Proceedings of the

Sixty-first Annual Meeting

of the

Utah Mosquito Abatement Association

Park City Marriott
1895 Sidewinder Drive
Park City, UT 84060

October 5 - 7, 2008

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October 5 - 7, 2008

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GLEN C. COLLETT
MERITORIOUS SERVICE AWARD

The **Glen Collett Meritorious Service Award** is presented to individuals who have distinguished themselves in administrative or technical service to mosquito control in Utah. The Utah Mosquito Abatement Association consists of mosquito abatement personnel, individual members from universities, health departments and related fields, as well as, individuals that help educate and supply control personnel with the tools they need to control mosquitoes. The UMAA first presented this award in 1970. The 2008 and 51st recipient of the Glen Collett Meritorious Service Award is **Clark Burgess**.

Clark Burgess graduated from BYU with a B.S. degree in horticulture in 1986. He has worked for the past 23 years for the Utah Department of Agriculture and Food (UDA&F). For the last twelve years he has worked as the Program Manager for the UDA&F State and Federal Pesticide Program. Clark supervises six state and federal programs: pesticide enforcement & certification, worker protection standards, ground water and endangered species.

UMAA members first met Clark through the process of obtaining their non-commercial pesticide applicators license. Clark oversees that program for the UDA&F and has a real passion for making sure that everyone that applies pesticides in Utah is properly trained in the use of those pesticides and has the proper certification. In 2000, Clark began working with the UMAA to upgrade the spring workshop. In that year, with Clark's help, the workshop became eligible for continuing education units that can be used for renewal of individual applicators pesticide applicators license in category 8 – public health. Since the workshop is held on a Saturday each year, it means that Clark gives up part of his weekend for the education and training of UMAA members. At the end of the workshop Clark administers a test for those individuals that need to recertify.

In 2004, the Utah Legislature allocated money to the UDA&F for the purpose of increasing the capacity for mosquito control around the state to help combat West Nile Virus. Clark was responsible for setting up a grant program, for various agencies to receive these funds. The program ran through 2009. During the five years that it was in place there were dozens of grants given out for everything from the purchase of mosquito light traps to the use of a bulldozer along canals to make mosquito control access possible. The grant program was responsible for the funding needed to start the Cache Mosquito Abatement District and the expansion of the North Summit Mosquito Abatement District to cover the entire county.

Mosquito control in Utah is fortunate to have such a good friend who helps our profession in so many ways.

Clark currently lives in Alpine on the family farm with his wife of 24 years and four children. His favorite hobbies are working on the farm and orchard, riding horses, going hiking and camping as a family.

Mosquito and Vector Control Association of California
President's Report to the Utah Mosquito Control Association

David Brown
Mosquito and Vector Control Association of California
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Elk Grove, CA 95624

The Mosquito and Vector Control Association of California (MVCAC) is the recognized professional organization addressing issues of mosquito control in California. Over the past 30 years this organization has grown and matured in its efforts to provide comprehensive services to its members. These services include training and outreach, representation, legislative advocacy and member services. In order for us to share the same understanding of the purpose of our organization, I would like to give a brief explanation of the goals of the MVCAC.

Training and Outreach

Information, training, and outreach have always been the foundation of the MVCAC. Information presented by members from around the state is shared with other colleagues to further support sound mosquito control efforts. The latest research on mosquito-borne infections, in particular West Nile virus, will help develop strategies to control mosquito borne diseases. The MVCAC annual meeting gives the membership the opportunity to exchange information regarding control methods, West Nile virus ecology and control, legislative updates and other aspects of comprehensive integrated mosquito control practices. The MVCAC is committed to providing a wide ranging outreach program to its members and the public at large.

Representation

The MVCAC is comprised of five regions. These individual regions elect a Board representative to express their concerns and opinions to the rest of the MVCAC leadership. The Board meets three to four times a year to discuss and vote on issues concerning the mission of the MVCAC and its members.

The MVCAC also has a cabinet-level structure on the Board consisting of a President, Vice-President, President-Elect, Past President, and a Trustee Representative. The MVCAC Cabinet frequently discusses issues concerning the membership and helps plan and direct the Board agenda.

Member Services

The foremost benefits of membership to the MVCAC are the services provided to its members. MVCAC publishes a newsletter to keep the membership aware of issues the Board and the various members are working on. The website is currently undergoing changes, but when completed, will be an integral tool to help convey information to our members. The website can be found at www.mvcac.org. We are developing a "members only" forum on our website that is both informative and timely, and goes beyond what we have had in the past.

The MVCAC and its members are also currently recognized by the is due to underreporting of less severe infections.

In closing, the MVCAC provides an opportunity for the members to express a unified message of public health. As we continue moving forward, striving to protect public health, we need to ensure science guides our policies and practices, and not the whims of political will. Our members deserve no less.

Scouts Take the Bite Out of Community Service

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At the AMCA Conference held in Sparks Nevada in March of 2008 a paper was presented entitled Scouting and Mosquito Control: Partners in Education. The paper was presented by Pamela C. Jacobson and Michael F. Muench.

The presentation introduced a service project developed in Florida. The project consisted of Girl Scouts going door to door to check yards for potential mosquito sources. The scouts received a patch for their participation. The dynamics in Utah provides organized Scout troops covering nearly all neighborhoods.

With this project in mind Val Bowlden contacted the Boy Scouts of the Great Salt Lake Council. Val worked with Steve Luna of the Boy Scout Council to set up parameters for the project which would:

1. Provide opportunities for Scout age boys (11-14 yrs.) to participate in a community public health service project.

2. Provide opportunities for boys to interact with adults by educating homeowners about West Nile Virus.

3. Reduce the number of mosquito sources and thus the potential for human cases of West Nile Virus.

The procedures used by the Scouts to get this information to home owners were:

1. Scouts produce and deliver an introductory letter.
2. On the intended dates, Scouts divide in teams of two and visit the homes.

3. Scouts will educate home owners using "Yard Check Handout" and "West Nile Virus Information Sheet".

4. Scouts will ask homeowner to accompany them on an inspection of their yard looking for possible sources.

5. When finished, thank the homeowners, using the "Yard Checklist Handout" indicate any sources they found.

This project also qualified Scouts for use as part of a Eagle Project. Five boys contacted South Salt Lake Valley Mosquito Abatement District for their Eagle Projects. Information was left at every home, either with the home owner or it was taped to a step.

Michael who completed his Eagle Project contacted 563 homes with the help of his parents, Scouts, Varsity Scouts, Cub Scouts & friends. Of these 563 homes 252 (45%) were not home; 265 (47%) rejected the offer to have a yard inspection and 45 (8%) were inspected.

If this program is continued or used in other areas improvements should include:

1. Have the scouts do the inspections earlier in the spring.

2. Provide more information on the Great Salt Lake Council Boy Scout web site about the project.

3. Provide West Nile Virus information to local libraries.

A LOOK at the SACRAMENTO-YOLO MOSQUITO and VECTOR CONTROL DISTRICT or WHAT HAVE WE BEEN DOING THESE PAST FEW YEARS?

DAVID BROWN
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This paper discusses the IPM program of the Sacramento-Yolo Mosquito and Vector Control District, the intervention the District has performed in response to West Nile virus amplification and the studies of efficacy and non-target impacts that have resulted from these interventions.

Introduction

The Sacramento-Yolo Mosquito and Vector Control District ("District") is located in the Sacramento Valley of California. The District is responsible for the control of mosquitoes and other vectors in both Sacramento and Yolo Counties, covering over 516,000 hectares with a human population of over 1.5 million people. Since 2005, the District has focused on the control of mosquitoes due to the arrival of West Nile virus. The District employs integrated pest management (IPM) techniques when controlling mosquitoes. These practices include the use of over 80 surveillance traps to determine mosquito abundance and virus activity and to more precisely direct control methods. The District has what could arguably be called the largest mosquitofish-rearing compound in the world, with 23 one hectare ponds dedicated to raising over 3,000 lbs of fish a year. In addition, the District has recently implemented an ecological department designed to encourage the use of Best Management Practices (BMPs) to reduce mosquito populations through non-chemical means.

District personnel use a larviciding-based methodology when implementing control methods. When using biological or ecological means is impractical or impossible, larvicides are applied when mosquito densities exceed 0.1 larvae per dip. This low threshold is designed to reduce the need for adult mosquito control measures.

In 1997, the District developed a Disease Response Plan to address mosquito-related pathogens. The plan was updated in 2005 (Sacramento-Yolo Mosquito and Vector Control District 2005) with the arrival of West Nile virus to the Sacramento Valley. While the District duly noticed and posted the meetings to the public, no members of the public attended the meetings nor did they provide input to the plan. The plan consists of 5 levels of response based on surveillance indicators that initiate that response. For example, Level 1 is a "maintenance" level of control, consisting of the normal day-to-day operations of the District. Level 2 is initiated when a mosquito-borne pathogen is identified within the District boundaries, and results in increased surveillance and control in the immediate area where the isolation occurs. Level 5 occurs when there is wide-spread, multiple human infections from a mosquito-borne pathogen and escalates the District response to include both aerial and ground adult mosquito control spraying.

The District has incorporated the State of California "California Mosquito-borne virus Surveillance and Response Plan" (Kramer 2005) as an appendix to the District plan. This plan includes a West Nile virus risk assessment table that uses various surveillance factors to develop a risk rating and determine an appropriate response. These surveillance factors include environmental conditions, mosquito abundance and infection rates, and virus transmission. An average rating is given that ranges between a "normal season" (1.0-2.5) to "epidemic conditions" (4.1-5.0).

In 2005, the District saw an increase of West Nile virus activity that resulted in a surveillance factor of 4.5 ("epidemic conditions"). In response, the District used localized ground ULV treatments in select areas and initiated aerial adult mosquito control over 48,000 hectares over a three day period. The results indicated a significant reduction in mosquitoes in the spray area and a reduction in human infections (Elnaim et al. 2008, Carney et al. 2008)

In 2006 the epicenter of virus activity shifted to Yolo County. The District followed the response plan and conducted aerial treatments to control adult mosquitoes over 10,000 hectares despite challenges from meteorological conditions (Nielsen et al. 2007). During this operation a University of California researcher questioned the extent of impacts on non-target organisms. The researcher placed sentinel cages of dragonflies, bees and butterflies in the treatment area. The study demonstrated no measurable impacts on most insects, but did show a decrease in insects the same size as mosquitoes (Boyce et al. 2007).

