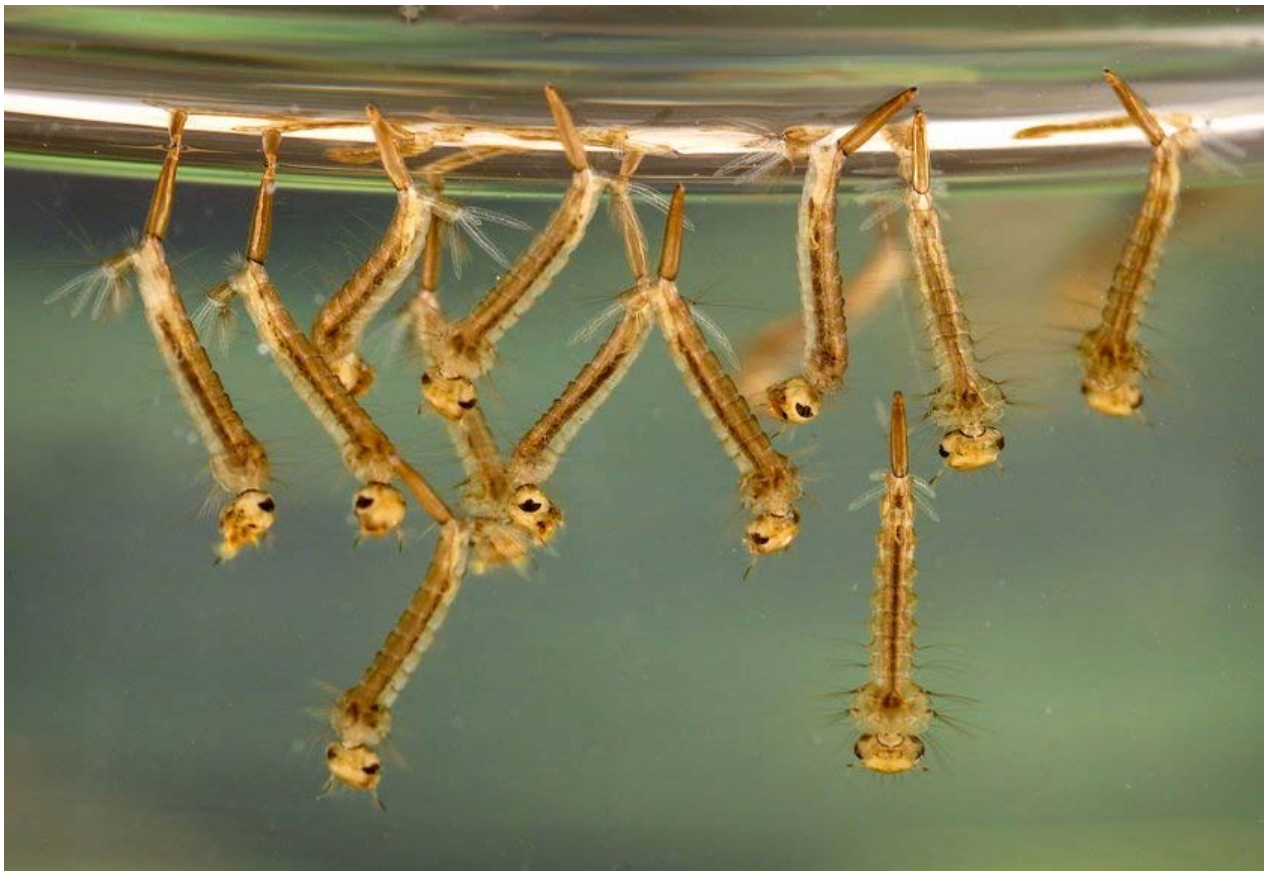
2019 Annual Report
Water Valley & Pelican Lakes
Mosquito Control Program



Vector Disease Control International
318 N. Garfield Ave Loveland, CO 80537
Phone 970-278-9977 Fax 866-929-1204
Website: www.vdci.net/Colorado

Water Valley & Pelican Lakes
Mosquito Management Operations

Annual Report For 2019

Table of Contents

	Page
PROGRAM OBJECTIVES	3
VDCI'S COMMITMENT	3
2019 SEASON PERSPECTIVE	4
CLIMATE COMPARISON DATA	
WEST NILE VIRUS SEASON	5
WNV ACTIVITY BY STATE (CDC 2019 HUMAN CASE MAP)	
NEUROINVASIVE INCIDENCE BY STATE (CDC 2019 HUMAN CASE MAP)	
COLORADO WNV DATA (CDPHE 2019 HUMAN CASE REPORTS)	
LARVAL MOSQUITO CONTROL	8
LARVAL SITE INSPECTIONS & TREATMENTS IN WINDSOR	
LARVAL ACREAGE TREATMENTS IN WINDSOR	
LARVICIDE PRODUCT APPLICATION BY TYPE	
VDCI SURVEILLANCE LABORATORY	9
CDC LIGHT TRAP COMPOSITE SUMMARY FOR WINDSOR 2019	
ADULT MOSQUITO LIGHT TRAP GENUS SUMMARY 2019	
CDPHE WEST NILE VIRUS MOSQUITO SAMPLE TESTING RESULTS	
CSU WEST NILE VIRUS MOSQUITO SAMPLING RESULTS – LARIMER COUNTY	
ADULT MOSQUITO CONTROL	13
SEASON DETAILS	
ADULT MOSQUITO CONTROL APPLICATION REPORT FOR WATER VALLEY 2019	
PUBLIC RELATIONS AND EDUCATION	14
MOSQUITO LINE CALLS FOR WATER VALLEY	
APPENDIX	16
1. GROUND ADULT MOSQUITO CONTROL APPLICATION DATA 2019	
2. INDIVIDUAL LIGHT TRAP SUMMARIES 2019	

