





#### **BOARD OF TRUSTEES**

PRESIDENT Stephen Morgan SHASTA LAKE

VICE PRESIDENT Vickie Marler SHASTA COUNTY

> SECRETARY Larry Mower ANDERSON

Michael McNamara REDDING

Dale Dondero SHASTA COUNTY

ADMINISTRATION

Peter Bonkrude, MS MANAGER Residents of the Shasta Mosquito and Vector Control District,

On behalf of the Board of Trustees and staff of the District we are pleased to present the 2016 Annual Report for the Shasta Mosquito and Vector Control District. Every year Shasta MVCD staff selects a theme to help tell the story of the season and 2016 is no different. It is easy to take for granted the sheer diversity of insect life and the impacts those differences have on our ecology, control efforts, and disease prevention priorities. Therefore in 2016 we are highlighting the natural history of the mosquitoes of California, with a focus on the major mosquito species of concern for our District. Scattered throughout the report the reader will find "cards" describing the mosquito, the preferred habitats, the diseases vectored and some other facts that help our staff make more focused control decisions.

This year, the District finally received precipitation that would be considered above average, providing for a lot of unknowns regarding how mosquito abundance would be affected. One outcome that became immediately apparent was the treehole mosquito season we experienced. Most mosquito species are affected by high and low precipitation levels, but one species, *Aedes sierrensis*, the western treehole mosquito, relies almost exclusively on natural water sources. Coming off several years of drought, the treehole mosquitoes took full advantage of the rainy winter/spring and hatched in much higher numbers than the previous five years. We saw abundance levels and the subsequent service requests skyrocket to double what we had experienced in previous years. This spring time mosquito loves to bite humans and in 2016 accounted for almost half of the service requests issued for the entire season! Interestingly, beyond the above average treehole mosquito season we experienced, overall our abundance numbers were lower than 2015 and our WNV positive indicators were at a five year low.

Operational research was a major focus of our 2016 season, highlighting the District's goal to stay innovative and to continually measure our efficacy. We conducted a ULV efficacy trial, attempting to quantify our impact in a heterogeneous landscape, our new chemigation system at the lumber mill, continued pesticide resistance testing, overwintering adult mosquito surveillance, larval control product testing, and analysis of the peak times for activity of our vector mosquito species to accurately target our applications.

In 2017, the District will continue to build on the research work accomplished in 2016. We will be finalizing the implementation of our invasive *Aedes* surveillance and control plan. The last few years invasive *Aedes* and Zika virus concerns have grown and our District will position itself to be ready to respond if either is discovered in our area. Finally, the District would like to extend our thanks to Trustee and President Stephen Morgan and Trustee Dale Dondero. 2016 was their final year serving on our Board of Trustees for the City of Shasta Lake and Shasta County at large. We appreciate the hard work, commitment and guidance they provided the District during their service.

Sincerely,

Peter Bonkrude District Manager

Agh Moyn

Stephen Morgan President, Board of Trustees

Our Mission: "To protect the public's health from vector-borne disease and nuisance, through a comprehensive mosquito and vector control program focused on innovation, experience, and efficiency."

## **Board of Trustees**



Left to Right: Darcy Buckalew, Guangye Hu, John Albright, Peter Bonkrude, Kelly Cleland, Kendra Angel-Adkinson, Haley Bastien, Robert Ault, Pete Ledbetter, Darrell Bible, Al Shabazian, Corey Boyer, Mike Alexander, Mark Mulcahy Not pictured: Valerie Peterson

# **District** History



# **Integrated Vector Management**

#### What is a Vector?

Vectors are living organisms that can transmit diseases between humans or from animals to humans. Many of these vectors are bloodsucking insects like mosquitoes, ticks, fleas, sandflies and triatomine bugs.

