2022 Annual Report



Delta Mosquito & Vector Control District

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ABOUT THE DISTRICT

The Delta Mosquito and Vector Control District (DMVCD) was established in 1922 to protect residents from malaria, a mosquito-borne disease that was common to the Central Valley then. The Visalia Women's Club played a key role in the formation of the District. Today, the District is responsible for control of mosquito vectors of West Nile virus (WNV), St. Louis encephalitis virus (SLEV), Western equine encephalitis virus (WEEV) Chikungunya, Yellow fever, and Zika viruses. The District covers 712 square miles including the cities of Dinuba, Exeter, Farmersville, Visalia, and Woodlake, and the communities of Cutler, Orosi, Goshen, Ivanhoe, and Traver, all within Northern Tulare County.

Our Vision

The DMVCD is the authority for vector control and vector-borne disease prevention in Northern Tulare County.

Our Mission

The DMVCD is committed to protecting the public's health from vector-borne diseases and discomfort by delivering exceptional services which preserve and enhance the quality of life and desirability of the area to make northern Tulare County a safe place to live, work, and raise a family.

Our Goals

- **1.** Provide continual surveillance of mosquitoes to determine the threat of mosquitoborne disease transmission and annoyance levels.
- 2. Use safe, integrated vector management (IVM) methods to keep mosquito populations suppressed.
- **3.** Promote cooperation and communication with property owners, residents, social and political groups, and governmental agencies.

The Board of Trustees

As an independent special district, DMVCD serves its residents under the guidance of the Board of Trustees. The seven-member Board of Trustees consists of one resident from each of the incorporated cities in northern Tulare County and two representatives for the county-at-large.

Trustees are appointed by their respective City Council or the County Board of Supervisors to govern the District knowledgeably and effectively. Board members serve two or four-year terms according to the rules of their appointing body.

The regular Board meetings are held on the second Wednesday of each month at 1737 W. Houston Avenue in Visalia at 4:30 PM. The meetings are open to the public.

Board Member

Greg Gomez Belen Gomez Kevin Caskey Linda Guttierrez Larry Roberts Rosemary Hellwig Vacant

Position

President Secretary Trustee Trustee Trustee Trustee Trustee

Representing

Farmersville Woodlake County-at-large County-at-large Dinuba Exeter Visalia

District Personnel

Administration

Dr. Mustapha Debboun, *General Manager* Mary Ellen Gomez, *Administrative Assistant* Rebecca Harlien, *Administrative Analyst I*

Public Relations

Erick Arriaga, Community Education and Outreach Coordinator

Laboratory

Crystal Grippin, *Scientific Program Manager* Javier Valdivias, *Biologist* Mark Nakata, *Biologist* Andrea Troupin, *Biologist* Juan Pablo Ortega, *Laboratory Technician II*

Operations

Hector Cardenas, Operations Program Manager Paul Harlien, Foreman Rick Alvarez, Vector Control Field Supervisor Bryan Ruiz, Vector Control Technician III Bryan Ferguson, Vector Control Technician III-Mechanic Mario Sanchez, Vector Control Technician III-Mechanic Adrian Sifuentes, Vector Control Technician II Paul Raper, Vector Control Technician II Carlos Rodriguez, Vector Control Technician II

Professional Associations

Delta Mosquito and Vector Control District participates in various professional organizations that promote best practices in vector and vector-borne disease control, research, and management of special districts. The District is a member of Mosquito and Vector Control Association of California (MVCAC), American Mosquito Control Association (AMCA), Society for Vector Ecology (SOVE), Entomological Society of America (ESA), National Association of County and City Health Officials (NACCHO),

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California Special District Association (CSDA), and the Tulare County Health Emergency Coalition (TCHEC).

Publications, Presentations, and Posters

Advances in Arthropod Repellents. 2022. Elsevier & Academic Press, San Diego, CA. 339pp. Coats, J., C. Corona, and **M. Debboun**.

Delta Mosquito and Vector Control District's wireless smart mosquitofish feeder system. 2022. *AMCA and MVCAC Annual Conference.* **Mark Nakata**, Crystal Grippin, Mir Bear-Johnson, Mustapha Debboun.

