2018 Year End Report

Gem County Mosquito Abatement District

6846 West Highway 52
Emmett, Idaho 83617

2018 Mosquito Surveillance and Control Summary Report

Mission Statement

The principle mission of the Gem County Mosquito Abatement District and the basic reason for its operation is to provide comprehensive and sustainable mosquito control as a means of protecting public and veterinary health by reducing the number of mosquitoes that transmit diseases. Secondary missions accomplished by the district's program include the improvement of human and animal welfare by reducing the number of nuisance mosquitoes, increasing yields and productivity in livestock, continual enjoyment of public and private outdoor recreation areas, and minimization of impacts mosquito populations may have on tourism and visitor-generated revenues for local area businesses.

District History

The Gem County Mosquito Abatement District (GCMAD) was created by election in 1960 using the "Idaho Abatement Act," Idaho Code Title 39, Chapter 28 for the purpose of alleviating the pressure mosquitoes were having on cattle production. Originally, the district was established to protect all of Gem County, but over time, several areas opted out of coverage. Currently, the district is approximately 145 square miles.

Mosquito control today utilizes an Integrated Pest Management program that realizes mosquito populations will not always be eliminated, but can be suppressed to tolerable levels for protection of public health and welfare. The program is reviewed annually to adjust for regulatory and ecological changes and requirements. Only scientifically sound methods are used for mosquito control in the GCMAD and decisions are based on consideration of what is ecologically and economically in the best interests of the district constituency over a sustainable period of time.

G.C.M.A.D Management and Staff

Board of Trustees:
Michele Chadwick, Co-Chairperson
Tom Carlsen, Co-Chairperson
Bonnie Diedrich, Member
Anita Taylor, Member

Ex-Officio Members:
Southwest District Health Dept.
Idaho Dept. of Agriculture
University of Idaho Extension Office

Full-time Staff:
Jason Kinley, Director
Cody Johns, Field Ops. Coord.

Seasonal Positions:
1 Office Assistant
6 Larval Control Technicians
4 Adult Control Technicians

Director's Letter

The 2018 mosquito control season was very successful for many reasons. To start, the beginning of the mosquito season was relatively uneventful, with little weather events that effect early mosquito production. Timely applications to flood waters in early spring helped minimize the impact that any flooding had on mosquito populations. The district's robust integrated mosquito management program focused primarily on the identification and treatment of larval mosquito development sites. In 2018, the GCMAD increased larval control by targeting more sites known for producing mosquitoes and treating those sites as necessary. As a result, the district applied more larval mosquito control products to standing water than in any past year.

West Nile virus (WNv) was found in mosquitoes during routine surveillance for the first time in the 2018 mosquito control season on July 2, 2018. The isolation of WNv on July 2 was almost the same date (July 10) as the initial detection in mosquitoes in 2017. The district collected nine positive samples of mosquitoes for WNv. This is greater than a 50% reduction in the number of positive mosquito samples when compared to 2017 (19 positive samples in 2017). One confirmed human case of WNv (fever) occurred in Gem County in 2018.

The district extended service to the recently annexed areas of UA Avenue, Gem Avenue, and Jackson Avenue of Gem County in 2018. The service provided included surveillance for WNv in mosquitoes, the treatment of standing water that produced mosquitoes, and regular fogging applications to control adult mosquitoes. The service provided by the district to the annexed area was effective and very well received by the constituents in those areas.

A primary goal of the district in 2018 was to assess the area's native mosquito population for pesticide resistance to the products the GCMAD regularly uses to control mosquitoes. District personnel conducted a bottle bioassay to assess the susceptibility of two common mosquito species, *Ochlerotatus nigromaculis* (the Irrigated Pasture Mosquito), and *Culex tarsalis* (the Western Encephalitis Mosquito) against permethrin and malathion. In addition, the district conducted a field trial to assess mosquito susceptibility in a field setting and to assess potential efficacy differences for different adult mosquito control products. The results were encouraging and are summarized on page 16 of this report. Assessments such as bottle bioassays and field trials are important in ensuring that the GCMAD selects effective products that perform as expected.

As part of the district's pesticide resistance management plan, it selected and utilized, on a limited basis, an adult mosquito control product, Deltagard™, to assess product efficacy and feasibility of use. The agent assessed was of a different chemistry (water-based) compared to the primary oil-based products the district commonly uses. Efficacy and ease of use was evaluated and future recommendations for use have been noted. The district looks forward to evaluating additional products to enhance the sustainability of mosquito control in Gem County.

On behalf of the GCMAD Board of Trustees, management, and staff; I am pleased to present the 2018 Mosquito Surveillance and Control Year-End Report.

Respectfully submitted,
Jason R. Kinley, Director
Gem County Mosquito Abatement District

Training and Education

In 2018, district personnel attended:

- The Idaho Mosquito and Vector Control Association Fall Public Taxing District Ethics and Administration Training Workshop, Meridian, Idaho.
- The American Mosquito Control Association (AMCA) Annual Meeting, Kansas City, Missouri.
- The Idaho Pest Expo, Boise, Idaho.
- The NWMVCA Spring Workshop, Richland, Washington.

Memberships, Affiliations, and Leadership Roles

- AMCA, regular member, Jason Kinley serves as President-elect for the AMCA Board of Directors.
- NWMVCA, sustaining member.
- IMVCA, sustaining member, Jason Kinley, board member-at-large for the IMVCA Board of Directors.

Public Education

The GCMAD understands that public education is a critical component of a modern mosquito control program. The following are examples of the district's public education efforts in 2018:

- The substantial use of the district's website: www.gcmad.org.
- Gem County Local Emergency Planning Committee participation.
- News releases from the district in the Emmett Messenger Index discussing pertinent and timely mosquito control information.
- Coordination with other mosquito control programs to ensure a coordinated message is relayed to media.
- Participated in the Youth Appreciation Day at the Gem Island Sports Complex, disseminated information to parents, activity booklets and story books to children.

Integrated Mosquito Management Policy

The GCMAD supports management of mosquito populations when and where necessary by means of an integrated program designed to benefit or to have minimal adverse effects on people, domestic animals, wildlife, and the environment. This Integrated Mosquito Management Policy recognizes that mosquito populations cannot always be eliminated, but must be suppressed to tolerable levels for the well-being of humans, domestic animals, and wildlife, and that selection of scientifically sound suppression methods must be based upon consideration of what is ecologically and economically in the long-term best interests of constituents of the GCMAD.

The following principles are to be followed:

- Mosquito control measures should only be undertaken when there is adequate justification based on surveillance data.
- The combination of methods for mosquito control should be chosen after careful consideration of the efficacy, health effects, ecological effects, and the cost versus benefits of the various options; including public education, legal action, natural and biological control, elimination of development sources, and pesticide applications.

