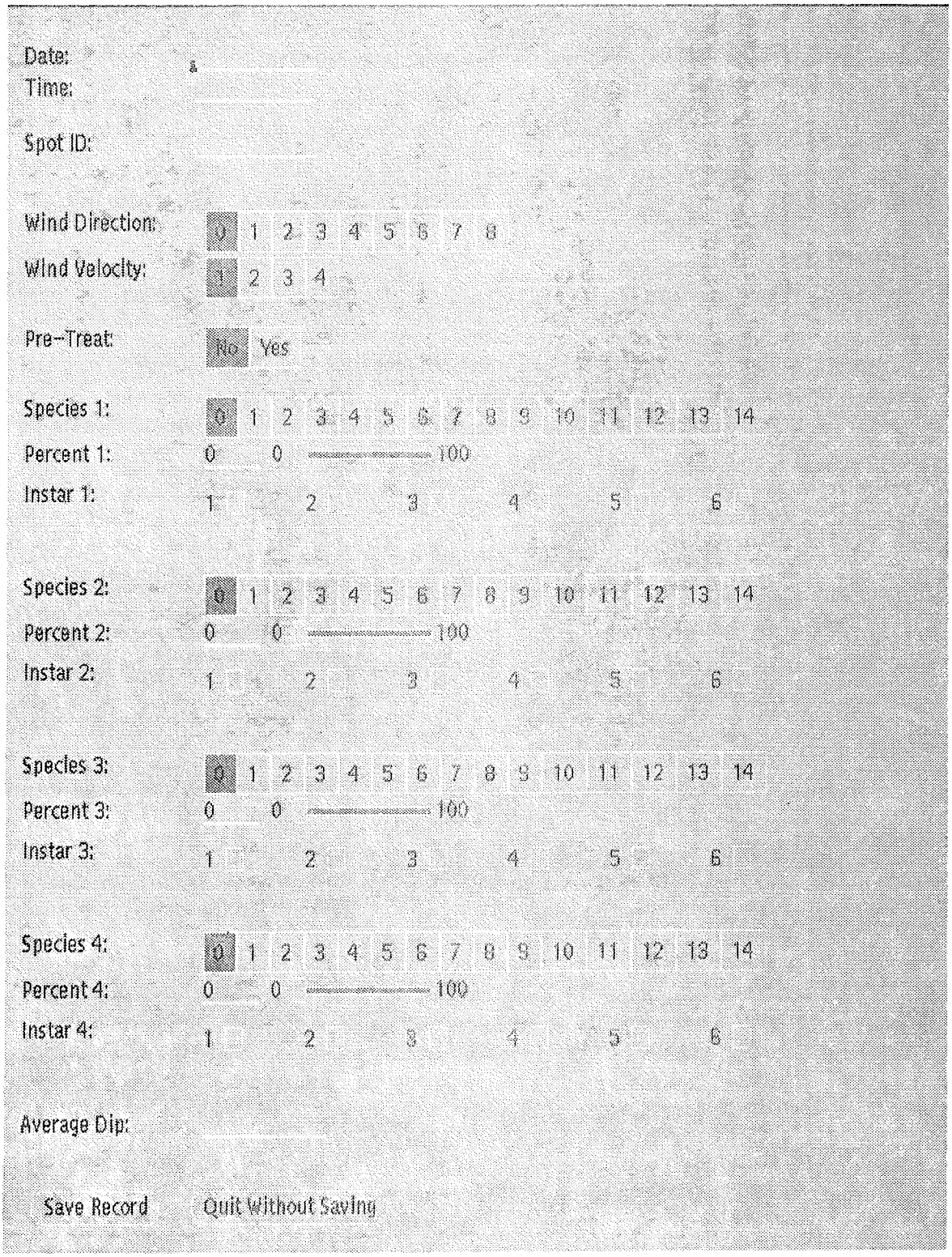


Figure 5. Menu 2 of data entry screen.