Kissing Bugs Among Us. 2022. *AMCA Annual Conference.* **Mir Bear-Johnson & Andrea Troupin**, Crystal Grippin, Javier Valdivias, Mark Nakata, Erick Arriaga, Mustapha Debboun.

Utilizing Archived Data for District Operational Decisions. 2022. *MVCAC Annual Conference*. **Hector Cardenas**, Crystal Grippin, Erick Arriaga, Rick Alvarez, Mark Nakata, Mir Bear-Johnson, Mustapha Debboun.

Pyrethrum resistance in *Culex quinquefasciatus* in Northern Tulare County, California. 2022. *AMCA and MVCAC Annual Conference*.

Javier Valdivias, Andrea Troupin, Mark Nakata, Crystal Grippin, Mir Bear-Johnson, Mustapha Debboun.

Developing a Triatomine Bug Surveillance Program in Tulare County, California. 2022. *SOVE.* **Crystal Grippin**, Andrea Troupin, Mark Nakata, Mir Bear-Johnson, Mustapha Debboun.

The WALS to the cemetery: Examining efficacy under field conditions. 2022. AMCA Annual Conference.

Crystal Grippin, Javier Valdivias, Paul Harlien, Bryan Ruiz, Andrea Troupin, Mir Bear-Johnson, Mustapha Debboun.

Dengue Virus-2 Infection Affects Fecundity and Elicits Specific Transcriptional Changes in the Ovaries of *Aedes aegypti* Mosquitoes. 2022. *Frontiers in Microbiology.* 13:8867878. F. Feitosa-Suntheimer, Z. Zhu, E. Mameli, G Dayama, AS Gold, A Broos-Caldwell, **Andrea Troupin**, et al.

Molecular analysis of knockdown resistance (kdr) mutations in the voltage-gated sodium channel of *Aedes aegypti* populations from Saudi Arabia. 2022. Parasites & Vectors, 15:375. Mashlawi, A.M., A.M. Al Nazawi, E.M. Noureldin, H. Alqahtani, J.A. Mayhoub, J. Saingamsook, **M. Debboun**, et al.

Ovicidal aroma shields for prevention of blow fly strikes caused by *Lucilia sericata* (Meigen), Diptera: Calliforidae. 2022. Vector-Borne and Zoonotic Diseases, 459-464. Khater, H.F., G.S. Selem, Z. Hocine, M.M. Baz, A. Selim, N. Ahemed, S.A. Kandeel, **M**. **Debboun**, and A.K. Abdelwahab. The contact/fumigant adulticidal effect of Egyptian oils against the house fly, *Musca domestica* (Diptera: Muscidae). 2022. International Journal of Veterinary Science, 1-7. Baz, M.M., R.I. Eltaly, **M. Debboun**, A. Selim, I.T. Radwan, N. Ahmed, and H.F. Khater.

Triatoma protracta (Uhler, 1894) (Hemiptera, Reduviidae) with *Trypanosoma cruzi* (Chagas, 1909) (Kinetoplastida, Trypanosomatidae) in the Central Valley of California, USA. 2022. Journal of Vector Ecology, 47: (1-3). **Mir Bear-Johnson** and **M. Debboun**.

SERVICE REQUESTS

The District provides services directly to residents in addition to routine surveillance and control efforts. Services include inspecting properties for mosquito-breeding sources, mosquitofish for front and backyard water features, and investigating reports of increased mosquito activity or standing water.

There were 743 service requests in 2022 (Table 1). This was a 25.1% decrease over the previous five-year average and an 18.1% decrease from 2021. This decrease was reflected in all categories of service requests, except for the Mosquito category, reporting the presence of mosquitoes, which increased by 39.0% compared to 2021 and 7.5% to the 5-year average. Part of this trend was due to increased resident understanding of the invasive *Aedes aegypti* mosquito. *Aedes aegypti* are aggressive, day-biting mosquitoes that prefer to lay their eggs in small, man-made containers, allowing them to thrive in common front and backyard environments. Although the number of mosquitofish requests dropped by 34.2% compared to 2021, it is still 23.4% higher than the previous five-year average, indicating an increase in the awareness of their use as an important control method for front and backyard water features. The number of requests for inspections and other requests was lower than both the 2021 numbers and the previous five-year average.