In 2007 and in 2008, the District experienced similar conditions of West Nile virus activity as what was seen in 2005 and initiated adult mosquito control by air over 22,000 and 36,000 hectares respectively in Sacramento County.

Discussion

From 2005 through 2007, adult mosquito control measures were employed when virus transmission had occurred from infected mosquitoes to vertebrate hosts. In 2008, treatments were employed based on the evidence of infected mosquitoes. While the District believes performing these control measures before transmission takes place prevents human infections, quantifying this is impossible. Explaining and justifying the rationale of performing treatments to prevent human infections to a public that is concerned about the risks of pesticide exposure has proven to be challenging. These challenges will increase as poor economic conditions escalate home foreclosures, resulting in abandoned swimming pools and other backyard mosquito development sites that result in mosquito emergence.

Recent legislation in California has attempted to stop adult insect control using aerial applications. It is incumbent upon mosquito control professionals to work with elected officials to discuss the risk/benefit of adult mosquito control measures to ensure adult mosquito control is not legislated out of our tool box. It is also important for us to investigate alternative methods to control adult mosquitoes.

In addition, it is important to have sound science direct our operations, and to work with researchers to identify and address issues of concern from our constituents.

References Cited

Boyce WM, Lawler SP, Schultz JM, McCauley SJ, Kimsey LS, Niemela MK, Nielsen CF, Reisen WK. 2007. Non-target effects of the mosquito adulticide pyrethrin applied aerially during a West Nile virus outbreak in an urban California environment. *J Am Mosq Control Assoc* 23(3):355-339.

Carney RM, Husted S, Jean C, Glaser C, Kramer V. 2008. Efficacy of aerial spraying of mosquito adulticide in reducing incidence of West Nile virus, California, 2005. *Emerg Infect Dis* 14(5): 747-754.

Elnaiem DA, Kelley K, Wright S, Laffey R, Yoshimura G, Reed M, Goodman G, Thiemann T, Reimer L, Reisen WK, Brown D. 2008. Impact of aerial spraying of pyrethrin insecticide on *Culex pipiens* and *Culex tarsalis* (Diptera: Culicidae) abundance and West Nile virus infection rates in an urban/suburban area of Sacramento County, California. *J Med Entomol* 45(4): 751-757.

Kramer, VL. 2005. California State Mosquito-Borne Virus Surveillance and Response Plan. http://westnile.ca.gov/website/publications/2005_ca_mosq_response_plan.pdf

Nielsen, CF, Reisen WK, Armijos V, Wheeler S, Kelley K, Brown D. 2007. Impact of climate variation and adult mosquito control on the West Nile virus epidemic in Davis, California during 2006. Proc. and Papers of the 75th Annual Conference of the Mosquito and Vector Control Association of California. 75: 125-130.

Sacramento-Yolo Mosquito and Vector Control District. 2005. Mosquito and Mosquito-Borne Virus Surveillance and Response Plan. Available at: http://www.fightthebite.net//download/Mosquito_Management_Plan.pdf

2008 UTAH DEPARTMENT of AGRICULTURE and GOOD EMERGENCY MOSQUITO CONTROL FUNDS AS USED by EMERY COUNTY MOSQUITO and WEED DEPARTMENT

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Since Emery County is large and the population is relatively small we face an annual challenge of funding an adequate mosquito control program. There are only three full time employees in the combined mosquito and weed control departments. Emery County is the sixth largest county in the state, yet it has a population of only 10,000. Another big challenge in 2008 was the tremendous amount of travel and the record high price of fuel.

The populated areas of the county are widely spread out. From our office in Castle Dale to the most distant town, Green River, it is well over 100 miles one way. The Green River area has had West Nile Virus positive samples every year since it was detected in the county in 2004. It is imperative that every effort be made to provide adequate protection for all county residents.

In 2008, Emery County Mosquito Department located three sentinel chicken flocks with a geographic distribution as wide as we had the capability of operating on a weekly basis. These flocks were located in Elmo, Green River and Ferron. We also had mosquito traps at these same locations. Since each of the chicken bleedings and light trap collections are made on different days it was a challenge of time and expense to maintain both programs.

The normal habitat created by high water on all our drainages is an annual event. This occurrence creates about 100 linear miles of potential habitat that need appropriate attention. We are now faced with a new situation. As agriculture land moves from flood irrigation to sprinkler irrigation these new systems are totally unmapped. We are starting all over in determining where our mosquito habitat is located.

For the 2008 season, we were once again awarded a grant in the amount of $7,489.00 from the Utah Department of Agriculture and Food. This was matched 100% by our own expenses. We were able to hire one part time person in the Green River area and one additional full time seasonal person in the department. This along with money for extra travel, made it possible for us to conduct what we feel was responsible and a successful countywide mosquito control program. Although West Nile Virus was detected almost countywide by our surveillance program there were no human cases.

Some of the programs we conduct in our weed control responsibilities also aide in our mosquito control. Weed control on the drains greatly reduce mosquito habitat. A program of biological control of tamarisk also aides in mosquito control. It has been shown that tamarisk blossom is a food source for mosquitoes and our release of the insect *Diorhabda elongata* is now causing total defoliation in some of our worse mosquito habitat. Mechanical weed control with backhoes, chainsaws and shovels of Russian Olives, *Tamarisk* and other restrictive vegetation improves drainage, reduces mosquito producing habitat and provides better access for mosquito adulticiding and larviciding activities.

We thank the utah Department of Agriculture and Food for the grants that we have received since 2004. They have allowed us to provide a higher level of protection to the residences of Emery County and reduce the risk and spread of West Nile Virus.

Blood, Money, and Power: Politics and Mosquito Control From the State House to the White House

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At the beginning of the Chapter 2 of Book 1 of his *Politics*, Aristotle is famously remembered for declaring: "Man is by nature a political animal." A paragraph later Aristotle makes an entomological connection "Now, that man is more of a political animal than bees or any other gregarious animals is evident. Nature, as we often say, makes nothing in vain, and man is the only animal who has the gift of speech". The philosopher proceeds to explain origin of the state in couples forming families, families joining into communities, and, finally, communities becoming states. To Aristotle the *telos* or end of all politics whether for bees or human beings lies in attaining the good (Barnes 1984).

No creature has made the task of achieving Aristotle's good more vexing and perilous than the mosquito. Perhaps it is for this reason that another Greek, Herodotus noted with interest in his *Histories* one of the earliest instances of mosquito control. Herodotus reported that Egyptians "who live in the vicinity of the marshes use their fishnets" to protect themselves from "the vast numbers of mosquitoes." In Upper Egypt, well-to-do Egyptians "use towers in which they climb up to sleep, since mosquitoes are unable to fly so high because of the wind." (Strassler 2006)

In a talk before a group of individuals who have built their careers on making life difficult for mosquitoes while waging war for the public good, it is only fair to add that there is at least one instance of mosquitoes playing a central role in state building. I am referring to the contribution of mosquitoes to David's rise to power as king of the Hebrew people. Some of you may recall the story of David and sling shot. The episode I would like to call to your attention comes in the twenty-fourth chapter of First Samuel. Saul and his army are pursuing David through the wilderness of the Enkedi. According to the Hebrew Scriptures, David seeks sanctuary in a cave. Later, Saul and Abner spend the night in the same cave. The next day they depart and David escapes.

Evelyn Mitchell, who was the first woman to write a book on mosquitoes and mosquito control, discovered a different account of David's encounter with Saul in the *Talmud,* the ancient collection of Jewish law and commentary on the Hebrew Scriptures. Mitchell recounts the variation on First Samuel at the beginning of her 1906 *Mosquito Life: The habits and life cycles of mosquitoes of the United States, methods for their control.* The stories are substantially the same with one major difference. In the Talmud, David exits the cave before Saul wakes. When David came to the cave's entrance, he found Abner asleep, sprawled across the opening as a sentinel against intruders. David gingerly steps over Abner only to have Abner move one of his legs so that his ankle rests on David's foot. At that moment, the future of Israel was uncertain. The anonymous author of the Talmud reports that the "Lord sent a mosquito;" the mosquito bit Abner; and, Abner moved his leg allowing David to scamper off. David was saved and Israel's future was secured. Christians in this room will recall the opening verses of Matthew, Chapter 1 which declare "From the house of David will come a Lord." Mitchell's story removes any doubt that you are biblically correct when they slap mosquito and say "Jesus." (Mitchell and Dupree 1906)

My objective is not to discuss the theology of mosquitoes. Rather I propose to spend a few minutes discussing the three episodes in the history of the American anti-mosquito movement that may be of some use for those endeavoring to advance the cause of mosquito control in 21st century. I propose to examine three episodes that reveal the close connection between politics and waging war on mosquitoes.

1. New Jersey: The Formation of the First Mosquito Abatement District

Few in this room have not heard of John B. Smith. Smith is one of the great figures in the history of mosquito control. We are approaching the centenary of the formation of the nation's first mosquito abatement law in 1912 in New Jersey. It is useful to remember the beginning of the movement. At the beginning of the twentieth century, Progressive reformers called for government action to improve the quality life. In New Jersey, a scandal developed in Hudson County in the midst of the Newark meadows. In the center of the vast salt marsh, there was a pestiferous area known as Snake Hill. This was the location of the Hudson County Almshouse, Lunatic Asylum, Penitentiary, and an establishment known as the "Mosquito Tavern."