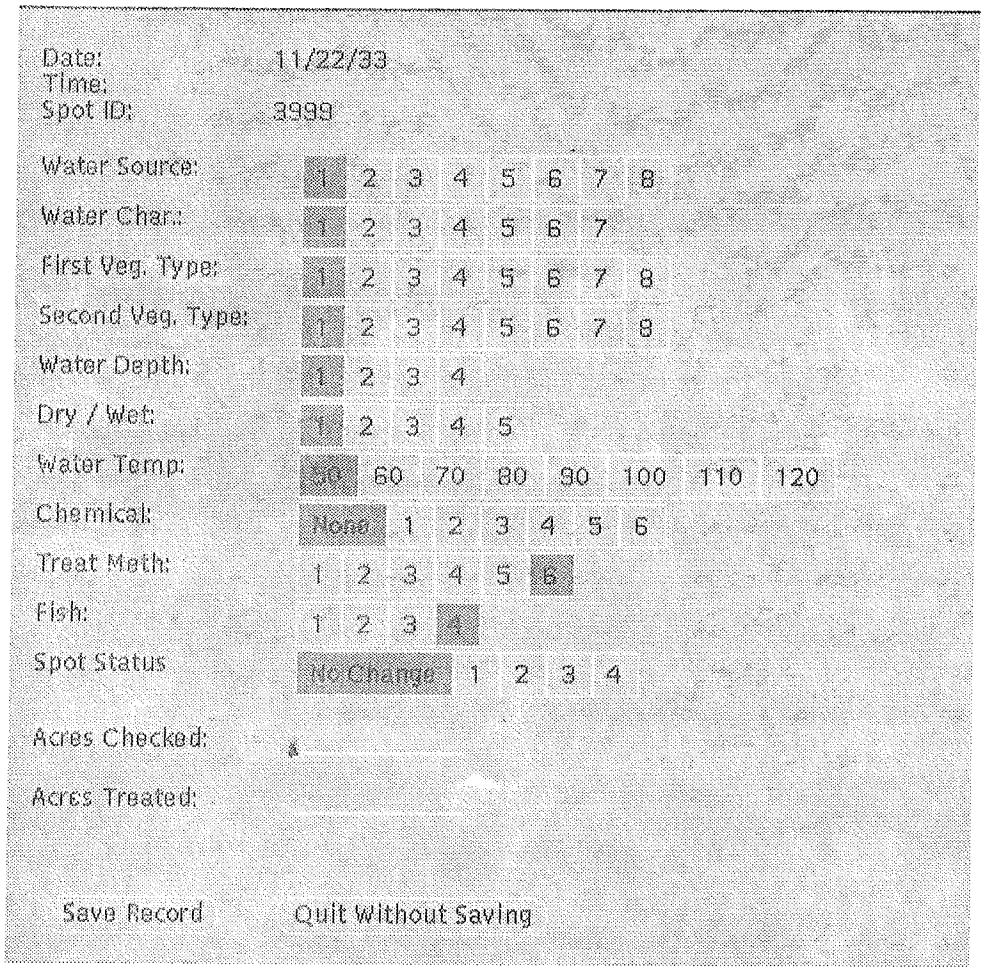


Figure 6. Complaint location overlay on inspector area map (Black dots denote a reported complaint at that address).