#### What is Integrated Vector Management (IVM)?

IVM is a "rational decision-making process for the optimal use of resources for vector control" (WHO 2008). This approach seeks to improve the efficacy, lower the cost, maintain ecological soundness and ensure the sustainability of our vector control methodologies. At Shasta MVCD we consider IVM as our tool box for mosquito and vector control. The IVM process is assessing the problem and putting together the right order and choice of tools to make the most effective control decision. Common tools utilized by the District include: advocacy and com-



munity outreach, collaborating with other agencies, integrating chemical and nonchemical control methods, a focus on staff traini



Vector Control District

chemical control methods, a focus on staff training and expertise and a strong surveillance system. Together these tools help provide staff with the evidence and information required to identify and control potential problem areas.



#### Zika:

Zika virus is a mosquito-borne virus that was first identified in Uganda in 1947 in monkeys that were being monitored for yellow fever. It was later identified in humans and sporadic outbreaks have occurred through the years. In 2007 a large outbreak occurred on the Island of Yap and in 2015 the current outbreak began building in Brazil and other parts of South America. Zika is associated with a mild fever, skin rash, muscle and joint pain, conjunctivitis, and a headache. There is scientific consensus that Zika is also a cause of microcephaly, Guillain-Barre and is being investigated for other neurological conditions (WHO). Zika virus is primarily thought to be transmitted via *Aedes aegypti* and *Aedes albopictus* mosquitoes.

#### In the world:

75 countries and territories have reported evidence of mosquito-borne Zika virus transmission since 2007, twelve countries have reported person to person transmission of Zika virus. Estimates of human Zika virus range from hundreds of thousands to millions worldwide.

#### In the US:

In the US we currently have \*216 locally acquired Zika human cases reported, in addition to \*4,593 that are travel-associated. Only Texas and Florida have reported locally acquired Zika virus. In the US territories we have an additional \*33,865 locally acquired cases reported and \*129 travel associated cases. Federal funding has been approved to help local jurisdictions combat Zika virus in the US, but those impacts will not be felt until next season at the earliest. The US is also working on several vaccines to prevent human illness.

## Zika & St. Louis Encephalitis

#### In California:

California currently has had no local transmission of Zika virus, but several counties in California do have the species of mosquitoes capable of transmitting Zika virus. Statewide efforts are focused on invasive *Aedes* surveillance and control, speeding up the laboratory testing, new control techniques and outreach to the public regarding invasive *Aedes* species and new emerging viruses.

#### In Shasta County:

Currently we have no locally transmitted Zika cases in Shasta County, and also the invasive *Aedes* are yet to be found in Shasta County. The District is redrafting its emergency response plan to include *Aedes* and Zika, Chikungunya and Dengue control, expanding and diversifying our surveillance efforts and training staff in the new mosquito species identification and control.



#### St. Louis Encephalitis:

First recognized in California in 1937, St. Louis Encephalitis virus (SLEV) caused frequent epidemics in humans and horses throughout California but with more intensity in the **Central Valley and Southern California counties. Most** people infected with SLEV will have few to no symptoms, but others can have serious effects on the central nervous system including fever, headache, stiff neck, confusion, coma, paralysis and sometimes death. The US has not experienced an epidemic since 1989, but the disease was found in California until 2003, the same year that West Nile virus (WNV) was first detected in the state. For 12 years no SLEV activity was detected in California despite a large increase in mosquito surveillance due to WNV. It is still unclear whether we will see an expansion of SLEV in 2017, but SMVCD staff continues to monitor its reemergence. Locally, in Shasta County we have not seen SLEV activity since 1997. In California in 2015, SLEV activity was detected in mosquito pools (38) and sentinel chickens (9). 2016 SLEV activity increased, with three human cases, 180 mosquito samples and 4 sentinel chickens.

## **Service Requests**



#### Service Request by Community

| Community     | %      |
|---------------|--------|
| Redding       | 49.32% |
| Anderson      | 12.53% |
| Palo Cedro    | 7.79%  |
| Shasta Lake   | 4.74%  |
| Enterprise    | 4.18%  |
| Cottonwood    | 3.95%  |
| Shingletown   | 3.61%  |
| Bella Vista   | 2.71%  |
| Igo & Ono     | 2.14%  |
| Happy Valley  | 2.03%  |
| Lakehead      | 2.03%  |
| Shasta        | 1.47%  |
| Millville     | 1.24%  |
| Mountain Gate | 1.13%  |
| Castella      | 0.34%  |
| Jones Valley  | 0.23%  |
| French Gulch  | 0.23%  |
| E. Lakehead   | 0.23%  |
| Oak Run       | 0.11%  |