In the 1890s, county officials outsourced responsibility for the orphanage attached to the Almshouse. A journalist discovered that the adoption agencies selling the children into peonage. This led New Jersey's Governor Foster Voorhees to organize a commission to study the problem: He called for a two-fold program of reclamation. First, the children's lives must be redeemed. As for the marshes, Voorhees directed the state's engineer, C.C. Vermeule, prepare a plan "for the reclamation of the miles of waste meadows lying between the west slope of Bergen Hill in Jersey City and the Passaic River." (Sackett 1914)

Two years later in nearby Jersey City citizens elected Mark Fagan mayor. Fagan, a Progressive, was one of the first politicians to make mosquito control an issue in a political campaign. Fagan, a former assistant undertaker, won the November election on a campaign of public health and mosquito free nights. Ridding Jersey City of mosquitoes would allow people to enjoy parks and evening concerts. "I wanted," Fagan declared, "to make Jersey City a pleasant place to live in; I'd like to make it pretty." (Noble 1946)

Governor Voorhees's call for reclamation of the state's salt marshes, Fagan's election, and the formation of local anti-mosquito groups such as the Village Improvement Association in South Orange, convinced John Smith that there was support for expanding his mosquito study. Smith, New Jersey's state entomologist and a professor at Rutgers University, prepared a plan for a statewide mosquito survey. In 1902, after working alone for nearly two years, Smith submitted a request for $10,000 to the New Jersey legislature.

Smith's objective was to "present a consistent plan of action, which will show what can be done by the individual, the local community and the State---a plan which will attain the result slowly or rapidly, in proportion to the energy or listlessness, with which it is carried out and which will prevent discouragements and failures due to attempts to accomplish the impossible." (Smith 1902) The legislature approved the plan but neglected to appropriate the needed funds.

Undaunted, Smith returned to the legislature a year later to renew his appeal. He decided that he must personally persuade the legislators about the significance of mosquito control. Later, Smith confided to his friend Turner Brakeley, "I wrote you I was going to Trenton to see the Committee on Appropriations and I did. I carried with me some of the last filled bottles of your bog born babies as an object lesson and it impressed them largely. They had never seen wrigglers before and the idea that these miserable things were already laying for them was a shock."(Smith 1903a)

Within six weeks, the legislature and the governor had passed Smith's amendment to the state's health law. "The Legislature of the State of New Jersey adjourned last night," Smith wrote to L.O. Howard. "Peace to its ashes. It was a real good Legislature. It treated me very decently and only cut one thousand dollars."

By 1904, Smith had completed his survey. He believed that immediate action was needed to fight the insect menace. He called on the legislature to add six words to the 1887 General Health Act designating "waters in which mosquito larvae breed" a public nuisance. Smith's campaign to win the legislature's approval for this amendment is instructive. He realized that it was necessary to educate the state's political leaders.

As a first step, he used the centennial of the Louisiana Purchase to attract attention to mosquito control. Smith proposed that New Jersey's display at the St. Louis exhibition portray ways in which mosquitoes could be suppressed in the twentieth century. Smith made a point to ask the state's most prominent politicians for their pictures which were displayed with the exhibit in St. Louis.

A few weeks later, Smith wrote to Speaker of the Assembly and President of Senate and asked permission to come before a joint session of the legislature and make a presentation on mosquitoes and mosquito control. Smith's talk punctuated with "lantern slides" mesmerized his audience from my appropriation." (Smith 1903b) Within days, the legislature passed the amendment and the governor signed the bill into law. In New Jersey, waters containing mosquito larvae were officially designated a public nuisance.

In 1911, mosquitoes became embroiled in the presidential politics. New Jersey's Progressive governor, Woodrow Wilson, launched his campaign for the presidency. In October 1911 the *Washington Post* reported that the New England Society of New Jersey, an association of prominent individuals living in New Jersey who were born in New England, "started what looks to us like a subtle and malicious assault upon Gov. Woodrow Wilson with a view to breaking down his presidential boom. The society cloaks its attack under the popular cry, "Death to the mosquito!" which every Jerseyman subscribes to." At its autumn meeting, the Society had passed a resolution criticizing Wilson and condemning "the ridiculous position occupied by the State in that it does nothing as a Commonwealth to get rid of its worst enemy." (Anonymous 1911)

During the Society's meeting, speakers accused Wilson's "inaction" in New Jersey's campaign to eliminate mosquitoes. This criticism carried an implicit comparison to President Taft's reputation as a mosquito warrior. Taft's supporters pointed to his support of anti-mosquito work in the Philippines and Panama. The *Post's* article ended with an editorial comment defending Wilson. "Is it fair, is it right, is it decent politics to make such demands on Gov. Wilson which are palpably out of his line of activity and beyond his power," the *Post's* reporter concluded. "Let the enemy take any other shape than a mosquito, and Woodrow Wilson would not flinch. But it is asking too much of him to demand that he shall rid New Jersey of mosquitoes." (Anonymous 1911) It was not entirely coincidental that five months later Wilson took time from his presidential campaign to prove his credentials as a dedicated mosquito warrior. On March 21, 1912, Wilson signed into law the bill that authorized the formation of the nation's first mosquito abatement districts in New Jersey.

Smith's pioneering work in New Jersey, the amendment of the General Health Law, and the passage of the nation's first mosquito abatement law underscores the first lesson in the relationship between politics and mosquito control: Mosquito control depends on educating political leaders.

2. Florida: The Creation of the Florida Anti-Mosquito Association

Sometimes educating political leaders is not enough. The origin of the anti-mosquito movement in Florida is a case in point. Mosquitoes almost prevented Florida's becoming a state. In the congressional debate on the question of whether to admit the territory into the Union, opponents used mosquitoes as an argument in their efforts to block statehood. John Randolph, Congressman from Virginia, declared "nothing wholesome" would come from Florida because it was "a land of swamps, of quagmires, of frogs, and alligators, and mosquitoes." (Mulrennan 1976) When statehood was eventually won in 1845, the Florida legislature created a flag that had three words emblazoned on it that might well have been a reference to the new state's residents' attitude towards mosquitoes: "Leave Us Alone."

Recurrent outbreaks of yellow fever, dengue fever, and malaria ravaged Florida well into the twentieth century. Joseph Porter, first state health officer putting down yellow fever outbreak in Jacksonville in 1888. Shortly after the Reed Commission delivered its report, Porter launched a statewide campaign to educate the population about mosquitoes.

It was not until after World War I that anti-mosquito work began in Florida. In 1919, the state's sanitary engineer, George Simons, enlisted the help of the U.S. Public Health Service in designing an anti-malaria campaign in Perry, Florida. A year later, the city leaders in Miami asked for Simons' assistance in developing a local campaign against mosquitoes. During the next eighteen months, Simons rallied for support for mosquito control throughout the state.

Matters came to a head in the summer of 1922 when there a dengue fever epidemic enveloped the Gulf Coast. Recently Gary Clark recounted the story of the 1922 dengue outbreak in *Wing Beats.* The numbers are astonishing. Epidemiologists estimated that there were as many as a half million cases of dengue fever. Florida was particularly hard hit. Perry and Miami escaped. Simons called the dengue outbreak a blessing because it showed the people of Florida that mosquito control could prevent future epidemics (Clark 2007).

On December 6, 1922, one hundred and fifty mosquito warriors gathered at Palmetto House in Daytona, Florida. The next day they organized themselves into the Florida Anti-Mosquito Association. The delegates elected the seventy-five year old Joseph Porter the organization's first president. Raymond Turck, a former Royal Canadian Mounties and state's new health officer, introduced Porter's presidential address. "Twenty-five years hence," Turck observed, "we will look back to this momentous date in Florida's history. It will be remembered as the natal day of an organization which I am confidant, will bring about the realization of the titanic work of controlling, if not eradicating the mosquito from the state." (Anonymous 1922) Taking the gavel, the seventy-five year old Porter echoed Turck's enthusiasm. The goal was clear. Victory over the mosquito was assured, Porter declared, if the people of Florida "Keep Everlastingly at It." (MacDonell 1932)

The Florida Anti-Mosquito Association served as a rallying point for mosquito control. During the next three years Simons, Porter, and Turck succeeded in building a grass roots movement that spread across the state. More than fifty communities organized Mosquito Leagues or implemented municipal ordinances mandating the enforcement of mosquito control measures (Anonymous 1923).

Simons was the driving force in the Florida Anti-Mosquito Association. He guided the Association's early development. As the organization's secretary, he coordinated the activities of the twelve person executive board (Anonymous 1922b). His first goal was to generate local support for mosquito control. Simons proposed that towns and communities form local mosquito leagues. The mosquito leagues had two objectives: First, to rally support for mosquito control programs in Florida's towns and communities; and, second, to demonstrate to Tallahassee that there was popular support for the State Board of Health's mosquito control initiatives.

Simons' passion for generating local support for mosquito control was rooted in the State Board of Health's public health strategy. During the next three years, Simons and his confederates organized hundreds of meetings throughout the state. They enlisted the support of the state's women's clubs and in 1925 they succeeded in winning legislative action to create mosquito control districts. The newly formed Indian River County along the east central Atlantic was the first county to organize a mosquito control district. Today, Doug Carlson, the 2009-2010 president of the American Mosquito Control Association, leads Florida's oldest mosquito control district.

The work of the Florida Anti-mosquito Association points to the second lesson of mosquito control. Effective Mosquito Control grows out of grass roots support. As important as it is to meet with legislators, it is essential to build local understanding of mosquito control.

3. Utah: Mosquito Control in the Great Depression

The third lesson for building mosquito control came in the 1930s. The Great Depression provoked tremendous changes within the anti-mosquito movement. The economic downturn forced the leaders of the anti-mosquito movement to temper their optimism and reconsider their objectives. Prospects for mosquito control dimmed as the Depression worsened. On Florida's East Coast, Martin County dissolved its mosquito commission. In 1933, the Florida Anti-

Mosquito Association cancelled the Association's annual meeting "due to shortage in funds." (Anonymous 1936) An ambitious plan for the Gulf and Atlantic Coast Anti-Mosquito Association was shelved.

The anti-mosquito movement reached its nadir point in 1933. Four years of depression robbed communities of the resources and political will to support the mosquito crusade.