Category	2022	2021	5-Year Average
Mosquito	431	310	400.8
Source	229	267	236.2
Mosquitofish	77	117	62.4
Inspection	3	202	268.2
Other	3	11	25
TOTAL	743	907	992.6

Table 1. Number of service requests by category in 2022 compared to 2021 and the previous fiveyear average.

Although service requests were received every month, the majority were between June and August (Figure 1). This corresponds to the warmest summer temperatures of the year in the District. Warm weather increases mosquito abundance, leading to an increase in service requests during the hot summer months. The majority of households who requested services



had used District services before. This was closely followed by households who had heard about DMVCD through friends and family (Figure 2).

Figure 1. Number of service requests by month in 2022.





INTEGRATED VECTOR MANAGEMENT (IVM)

The DMVCD uses evidence-based IVM principles to protect residents from vectors and vector-borne diseases. The IVM combines surveillance, control, and community outreach techniques to improve the effectiveness, ecological soundness, and sustainability of vector control programs.

Surveillance

The District monitors vector abundance and arbovirus activity through a variety of adult mosquito traps and by testing mosquitoes and dead birds for WNV, SLEV, and WEEV. Human cases are also reported and investigated alongside the Tulare County Public Health Department.

Districtwide, the average number of mosquitoes was 25.0, with an average of 22.8 female mosquitoes per trap night, for the 2022 mosquito season. Female mosquitoes can transmit diseases of public health concern because they require a blood meal to lay eggs. During 9,293 collections, the District caught a total of 232,127 mosquitoes, of which 91.2% were female (Table 2). Of the 16 mosquito species represented, *Culex quinquefasciatus* contributed the most to total mosquito abundance at 77.8% followed by *Ae. aegypti* at 16.3% and *Culex tarsalis* at 3.6%.

SPECIES	FEMALES	MALES	TOTAL	Mosquitoes per Trap Night
Culex quinquefasciatus	176,050	4,499	180,549	19.4
Aedes aegypti	22,741	15,045	37,786	4.1
Culex tarsalis	7,746	673	8,419	0.9
Culex stigmatosoma	4,029	192	4,221	0.5
Anopheles freeborni	420	14	434	0.0
Culex erythrothorax	304	0	304	0.0
Anopheles franciscanus	206	2	208	0.0
Aedes melanimon	56	0	56	0.0
Culex thriambus	46	3	49	0.0
Aedes nigromaculis	38	0	38	0.0
Culiseta inornata	26	1	27	0.0
Culiseta incidens	17	0	17	0.0
Culiseta particeps	6	1	7	0.0
Aedes vexans	6	0	6	0.0
Aedes sierrensis	4	0	4	0.0
Anopheles punctipennis	2	0	2	0.0

Table 2. Adult mosquito abundance by sex and species in 2022.

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TOTAL	211,697	20,430	232,127	25.0

Vector control technicians collected 579 larval samples. Of these, 142 were collected to identify the species present and 437 to monitor control efforts. *Ae. aegypti* species were identified in 47.9% of samples followed by *Cx. stigmatosoma* at 26.0%, *Cx. quinquefasciatus* at 17.6%, and *Cx. tarsalis* at 8.5% (Table 3). None of the mosquito larvae collected to monitor control efforts showed resistance to the treatment.

Table 3. Mosquito species identified in larval samples in 2022.

SPECIES	SAMPLES	PERCENT of SAMPLES
Aedes aegypti	68	47.9
Culex stigmatosoma	37	26.0
Culex quinquefasciatus	25	17.6
Culex tarsalis	12	8.5

Every mosquito sample contains 10 to 50 female mosquitoes of a single species that were caught in the same trap. The five *Culex* species tested are *Cx. quinquefasciatus*, *Cx. tarsalis*, *Cx. stigmatosoma*, *Cx. thriambus*, and *Cx. erythrothorax*. A total of 4,753 mosquito samples composed of 167,013 individual mosquitoes were tested in 2022. While no samples were positive for WEEV, 977 tested positive for WNV (Figure 3), 6 for SLEV (Figure 4), and 3 for both WNV and SLEV.