- Mosquito development sources, whether natural or created by human activity, should be altered in such a manner as to cause the least undesirable impact on the environment.
- Pesticide application methods should be used in the most efficient and least hazardous manner in accordance with all applicable laws, regulations, and available scientific data. The registered label requirements for the pesticide used will be followed. When choices are available among different effective pesticides, those offering the least hazard to non-target organisms should be used. Pesticides will be chosen and used in a manner that will minimize the development of resistance in mosquito populations.
- Personnel involved in mosquito control programs should be properly trained and supervised, certified in accordance with relevant laws and regulations, and kept current with improvements in management techniques through continuing education and/or training programs.
- All necessary personal protective equipment should be provided to technicians making pesticide applications and proper handling, mixing, loading, and application training should be provided by supervisory staff, in accordance to all relevant pesticide label language.

Mosquito Surveillance and Control Objectives

The GCMAD is an independent taxing district, formed, organized, and governed by Idaho Code and is mandated by law to protect public health by controlling mosquitoes and the transmission of mosquito-borne disease. Mosquito control in Gem County can start as early as April 1st. In 2018, the GCMAD started regular larval mosquito inspections and treatments by May 1st. Fogging for adult mosquitoes began in June 2018, and continued until the end of September. Mosquito control applications and operations were determined by mosquito surveillance conducted throughout the district. Only when control thresholds were reached or surpassed were applications made. Thresholds were determined with New Jersey light traps at 12 different permanently established sites and through the use of CO_2-baited CDC light traps deployed at variable sites throughout the district. This allowed for real-time response to mosquito infestations. This report summarizes the results of surveillance conducted to monitor adult mosquito population dynamics, virus activity in adult mosquitoes, and the control products used in 2018.

The 2018 mosquito surveillance initiative began in the first week of May and continued through the third week of September. The initiative involved trapping adult mosquitoes with New Jersey light traps at 12 different permanently established sites within the district to determine population dynamics of both vector species and nuisance species of mosquitoes. Additionally, carbon dioxide (CO_2)-baited CDC light traps were deployed on a weekly basis at different sites to monitor mosquito populations for the presence of West Nile virus (WNv).

Weather impacts mosquito production substantially and early consistent treatment of mosquito production sites is critical to the seasonal success of a control program. Wet weather in early spring followed by an unseasonable warm up can substantially increase mosquito production early in the season. In 2018, the early spring was relatively uneventful with typical rain amounts and temperatures. In addition, there were not long periods of time where temperatures were greater than 100°F in the summer (July and August), and this helped keep mosquito numbers manageable.

Commonly Found Mosquito Species in Gem County:

Anopheles

Anopheles freeborni, the Western Malaria Mosquito, overwinter in sheltered locations and emerge in early spring. The species is one of the first biters of the season, attacking when the air is still cold. They bite freely from dusk to dawn. Females lay eggs in permanent water sources associated with poor irrigation practices.

Aedes

Aedes vexans, the Inland Floodwater Mosquito, overwinter in the egg stage and there are generally one or more broods per season. Irrigation practices with poor drainage suits this species well. The females feed in shady places during the day and can be particularly annoying at dusk and after dark. They are troublesome biters and have a flight range of 1 to 5 miles.

Culiseta

Culiseta inornata, the Winter Marsh Mosquito, prefer to feed on larger mammals, and at times, are very troublesome to livestock. Active biting by this mosquito can occur during the fall. Dusk is the most common time for biting activity. They are active flyers and can disperse 5 to 10 miles from their emergence sites.

Culex

Culex pipiens, the Northern House Mosquito, is named so because of its close association with human habitation. The species is considered a domesticated mosquito species because of this close association. It is a multi-brood mosquito and eggs are laid in rafts in temporary and permanent sites, such as catch basins, retention ponds, road side ditches, and any open container where water may hold for ten days or longer. Birds are the preferred hosts for this mosquito. *Culex pipiens* is a vector of Western Equine Encephalitis (WEE), SLE, and WNv.

Culex tarsalis, the Western Encephalitis Mosquito, overwinter in protected places such as cellars, outbuildings, culverts, animal burrows and other sheltered locations. Upon emerging, the female seeks a blood meal to mature her eggs. Preferred breeding sites include temporary to permanent water sites such as marshes, waste irrigation water, ditches, retention ponds, catch basins, and open containers. Females are persistent biters and prefer birds in the spring, then later turn to mammals and humans as a source for a blood meal. *Culex tarsalis* is a vector of WEE, SLE, and WNv.

Ochlerotatus

Ochlerotatus nigromaculis, the Irrigated Pasture Mosquito, is a common pest mosquito of the agricultural communities and surrounding areas of southern Idaho. It is a ferocious biter, inflicting a painful bite. It is a strong flyer and may migrate several miles from its development site. The primary habitat of this species has been largely created by agriculture, irrigated pastures are the most common development sites. The winter is passed in the egg stage with hatching occurring within hours of flooding. This mosquito species is capable of transmitting WEE, SLE, and California encephalitis virus.

Mosquito Population Dynamics

The ongoing mosquito surveillance project allows the GCMAD to assess the current mosquito populations on a week to week basis throughout the mosquito season. Each weekly trapping result determines whether or not necessary mosquito control procedures are warranted and should be implemented.

Procedures

Insects were collected daily from New Jersey light traps for sorting and identification of mosquitoes. The number of vector mosquitoes (*Culex pipiens* complex and *Culex tarsalis*) and the number of nuisance mosquitoes (*Aedes* and *Ochlerotatus* species) were determined for each week and reported. Included in weekly reports were updated line graphs to show population trends throughout the season (Figure 1). Also, three year histories were collaborated and compared to determine where lack of control was occurring (Figure 2).