Responding to requests for service can be one of the District's strongest tools to inform our District residents about public health mosquito control. In addition to giving our staff the opportunity to impart information to the public, we in turn gain valuable information about disease and nuisance mosquito problems throughout the District. These requests are for a wide range of mosquito and vector related issues including: mosquito fish requests, biting mosquitoes, neglected swimming pools, and general questions about insects,

mosquito control, and how the public can protect themselves. We rely on these requests to help drive the District operational response, providing our staff with a real-time assessment of where the mosquito issues are beginning. This helps the staff focus on surveillance and control efforts. The public can issue a service request via the telephone Monday-Friday from 8am to 4pm or 24 hours a day through the District's online service request form. During the season we make it a priority to respond to those requests within 24-48 hours.



Aedes sierrensis



Known as the western treehole mosquito. One of the first species to hatch in early spring. This mosquito generates the most service requests for the District as they are very aggressive biters.

Small dark mosquito with white bands on their legs.

| Flight Range        | Habitat                                     | Preferred Host           | Diseases         |
|---------------------|---|--------------------------|------------------|
| Less than 1<br>mile | Treeholes, tires,<br>man-made<br>containers | Small mammals,<br>humans | Canine heartworm |

## **Neglected Pools**

This year the aerial surveillance identified a total of 727 pools for inspection by the District staff. This is an increase of 402 pools over the 2015 season. One neglected pool can have the potential for breeding millions of mosquitoes during the season that can spread West Nile virus (WNV). Therefore, missing just one unattended swimming pool can put the public health at risk.

The aerial program is still an effective and economical tool utilized to detect neglected swimming pools. The program was initiated in response to the increased property foreclosures following the economic downturn. Since that time, we have inspected 4,214 pools and treated 564 pools with chemical control products and/or mosquito fish. The neglected pools continue to be a problem for "urban" mosquito breeding throughout the District. The volume of treated pools in 2016 was higher than the previous five years.



2008

2009

2010

2011

2012

2013

2014

2015

2016





8%



Pursuant to the CA Health and Safety Code; ► A vector is defined as: "Any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury including, but not limited to, mosquitoes, files, mites, other arthropods, and

Including, but not limited to, mosquites, lines, mixes, other artinopoos, and ordents and other wretebrates: A vector related public nuisance is defined as any of the following: 1. Any property, excluding water, that has been artificially altered from its natural condition so that it now supports the development, attraction, or harborage of vectors. The presence of vectors in their developmental stages on a property is sufficient evidence that the property is a public nuisance. Items for externst "The assessed of

property is a public nuisance. 2. Any water that is a breeding place for vectors. The presence of vectors in their developmental stages on a property is evidence that the property is a public nuisance. 3. Any activity that supports the development, attraction, or harborage of vectors, or that facilitates the introduction or spread of The district may abate a public nuisance pursuant to this article: The person or agency claiming ownership, title, or right to property or who controls the diversion, delivery, conveyance, or flow of water shall be a supported on the pursuant of the supersonal be responsible for the abatement of a public nuisance that is caused

 be responsible for the addentient to a public hospital to a solution to a solution to a solution of the solution Date:

Door hangers are left for residents that might have potential mosquito breeding sources. The purpose is to encourage them to call the District for assistance.



Biological control (or biocontrol) is using a natural predator to control a pest organism. For the control of mosquitoes, *Gambusia affinis* or mosquito fish are an effective biocontrol agent. Mosquito fish are released into confined water bodies where they quickly begin to consume mosquito larvae and reproduce prolifically. In 2016 the District planted fish in 996 different sites, releasing over 74 pounds of fish; this represents approximately 75,000 fish. Included in the total fish releases, the District received 390 requests for mosquito fish from District residents. The District has an outdoor pond that supplements a sophisticated, 2400-gallon indoor fish-rearing facility to meet the goal of supplying sufficient fish to District residents.