In 2022, 13 dead birds were reported to the District directly or through the California WNV Call Center. Of these, 9 were viable for disease testing. Dead bird carcasses are considered testable only if they have died within the past 48 hours, have no obvious physical trauma that led to death, and are of an accepted species for testing. Of the 9 birds tested, 2 were positive for WNV (Figure 5).

The Tulare County Public Health Department reported 8 human arbovirus infections to the District in 2022. Of these, 6 were WNV and 2 were SLEV.



Figure 3. WNV positive mosquito samples in 2022 compared to 2021 and the previous 5-year average.



Figure 4. SLEV positive mosquito samples in 2022 compared to 2021 and the previous 5-year average.





Control

Delta Mosquito and Vector Control District's mosquito control program is prevention focused, relying on the early identification and control of larval mosquito sources to reduce the biting adult mosquito populations. Physical, biological, and chemical control methods are used to control larval sources, allowing for mosquito-specific control. The vast majority of the District's mosquito control program consists of larval-based control. Mosquito larviciding is both efficient and cost effective. Larval based control eliminates mosquito larvae before they develop into mosquitoes that are capable of transmitting mosquito-borne diseases to humans. Laval based products used to control mosquito larvae are target specific, i.e., they have minimal to no effects on non-target organisms. However, when adult mosquito populations become a threat to public health and transmit diseases such as WNV, the District takes measures to control adult mosquitoes by conducting adult mosquito treatments to break the disease cycle in the population and continue with surveillance and larval based control.

The Urban Mosquito Program main focus is to reduce the mosquito populations of both native and invasive species of mosquitoes in urban locations throughout the District's jurisdiction. Surveillance trapping efforts allow operations to make scientific based decisions on the use of resources to reduce arbovirus disease risk and high mosquito population. In addition, operations expanded on the Wide Area Larviciding System

(WALS) program in 2022. The WALS is an additional tool in our Integrated Vector Management Program (IVM) and is a method to dispense larvicides to a broader geographical area to target mosquito larvae in difficult to find breeding habitats. We utilize this method to target *Ae. aegypti* which is a cryptic breeding mosquito in urban locations. This mosquito season we increased our applications from 2021 with 7 applications covering 63.5 acres per application to 48 applications covering 50 acres per application.

In 2022, technicians controlled 3,786 (15.24%) mosquito-breeding sources out of 24,836 known or historical mosquito sources inspections (Table 4). Catch basins were treated monthly during the high mosquito season. In accordance with IVM principles, a variety of control methods were used to control mosquito-breeding sources and prevent insecticide resistance in mosquitoes (Table 5).

The District developed an Unmanned Aircraft System (UAS) application program (Figure 6). Four staff members were trained and certified in the Federal Aviation Administration part 107 to pilot small UAS. In addition, the 4 staff members were certified by the Department of Pesticide Regulation to conduct aerial application by UAS. The intent of this program is to integrate this aerial method to the IVM program to focus in rural problematic areas. This program allows the District to survey and conduct applications in a safe and effective manner in locations that are virtually inaccessible by traditional ground application methods. This season the District conducted a total of three applications in rural locations.



Figure 6. Staff of DMVCD conducting an Unmanned Aircraft System application mission.

Table 4. Total sources and treatments of catch basins and historical sources in the District in2022.

SOURCE TYPE	TOTAL SOURCES	TREATED	INSPECTIONS
Catch Basins	13,500	63,808	63,808
Historical Sources	2,958	3,786	24,836

Mosquitofish, *Gambusia affinis*, are a large component of maintaining permanent water sources such as ponds and troughs. In 2022, the Alburn Fish Hatchery produced 15,871 mosquitofish. Of these, 3,303 mosquitofish were used to treat 91 mosquito-breeding sites in 2022 (Table 4). Free mosquitofish are also available to residents by request.