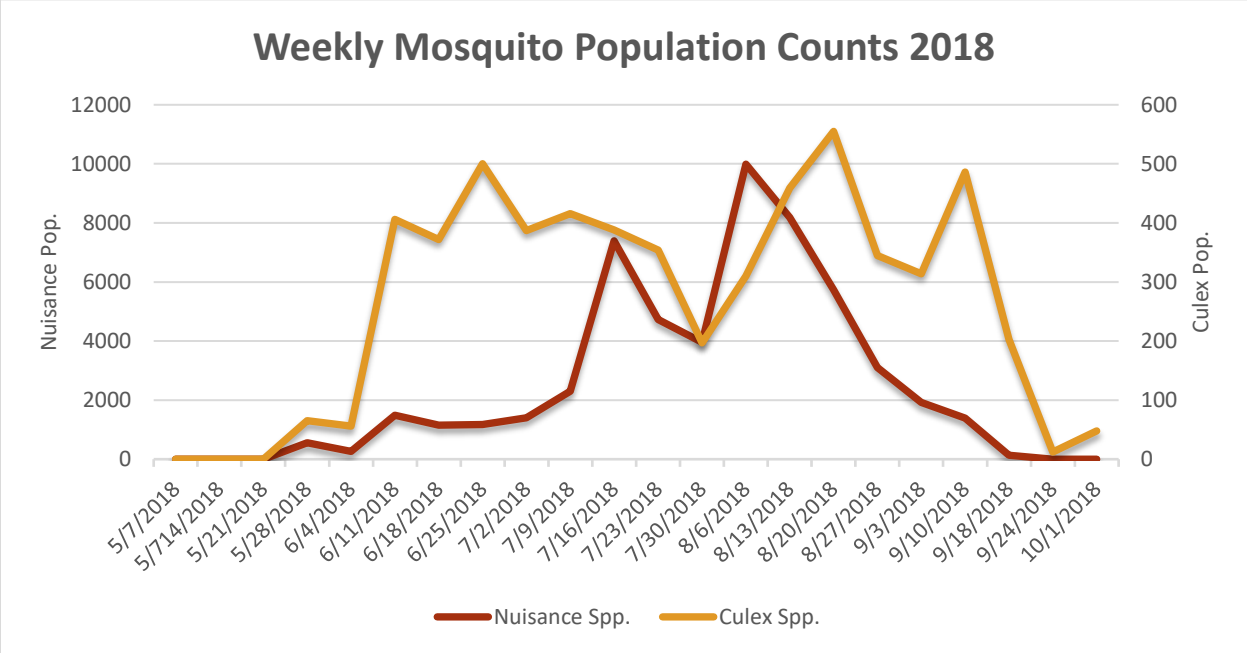


Figure 1. *Aedes* and *Culex* mosquito population levels during the 2018 mosquito season in the GCMAD. Fluctuations of nuisance and vector mosquitoes were seen throughout the season with largest populations occurring in early August for nuisance mosquitoes and mid-June and mid-August for vector mosquitoes.

Results

In 2018, 60,774 adult mosquitoes were collected and identified from New Jersey light traps. *Aedes* (nuisance mosquitoes) populations were highest in early end of June. In late-June and late-August, *Culex* (vector species) population numbers were highest, with the most *Culex* mosquitoes collected on Sunset. The total number of mosquitoes collected in 2018 and the number of mosquitoes (nuisance and *Culex*) is reported in Table 1. The total number of mosquitoes collected on Mill Rd (10,199) was highest in the District. The mosquito population on Ranch Rd showed the greatest reduction (2,336) in 2018 (Figure 2). The Fuller Road trap collected the fewest mosquitoes (411). In 2018, 4 traps showed a decrease in populations, 8 traps showed an increase in populations when compared to populations collected in 2017.

Table 1. Total numbers of mosquitoes collected by New Jersey light trap per trap site in 2018.

2018 New Jersey Trap Totals

Site	# Nuisance	# Culex	Total
4th Street	232	772	1,004
Locust	141	463	604
Fuller	188	223	411
Sunset	696	980	1,676
Foxfire	3,769	432	4,201
Mill	10,199	190	10,389
Ranch Rd	3,512	274	3,786
TomsCabin	5,697	438	6,135
Bishop	5,443	574	6,017
GCMAD	9,309	592	9,901
Hwy 52	6,613	506	7,126
Letha	9,078	446	9,524
Season Totals			60,774

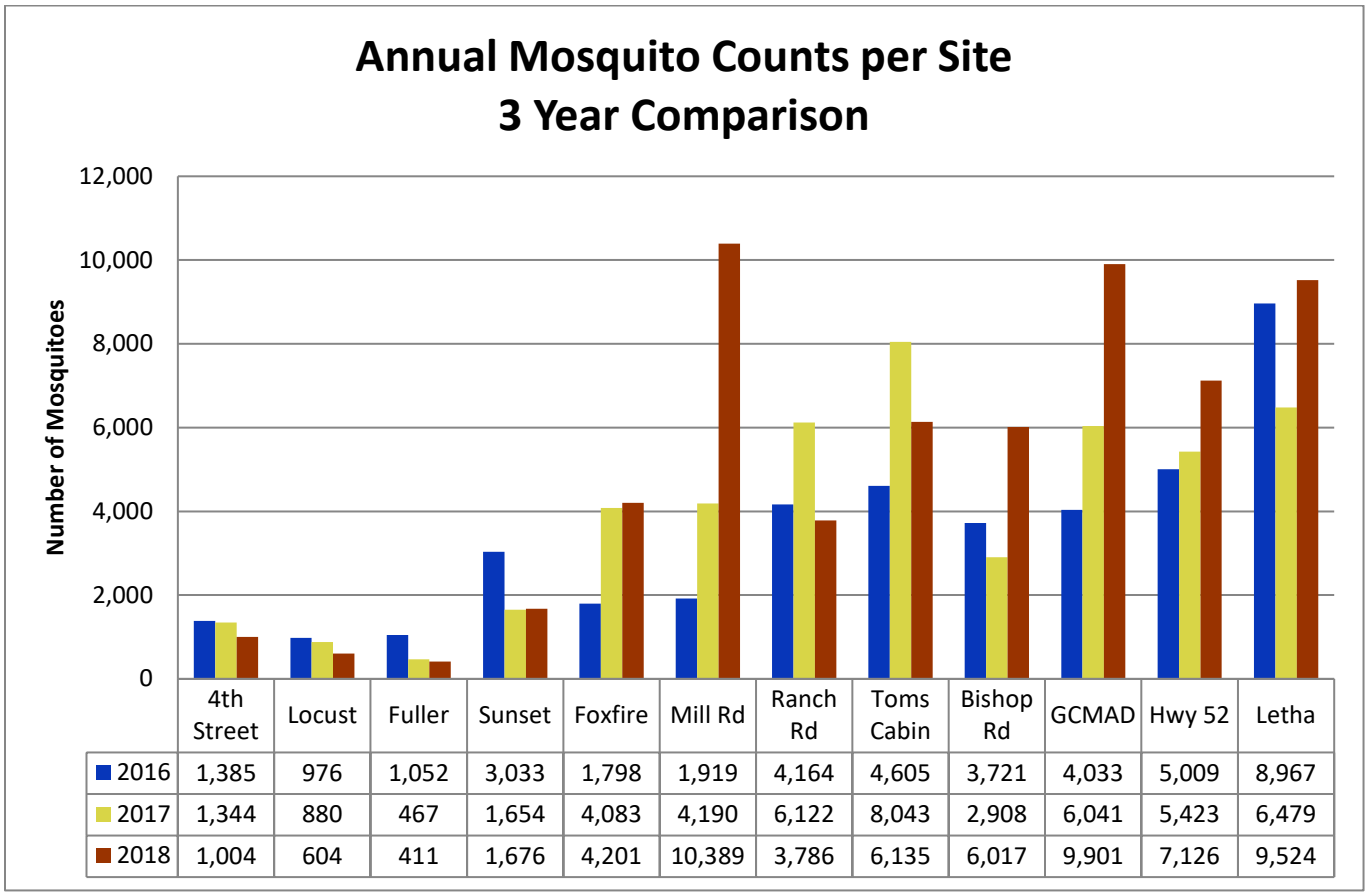


Figure 2. Three-year annual mosquito totals collected using New Jersey light traps in the GCMAD.

It is important to note in Figure 2 that the trap location on Mill Rd was changed this season from previous seasons to better locate the trap proximal to where the predominant mosquito problems arises from for that general area. Therefore, the increase at the Mill Rd trap is a result of trap relocation and not due to lack of control performance. Also, the overall increase of mosquitoes at all locations in the western portion of the district as compared to previous seasons was a result of staffing challenges and the loss of veteran seasonal employees trained in the area.