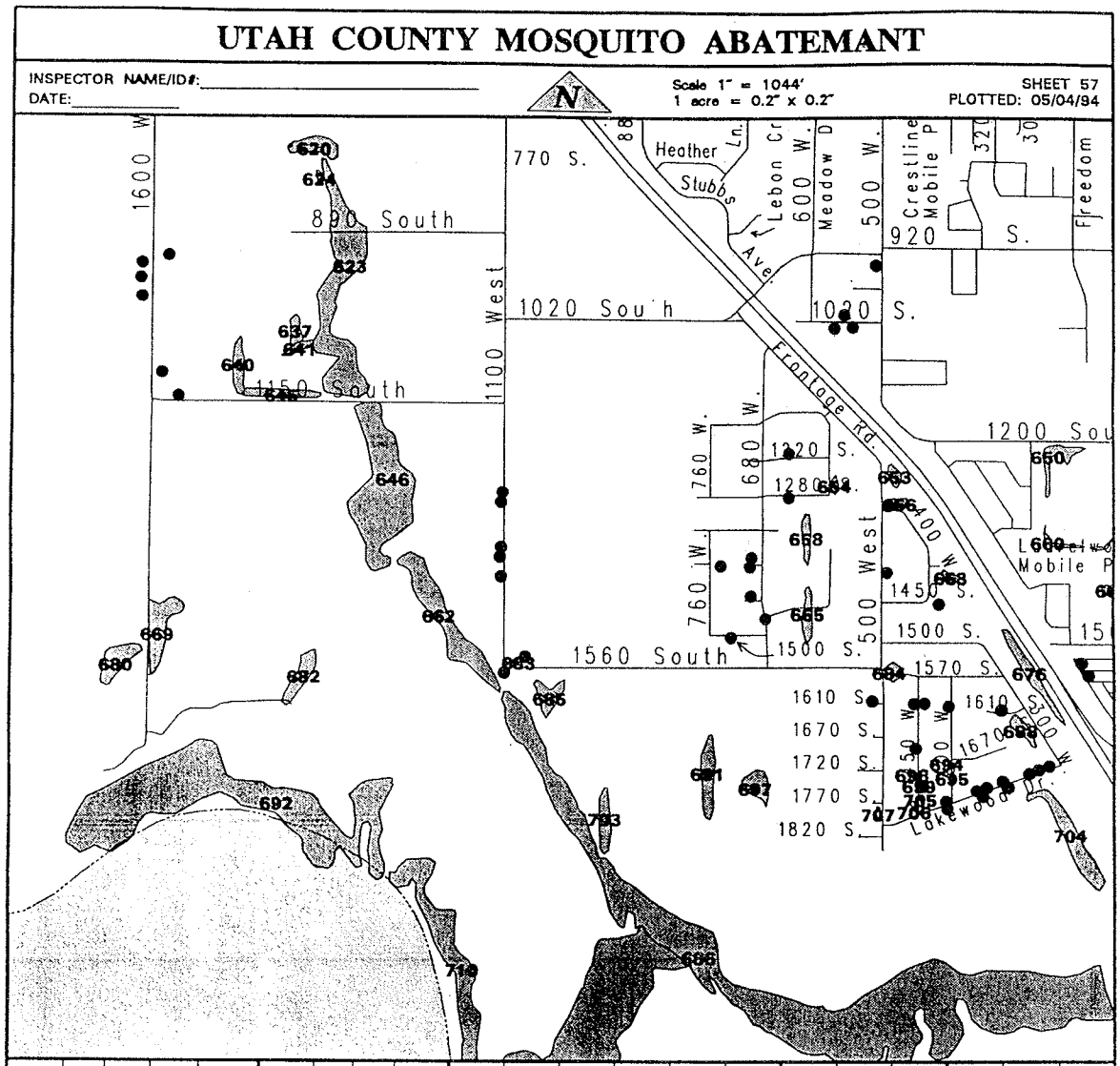
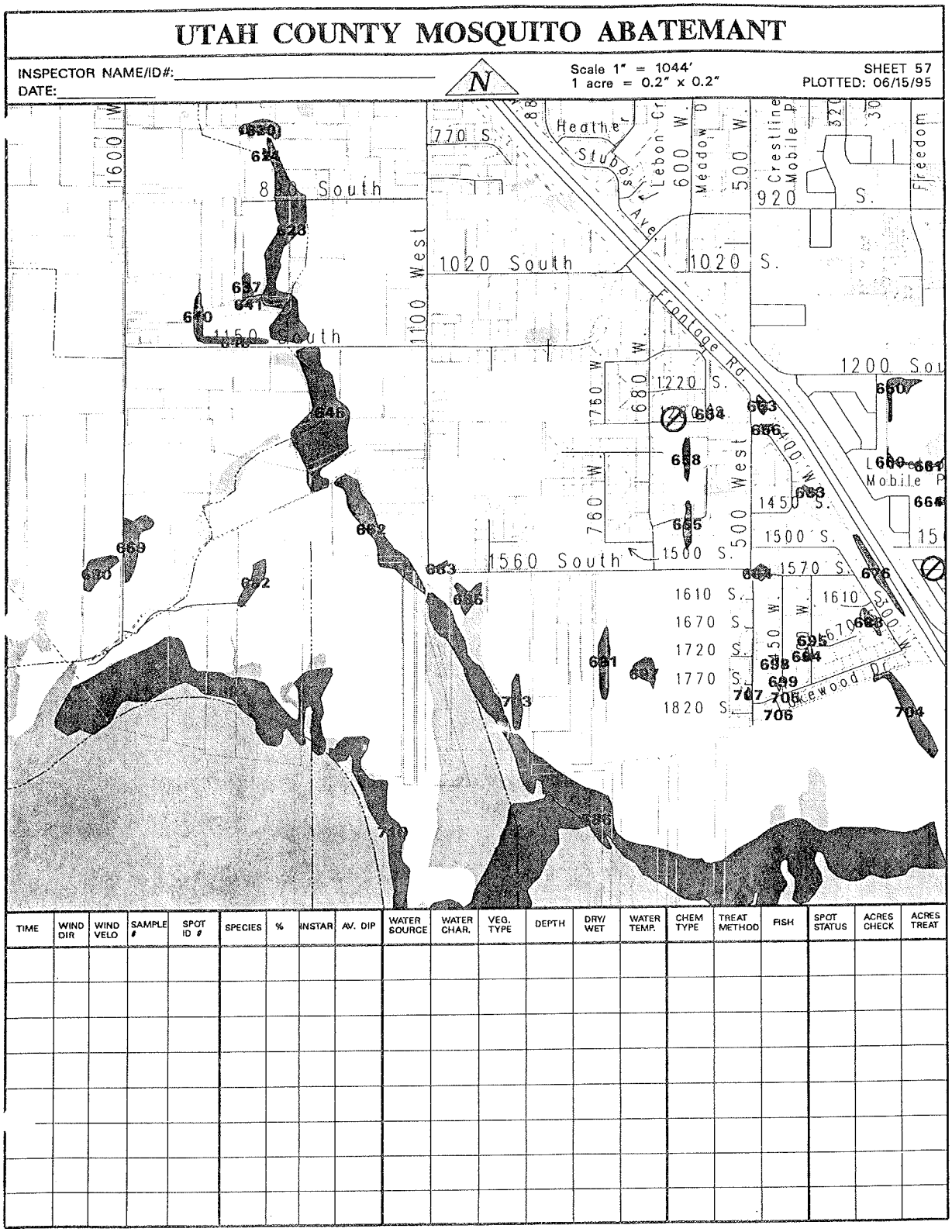