New Jersey offers graphic examples of the Great Depression's harm to the mosquito crusade. Programs were gutted as budgets were slashed. Veteran mosquito warriors watched as two decades of work disappeared in the economic collapse. In April 1933, Fred Bishopp, Chief of the USDA's Division of Insects Affecting Man and Animals since 1926, offered a glimmer of hope to the struggling New Jersey mosquito warriors. "It seems to me," Bishopp declared in a speech in Atlantic City, "that the great public benefits to be derived from anti-mosquito operations and the excellent opportunity which it gives for utilizing large numbers of the unemployed cannot be too strongly emphasized." (Bishopp 1933) Bishopp singled out Massachusetts as an example of how other states and the federal government could use mosquito control to provide jobs for unemployed. In Massachusetts, the State Reclamation Board's "first concerted action was on the island of Nantucket."" In 1930, the legislature provided support to the Cape Cod Mosquito Project as part of the state's depression relief initiative (Wright 1934).

In fall of 1933, Franklin Roosevelt called for an unprecedented action: The federal government would provide jobs for the unemployed. The new program, the Civilian Works Administration (CWA), was one of a series of federal initiatives aimed at providing economic relief to an impoverished nation. Mosquito control was a central component in the CWA. Louis Williams, an experienced USPHS malaria worker, and Fred Bishopp, chief entomologist at the USDA, took charge of organizing the federally funded anti-mosquito campaign. Williams directed the CWA malaria control efforts while Bishopp led guided the pest and nuisance anti-mosquito campaign. The story of the CWA and its successors is complex. There were successes. Existing programs were saved and new programs were launched.

There was a downside. The primary objective of the federal program was work-relief and not mosquito control. There was little entomological or engineering guidance. Ditches were dug with little planning. Sensitive wetlands were drained with no regard for the environmental consequences. By the mid 1930s, many considered the CWA and later, Works Project Administration (WPA) and Civilian Conservation Corps (CCC) anti-mosquito work a federal boondoggle. Perhaps worse, local and state authorities came to assume that federal government would carry the burden for mosquito control. Needed maintenance was neglected.

Utah was the bright, shining exception to this unfortunate pattern. In Utah, Bishopp asked George Knowlton, an entomology professor at Utah Agricultural College, to organize the CWA effort. Knowlton received a $603,273 allotment to hire a thousand men for mosquito work. Six counties participated in the program. Knowlton directed the majority of the federal funds, $416,990, to the Salt Lake City Mosquito Abatement District (SLCMAD) where a young thirty-two-year-old named Don Rees served as the

SLCMAD's part-time supervisor (Chamberlin 1935).

Don Rees was the catalyst for "mosquito abatement in Utah." Born in 1901, Rees earned his B.S. (1926) and Masters (1929) degrees in zoology from the University of Utah. Rees' interest in mosquitoes grew out of his graduate studies. In 1928, Joseph LePrince recommended that the SLCMAD conduct a scientific survey. The district's trustees asked Ralph Chamberlin to lead the study. Chamberlin assigned Rees the job of doing the fieldwork. Rees based his master's thesis, "An Investigation on the Mosquitoes of Salt Lake County," on this work. After completing his degree, Rees took charge of the SLCMAD as the district's part-time supervisor (1930-1937) (Nielsen 1997).

Rees guided the CWA's mosquito work in Utah. Rees' scientific background and practical experience made him an invaluable resource. Somehow in the midst of supervising the Salt Lake CWA work, guiding the six other CWA county projects, Rees continued to collect data on the state's mosquitoes. This work became the basis of Rees' dissertation.

The Utah CWA project's success grew out Rees' careful fieldwork. By 1933, Rees had formulated a detailed drainage plan for the Jordan River and the salt marshes east of the Wasatch Front. Without federal funds, Rees estimated that it might have taken as much as twenty years to finish the work. "The launching of the Federal plans for employment of large numbers of men," Ralph Chamberlin explained, "made possible the essential completion of this program and its extension in some respects."(Chamberlin 1935)

Federal support for mosquito control on Long Island in Suffolk County, New York provides a striking contrast to Rees' careful work. Mosquito control in Suffolk County languished until 1933 when local officials organized a mosquito abatement commission. Spurred by the idea of receiving federal support for mosquito control, Suffolk County officials used their political connections in Albany and Washington to apply for FERA and CWA funds. Between June 1, 1933, and February 15, 1934, Suffolk County received $547,000 from the federal government for pest mosquito control. During this period, relief workers dug a lattice-work of nearly eight million feet of ditches through the county's salt marshes and wildlife preserves. No thought was given to the environmental consequences of the undertaking (Froeb 1936).

The CWA, CCC, and WPA mosquito projects created a legacy of hostility between advocates of mosquito control and an increasingly vocal group of hunters, fishermen, and wildlife advocates. The Third Annual National Wildlife Conference held in Baltimore in March 1938 revealed the depth of the distrust between the mosquito warriors and the wildlife advocates. J.N. "Ding" Darling had organized the first National Wildlife Conference in 1936. The Third Conference in 1938 devoted a special session to a debate over the question: "What is Wrong with Mosquito Control". Clarence Cottam and William Vogt presented the case against mosquito control. Fred Bishopp and Louis Williams, Jr. delivered the mosquito crusaders' rebuttal. The meeting ended in a shouting match.

During the next decade, Utah was cited as an example of where the federal dollars had been employed in an environmentally responsible manner. A dedicated hunter and supporter of conservation, Rees forged a mosquito control program that balanced the sometimes competing interests of sportsmen, farmers, and public. Rees' work in Utah revealed the third lesson of mosquito control. Effective mosquito control must be guided by science and remain sensitive to the environment.

The story of the American mosquito control movement contains many valuable lessons. The experiences of mosquito control workers in New Jersey, Florida, and Utah in the first half of the twentieth century emphasize the necessity of educating political leaders, building grassroots support, and remaining good environmental stewards.

Perhaps the best summary of the lessons of mosquito control was presented sixty years ago. In February 1949, William Herms, one of the nation's leading medical entomologists, delivered his farewell address to the first West Coast meeting of the newly formed American Mosquito Control Association. Herms, whose pioneering work led to the development of mosquito control in California, admonished the mosquito warriors to "*Know well* the insects" and to "*Keep faith* with the folks who look to you for the accomplishments of mosquito control (emphasis in original)." (Herms 1949) The mosquito control movement must not lose sight of these imperatives. "Yours is, therefore, a serious responsibility based on *good will*," Herms concluded, "your constituents look expectantly and confidently to you for the abatement of annoying and disease-bearing mosquitoes. You have a job to do, do it with sincerity and devotion. Continue to be worthy of the good will of constituents." (Herms 1949) It would be foolish to forget this.

References Cited

Anonymous. 1911. Gov. Wilson and the Mosquito. *The Washington Post*, October 11, 1911, p. 6.

Anonymous. 1922a. Declare War on the Mosquito. *St. Petersburg Times*, December 7, 1922, p. A1.

Anonymous. 1922b. Anti-Mosquito Board Formed. *St. Petersburg Times*, December 8, 1922, p. 1.

Anonymous. 1923. May Request Larger State Health Levy. *St. Petersburg Times*, March 22, 1923, p. 2.

Anonymous. 1936. Summary 1932-1936. Proceedings of the Tenth Annual Meeting of the Florida Anti-Mosquito Association. Clearwater, Florida. March 14-15, p. 1.

Barnes J. 1984. Aristotle, The Complete Works of Aristotle Princeton: Princeton University Press, 1984. 2 vols., vol. II, p. 1987-88.

Bishopp FC. 1933. Some Accomplishments in Mosquito Work Throughout the World During 1932. Proceedings of the Twentieth Annual Meeting of the New

Jersey Mosquito Extermination Association. New Brunswick, New Jersey: Modern Printing Company, 80.

Chamberlin RV, Rees D. 1935. Accomplishments in Mosquito Control in Utah. Proceedings of the Twenty-Second Annual Meeting of the New Jersey Mosquito Extermination Association, p. 96, 97.

Clark G. 2007. Between 500,000 and 600,000 Cases of Dengue in Texas. Wing Beats 18(4):16-17.

Froeb AC. 1936. Accomplishments in Mosquito Control in Suffolk County, Long Island. Proceedings of the Twenty-Third Annual Meeting of the New Jersey Mosquito Extermination Association, p.128.

Herms William B. 1949. Looking Back Half a Century for Guidance in Planning and Conducting Mosquito Control Operations. Proceedings and Papers of the Seventeenth Annual Conference of the California Mosquito Control Association, p. 89, 93.

MacDonell VL. 1932. History of the Florida Anti-Mosquito Association. Proceedings of the Tenth Annual Meeting of the Florida Anti-Mosquito Association. Clearwater, Florida. March 14-15.

Mitchell EG, Dupree JW. 1906. Mosquito Life, the Habits and Life Cycles of the Known Mosquitoes of the United States; Methods for Their Control: and Keys for Easy Identification of the Species in Their Various Stages. New York and London: G.P. Putnams's Sons. 1.

Mulrennan J Sr. 1976. Traveling Through Memory Lane of Mosquito Control In Florida. Report of the Forty-Seventy Annual Meeting of the Florida Anti-Mosquito Association. Longboat Key, May 3.

Nielsen Lewis T. Reese Don Merrill. 1997. Accomplishments in Mosquito Control in Utah. Proceedings of the Twenty-Second Annual Meeting of the New Jersey Mosquito Extermination Association. Atlantic City, 96, 97.

Noble RE. 1946. New Jersey Progressivism before Wilson. Princeton, p.19.

Sackett WE. 1914. Modern Battles of Trenton: From Werts to Wilson. New York: Neale Publishing Company, 92-93.

Smith J. 1902. Report of the Entomological Department of the New Jersey Agricultural College Experiment Station for the Year 1901. John Murphy Publishing Co., p. 581, 587.

Smith J. 1903a. Letter to Turner Brakeley, March 9, 1903 in John B. Smith Papers, Letter of John B. Smith. Black Hall, Rutgers University.

Smith J. 1903b. Letter to L. O. Howard, April 2, 1903 in John B. Smith Papers, Letters of John B. Smith. Black Hall, Rutgers University.

Strassler RB. 2007. Herodotus, The Landmark Herodotus: The Histories, New York: Partheon, p.156.

Wright E. 1934. Mosquito Control Work of the Massachusetts Reclamation Board. Proceedings of the Twenty-First Annual Meeting of the New Jersey Mosquito Extermination Association. New Brunswick, New Jersey, p.114.