Physical Control Effort

District staff brushing: 990 man-hrs Cal-Fire Crew: brushing 3,250 man-hrs

Herbiciding: 677 acres Backhoe work: 60 hrs

An effective and long lasting control tool our District employs is physical control. This is the process of using mechanical means to modify or remove a mosquito breeding habitat, thereby suppressing the adult population. In addition to reducing or stopping mosquito production, physical control is also utilized to allow District personnel more effective access to the mosquito breeding habitats.

The District's physical control efforts take many shapes, varying in scope and type according to the needs of a given project. These projects can include source reduction (i.e. the mitigation or elimination of a mosquito source), hand brushing in and around sources, modifying sources to augment the impact of natural mosquito predators, herbiciding, and the physical removal or burning of brush. As in years past, the District utilized Cal-Fire Sugar Pine Conservation crews to accomplish many work-intensive brushing projects.







| Anopheles freeborni | Known as the western malaria<br>mosquito.   |
|---------------------|---|
| 6                   | Light brown mosquito, with spotted wings, resting with their abdomen in the air.                          |
| X                   | Freeborni are also known to be an<br>overwintering mosquito, seeking<br>shelter in barns, sheds or eaves. |
|                     |   |

| Flight Range | Habitat                                     | Preferred Host           | Diseases |
|--------------|---|--------------------------|----------|
| 10 miles     | Open fields<br>with algae or<br>plant cover | Large mammals,<br>humans | Malaria  |

## **Immature Mosquito Control**

The most visible connection to mosquito control for most people is usually the flying and biting adult mosquitoes. In reality for control, larvae and pupae (immature mosquitoes) make up a more important part of the mosquito life cycle. During this period immature mosquitoes live and grow in water before they emerge into adult mosquitoes. The immature mosquitoes are relatively immobile, concentrated, contained and accessible to staff. Therefore, it is usually more effective to control immature mosquitoes before they become flying adults.

The products used to control mosquito larvae are called larvicides, which are approved for use by both U.S. and California environmental and public health agencies. Larvicides control immature mosquitoes before they become adult mosquitoes.

The larvicides used in our program are products of naturally occurring bacteria (e.g. Spinosad and Bti), insect growth regulators (IGR, methoprene), or surface oils.

The District staff inspected 15,896 sites for mosquito breeding and conducted 3,544 applications to control mosquito larvae and pupae living in ponds, ditches, puddles, catch basins, neglected swimming pools, vernal



pools, and tree holes. The District staff inspected approximately 8,000 catch basins and treated 755 for mosquito breeding. Catch basins can cause a serious mosquito-breeding problem in the urban and suburban areas. The water retained in the catch basins from rain and excessive irrigation of lawns, vegetation gardens and flower beds breed mosquitoes that are known vectors of West Nile virus.



Aedes vexans Known a floodwat Narrow v leg and a segment nuisance means to

Known as an inland floodwater mosquito.

Narrow white bands on their leg and abdominal segments. Primarily a biting nuisance, the word vexãre means to torment or annoy.

| Flight<br>Range       | Habitat  | Preferred<br>Host           | Diseases   |
|-----------------------|--|-----------------------------|------------|
| Less than<br>10 miles | Pastures, irrigated<br>fields with<br>organic matter | Large<br>mammal &<br>humans | Major pest |

Adulticiding refers to the practice of controlling adult mosquitoes by applying chemical products. It is the most visible method of mosquito control to the public. Reducing adult mosquitoes can limit outbreaks of mosquitoborne diseases by decreasing potentially infectious mosquito populations that cause a risk to the public.

Adult mosquito control products are applied by ultra-low volume (ULV) truck-mounted sprayers. The applications are made at dusk and dawn when mosquitoes are generally their most active. These dusk and dawn applications are not only the most effective time to control adult mosquitoes but are also optimal to avoid adverse effects to insects like butterflies and bees. ULV sprayers disperse very fine aerosol droplets that stay in the air and contact flying mosquitoes. Usually it requires an ounce or less of the product per acre. The products used are permethrin, pyrethrin, etofenprox, and malathion. These products pose a minimal risk to humans, animals, and the environment when applied according to their labels.