Figure 7. "Call Before Spraying" overlay on spray Request Map Form ('∅' symbol denotes a hazardous spray situation where notification of resident at that location is required before spraying).



THE EFFECTS OF LUNAR PHASES ON MOSQUITO LIGHT TRAP COLLECTIONS

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Surveillance and monitoring of adult mosquitoes is critical to any well managed mosquito abatement program. Only through surveillance can mosquito abatement districts (MAD's) effectively predict if, when, and where adulticides are to be used, make the best use of personnel and evaluate the results of larval and adult control efforts. MAD's have utilized a multitude of devices and methods to monitor the movement of adult mosquitoes. The problem with all of these techniques is that there will always be considerable fluctuation from one sample to the next (Bidingmayer 1967). Another problem with all surveillance techniques is that the proportion of the total mosquito population in flight may vary in relation to numerous environmental, biological and operational factors.

Listed below are some of the most important factors to be considered when attempting to gain information from surveillance data.

biological
- species
- sex
- physiological state
- population size
- seasonal trends
- activity level

meteorological
- temperature
- humidity
- wind
- day length
- light intensities

operational
- type of trap
- attractant
- frequency of
- collection

positional
- distance from breeding area
- habitat
- competing attractants
- food sources
- reflecting surfaces
- control activities
- predators
- vegetation

All of these factors make it extremely difficult to fully interpret data collected on adult mosquito activity. Even though a tremendous effort has been made to devise surveillance techniques, not much has been done to aid in the interpretation of collections made from these sampling methods. For this talk we have concentrated only on light intensities and its influence on mosquito flight as monitored by the standard New Jersey light trap. Specifically, we are interested in light intensities produced by different lunar phases. It is our attempt at explaining one factor affecting one sampling technique.

Janousek and Olsen (1994) used the unique opportunity of a total lunar eclipse during a full moon to look at the flight activity of mosquitoes in Texas. They found that the number of mosquitoes in flight decreased and the number collected in light traps increased during the eclipse. This trend was exactly reversed after the eclipse was over and the full moon returned. Bidlingmayer (1967) found similar results, that high light intensities stimulate greater flight activity, and that low light intensities enable light traps to operate more effectively despite the smaller numbers of mosquitoes in flight. The results of the above studies suggest that light traps should collect more adults during the new moon phase (low light intensity) and significantly less during the full moon phase (high light intensity). Locally it has been noted that large migrations of mosquitoes from the marshes into the urban areas along the Wasatch Front have

been during or around a full moon (Rees 1945; Rees and Nielsen 1947; Rosay et al. 1982). It is also the authors' belief that mosquito migrations can be triggered or enhanced by the occurrence of a full moon. This is based solely on the authors' personal observations. This agrees with the view expressed by Bidlingmayer (1967) and Janousek and Olsen (1994), that flight activity increases during periods of high light intensity.