Vector Concepts Design Standards for Development

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Historical Mosquito Control Activities

Pesticides have been traditionally used by vector control agencies to combat mosquitoes with the first use of petroleum hydrocarbons for larviciding. Early practices emphasized the elimination of places where mosquitoes were found to be breeding. This method, referred to as source reduction, continues to be in current use. The most profound change occurred just after the Second World War when chemical control methods became available that allowed for large area treatments (Schaefer 1993). Currently, pesticides are still used for controlling mosquito nuisances and to disrupt the transmission cycle of the diseases they transmit. With development of insecticide resistance and limitations due to pesticide use, there is a need to regulate the production of habitats that promote vector populations. As a result regulations were adopted by the Vector Borne Diseases Program, of the Washoe County District Health Department in Nevada, to participate in planning through Community Development in designing urban infrastructure that reduces the ponding of water.

Regulations Governing the Prevention of Vector-Borne Diseases

With the recognized shift away from agriculture to growth of an urban environment and the need to protect the increase in population as well as the tourism industry in Washoe County, the Vector-Borne Diseases Program of the Washoe County District Health Department initiated Health Regulations Governing the prevention of Vector-Borne Diseases. The purpose of the program was to establish regulations for requirements in assisting professionals, such as city and county planners and engineers, in that the Vector Borne Diseases Program would become a planning partner in development. Furthermore the regulations represent standards for the prevention of Vector-Borne diseases in land development and redevelopment. More importantly, these standards form the basis from which conditions will be required during the review of development and redevelopment project plans.

In April 2003, a series of 3 public advertised work shops were established to provide public comment on the proposed regulations. Stakeholders were contacted which included the cities of Reno, Sparks and Washoe County Community Development Departments, engineering firms including the building industry, Builders' of Northern Nevada, and Associated General Contractors who could be impacted by the proposed regulations (Washoe County District Health Department, Procedures for Amending and Adopting Regulations, volume 3). The draft regulations were then presented to the Washoe County District Board of Health and adopted unanimously on May 22, 2003. The final version of the draft regulation was sent to the secretary of the State Board of Health for approval. The draft regulations were placed as an agenda item and approved in June of 2003.

As a result of the approval of the regulations, copies of plans for annexations, parcel maps, changes in land use, subdivisions, special use permits, site plans, abandonment's, amendments, reversions, building construction plans and final maps were sent to the Washoe County Health Department for review. Revisions are prepared addressing health and safety issues following set standards and regulations. These reviews include designs for grading, landscape, rockery walls, catch basins, channels, detention/retention basins and any type of development or construction that would cause potential vector-borne disease issues.

Conclusion

When the local regulations were initiated in the fall of 2002, it was hard to imagine the positive affects realized in the Community Development Departments of Reno, Sparks and Washoe County and the benefits to the citizens of the community. The Vector-Borne Diseases Program through the establishment of these regulations has become a planning partner in development and redevelopment projects which assisted professionals in planning by designing and modifying infrastructure toward an environmental health perspective to mitigate the impact and severity of diseases from mosquitoes.

Nationwide public health needs to be elevated in priorities and recognized to adequately address these needs through an action plan (Hazeltine 1993). The action plan our program undertook in our community allowed us to step out of our role as an agency reliant on the use of pesticides for insect control, to one of becoming proactive thru the planning process in Community Development. Furthermore, involvement in planning allowed us to review development proposals and condition these projects thru design standards for hydrology features that would reduce standing water habitat for insects. As a result of this approach "vector friendly" urban infrastructures have been designed in new developments and redevelopment projects.

References Cited

Hazeltine W. 1993. Working for Amendments of Federal Laws Which Impact mosquito Control. Proceedings and Papers of the Sixty-First Annual Conference of the California Mosquito and Vector Control Association. January 24-27, 1993; Bakersfield, CA. 61:95-97.

Schaefer CH. 1993. Chemical Mosquito Control Agents in California: The past, The Present and The Future. Proceedings and Papers of the Sixty-First Annual Conference of the California Mosquito and Vector Control Association. January 24-27, 1993; Bakersfield, CA. 61:91-94.

Phoenix Fogger Retro Fit Instructions

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The main reason Sevier County Mosquito is changing from the Constant flow system to the Variable Flow is twofold. The first is the potential to save to 15% on chemical. The second is the ability for nighttime foggers to slow down and do a much better job of fogging. We would like to thank the Utah Department of Agriculture and Food (UDAF) for this grant and for the grants we have had over the past five years.

Sevier County had a very successful year this year of 2008. There was no WNV detected in our county, no positive mosquito pools or sentinel chickens. The county had lots of flood water mosquitoes that really resulted in lots of complaints in the county.

This year the mosquito department was able to get a new RAMP System using money from a UDAF grant. The RAMP System will be used to test mosquito pools for West Nile Virus. Unfortunately, the RAMP System was purchased late in the season and no mosquito pools were tested in 2008. The UDAF grant also allowed the mosquito department to convert existing ULV sprayers from constant flow to variable flow machines.

Below is a description of the steps and procedures needed to make the conversion of the mosquito departments existing foggers from a constant flow rate to variable flow rate that adjusts the amount of spray material with the speed of the spray vehicle.

Retrofit Fogger Instructions

1. Unscrew the Engine Harness from the bottom of the pump box.
2. Cut every wire from where they are connected inside of the pump box. There should be 9 different colors: small red, large red, green, blue, orange, gray, black, purple, and brown.
3. Remove Tiny Tach from Engine along with anything else that will prohibit the pump box from being removed.
4. Remove the Pump box and the Tiny Tach, Hobbs meter, pump, and pressure gauge from the pump box.
5. Remove the gear device from the bottom of the pump along with the fittings from the pump head.
6. Remove the spiral wrap from the wires. Expose all of the wires from the flush and spray solenoids and the gray and brown wires from the top of the engine. Peel back the spiral wrap from the purple, orange, and red wires that lead to the front of the engine from where they meet the brown and gray wire from top of the engine.
7. Remove the blue wire from the spray solenoid and throw away.

Flush and Spray Solenoids

8. Replace the red wire from the flush and spray solenoids with a black wire and ground to the frame (see below for ground placement), Fig. 1.
9. Remove the spray and flush solenoids and replace with London Fog Flush solenoid, Fig. 2.
10. Once Flush solenoid is in place, connect the green wire and black wire to the flush solenoid.

Hobbs Meter

11. Place the Hobbs meter in the side of the engine as shown below. Make sure to also drill a hole on the corner for the two wires for the Hobbs meter, Fig. 3.
12. Butt Splice the Red wire from the Hobbs meter with the brown wire from the throttle solenoid. Cut the brown and strip the brown and red wires and connect to one end of the butt splice, than strip the brown wire and connect to open end of butt splice.

13. Next take the black wire from the Hobbs meter and butt splice to black wire from the flush solenoid. Cut the black wire from the flush solenoid and strip along with the black from the Hobbs meter and connect to one end of the butt splice, than strip the black wire and connect to open end of butt splice.

Throttle Solenoid

14. Open up the air filter enclosure on top of the engine and unbolt using both a 10mm and 8mm.
15. After the black top is off, remove the white wire (connected to throttle solenoid) from the red wire.
16. Disconnect the other white wire from the brown terminal and connect the brown wire to the white wire removed in step 15.
17. Cut the loose white wire from the throttle solenoid right next to the terminal and crimp on a 5/16" ring terminal (supplied and marked throttle solenoid ground).
18. Connect the 5/16" ring terminal to the engine using the bolt next to the OHV writing. This will ground the throttle solenoid. (See Figure 4 for placement and connections)
19. Pull out the red wire from the top of the engine and reinstall the black cover.

Added Starter Relay

20. Cut back the red wire that you disconnected from the throttle solenoid right after it leaves the top of the engine and crimp on a female insulated spade terminal to the end of it.
21. Take the black wire in with the start relay bag and connect the flag terminal on *#86 on the start relay.* Take the ring terminal end and place behind the mounting tab on the relay.
22. Install the start relay under the end of the muffler with one exhaust tube. (see picture below) *<u>Make sure the black wire is in between the tab and engine block, that wire serves as the relay ground,</u> Fig. 5.
23. Peel back the spiral wrap from the starter solenoid to right after the key enclosure.
24. Disconnect the purple wire from the starter solenoid and pull apart from the black wire with the white trace.
25. Add wire to purple wire if it is not long enough to reach the starter relay. Preferable purple wire so as not to confuse what the function is. *Connect to #85 on starter relay*, see Fig. 5. If number is hard to read the numbers are on the bottom of the relay.
26. Connect the red wire as mentioned in step 20 to *#30 on the starter relay.*
27. Connect the red wire with black trace, supplied with starter relay with a female insulated spade terminal on one end, to *#87 on the starter relay.*
28. Cut the flag terminal off on the black wire with white trace that was connected to starter solenoid and strip.
29. Solder the small red wire (supplied, has one female insulated spade terminal), red with black trace and black wire with a white trace together and place heat shrink over it.
30. Connect the red wire with spade terminal on it to the starter solenoid, now replacing the original purple wire, Fig. 5 and Fig. 6.

Pressure Gauge

31. Drill two holes 4.48" apart next to the Phoenix Fogger ID Tag beside the blower so that one can mount the pressure gauge and bracket. Drill to fit a 10/24 Allan head screw, Fig. 7.
32. Once bracket with gauge is mounted, place the 3/8" tubing from the nozzle (the tubing closest to you looking at the nozzle (make sure it is the pressure line and not the fluid line).
33. Connect 3/8" (supplied and marked as pressure line) with reducer fitting to the remaining fitting on the Tee union. Take the 1/8" tubing from the bottom of the pressure switch on the pump box and attach it to the reducer fitting.

Engine Harness Assembly

34. Place spiral wrap back around the flush solenoid wires, engine wires and throttle and choke solenoid/Hobbs meter wires.
35. Leave around 8-10" on wires exposed for assembly of engine harness (8 wires

should be left after removal of flush/spray solenoid red wire in step 8.)

36. Place part # 9104 around the 8 wires and strip the wires back just enough to crimp an AMP male pin on each wire.
37. Crimp an AMP male pin on each of the 8 wires.
38. Install part # 9101: (numbers are same below as labeled on the AMP plug #9101) Table 1.
39. Once engine harness is installed, place the spiral wrap around and screw in #9104 to #9101. Screw the two cord grip screws in, Fig. 8.