Virus Monitoring in Mosquitoes

Disease prevalence and risk can be determined by monitoring mosquitoes for the presence or absence of viruses in the mosquito population. Virus monitoring allows for the identification of dominant mosquito species, minimum field infection rate determination, and indicates areas with virus activity/transmission occur. By monitoring vector species and virus activity, an important assessment of virus activity at each location can be determined throughout the mosquito season and appropriate response protocols can be employed.

Procedures

Generally, mosquitoes were collected in different areas throughout the district with CO_2-baited CDC light traps from June 1 until the last week in September. Traps operate on four D-cell flashlight batteries and can be set up in any area of the district. After collection, mosquitoes were taken back to the GCMAD facility, sorted, identified, and pooled according to species, date, and location. *Culex* species were then tested at the GCMAD facility using the Rapid Analyte Measurement Platform (RAMP) System for the presence of WNv. Other species (*Aedes*) were identified, counted, and discarded, unless the specimens were identified as exotic species (*Aedes aegypti* or *Aedes albopictus*).

Results

A total of 4,123 vector species mosquitoes were processed from CO_2-baited CDC light traps in 2018. The GCMAD tested all vector species pools for presence of WNv using the RAMP System or through the use of the Idaho Bureau of Laboratories using reverse-transcriptase polymerase chain reaction analysis. The minimum number of mosquitoes tested per sample was 1 and the maximum was 50. Of the 279 samples tested by GCMAD in 2018, 9 pools (3.2% of all samples) tested positive for WNv. *Table* 2 indicates the number of pools of each species tested by GCMAD and the number of positive pools determined by testing. Figure 3 is a line graph that shows the number of mosquitoes collected at different trapping events during the 2018 mosquito season as compared to previous seasons.

Table 2. Assay results of mosquito species tested by GCMAD in 2018.

Mosquitoes Tested by GCMAD in 2018				
Species	**# of Samples**	**# Mosquitoes**	**# Positive WNV Pools**	**# Positive SLEV Pools**
Cx. pipiens	**87**	**498**	**2**	**0**
Cx. tarsalis	**192**	**3,625**	**7**	**0**
Season Totals	**279**	**4,123**	**9**	**0**

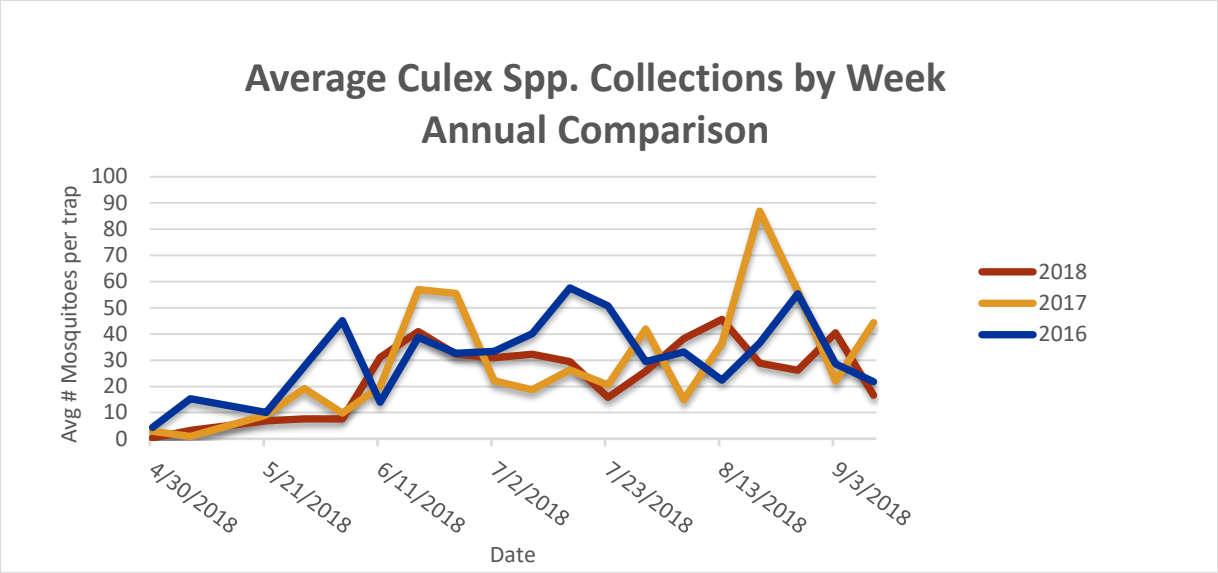


Figure 3. District-wide three-year weekly average *Culex* collections.

2018 Citizen Service Requests and Complaints

The district used input from citizens, either by telephone or website, to correlate the mosquito population information generated from the population trap surveillance.

Procedures

Telephone and website service requests were recorded manually into a computer database. The information taken by the GCMAD receptionist included name, address, contact information and reason for request. The requests were separated into three different categories: standing water/larval mosquito control applications, barrier applications, or fogging applications.

Results

The GCMAD satisfied 200 service requests in 2018. Of those requests, there were 110 requests for barrier sprays (55%), 56 fogging requests (28%), and 34 larvicide service requests (17%) in 2018 (Figure 4).

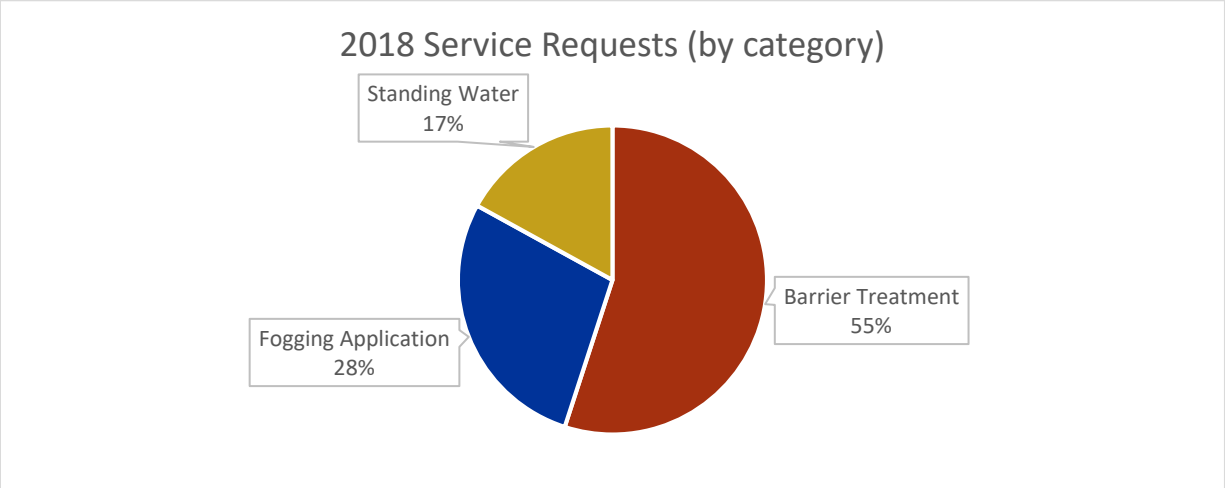


Figure 4. District-wide service requests received in 2018.