To test these views, lunar phase dates during June, July and August from 1977 through 1994 were recorded. Two traps from SLCMAD were chosen to obtain collection data corresponding to the lunar phase dates. These traps have been in the same location for the above time frame and both collect numerous adults throughout the summer months. Two sets of data were obtained: all females lumped together and female *Cx. tarsalis* by themselves. The rationale being that only female *Cx. tarsalis* are involved in disease transmission and this species is continually abundant throughout the summer. Similarly, data was obtained from four traps from Davis County MAD (DCMAD), for 1993-1994 (female *Cx. tarsalis* only).

Generally, New Jersey light trap collections of mosquitoes increase throughout the season. Thus, collections made during a new moon in June would not be directly comparable to full moon collections in August. Therefore, the data was arranged linearly for three lunar phases per year so that a quick visual inspection would show whether or not full moon collections were greater than either the preceding or following new moon. Data was also totaled for each of four different phases of the lunar cycle and analyzed using tests of goodness of fit.

RESULTS

Initially, data from only 1993 and 1994 were examined. Traps from DCMAD had new moon collections less than the collection of the full moon either preceding or following 46% of the time for the female *Cx. tarsalis* only. Traps from SLCMAD for the same time period, however, had 73% of the new moon collections greater than preceding or following full moon collections. However, both sets of traps were similar in percentage of collections during each moon phase, with collections during the new moon phase being significantly greater than during the full moon phase (Table 1).

Data from the two SLCMAD traps from 1977-1994 was then examined. The number of females collected during the new moon phase was greater than during the preceding or following full moon 60% and 54% of the time, respectively, for all species and *Cx. tarsalis* only. The total of all new moon collections was significantly less than during the full moon for both all species combined and *Cx. tarsalis* only (Table 2). The greatest percentage of female mosquitoes collected was in the last quarter, followed by first quarter, full and new moon phases.

DISCUSSION

The initial results from the 1993-1994 data seemed to support the views of other authors, that more mosquitoes are collected during the new moon phase than during the full moon. Those previous authors had based their findings on single day or short term data. However, it appears that our data collected over a many year period allows for more singular year fluctuations to reach a norm. Fewer females were collected during the new moon phase than any of the four phases looked at. Furthermore, the full moon collections were less than either of the first or last quarter phase collections.

Examination of new moon collections and the preceding or following full moon collections gave no indication towards a dominance during either phase. This data is based on collections within single years and therefore considered as short-term data.

The possible explanation for these findings is unknown. For control purposes, we should be aware and expect differences in our light trap collections to occur with the different phases of the moon. Differences between lunar phases within a month or even a year cannot be predicted.

The lunar phases of the moon as relating to night time light intensities is just one of the many factors affecting adult mosquito surveillance. Perhaps the following quote explains why this subject has not been more seriously pursued. "Professional credibility

has always been precious, but especially in a day when university tenure and government research funds are as difficult to obtain as a free trip to the moon, many scientists have been reluctant to engage in or publish research about lunar cycles," (Katzeff 1981).

Table 1. Percent of female *Cx. tarsalis* collected in New Jersey light trap collections for each lunar phase for 1993 and 1994 only.

District	PHASE OF MOON			
	New	First Quarter	Full	Last Quarter
DCMAD	32.6	24.6	18.0	24.8
SLCMAD	29.4	20.0	12.2	38.4

Table 2. Number and (percent) of female mosquitoes collected in two New Jersey light traps, 1977-1994, SLCMAD.

	PHASE OF MOON			
Females	New	First Quarter	Full	Last Quarter
All Species	2,677 (21.3)	3,202 (25.4)	2,854 (22.7)	3,858 (30.6)
Cx. tarsalis	1,515 (20.5)	1,865 (25.3)	1,719 (23.3)	2,280 (30.9)

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SPECIAL DISTRICTS—WHERE ARE WE??