Installation of the Pump Box with LondonFlow GPS

40. Remove formulation tank and drill 4, 5/16" holes in the tank tray closest to the engine. For dimensions measure back of the pump box, they should be around 6" W x 10 9/16" L, Fig. 9.
41. Place the four 5/16"-18 1 ¼" bolts with washer through the holes along with two 5/16"-18 nuts on each bolt. Tighten.
42. Install pump box onto the four bolts and tighten using supplied fasteners.
43. Once box is tightened, screw in the engine harness to the plug that is closest to the pressure switch. And screw in the remote cab control into the other plug (closest to the pump override switch).

Fluid Line Installation

44. Install the two standoffs onto the tank tray; there should be two holes already in there for placement.
45. Install the fluid 18" 3/8" fluid line on the filter and the #3 post on the flush solenoid. The two other posts should have fluid lines already attached via step 9.
46. Place the 60" fluid line from post #2 through the two standoffs and through top of the pump box and connect to pump.
47. Take the fluid line from the nozzle and push through the two standoffs with the 60" fluid line.
48. Once the nozzle fluid line is through standoffs, place the supplied fitting labeled Nozzle fluid fitting on the end of line. Make sure to connect the straight fitting to the nozzle fluid line and that he 90° elbow is pointing up.
49. Attach the 15" 3/8" tubing to the 90° elbow and tighten. Connect the other end of fluid line to the pulse dampener through the top of the pump box.

Garmin Antenna Installation

50. Take the Garmin antenna and yellow mounting bracket out of the box.
51. Using the hole in tank tray closest to the gas tank, mount the yellow bracket and place antenna on top (fasteners supplied), Fig. 10.

The Sevier County Mosquito Departments would like to thank the Utah Department of Agriculture and Food for providing this grant and for grants over the past five years.

Fig. 1. This is a ground from the 'kill relay' in the pump box and needs to be replaced after installation of the pump box. (Flush & Spray Solenoids, Step #8)

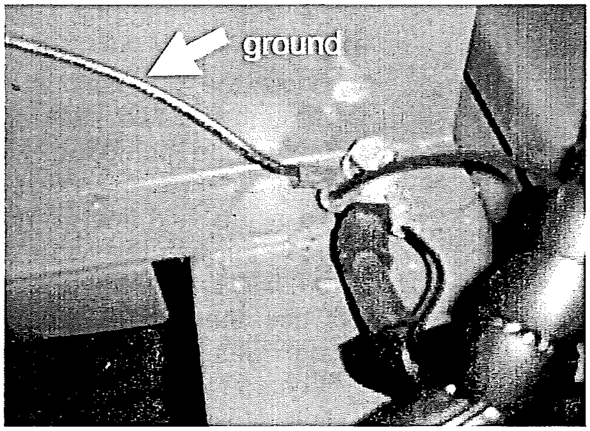

Fig. 2. Make sure that the flush solenoid is mounted so that post #2 fitting is closest to the formulation filter. Also, install the flush fluid line to post #1 on solenoid. Use fasteners labeled flush solenoid. (Flush & Spray Solenoids, Step #9)

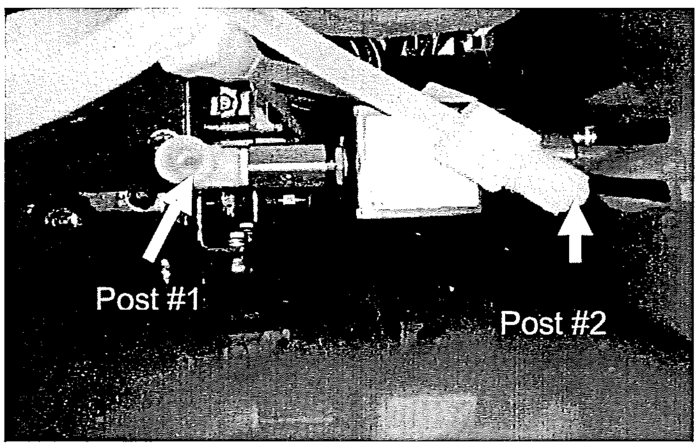

Fig. 3. Hobbs Meter, Step #11.

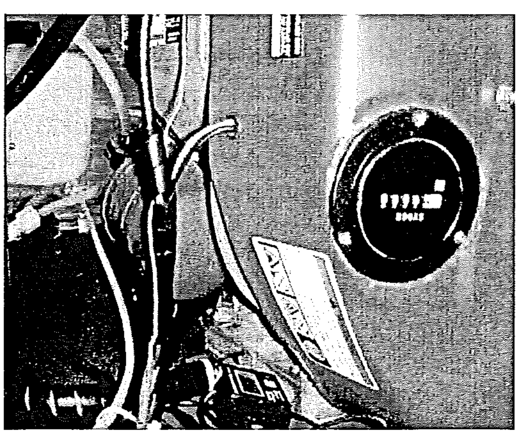

Fig. 4. Throttle Solenoid, Step #18.

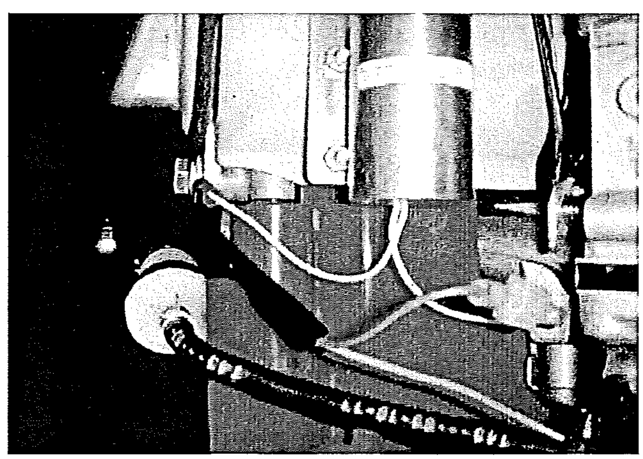

Fig. 5. Added Starter Relay, Step #22.

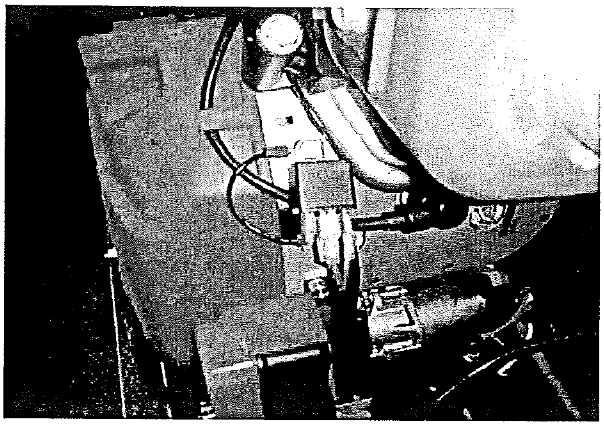

Fig. 6. Added Starter Relay, Step #30.

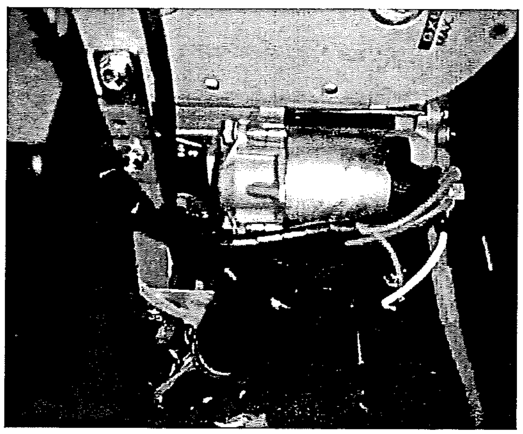

Fig. 7. Pressure Gage, Step #31.

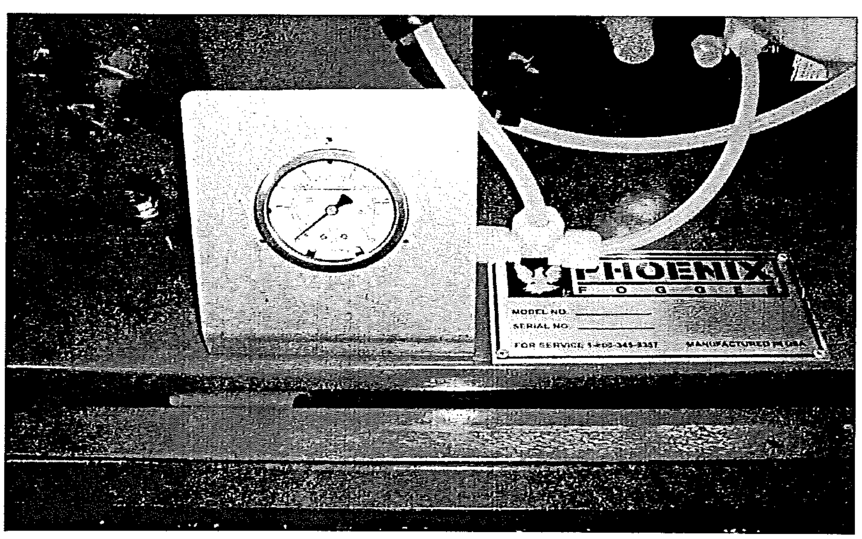

Fig. 8. Engine Harness assembly, Step #39.

Fig. 9. Installation of the Pump Box with LondonFlow: GPS, Step #40

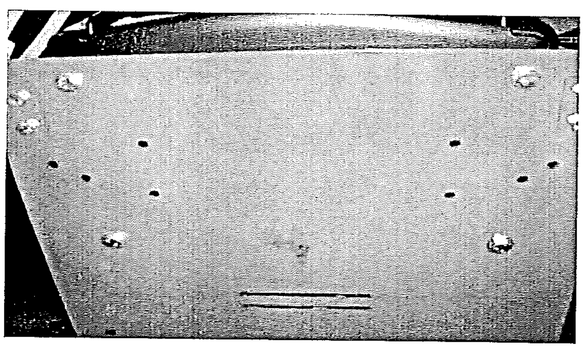

Fig. 10. Garmin Antenna Installation, Step #51.