In 2016, the District staff completed 527 adulticiding routes and treated a total of 127,139 acres. Residents can go to our website, www.shastamosquito.org/foggingupdate, to review where and when our adult mosquito applications will be conducted, and can subscribe to our spray notification list.





Each dot represents a **ULV** fogging route



Applications are monitored via computer program. Green lines indicate when the fogger is on, red is when it is turned off.



Anopheles punctipennis Known as the woodland malaria mosquito.

> Large mosquito, dark and cream colored scales on wings. Generally stays outdoors and does not enter dwellings.

| Flight Range        | Habitat  | Preferred Host           | Diseases |
|---------------------|--|--------------------------|----------|
| less than<br>1 mile | Cool, shaded,<br>grassy pools in<br>streams/creeks | Large mammals,<br>humans | Malaria  |

Cow Creek

## **Other Vectors**

Like mosquitoes, ticks can also vector infectious agents such as *Borrelia burgdorferi* (Lyme disease) and *Borrelia miyamotoi*. The staff survey and test tick populations in locations throughout the District



# <complex-block>

Tick Surveillance

-

lxodes pacificus

There are a few common species within the District. Western black legged tick (*lxodes pacificus*) populations are regularly tested for infectious agents. American dog tick (*Demacentor occidentalis*) and Pacific Coast tick (*Dermacentor variabilis*) are not currently known to vector any disease within the District.

| Test Results for Ticks gathered between Nov 2015 - Mar 2016              |                 |                   |           |  |  |
|--|-----------------|-------------------|-----------|--|--|
| Positive S   | Samples Found o | f 323 Total Sampl | es (1479) |  |  |
| Infectious Positive Percent of Minimum<br>Agent Samples Samples Rate (%) |                 |                   |           |  |  |
| Borrelia<br>burgdorferi  | 6               | 1.86              | 0.41      |  |  |
| Borrelia<br>miyamotoi  | 22              | 6.81              | 1.49      |  |  |

#### **Rodent Borne Disease Surveillance**

The District has collaborated with the California Department of Public Health in trapping and testing rodents for the presence of diseases such as plague and hantavirus. District staff participated in surveillance of a high traffic camping facility east of Shingletown. None of the five rodents sampled were positive for plague or hantavirus.



Dermacentor variabilis Dermacentor occidentalis



CDPH and District staff process rodents such as *Peromyscus* spp. and *Tamias* spp. (pictured right)

## West Nile virus

#### West Nile Virus Activity in California Counties 2016 YTD

Modoc

Lasser

Plumas

Mono

Inyc

Siskiyou

Trinity

Humbold

In 2016, West Nile virus (WNV) activity within the District was at its lowest level since 2011 based upon routine mosquito-borne disease surveillance. Shasta MVCD uses three surveillance tools for routine monitoring of WNV disease activity within the District: sentinel chicken blood samples, dead bird saliva samples, and samples of wild-caught mosquitoes.

WNV was first detected in dead birds in Shasta MVCD in 2004. Every year since, WNV has been detected by at least one surveillance method within the District.

Targeted mosquito control based on surveillance of mosquito populations and disease activity tends to keep transmission of WNV to humans and horses relatively low within the Shasta Mosquito and Vector Control District. One human case and one horse case of WNV were reported from within the District in 2016.

| WNv Positives     | Shasta MVCD |      |      |       | California |       |
|-------------------|-------------|------|------|-------|------------|-------|
|                   | 2016        | 2015 | 2014 | 2016  | 2015       | 2014  |
| Humans            | 1           | 2    | 2    | 426   | 641        | 754   |
| Horses            | 1           | 2    | 1    | 21    | 1          | 16    |
| Sentinel Chickens | 3           | 18   | 11   | 343   | 449        | 440   |
| Mosquito Samples  | 12          | 48   | 33   | 3,528 | 3,287      | 3,338 |
| Dead Birds        | 3           | 15   | 6    | 1,351 | 1,333      | 2,430 |

as of 1/26/17

#### 30 Counties with Human Cases

San Mate

> Santa Cruz

Counties with West Nile virus activity (no human cases)