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Since the introduction of H.B. 213, a bill introduced in the Utah State legislature to sunset all Special Taxing Districts, Special Taxing Districts have been under the legislative gun ever since. Why? Simply because the perceived nature of what we do seems to be a mysterious, out of control, taxing entity. In order to change the political and public perceptions of who we are and what we do, the Special Taxing Districts organized the Utah Association of Special Districts (UASD) on May 1, 1989, to accomplish the following as reflected in our mission statement:

The UASD is an association dedicated to promoting the proper and efficient operation of all Special Service Districts within the State of Utah. The UASD is a proactive, values driven association composed of representatives from a broad range of Special Taxing District classifications. The UASD is committed to:

- Assisting all Special Taxing Districts in fulfilling their respective missions.
- Informing governmental and public officials and those who receive service from the member districts of the UASD, as to the purpose, operation and accountability of Special Taxing Districts.
- Promote Special Taxing District awareness by providing training, legislative updates and input on current laws and regulations to district officials and staff.
- Assist all Special Taxing Districts in complying with regulations even though they may lack funds, personnel or resources.
- Promoting unity among Special Taxing Districts and all levels of State and Local Government.

The UASD, of which the UMAA is an associate member in good standing, feels that it has been very successful in protecting the general interests of all of the Districts as well as being proactive in heading off potential problems brought to light by new legislators each new session. For instance, in the 1993 legislative session a new bill was introduced that would put tight controls on Special Taxing Districts. That bill was very similar to the H.B. 213 of 1989 and we felt we were back at square one. The new legislator that sponsored the bill had a personal complaint against a Special Taxing District in his area and in order to "punish" them, he introduced legislation that would punish all of us. The UASD was able to talk to him and point out the existing constraints that were already in place and he withdrew the bill. It took a lot of effort and willingness to work with him on legislation that was meaningful to him and his constituents.

Frustrations like this arise very subtlety and can pick up steam in one of the houses and be law before we blink. It is imperative that we have those who will dedicate some of their time and efforts to protect UASD members. In the 1994 session of the legislature, over 60 bills were introduced that directly effected Special Taxing Districts. Of those less that 10 made it to the final vote and only one really affected us.

We appreciate the UMAA's willingness to support the UASD and to work to improve your understanding of all of the different mandates and requirements that face different Special Taxing Districts. In order to cause real change on the Hill, each one of us must contact and communicate with our Legislators in both Houses. Every legislator that we have worked with to help our collective causes will first state what he feels that his/her constituency is saying on the subject. If they feel that there is sufficient pressure, they do pay more attention and will even act on this pressure. Because the House of

Representatives will be totally elected or reelected this session, we could have a good bit of work to do in educating the new members about our feelings and philosophy. We need all of your help. We realize that you represent your own constituencies but you also act as the governing bodies of these Districts and should act in their best interests, too.

Even though we are one of the most watched-over entities in the state, the Legislature still feels that members of the UASD don't have enough monetary controls. Ways to avoid this kind of legislative frustration with the Special Taxing Districts is to follow all of the regulations and laws that govern us and if we don't like them then we do what we can legally to change them, not just ignore them. Case in point. There are several interpretations of the nepotism law that individual Special Taxing Districts need to be aware of so that they don't face the potential wrath of the State Auditors office. There are many instances where the law can and will trip us up if we are not conversant with it. As the UASD makes seminars available for managers and trustees, please make an effort to attend them because they have been organized based on the need of our members and changes or additions to law or statutes.

So what is on next years agenda on the Hill? There appears to be several bills that will act to change the way some Special Taxing Districts organize their Board of Directors. These laws will probably effect the Utah Transit authority more than the rest of us. There is pressure from several legislators to create a state oversight committee for Special Taxing Districts. Recodification of the laws and statutes influencing the Special Taxing Districts is being considered. This particular effort would be an attempt to pull all of the various governances together so that one specific law pertaining to a need, such as taxation, would apply to every unit concerned.

Changes in the taxing structure of construction cost, reuse water issues and number of term/years of trustees are of interest to the UMAA. Reuse water issues may provide differing amounts of water that has been available to irrigators in the past which could affect our marshes and irrigated pasturage. Water in general is going to be a hot issue with the governor taking the stance that the State is going to get out or stay out of the development of our water resources. He has stated that these developments should take place in the private sector and it looks like there will be some real debate before this problem is resolved. there are differing feelings about who gets what water when and where between the Sewer Districts and the water suppliers and users. Another series of issues that we are involved with in conjunction with the Utah Advisory Council on Intergovernmental Relations (ACIR) is the unfunded mandates that come to us from Federal and State government. These mandates are under scrutiny and there will be every effort to have them recalled and reconsidered.

Again, we must be active and inform our respective legislators as to what and why we do what we do. Feedback from those who write the law is that the average legislator just cannot assimilate all of the information that is put before them in a session. They rely on a few legislators that are supposedly in the know and vote their way on issues they have no interest in or capacity to learn about in the given time frames they are laboring under. It then behooves all of us in the business of providing special services to our constituents to keep those who can affect change informed and involved. Good luck!!!