Surveillance Summary

A total of 64,897 mosquitoes, (60,774) in New Jersey light traps and (4,123) in CO_2-baited CDC light traps were collected, identified, and processed by the GCMAD in 2018. When compared to the 2017 mosquito season, there was a increase of 5,687 mosquitoes collected in 2018. Nine mosquito samples tested positive for WNv. In 2018, there was a decrease of 10 WNv positive mosquito samples collected as compared to 2017. As of Decmeber 1, 2018, there was one confirmed human case of WNv (fever) reported in Gem County. No horses tested positive for WNv in Gem County in 2018. A total of 200 hundred service requests were satisfied in 2018.

Future Considerations

A sustainable integrated mosquito management (IMM) program must consider revising methods for surveying mosquitoes. In 2018, some surveillance was modified to better streamline data collection. One way the district accomplished this was by dividing the district into two workable trapping areas and by deploying CO_2-baited CDC light traps (arbovirus traps) to one of the trapping zones one night and then deploying arbovirus traps to the other trapping zone the subsequent night. This allowed for the collection of information at a manageable level so that analysis could be completed in a timely manner. The use of arbovirus traps still indicated where high mosquito populations existed and was used to determine if those mosquitoes were infected with WNv.

In 2019, the district will investigate utilizing different trap styles to better sample for invasive *Aedes* species of mosquitoes. *Aedes aegypti* and *Aedes albopictus* are the primary vectors of Zika virus and have not established local populations in Idaho yet. Areas along the western seaboard of the United States are experiencing expanding ranges of invasive *Aedes* mosquitoes, and it is important to survey for these types of mosquitoes so that appropriate responses to any isolated populations of invasive *Aedes* can be swiftly addressed before the mosquitoes can establish a local population.

Mosquito Control Report

The goal of the GCMAD is to use a fully integrated approach to control mosquitoes and the spread of mosquito-borne disease. The district also strives to maintain a level of control that responsibly abates mosquitoes while limiting the effects of applications to the environment. Since environmental safety and preservation is a critical part of any responsible IMM program, the GCMAD tracks and records how much larval mosquito and adult mosquito control products were used in the mosquito season.

Source Reduction Projects

The elimination or reduction of standing water by means of physical alteration of land is an effective and sustainable method of mosquito control and the district has identified physical control of mosquitoes as an appropriate method of mosquito control in Gem County. Through the Source Reduction Program, the GCMAD intended to reduce and eliminate slack or standing water on private property that supports mosquito development. This program is designed to assist landowners financially in cleaning up mosquito development sources. The GCMAD did not participate in any projects in 2018 due to lack of property owner participation.

Larval Mosquito Control Operations – 2018

In Gem County, an aggressive larviciding program is an important key to a successful IMM program. The GCMAD larviciding program is designed to control mosquitoes in the water before they can emerge as adults. Larviciding is one of the most effective ways to control mosquitoes because focus is on a certain source. The GCMAD is divided into 4 operational sections. Trained and licensed larval mosquito control (larviciding) technicians work in groups of two, equipped with ATV's, larval mosquito control products, backpack dusters, backpack sprayers, hand spreaders, global positioning system (GPS) handheld units for application data entry, and other equipment necessary to complete larval mosquito control objectives.

Larval treatments began in April to permanent sites, such as storm water retention ponds, catch basins, and some marshes. In the district, there are hundreds of development sites that are inspected throughout the summer. The GCMAD relies heavily on *Bacillus thuringiensis israelensis* (Bti) to control mosquitoes. The bacterium is applied to standing water in a granule or liquid formulation. The district applied 62,397 pounds of Bti granule, 65 gallons of Bti liquid, 106 pounds of *Bacillus sphaericus* (Bs) granule, 160 pounds of Bti/methoprene granule, 2,850 pounds of methoprene granule, to standing water in 2018. Additionally, the GCMAD used applied 2,387 methoprene (insect growth regulator) pouches to control mosquito larvae in stock tanks, horse troughs, and other similar sites. The district applied 29 gallons of larviciding oil to standing water in 2018. Crews made a total of 24,813 inspections, with district staff treating 6,090 of the inspections, resulting in 8,840 acres of mosquito production habitat treated in 2018 (Figure 6). Table 3 shows larval mosquito control products and amounts used in 2018.

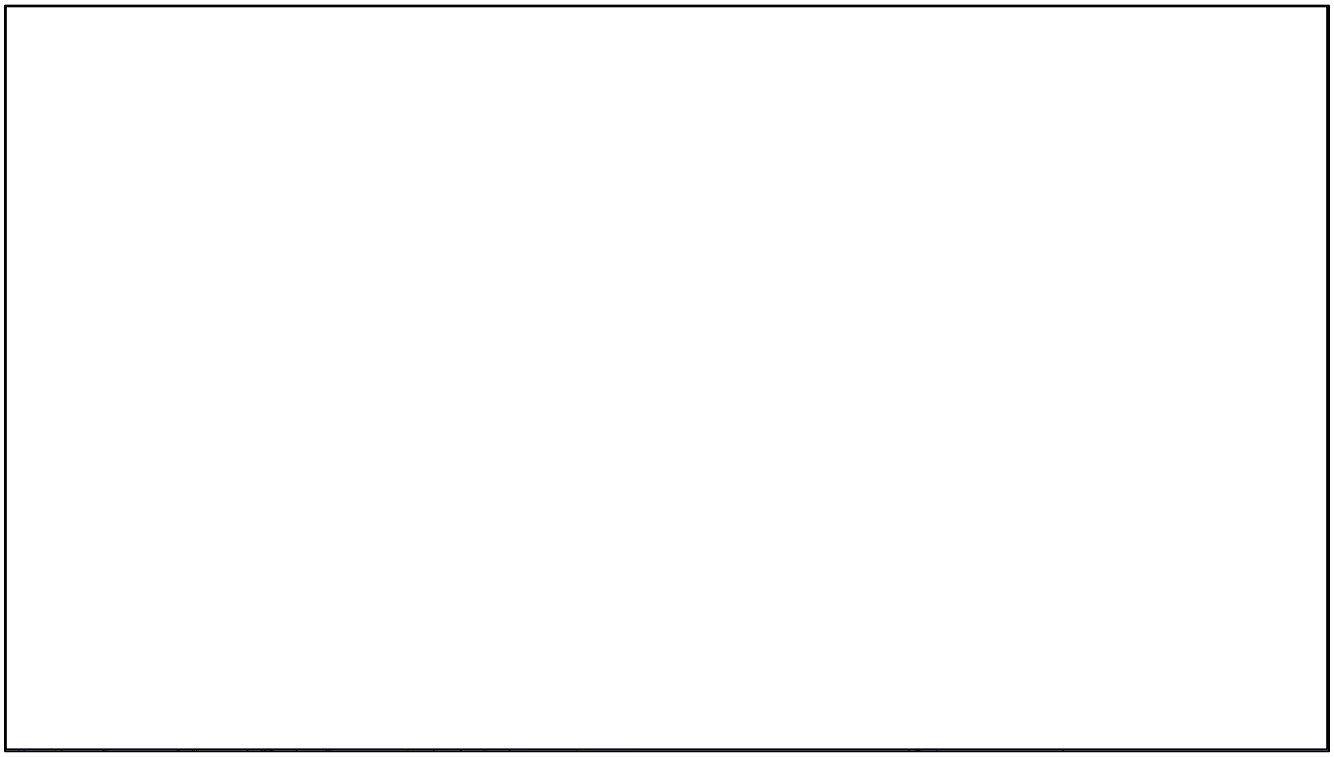


Figure 6. Sites shaded represent sites identified as larval mosquito development sites.