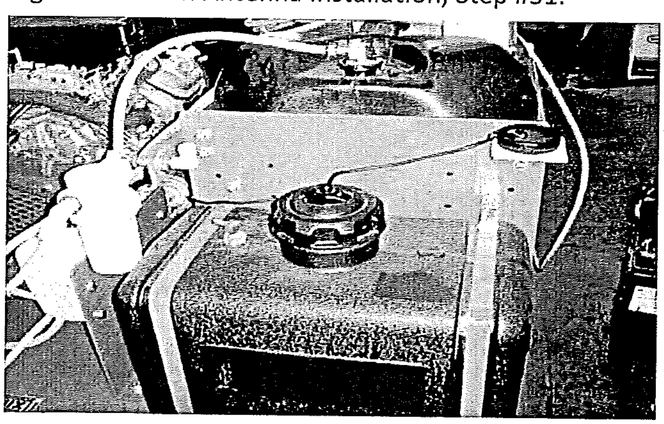

Table 10. Engine Harness Assembly, Step #38

# on plug-Color	Function
1. Red	Main 12 volts from battery
2. Open	
3. Purple	Start
4. Orange	Ignition Kill
5. Gray	Choke Solenoid
6. Green	Flush Solenoid
7. Brown	Throttle Solenoid
8. Open	
9. Black	Ground
10-14. Open	

VARIABLE FLOW RETROFIT for ULV FOGGERS

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The Uintah Mosquito Abatement District received a grant from the Utah Department of Agriculture and Food (UDAF) for $5,580.00 to be matched by the district. The purpose of the grant is to help in the control of mosquitoes and reduce the risk of West Nile Virus to the residents of Uintah County. These funds were used to convert our current fleet of eight truck mounted ULV foggers from fixed flow units to variable flow units.

Background

Mosquito Control in Uintah County in 2008 has proved to be very challenging. One of the major challenges for the district is the Green River bottom land which is flooded each year to provide habitat for local endangered fish. As the Yampa River each year comes to peak flood stage, the Flaming Gorge Dam is opened up to increase the flows down the Green River. From the confluence of the two rivers down stream, major acreages of bottom lands are inundated by river sub up waters and also flood waters. These flooded areas are perfect mosquito producing habitats. In 2008, with the cool spring and high snow pack in the Yampa drainage by mid May, we saw the 2nd highest flow on the Green River in the last 24 years. Even after a very effective aerial larvicidal program of 23,840 acres with BTI we still saw migrations of adult mosquitoes into populated areas of the county. By the end of the hot summer many of these flooded areas still had standing water left by the spring flood and produced *Culex tarsalis* all season. Needless to say this has been a very busy year.

Intergraded Pest Management is an important part of the district's operation. Therefore, in addition to a very aggressive larvicidal program, adulticidal control is chosen as a secondary measure, especially when needed to achieve maximum kill rates on vector mosquito populations such as the WNV vector, *Culex tarsalis*.

Because of the large size of our district (4500 sq. miles), limited man power, and limited equipment we felt that by going to variable flow controls on the foggers we could increase the productivity of the adulticidal program and therefore reduce the risk of WNV to the residents.

Results

One of our London Fog 18-20 foggers was fitted with a variable flow control at the first of the summer. The fixed flow FMI pump was fitted with the variable flow conversion and installed on the fogger. In addition to the variable flow pump conversion, a Garmin antenna and a cab control unit with a warning light was also installed.

A second fogger was fitted with the variable flow set up later in the summer. The remaining 6 foggers will be converted to variable flow now that the mosquito season has ended. We did not feel that we could have any more of the units down in the busy part of the season.

Assessment

1. The variable flow foggers were able to increase the efficiency of the adulticidal program by allowing us to increase the total number of acres fogged in an evening by about double, while still be in calibration at lower speeds. The fixed flow units operate at 10 mph while the variable flow units can operate anywhere between 3 mph to 23 mph. Therefore whenever conditions allow, we fog at 20 mph, which increases the total area covered.

2. Not only does the variable flow unit increase the area covered but it cuts the labor cost by reducing the amount of time it takes to cover a given area.

3. Accurate application is achieved at any speed between 3 to 23 mph. We flow tested the units while moving and achieved the following results:
   Original calibration – fixed flow – 4 oz. @ 10 mph
   Variable flow calibration
   2 oz. @ 5 mph
   4 oz. @ 10 mph
   6 oz. @ 15 mph
   8 oz. @ 20 mph
   Flow tested and checked for accuracy at each speed.

4. The unit has built in protection for under or over speed. If the operator drops below 3 mph or goes over 23 mph the pump will turn off and the warning light on the cab control will blink letting the operators know they are under or over speed and the pump is off. By coming back into the correct speed the light will go out and the pump will again begin to operate.

ACKNOWLEDGEMENTS

Uintah Mosquito Abatement District would like to thank the State of Utah and the Utah Department of Agriculture and Food for the grant that has made it possible for us to upgrade our foggers with the new variable flow capability. With the variable flow capabilities we will be more effective with our fleet of foggers and thereby achieve increased success in the fight against WNV vectors.

Rich County Mosquito Surveillance

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Bear River Health Department (BRHD) received $6550.00 in funding from the Utah Department of Agriculture and Food in 2008. The grant included funds for mosquito surveillance in Rich County and $1500.00 for RAMP testing and supplies. Total expenditures for the same period including cash and/or in-kind from BRHD equals $13,050.00

Surveillance work was done with eight (8) CO_2 mosquito traps from June 17th to September 16, 2008, on Monday and Tuesday of each week. Mosquito traps were set-up on Monday evening and collected Tuesday morning for identification, packaging and transport to the Utah Department of Health Lab for testing. Rich County partnered with Cache County for the purchase a RAMP testing system for WNV. The system was ordered in July and by the time all the equipment was received and operating, the mosquito counts in Rich County had significantly dropped and surveillance had virtually ended.

For comparison, surveillance data from mosquito traps in Cache and Rich Counties is attached. During 2008 (Table 1), 44.5% of the mosquitoes collected in Rich County were *Ochlerotatus* or "flood water" mosquitoes compared to 34% in 2007, 68% in 2006, 86% in 2005 and 82% in 2004. In 2008, 55.1 percent of the total mosquitoes trapped were of the genus *Culex,* the primarily vector of West Nile Virus (WNV) compared to 66% in 2007, 32% in 2006 and 10% in 2005. The WNV has not yet been detected in Rich County.

Educational materials were made available to residents of Rich County through the BRHD office in Randolph as well as distributed to local businesses in Randolph, Woodruff, Laketown, and Garden City. The Utah Department of Health, "Fight the Bite" campaign information was primarily used.

The Rich County mosquito surveillance program was aided by the following personnel: Joel Hoyt - Program oversight, rap coordination and initial placement, identification, liaison with Rich County Commissioner; Grant Koford - equipment, identification, shipment of samples to lab; Sarah Cheshire - lab coordination, identification, reports; Todd Barson – identification; Josh Greer – identification; Julie Seamons - secretary, record keeping, packaging; Brandon Longenecker - trap collection and transportation; Russell Thompson - trap set-up & collection, trap maintenance; Linda Brown – billing, health education materials; and, Bill Cox - Rich County Commissioner, aerial spraying.

Table 1. Adult mosquitoes collected in Rich County in 2008.

Species	Total #	% of collections
Culex tarsalis	616	54.8
Culex pipiens	3	0.3
Ochlerotatus	500	44.5
Culiseta	4	0.4
Aedes	0	0
Anopheles	0	0
Totals	1123	100

Table 2. Adult mosquitoes collected in Cache County in 2008.

Species	Total #	% of collections
Culex tarsalis	36659	90.7
Culex pipiens	2932	7.3
Ochlerotatus	774	2
Culiseta	46	0
Aedes	0	0
Anopheles	3	0
Totals	40414	100

Observations from Using a Collection Bottle Rotator Trap

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Introduction

The Utah County Health Department Mosquito Abatement Division received a matching grant of $10,860 from the Utah Department of Agriculture and Food (UDAF). The purpose of the grant was reduction WNV vector mosquitoes and utilizing trapping information more effectively.

Methods

Our approach for this goal was three fold. First, obtain lab equipment and supplies to test for WNV in our own lab to determine same day results. Second, expand catch basin mapping and treating to better control *Cx. pipiens*. Third, using a Bottle Rotator Trap, determine the most active time for mosquito species to improve efficacy in ULV applications particularly in residential habitats. This paper concentrated on what we discovered with the trapping results. A Rotator Bottle Trap was purchased from John W. Hock Co., a La Crosse WS-2317U weather station was purchased from Sportsman's Warehouse and a 12 volt deep cycle marine battery was used to power the trap (Fig. 1). The Utah County Public Works shop created a 42" stand of 1" square tubing that could be inserted 12" into the ground and stabilized by four 16" horizontal legs. An extra collecting bottle was attached to the entrance funnel to receive a CDC mosquito trap with an insulated container for dry ice. A no pest strip was purchased and cut into pieces to be inserted in each bottle to kill trapped insects.

Trapping sites were based on locations that had previously produced high numbers of *Cx. pipiens* in the communities of Pleasant Grove, Provo Orem and Spanish Fork. After preliminary trapping it was determined that traps would be set at two hour increments from 4:00 PM to 8:00 AM. Insignificant numbers of mosquitoes were caught outside of these hours. Weather data was collected every 15 minutes that included temperature, humidity, wind speed and direction (Fig. 2). This data was downloaded and converted to an excel spread sheet following each trapping.

Trapping occurred during 24 dates from 16 June to 31 July. Mosquitoes were sorted, identified and counted each morning by numbered bottle (Fig. 3).

Results

Throughout the trapping, mosquito activity was gathered for 10 species. Totals for each species were assembled and then converted to a percent of each species that was trapped during the two hour increments.

The peak flight time for the most abundant six species was 8 to 10 PM regardless of any other factor (Fig. 4). This remained constant throughout the mosquito season. Two species, *Oc. increpitus* and *Oc. dorsalis,* showed a smaller secondary activity peak in the 4-6 AM time period.