NORTH SUMMIT COUNTY FAIR — PUBLIC RELATION'S CAMPAIGN

JOHN JAUSSI
North Summit MAD
Coalville, UT 84017

Since the formation of the North Summit Mosquito Abatement District (NSMAD) eleven years ago, the board president, Dell Bush, board members, and district personnel have walked a careful line between drawing unfavorable attention and projecting a positive image. The District from its inception has aligned itself with the Utah Mosquito Abatement Association and, more in particular, with the Salt Lake City Mosquito Abatement District. Our District has relied as well on the expertise of Glen Collett and Sammie Dickson so that the district could use the best scientific advances and practical field operations that are available. Since our district was formed amidst great political opposition of powerful community leaders who also held and still hold powerful state elected offices, the District has made every effort to provide the finest service with the least amount of tax money. Shortly after the formation of the District, those political leaders spear headed a movement to sunset all special service districts. A bill to eliminate mosquito abatement districts as well was passed at the last moments of the 1986 session, which provided a means to vote out mosquito abatement districts. Local supporters of the NSMAD were able to modify the bill so that it would not be used to paralyze districts during a possible vote nor needlessly harass districts with petition drives. As of yet, no petition drive has been mounted in Summit County, nor do we expect any. Since those trying times, the district has functioned with real success. Support for the District has grown even stronger as the service has been rendered.

Since the District employs four part-time employees and operates on a budget of $35,000 to $45,000, the District has been careful of using funds for public relations. For years, the board president, board, and manager have talked of having a booth in the county fair to encourage good irrigation practices, proper care of water and reuse by home owners, emptying horse troughs, and disease control. The District also wanted the public to know just how the District used an integrated pest control program with emphasis on water and biological control, as well as, chemicals. Field procedures needed to be explained to the public to encourage their continued support. What was needed was someone with an ability to organize and create an informative and interesting campaign. When the District hired Ryan Ferry four years ago, we recognized his artistic creativity from the start. He has been enthusiastic and hard working. The first year he drew a cartoon of the four District workers. We then started talking about a fair project in earnest. Ryan is earning a college degree in communication at Weber State University. His interest in multi-media productions went along with what the District had in mind. This summer he approached the District with a plan for the fair project. The project was approved by the board in early spring. The board members have been actively involved giving advice and approval. The president of the board, Dell Bush, and Grant Geary even constructed the backdrop for the displays. Ryan Ferry and his production crew have been paid nominally for all of the hours spent on this project. The project has been an opportunity for them and a service to the District. The District has benefited from a positive public relation's campaign.

DIBROM CONCENTRATE RESULTS IN NEVADA, UTAH AND IDAHO

PAM KNOEPFLI
Valent U.S.A. Corporation
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The following three articles, chronicalling the use of Dibrom Concentrate as an aerially applied mosquito adulticide, are presented to demonstrate effectiveness and application techniques of the product.

Article 1

DIBROM CONCENTRATE USAGE - 1994 GEM COUNTY MOSQUITO CONTROL DISTRICT

RONALD VAUGHN
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Emmett, ID 83617

As a result of poor adult mosquito control with malathion in Gem County and the February Dibrom Concentrate meeting sponsored by Valent U.S.A., Dibrom Concentrate was used for the first time. The mosquito kill I have gotten this year has been excellent with Dibrom Concentrate. What started out as a trial, turned into utilization of 360 gallons of Dibrom. My intent for 1995 is to utilize Dibrom Concentrate for all my aerial adulticiding and am considering utilizing it with my ground equipment. The only problems I encountered had to do with setting up my plane for utilization of Dibrom Concentrate. After I accomplished this, all has gone smoothly. An added asset to my system is that I made it a closed system utilizing an Oberdorfer pump to transfer the Dibrom from the drum to my tank, alleviating physical contact with the chemical. Flushing is achieved by running Jet-A through the system after spraying. I also remove the nozzles and soak them in a cleaning solution after flushing.

A CO_2 system which Dibrom Concentrate could be utilized through was given to each district per first pallet of Dibrom purchased if so desired. Unfortunately, I did not find this system satisfactory. My plane does not have an agricultural hopper, so I needed to position the entire system inside my plane, a situation I was not comfortable with. I therefore began to investigate a system which could handle Dibrom, as well as any other chemical I would be using (i.e., larvicides). Below is a recap of the system I put together and am currently using. The specifics listed are for utilization of 1/2 oz. Dibrom Concentrate per acre; about half-way through my adulticiding I moved this rate up to 3/4 oz. to achieve a much better kill and to prevent possibility of resistance.