Table 3: Larviciding products and amounts used in 2018.

Larvicide Usage in 2016, 2017, 2018

	Amount Used		
Product	2016	2017	2018
Bti granule	53,486 lbs	43,698 lbs	62,397 lbs
Bti liquide	76 gal	20.5 gal	65 gal
Bs granule	136 lbs	254.5 lbs	106 lbs
Bti/methoprene granule	0 lbs	1,164 lbs	160 lbs
Methoprene:			
30d WSP	1,647 pouches	1,995 pouches	2,387 pouches
granule	1,600 lbs	3,082 lbs	2,850 lbs
Larviciding Oil	26 gal	92 gal	29 gal

Adult Mosquito Control Operations – 2018

The mosquito population naturally increases as the season progresses. When these numbers reach a certain threshold, the district begins an adult mosquito control program, referred to as 'adulticiding or "fogging." Adult mosquito populations can be reduced with adulticide applications. The best time to make applications for adult mosquitoes is at dawn or dusk, when mosquitoes are most active and looking for a blood meal. When fogging for adult mosquitoes, only appropriate products that are effective are used. In addition, all fogging applications were recorded by a GPS field computer mounted in the cab of the fogging vehicles. The GPS unit recorded data such as time, temperature, location, wind direction and speed, data regarding the applicator, the product amount applied, and when and where the control product was applied. This information was then uploaded to the district's geographic information system (GIS) and reports about fogging application could be quickly queried and referenced. The GCMAD used daily recorded telephone messages available by calling the district office to notify residents when adulticiding operations would begin and what areas were targeted for a specific evening. The GCMAD website was also updated every day with the areas targeted for adult mosquito control applications.

The GCMAD primarily relied on permethrin-based adulticide agents. Permethrin is a synthetic pyrethroid, a synthetically derived compound similar in composition to natural pyrethrins that are isolated from chrysanthemum flowers. In 2018, the GCMAD used 195 gallons of permethrin-based agents (Figure 7). In addition, the district used 75 gallons of a water-diluted deltamethrin-based adult mosquito control product to determine if efficacy and control is improved with a different product and diluent. District personnel applied the adulticide products using truck-mounted ULV foggers. Figure 7 shows a three-year comparison of the quantities of adult mosquito control products used in the GCMAD.

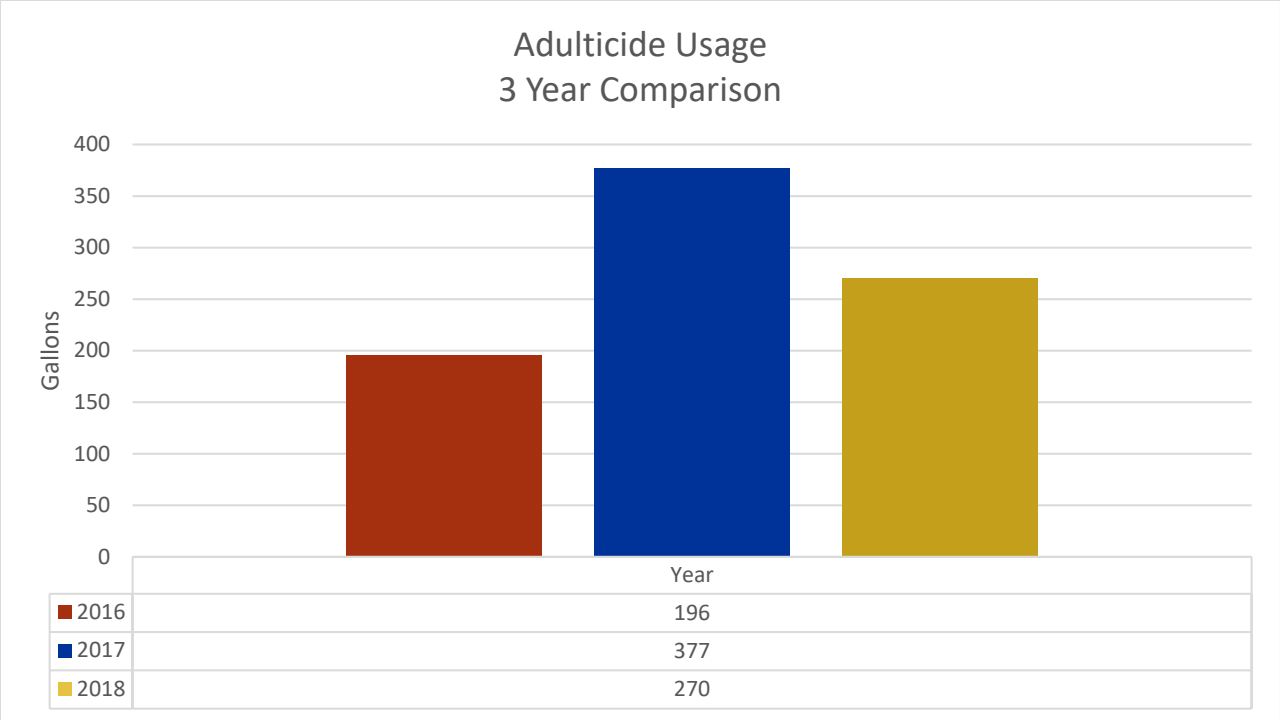


Figure 7. 3-year comparison of adult mosquito control products used in the GCMAD.

The GCMAD started using barrier treatments in the district in 2008 to control adult mosquitoes in populated areas, such as the Gem Island Sports Complex, the Emmett City Park, and residential properties. In 2017, the district treated 179 sites compared to 138 sites in 2016. Figure 8 shows a three-year comparison of barrier treatments used in the district.