Counties with West Nile virus activity (number of human cases)

San Luis

Santa Barbara

#### West Nile Virus Surveillance Activity

Shasta MVCD 2007-2016 Positive Indicators



#### **Culex pipiens**

Known as the northern house mosquito. Plain light brown mosquito that lacks any

markings. Their abdomen is marked with pale-colored scales that form banding on each segment

| Flight Range        | Habitat  | Preferred<br>Host | Diseases                                  |
|---------------------|--|-------------------|---|
| Less than<br>1 mile | Polluted water,<br>residential &<br>commercial sources | Birds,<br>humans  | West Nile virus<br>St. Louis Encephalitis |

## **Vector & Disease Surveillance**

#### New Jersey Light Trap (NJLT)

New Jersey light traps placed at 17 fixed locations throughout the District use a timed light source to attract mosquitoes overnight in jars that are collected on a weekly basis. Mosquitoes from the jars are identified by sex and species and counted from April through October. These traps provide useful mosquito population trend information since they have been generating data for almost 50 years.

#### **BG Sentinel II**

Traps are designed to have a shape suggestive of larger mammals. They also use a scent lure, CO<sub>2</sub>, and wind currents that supplement the visual cues. These traps are especially effective at catching invasive mosquitoes like *Aedes albopictus* and *Aedes aegypti* that prefer to feed on humans and can spread diseases such as Zika virus, Dengue and yellow fever. The District uses these traps in response to public complaints of unusual mosquito behavior that may suggest the presence of any new mosquito species.



#### CDC Autocidal Gravid Trap (AGO)

The Centers for Disease Control's Autocidal Gravid Trap (AGO) is designed to attract and capture container breeding mosquitoes. These mosquitoes prefer flower pots, buckets and anything that will hold a small amount of water. In 2016 the District used six AGO traps at locations where invasive mosquitoes are likely to arrive. The mosquito is forced to enter through a tube lined with sticky paper; the slightest contact with this surface ensnares the mosquito. Identification of non-native mosquitoes warrants further inspection of the surrounding area and a comprehensive management program.

#### **Encephalitis Virus Surveillance Trap (EVS)**

Encephalitis virus surveillance (EVS) traps emit carbon dioxide to lure mosquitoes seeking a blood meal. EVS traps are set at 44 fixed locations on a weekly basis to evaluate the mosquito population in that area. Additionally, EVS traps catch live mosquitoes that are suitable to test for the presence of mosquito-borne diseases. In 2016, there were 12 EVS samples which were positive for West Nile virus.

These four traps are currently the most commonly used by the District. Traps not featured include gravid traps, ovicup traps, and many other designs which the District uses to capture specific mosquito populations of interest.

## **Vector & Disease Surveillance**

#### Average Mosquitoes per Trap Night per Year by Genus

1992 to 2016 Combined New Jersey and CO2- baited EVS Traps



#### EVS Samples & Test Results 2014-2016

| Year | Number of<br>samples<br>submitted | Number of<br>WNV+<br>samples |
|------|-----------------------------------|------------------------------|
| 2016 | 472                               | 12                           |
| 2015 | 552                               | 48                           |
| 2014 | 509                               | 33                           |

#### Percentage of Adult Mosquito Types



#### **Dead Bird Surveillance**

Dead bird surveillance is another tool to monitor the presence and spread of viruses in the environment. Reports of dead birds have declined in recent years and this number continues to wane. In 2016 the District recieved 52 dead bird reports and three of four tested were WNV positive.

| Culex tarsalis |              | Known as th<br>mosquito.  | Known as the western encephalitis mosquito.   |   |  |
|----------------|--------------|---|---|---|--|
| A.A.           |              | <i>Culex tarsalis</i><br>adults, in cav<br>outdoor buil<br>Black mosqu<br>on it proboso | can overwinter as<br>ves, tree hollows or<br>dings.<br>ito with a white band<br>is and tarsal joints. |   |  |
|                | Flight Range | Habitat   | Preferred Host  | Diseases  |  |
|                | 10-15 miles  | Lakes, ponds,<br>freshwater or<br>agricultural  | Birds, mammals,<br>humans   | St. Louis Encephalitis<br>Western Encephalitis<br>West Nile virus |  |