Two species, *Culex tarsalis* and *Cx. erythrothorax,* both WNV vectors, had peak times from 10:00 PM to midnight and didn't shift over the summer. The two hour period between 10:00 PM to midnight was designated as the critical spraying time. When looking only at *Culex tarsalis, Cx. erythrothorax* and *Culiseta inornata*, it is amazing to see the rapid drop in activity after midnight (Fig. 5).

Collections of three species, *Aedes vexans*, *Anopheles freeborni* and *Culex pipiens* were outside of the time frames of other species. *Aedes vexans* flew very early with 6:00 PM to 8:00 PM being peak activity times. Activity seemed to shift towards the 8 PM hour as the summer progressed. The *An. freeborni* data is inconclusive due to the very few that were trapped but our limited data suggested it flew later in the evening than most local species. *Culex pipiens* was the latest flying species we trapped at night early in the summer. They peaked about midnight but continued to bite well into the 2-4 AM interval. We noticed that their activity time moved earlier as we got to the end of July and the first of August. It appeared that the shortened daylight was a factor and perhaps there was a behavioral adaptation linked with birds roosting earlier providing an earlier available blood meal.

Discussion

From this study we altered some of our spraying practices. We had discovered that most local mosquito species had very specific flying times that would be best for targeting their control. We shifted most of our spraying to the evening. We instructed our sprayers that the prime effective spraying time was 9:00 PM until midnight. Urban spraying routes could be extended until 2:00 AM when targeting *Cx. pipiens.* Evening residential spaying is often problematic because of human activity that often extends into the late evening hours and summer storm fronts frustrate control efforts.

Further plans for this study are to correlate the weather data we gathered with our mosquito data. We also plan on shortening the time intervals during active flight hours to 1 hour increments and 30 minute increments to more precisely identify peak mosquito activity. Extending trapping into August and September to better document later flying species will also be addressed.

Fig. 1. Assembled ABC CO_2 trap (top), rotator bottle trap (middle), and 12 v marine battery (bottom).

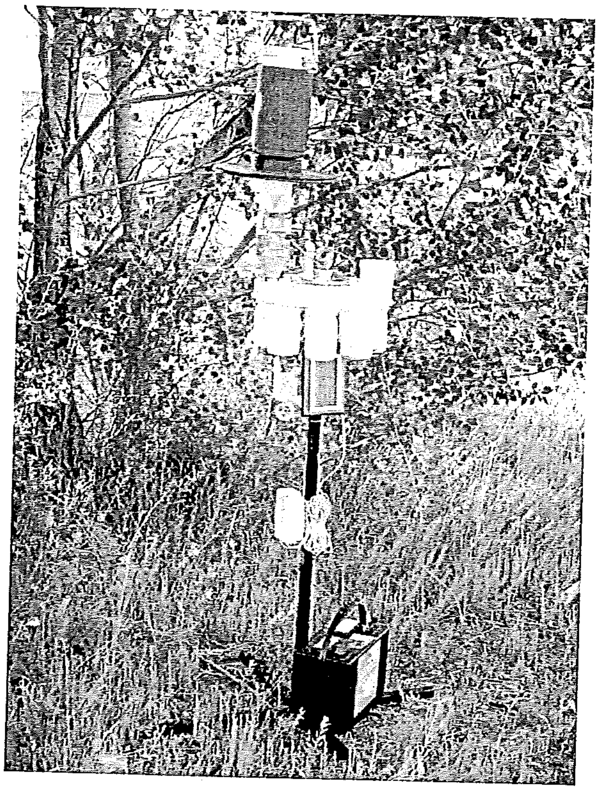


Fig. 2. Weather station screen.

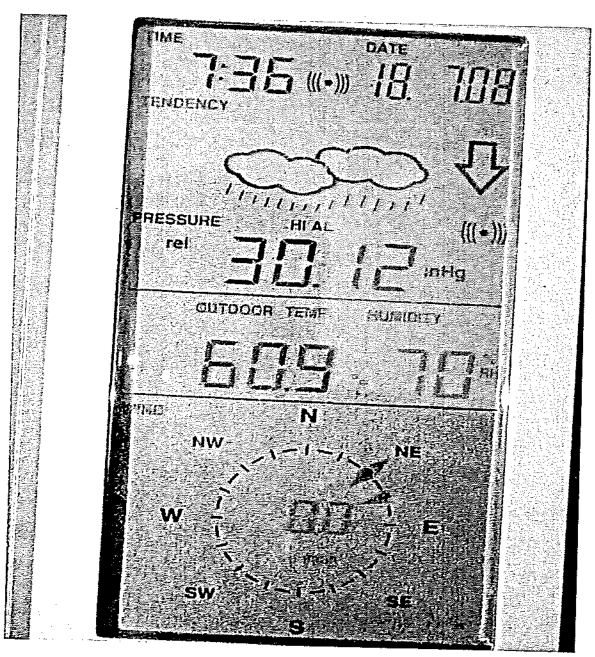


Fig. 3. Rotator trap collection bottles.

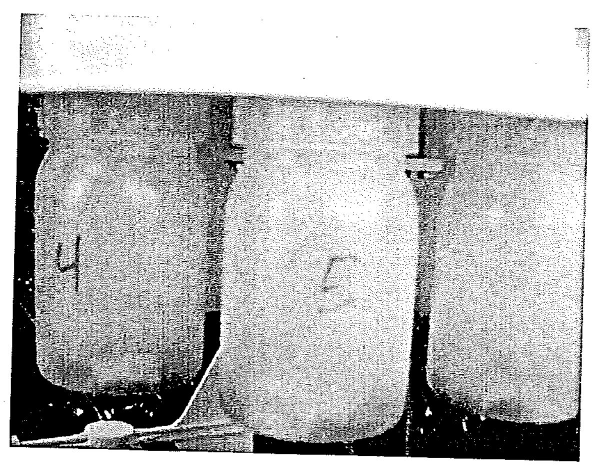


Fig. 4. Peak collection activity of collections made by rotator bottle trap for 24 hour per day showing six most collected species.

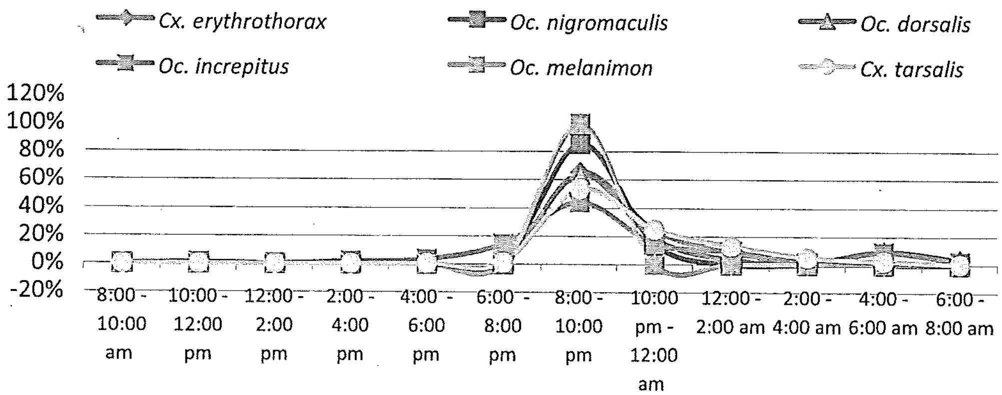
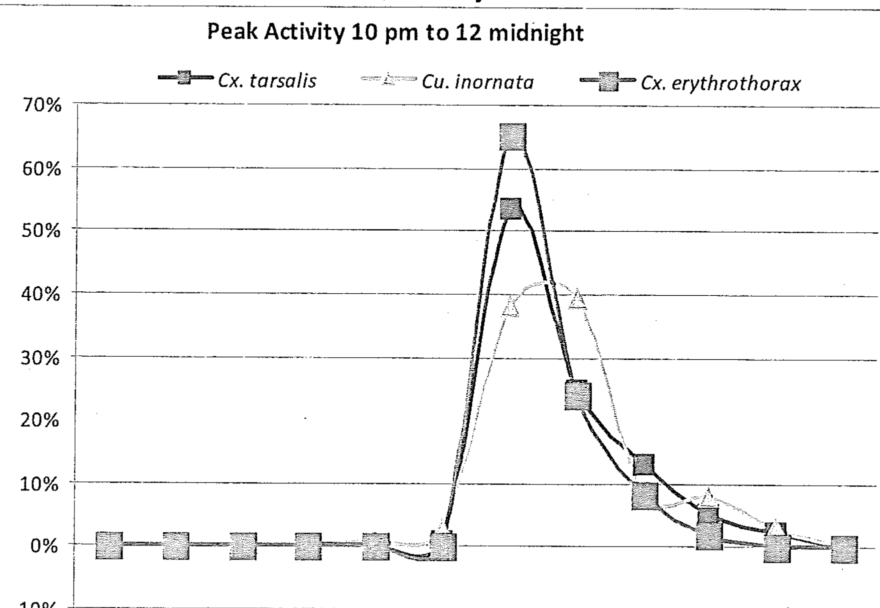


Fig. 5. Collection of adult mosquitoes by rotator bottle trap operating for 24 hours per with two hour collection intervals for *Cx. tarsalis, Cx. erythrothorax* and *Culiseta inornata.*



	8:00 - 10:00 am	10:00 - 12:00	12:00 - 2:00 pm	2:00 - 4:00 pm	4:00 - 6:00 pm	6:00 - 8:00 pm	8:00 - 10:00 pm	10:00 pm - 12:00	12:00 - 2:00 am	2:00 - 4:00 am	4:00 - 6:00 am	6:00 - 8:00 am
Cx. tarsalis	0%	0%	0%	0%	0%	1%	53%	25%	13%	5%	2%	0%
Cu. inornata	0%	0%	0%	0%	1%	3%	38%	39%	8%	8%	3%	0%
Cx. erythrothorax	0%	0%	0%	0%	0%	0%	65%	24%	8%	2%	0%	0%

Fig. 6. Collection of adult mosquitoes by rotator bottle trap operating for between 8:00 PM and 6:00 AM with two hour collection intervals for *Anopheles freeborni, Culex pipiens* and *Aedes vexans*.