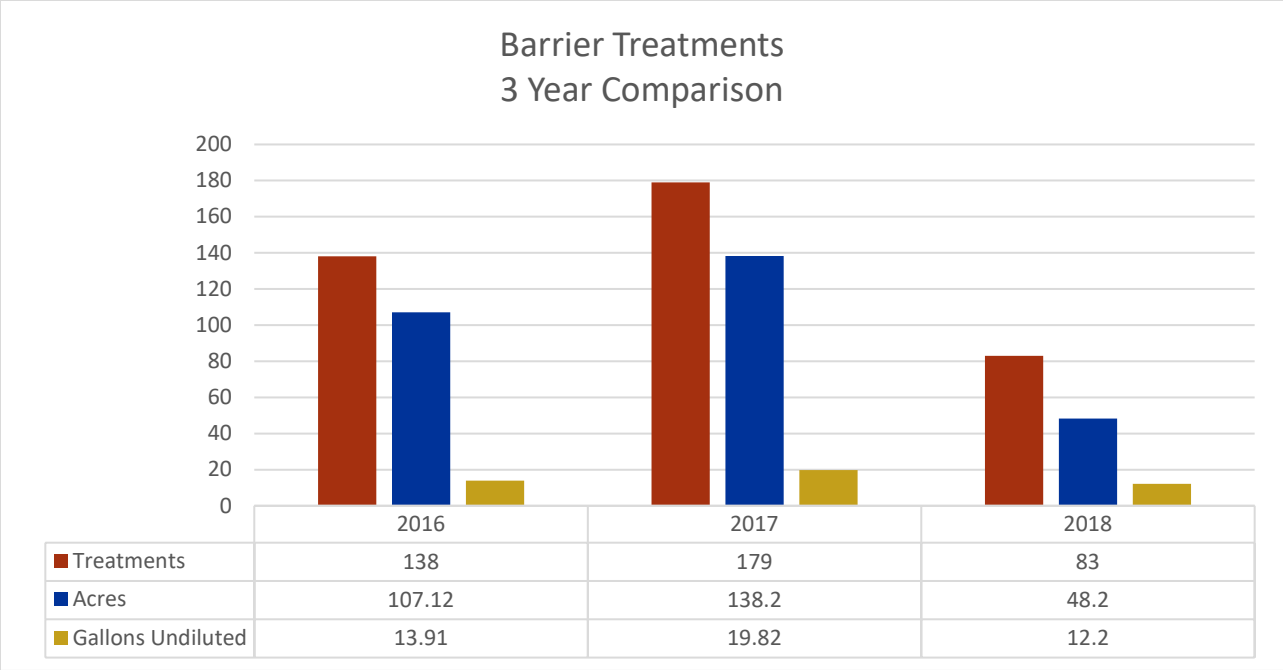


Figure 8. 3 year comparison of barrier treatments by GCMAD.

Cost Comparisons

The GCMAD spent $181,055.15 on mosquito control products in 2018. In 2018, the GCMAD spent $156,335 on larval control products and $24,720 on adulticide products. Figure 9 shows the amount of money spent on larvicide and adulticide products and the percentage of product budget spent on the respective product category. Figure 10 shows a 3 year comparison of product costs for the district.

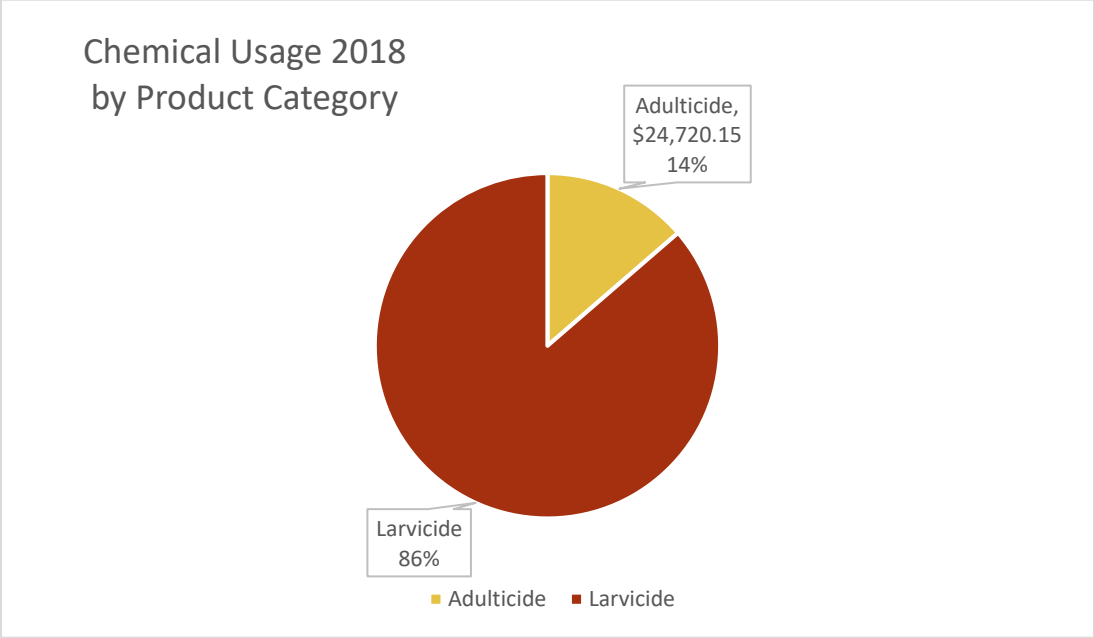
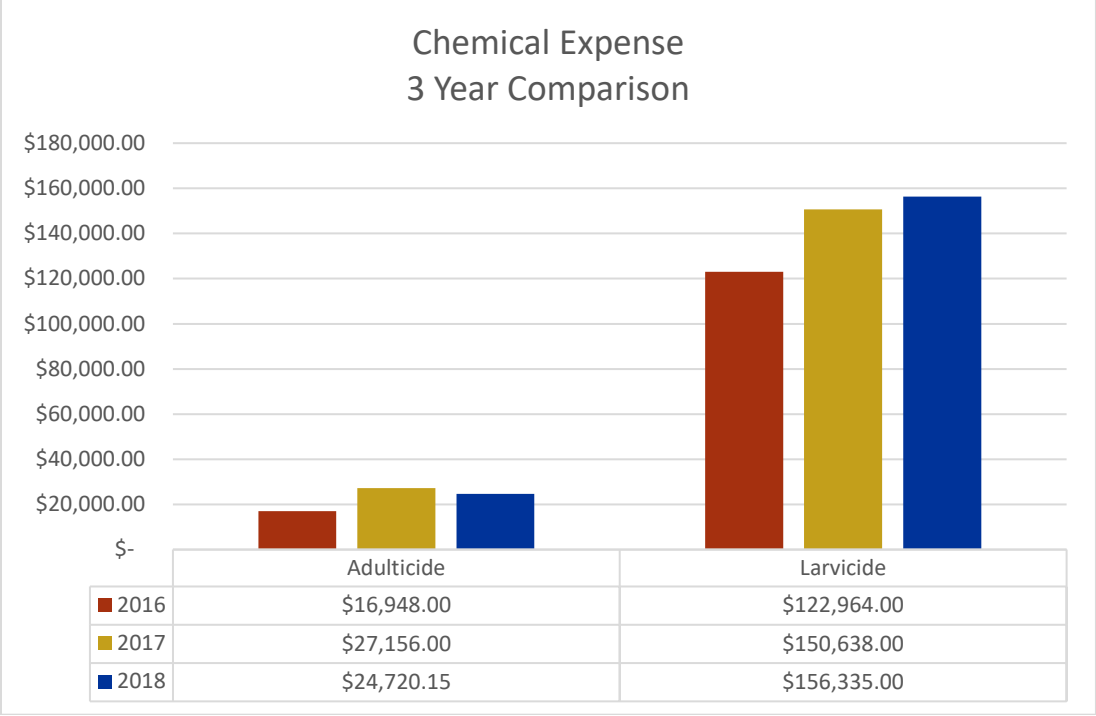


Figure 9. The amount of money spent on larvicide and adulticide products and the proportion of product budget spent on each category.