#### **Sentinel Chickens**

Sentinel chickens have long been used in California to detect diseases circulating in the environment. Chickens are used for a number of reasons including ease of care, and they do not suffer any adverse effects due to infection. District staff monitored five flocks of eight chickens each located throughout the District from rural Cottonwood to central Redding. Blood samples were taken from each bird between April and October every two weeks. The California Department of Public Health tested the sample for immune response to mosquito-borne diseases. In 2016 three of the forty chickens tested were found to have been exposed to West Nile virus.

## Research

#### Chemigation



eservior, pump and timing system

#### Overwintering

Female Culex spp. mosquitoes have been shown to harbor West Nile virus throughout the winter and possibly transmit the virus the following spring. To determine if this mode of transmission occurs within the District, staff have collected and tested some 632 female *Culex* spp. in 29 samples from overwinter resting sites. All samples were negative for the presence of West Nile virus.

Shasta MVCD makes an effort to continually improve upon control activities to find the most effective and efficient control methods. Log mill operations pose challenging control problems due to their size, safety concerns, and ability to breed numerous mosquitoes. With the help and cooperation of mill staff, the District has been able to not only keep mosquito breeding as low as possible but also has the opportunity to try innovative techniques to improve mosquito control and staff safety. Between 2014-2016 the District established a system to broadcast larvicide over the mosquito breeding sources using the existing sprinkler system. Although 2016 was the first year we have implemented this "chemigation" at the mill property, we are encouraged by the preliminary results and plan to continue the application method next season, see graph below.



#### **Swath Width**

In adult mosquito control, the swath width is the operationally effective area of the product that exits the truck mounted ultra-low volume (ULV) spray system. The way this spray moves through the habitat plays a large role in the efficacy of our adult mosquito control applications. In 2016, SMVCD staff conducted field trials to determine

the distribution and efficacy of our truck-mounted ULV application in suburban and urban settings. By placing caged mosquitoes in different areas of the sites tested, staff hoped to characterize the application and identify operational variables that could lead to more effective control. Results from the caged mosquitoes largely show reasonable mortality at the front, middle, and backyard locations with an expected decline as the spray moved from front to backyard. Additionally, some site specific factors (physical barriers, wind direction) underscore the importance of attention to wind direction while conducting truck-mounted ULV applications.



## Research

#### Larvicide Efficacy Tests

The District conducted larvicide efficacy tests in the field to ensure that the products used offer effective and sustainable control of mosquitoes. The results of the test showed that the spinosad based granules provided effective control for 4 weeks. The methoprene based product was unable to match the length of control time attained by the spinosad product hitting product failure after only 3 weeks. Continued research will be focused on investigating the reasons for the product failure and adding alternative products to maintain effective and sustainable control of mosquitoes. Field Efficacy Test of Mosquito Larvicides



#### **Bottle Bioassay**



#### Churn Creek Bottom Area Bottle Bioassay -- Malathion

Samples of adult wild mosquitoes are placed in bottles treated with tiny amounts of adulticide active ingredients. The same is done with susceptible lab-reared mosquitoes (CQ1). The time it takes for the different strains of mosquitoes to die is compared to determine their relative sensitivities to the products.

Three active ingredients were tested on mosquitoes from two locations on two different dates in 2016. Overall, it appears that local mosquitoes are more susceptible to an organophosphate product, malathion, than they were to the pyrethroid products etofenprox and permethrin.

#### **Rotator Trap**

A rotator trap uses collection jars mounted on a carousel to take samples at different time intervals. The samples taken can be used to determine peak activity times for adults of different mosquito types. This information can be used to determine the best times to apply adult mosquito control products.