SPECIFICS

Plane:	Cessna 182
Speed:	115 mph
Height:	75-100 ft. off ground
Swath:	250 ft.
Rate:	3/4 oz. per acre
Pressure:	45 psi

EQUIPMENT

- Nozzles
  Number 8001.5 (2 flat fan nozzles; positioned on one wing)
- CO_2 tank (20 psi) with pressure gauge
- Tank
  55 gal. polypropylene
  G&R Ag Products Inc.
  Caldwell, ID/Pasco, WA

- Air pump (operates from CO_2 tank)
  "Sure Flo" (SHUR)
  Air operated demand pump Model No. 166-300-xxy
  2 chamber dual diaphragm
  Mfg. phone number: 800-854-3218

  * Pump is rated to handle Naled; however, it is still in the experimental stage to test its longevity.
- Transfer Pump (Dibrom to delivery tank)
  Oberdorfer - 1/3 HP
  992 RM-s5-F01

NOTE:
Per Pam Knoepfli, to increase output to 3/4 oz./acre, with no changes to the above specifications, simply change both nozzles to #8002's and increase psi to 50.

Article 2

FREY-SPRAY MOSQUITO REPORT - 1994 CHURCHILL COUNTY, NV

JERRY FREY
Frey-Spray
Fallon, NV 89406

Frey-Spray covers five city and county mosquito programs throughout Nevada. Many different materials are used for larvaciding and adulticiding. This report is about Dibrom Concentrate by Valent.

Churchill County is located around Fallon, 60 miles east of Reno. During the 1994 season we treated nearly 40,000 acres while applying Dibrom seven times in Churchill County.

Dibrom was applied by aircraft without dilution at .75 ounces per acre (Ultra Low Volume). The usual load is 30 gallons of Dibrom covering 5,170 acres. Under 55 pounds of pressure the Dibrom is pushed out of three 10 gallon pressure cans placed on a false floor in the hopper of an ag aircraft. On the outboard section of each wing are two nozzles with 8001.5 spray tips. The tips are aimed into the slipstream at 45 degrees. At 115 m.p.h. a droplet size of 80 microns or less is obtained. One hour with the spray valve on is required to dispense the load through the four nozzles. We select quiet evenings during maximum adult activity to treat vast acres.

A 300 foot swath width is used cross wind (no more than 7 m.p.h.) to cover 72 acres per minute. Each swath is completed up wind of the previous pass. A common power line pole is spaced 300 feet from one another. We combine that spacing, section lines, ditches and fence rows to stay straight eliminating the use of flaggers. Application altitude is 150 to 200 feet above the ground.

When spraying is finished we flush the system while airborne with 2 1/2 gallons of jet fuel. Our aircraft are externally washed once per week as the small droplet size of Dibrom does not harm our paint. However, spills causing any area to become wet with Dibrom are cleaned immediately with straight Mr. Clean detergent followed with a rinse of water.

Moisture (water) of any amount needs to be flushed from the system using jet fuel. Water is not compatible with Dibrom concentrate.

We have used Dibrom since 1973 successfully without harm to aircraft or automobile paint. Corrosion to aluminum aircraft parts has not been detected. One of our aircraft has applied Dibrom for eleven years.

Article 3

DIBROM CONCENTRATE TRIAL WEBER COUNTY, UTAH

BRUCE BENNETT
Weber County MAD
Ogden, UT 84404

On 19 August 1994 the inspectors of Weber County MAD found a large number of the *Aedes dorsalis* along the western areas of the county bordering the Great Salt Lake. The landing rate of this particular species was between 20 and 75 at one time.

The area was blocked off as being around 2,500 acres. It was mapped for airspray that evening. Due to storm fronts moving into the area it was not sprayed until two days later.

The mosquitoes were checked once again to make sure they had not moved. They were still in the area so we proceeded to spray them that evening. We used Dibrom at a rate of .75 oz. per acre. The temperature was around 80° or slightly higher. The plan flew at a speed of 110 mph and a height of 75 feet. The next morning the same area was checked by the same operator, and he found a 90% kill and in some spots no mosquitoes at all.

We feel this was a very successful spray application and Dibrom did a good job on *Aedes dorsalis*.