 Table 5. Operational data for control efforts in 2022.

PHYSICAL CONTROL OPERATIONS	2022	2021	2020
Number of sources	**	**	554
MOSQUITOFISH OPERATIONS			
Number of sites stocked	91	161	184
Number of fish used	3,303	3,856	3,214
ADULTICIDE OPERATIONS			
Number of operations	26	12	5
Pyronyl 525 (oz)	4,606.7	4,859	2,961.1
Fyfanon EW (oz)	7,186.2	N/A	N/A
SURFACE AGENTS			
Agnique Liquid (oz)	518	424.8	666.5
BVA2 larvicide (gallons)	5,352.5	5,867.5	4,492.8
BIORATIONAL LARVICIDES			
Bacillus thuringiensis israelensis (Bti)			
VectoBac 12AS (oz)	25,958.6	30,454.5	140,974
VectoBac G (lb)	60	40	41
VectoBac GR (lb)	287	0	40
VectoBac WDG (lb)	1,200	74	88
Bacillus sphaericus (Bs)			
VectoLex Granules (lb)	175	15	45
VectoLex WSP (each)	541	351	1,512
Bti and Bs			
FourStar 180 (each)	121	99	7
Spinosad			
Natular 2EC (oz)	1,521.5	926.9	853
Natular DT (each)	126	0	237
Natular G30 (lb)	291.7	18.25	31.9
Natular XRT(each)	342	46	0
Insect growth regulator (methoprene)			
Altosid Briquets (each)	68	147	164
Altosid Liquid (oz)	909.5	488.1	1,148

Altosid Pellets WSP (each)	63,808	57,726	69,572
Altosid Sand Mix (lb)	13	618.6	695.5
Altosid XRG (lb)	351.1	498.3	482
Altosid XRG Ultra (lb)	1,597	N/A	N/A
MetaLarv XRP (each)	N/A	1,394	00
Sumilarv WSP 25g (each)	43	N/A	N/A

** Data for 2022 was not quantifiable due to the implementation of a new data record system Fieldseeker.

Community Education and Outreach

The goal of community education and outreach is to increase resident participation in preventing nuisance biting and vector-borne diseases by educating residents to reduce mosquito-breeding water sources and use the appropriate personal protective measures to reduce mosquito bites.

In 2022, the District purchased a new van with brand imaging and new canopy booth set-up (Figure 7) for use at different events throughout the year. District staff attended a total of 89 events which included 22 Rawhide baseball games, 20 farmers markets, 9 community events, 5 flea markets, 8 school events, and a senior center event in Visalia. These events were attended by over 600 visitors and took place in Visalia, Exeter, Farmersville, Dinuba, and London.



Figure 7. DMVCD outreach booth setup.

During the mosquito season, the District had weekend radio spots on the local top-hits radio station. Messaging focused on reducing mosquito-breeding sources and bite prevention. In total, 120 thirty-second radio spots were aired monthly from July to October. Additionally, 8 half-page advertisements were placed in a local newspaper, *The Good Life* whose senior audience is at high risk of neuroinvasive WNV infections.

The technicians were provided new door hangers that were redesigned to clarify messaging at each of their property visits (Figure 8). Technicians were also provided with mosquito species information cards to educate residents during residential inspections (Figure 9). With the new drone program, the new trailer for the equipment has been wrapped with the District's logo and mission (Figure 10).

NOTICE We Need Access to Your Property

Please prepare your property for a technician's visit on

1st Visit on:	2nd Visit
or call (559) 732-8606 to re	schedule.

Property visits are an inspection of your front and backyards for water sources where mosquitoes may breed. Mosquitoes have the potential to transmit mosquito-borne disease to humans.

They were unable to access your property due to:

Locked Gate
Dog(s)
Other:



Our technicians will check and discuss options for larger water sources, like fountains, ponds, and unused pools.