	Adulticide	Larvicide
2016	$16,948.00	$122,964.00
2017	$27,156.00	$150,638.00
2018	$24,720.15	$156,335.00

Figure 10. Three year comparison of product costs for the GCMAD.

Other Control Initiatives

Contractual Services:

Shadow Butte Elementary School, located outside of the current district boundaries, was provided service at the beginning of the 2018 school year. This was made possible by a contract between the GCMAD and the Emmett School District. Shadow Butte Elementary was treated with a ULV fogger on a regular basis when school was back in session in late August 2018 and received barrier treatments prior to the beginning of the school year.

Pesticide Resistance Monitoring:

Bottle bioassays were conducted for two different species of mosquitoes for two commonly used insecticides, permethrin and malathion. The bottle bioassay was facilitated by Dr. Janet McAllister of the Centers for Disease Control and Prevention Division of Vector Borne Diseases (CDC-DVBD). Assays were performed after training on June 6, 2018. In addition, field trials assessing the efficacy of commonly used adult mosquito control insecticides (permethrin and deltamethrin) on native mosquitoes were conducted the week of July 16, 2018.

Procedures:

Bottle Bioassay: Standardized procedures as established by CDC-DVBD were used to conduct bottle bioassays. In general, mosquitoes were collected in the larval stage and reared to adults in emergence containers. Once emerged, adult mosquitoes were fed a 10% sugar solution to decrease potential expiration due to dehydration or lack of food. Mosquitoes were exposed to active ingredients as described in the CDC-DVBD bottle bioassay protocols and results were assessed.

Field Trial: In general, adult mosquitoes were collected using mechanical aspirators in field sites were adult mosquito populations were high. The mosquitoes were taken in cages of 10-20 specimens per cage back to the GCMAD facility where they were provided access to a 10% sugar solution to ensure survivability. Stands were placed in an open field at 100 feet, 300 feet, and 500 feet from the road in which the insecticide application vehicle will travel and apply from. After application, the cages were inspected, the number of dead mosquitoes counted and tallied, and cages were removed from stands, provided 10% sugar solution, and taken back to the GCMAD facility. Additional inspections for mortality were conducted at 1 hour after the application and 24 hours after the application.

Results:

Bottle Bioassay: For permethrin, all mosquito specimens of species *Ochlerotatus nigromaculis* and *Culex tarsalis* showed susceptibility and 100% mortality within 30 minutes of exposure. For malathion, only *Cx. tarsalis* was assessed and only a 50% mortality rate after 90 minutes was expressed. This is concerning since the GCMAD has not used a malathion-based insecticide for over 10 years. Further assessment is needed to quantify the breadth and scope of resistance to malathion.

Field Trial: For permethrin, mosquitoes exposed to the product, Perm X 30-30 diluted 1 part concentrate to 4 parts of diluent oil, showed greater than 95% mortality at all distances from the application line. Mortality rates were easily

established since most cages and specimens showed mortality within 1 hour of exposure. Unfortunately, the weather conditions would not allow for assessment of deltmethrin and field efficacy could not be evaluated.

Conclusions:
The GCMAD has a vested interest in ensuring that the products it selects to control mosquitoes are efficacious and its use of such products is judicious and sustainable. In 2018, it used two different methods to analyze pesticide resistance potential. Thankfully, the district still sees effective and sustainable control from its primary adult mosquito control product, permethrin. The district will continue to expand its use of bottle bioassays and field trials to better determine breadth and scope of pesticide resistance in native mosquito populations. The GCMAD would like to thank Kevin Nesbit for his assistance and willingness to allow district personnel to utilize his property for the field trial.

Closing Remarks

This report summarizes data from the 2018 mosquito control season. The district spent substantially more on larval mosquito control products as compared to adult mosquito control products in 2018. District operations focused on controlling mosquitoes during the larval stage of development, knowing that larval control is much more efficient and sustainable than adult mosquito control. According to usage data, the district used more larvicide product in the GCMAD during the 2018 control season when compared to any other previous season. The district saw a 50% reduction in the number of WNv positive mosquito samples and a 66% reduction in the number of human cases in Gem County in 2018 as compared to 2017.

In 2019, the GCMAD will continue to leverage more residual mosquito control product for long term control of mosquitoes in known, persistent areas of infestation. In addition, the district will assess the feasibility of using an unmanned aerial vehicle (UAV), sometimes referred to as a drone, to make applications to standing water. The use of such technology would have many benefits for the district and would help alleviate the impact district operations have on the land (such as ruts in fields, lodging of grass or hay, or the dispersal of weed seeds).

In 2019, the district will be making substantial improvements to its infrastructure and facilities. The GCMAD intends to construct an administration building that will house a better-equipped laboratory, a conference and training room with audio/visual technology for enhanced training and a district-provided location for trustee public meetings. The administration building will provide necessary Americans with Disabilities Act (ADA) compliant fixtures, doorways, and accessability. The new administration building will also improve the reception area for when citizens come to the district office and will provide needed office space for the director, deputy director, office assistant, surveillance coordinator.

The district wants to continue working closely with local governments, service and civic groups, and constituents to raise awareness and help reduce mosquito development habitat in the GCMAD. The GCMAD is confident that these goals are achievable. The district had a productive season due to the diligent work of many people. This success would not be possible without the commitment, support, and efforts of all the citizens of the GCMAD, the GCMAD staff, and the GCMAD Board of Trustees.

Schedule of Detail Actual and Budgeted Cash Disbursements
General Fund
For the Year ended September 30, 2018

	Actual	Original & Final Budget	Variance from Final Budget
Personnel Services:			
Salaries and Benefits	304,397	331,248	26,851
Materials & Services:			
Liability Insurance	7,477	7,477	0
Office/Utilities	29,106	25,000	(4,106)
Chemicals	181,055	175,000	(6,055)
Drainage	0	2,500	2500
Fuel/Parts/Repair/Facility	51,218	40,000	(11,218)
Professional Services/Auditing	29,614	33,000	3,387
Miscellaneous/Travel/Training	7,120	7,500	380
Contingency	25,000	25,000	25,000
Total Materials & Services	**305,589**	**315,477**	**9,888**
Capital Outlay:			
Total Capital Outlay	**33,956**	**25,000**	**(8,956)**
Totals	**668,943**	**671,725**	**27,783**

Declaration

I, the under signed, have read and approve the attached Gem County Mosquito Abatement District's "2018 Year-End Report" for the 2018 mosquito control season.

Gem County Mosquito Abatement District Board Members:

Gem County Commissioners:

_____
Michele Chadwick, Co-Chairperson

_____
Bill Butticci

_____
Tom Carlsen, Co-Chairperson

_____
Mark Rekow

_____
Bonnie Diedrich

_____
Bryan Elliott

_____
Anita Taylor

Appendix 1. Fiscal Year 2018 Accounting Review and Audit Report

Appendix 2. Environmental Protection Agency National Pollutant Discharge Elimination System Permit 2018 Annual Report.