A rotator trap was set on three occasions at different sites within the District. Different mosquitoes showed different peak activity times. All traps showed peaks of activity a couple of hours after sunset and a couple of hours before dawn. In mid-summer, mosquitoes seemed to be virtually absent prior to sunset, at midnight or after dawn. Total of Mosquitoes Caught by Time of Capture



Rotator Trap Set at Three Different Locations on Three Different Nights

## Outreach



A significant portion of mosquito control is informing the public of the hazards of mosquito-borne diseases and empowering our community to take mosquito control into their own hands by following the **4-D's**. District staff have a full and varied schedule of public outreach including booths at the Shasta District Fair, home and garden shows, and health fairs as well as speaking engagements with community service groups and schools.





Follow the 4-D's

**Drain or Dump** standing water around the house. Mosquitoes can't start their life without water.

**Dusk or Dawn** are when mosquitoes are most active. Avoid being outdoors when mosquitoes are present.

**Dress** in long sleeves and pants during dawn and dusk or in areas where mosquitoes are active.

Dec 125

Oct Z28

**Defend** yourself against mosquitoes using repellents containing DEET, Picaridin, Oil of Lemon Eucalyptus or IR3535.

> Apr 1,219









NorCal Boat, Sport & RV Show



In 2016 the District participated for the first time in the "Bats, Bees and Butterflies Bioblitz" at the Whiskeytown National Recreation area's Whiskeytown Environmental School. District personnel manned an educational booth for the public. Also, grade school children participated in hands-on demonstrations of tick and mosquito collection. This was a two day event studying the park's biodi-

versity and celebrating the centennial of the formation of the National Park Service.

> Centennial Bioblitz at Whiskeytown Lake











SHAST / COUNTY OFFICE EDUCATION spring HOME & GARDEN expe



Whole Earth FESTIVAL

Science, Technology, Math & Engineering (STEM) Fair

Total

6,801

2016 Website Visits

848



1,500 9th graders attend this event



#### **Statement of Financial Position:** FY 2015-2016 (June 30, 2016)

| 3,316,208 |           |
|-----------|-----------|
| 1,503     |           |
| 42,111    |           |
| 78,301    |           |
| 51,273    |           |
| 515,585   |           |
| 128,627   |           |
| 4,133,608 |           |
|           |           |
| 24,783    |           |
| 1,650,608 |           |
| 143,113   |           |
| 1,818,504 |           |
|           |           |
|           | 1,818,504 |

| Property Taxes           |       | 1,162,187 | 47.96% |
|--------------------------|-------|-----------|--------|
| Assessments              |       | 1,188,291 | 49.03% |
| Interest & Miscellaneous | _     | 72,925    | 3.01%  |
|                          | TOTAL | 2,423,403 | 100%   |

| 2015-2016 EXPENDITURES |       |           |        |  |
|------------------------|-------|-----------|--------|--|
| Salaries and Benefits  |       | 1,666,194 | 72.62% |  |
| Service and Supplies   |       | 599,357   | 26.12% |  |
| Utility Expense        | _     | 28,882    | 1.26%  |  |
| r                      | TOTAL | 2,294,433 | 100%   |  |

#### **Utility Expense EXPENDITURES** 1% Service & 26% **Supplies** Salaries & Benefits 73%

# **Financial Highlights**

#### **Financial Administration**

The Shasta Mosquito and Vector Control District's objective is to be ethically and fiscally responsible in accordance with Generally Accepted Accounting Principles (GAAP), Governmental Accounting, Auditing and Financial Reporting (GAAFR) as well as California State Controller reporting guidelines. The District depends on property tax revenues and benefit assessments to fund its operations and to achieve the District's mission.

During this year, the new treasury management system implemented in 2015 has continued to be successful. The system has shown positive operating results in efficiency and transparency as well as more up to date financial reporting. We will continue to strive to make the financial reporting transparent for the board of trustees, staff and the public.

The District is audited annually by an outside independent auditing firm. This independent firm audits the financial statements and internal controls of the District to ensure that the financial statements are free of material misstatement. The District has continued to receive an Ungualified Opinion, which is the best opinion available



#### **Actual Revenue vs Actual Expenditures**



# Shasta Mosquito & Vector Control District



19200 Latona Road Anderson, CA 96007 www.shastamosquito.org contact@shastamosquito.org Phone: (530) 365-3768 Fax: (530) 365-0305