Date:

Inspector:



Delta Mosquito & Vector Control District 1737 W. Houston Ave, Visalia 93291 559-732-8606 - www.deltamvcd.org Hours of Operation: M - F 7:00 am - 4:00 pm No representative of DMVCD will ever ask you you to pay for services.

Figure 8. The new DMVCD property inspection door hangers.



Figure 9. Mosquito information cards used by technicians to educate residents during residential inspections.



www.deltamvcd.org 17 Figure 10. DMVCD drone trailer with completed graphic wrap.

The District also celebrated its 100th year anniversary, since its creation on September 19, 1922. For this monumental anniversary, the District created a summary of the major milestones of the District during its 100 years of service (Figure 11). Additionally, the Tulare County Historical Society and California Special Districts Association posted a write-up about DMVCD's 100-year history on its website. The District held an open house on October 8, 2022, inviting all residents within the District to celebrate its 100-year anniversary.



Figure 11. Key milestones during the District's 100 years of service.

In addition, Special District Leadership Foundation (SDLF) recognized Delta Mosquito and Vector Control District as one of the 10 SDLF Transparency Challenge winners in the September/October 2022 issue of *Special Districts*, a publication of the California Special District Association (Figure 12).

SDLF TRANSPARENCY CHALLENGE: DISTRICT SPOTLIGHT

District Spotlight

THE SPECIAL DISTRICT LEADERSHIP FOUNDATION RECOGNIZES Delta Mosquito and Vector Control District

The Special District Leadership Foundation (SDLF) recognizes the Delta Mosquito and Vector Control District (District) as one of the ten 2021 SDLF Transparency Challenge winners! The district shares their insight about the process and the benefits of this transparency recognition.

Share your experience completing the Transparency Challenge

Our Delta Mosquito & Vector Control District (DMVCD) already had most of the appropriate documents, and needed only to add some policies and ensured all documents were posted on the DMVCD's website. Going through the comprehensive list gave us a better understanding of where various documents are kept at the DMVCD and encouraged us to take a closer look at the number of our policies. This experience was invaluable and definitely made us more aware of all of the steps and requirements resulting in us taking the time to further educate ourselves and staff about some of the additional rules and regulations pertaining to special districts. Overall, the SDLF Transparency Challenge application process was not difficult but quite educational and rewarding.

Why was completing the challenge important to your district?

As an independent special district who seldom has members of the public attend board meetings, it can feel like we don't need to change or update what we are currently doing. Working towards a goal such as the Transparency Challenge helped highlight how improvement is always needed and how important it is to continue to conduct important transparency activities of our district. Additionally, it made all of us more confident in our actions by increasing our special district transparency and becoming more responsive to all members of the public and their concerns.

Now that you have earned your SDLF Transparency Certificate, how will you use the recognition to highlight your district's

accomplishment to your customers, constituents, and/or other stakeholders?

As a district, we look forward to continuing to update our documents and make sure all of them are available, transparent, current, and up-to-date. Our members of the DMVCD Board of Trustees are aware of our district transparency, and we are always ready to direct all members of the district if they have any questions to our district transparency page on our DMVCD website. We always aspire to be transparent and hope that this will make all the members of our district feel more confident in our activities, services, and be more willing to engage with Delta Mosquito and Vector Control District.

About Delta Mosquito and Vector Control District

Delta Mosquito and Vector Control District, founded in 1922, is a special district charged with protecting the public from mosquito-borne diseases and mosquito nuisances. They protect northern Tulare County including Visalia, Dinuba, Exeter, Farmersville, Woodlake, Cutler, Orosi, and Ivanhoe. Their team is committed to protecting public health through mosquito control activities and mosquito-borne disease surveillance. For more information, visit deltamvcd.org.



It is now more important than ever for local governments (including special districts) to be open and accessible to the public. The Special District Leadership Foundation's Transparency Challenge showcases the many steps districts take to show they are available and transparent to their constituents and customers.

Learn more at https://www.sdlf.org/home.

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Figure 12. Special District Leadership Foundation (SDLF) recognizing DMVCD as one of the 10 SDLF Transparency Challenge winners.

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