Program Objectives

Vector Disease Control International, LLC (VDCI) completed its 15th year of cost-effective Integrated Mosquito Management (IMM) for Water Valley in 2019. The primary objective of Water Valley's IMM Program is to monitor and reduce mosquito populations through the use of specific, environmentally sound, control techniques in order to protect its residents from the threat of mosquito-borne diseases. VDCI prioritizes the detection and elimination of larval mosquitoes in aquatic habitats, in conjunction with the monitoring of adult mosquito populations through routine surveillance, in order to assess West Nile virus vector species abundance in the area.

Open communication is maintained by VDCI between the HOA Residents, Property Management Companies, the Weld and Larimer County Departments of Health & Environment and surrounding municipalities to ensure that the highest level of mosquito control and epizootic response is achieved. This diligent and cooperative communication is important to the Water Valley mosquito management program and provides significant benefit to public health throughout the entire area.

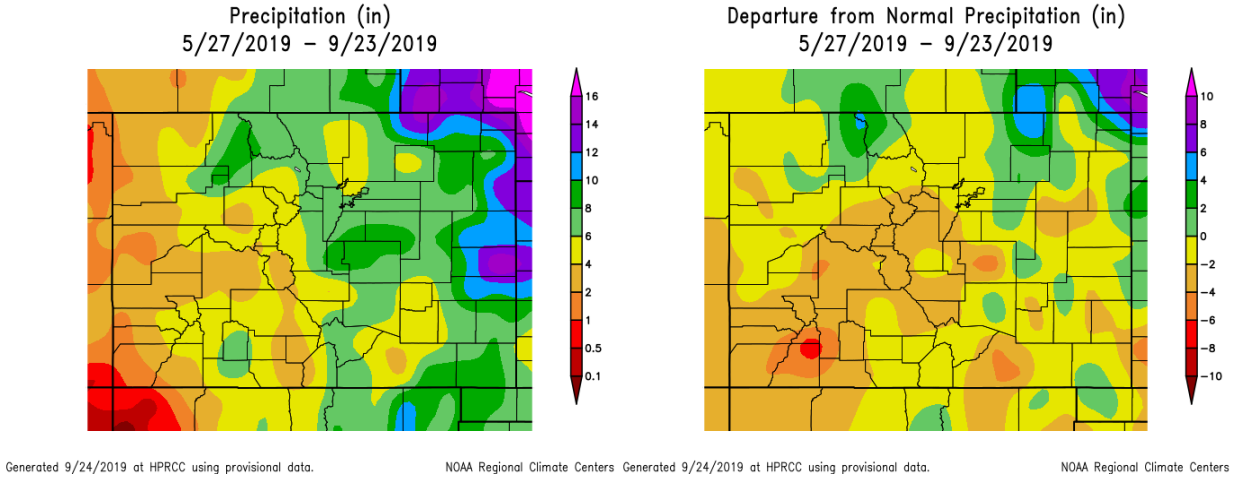
VDCI's Commitment

Vector Disease Control International is a company built on the foundations of public health, ethics, professionalism, and technical expertise. VDCI is committed to providing our customers with scientifically based, environmentally sensitive and technologically advanced Integrated Mosquito Management (IMM) programs of the highest quality. All of our employees are committed to excellence in vector control and public health and strive to improve the quality of human life in communities through public education and the control of mosquitoes and the diseases they can transmit. VDCI currently has programs across the state of Colorado, providing services for towns, cities, counties, homeowners associations, and encephalitis surveillance monitoring programs for county health departments.

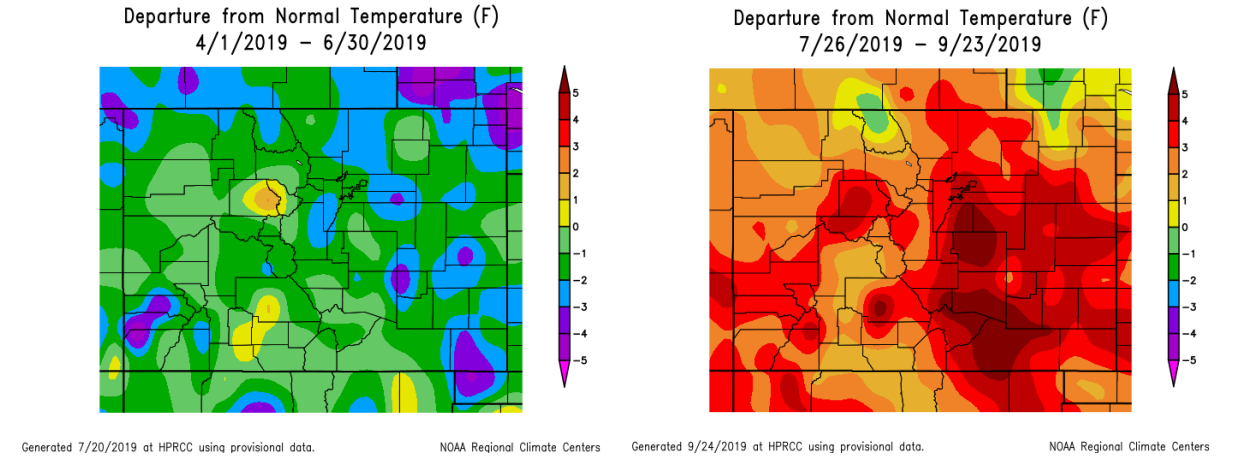
Vector Disease Control International, as the contractor for Water Valley, will continue to use proven scientific Integrated Mosquito Management techniques to survey and control local mosquito populations using biorational larval controls and limited low-toxicity insecticide applications. All of the methods and materials used have been reviewed and registered by the US Environmental Protection Agency, the Centers for Disease Control, the Colorado Department of Agriculture and the American Mosquito Control Association.

2019 Season Perspective

At VDCI we have come to expect each Colorado summer to present a unique set of temperature, precipitation, irrigation, and human interactions that combine to create new and different challenges in both mosquito control and mosquito-borne disease proliferation. May and June 2019 started off with below average temperatures and snowpack levels 534% above the state average, or approximately 23 times the amount they were at in early June 2018. As the season started, precipitation was higher than average throughout most of the state, however with along with the below average temperatures, typical mosquito proliferation did not occur until July. As the summer moved on the temperature rose and precipitation slowed. Denver set a new state record with the highest temperature ever recorded in the month September, only to break that record the very next day with a high of 100 degrees set on September 2nd, 2019. West Nile virus activity in both mosquito and human populations remained below average throughout the summer.



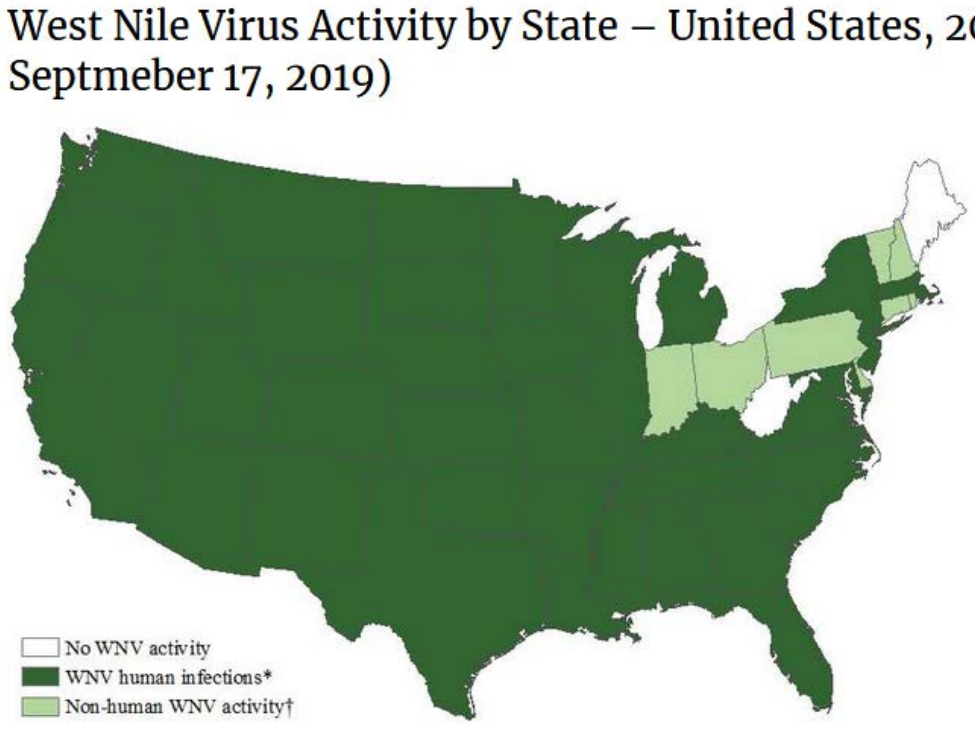
Temperatures throughout Northern Colorado seem to increase every summer and 2019 was no different. With the exception of May and June 2019, The High Plains Regional Climate Center reports temperatures 2-3 degrees higher than average throughout the 2019 summer months. As temperatures increase so does the rate of growth in larval mosquito populations.



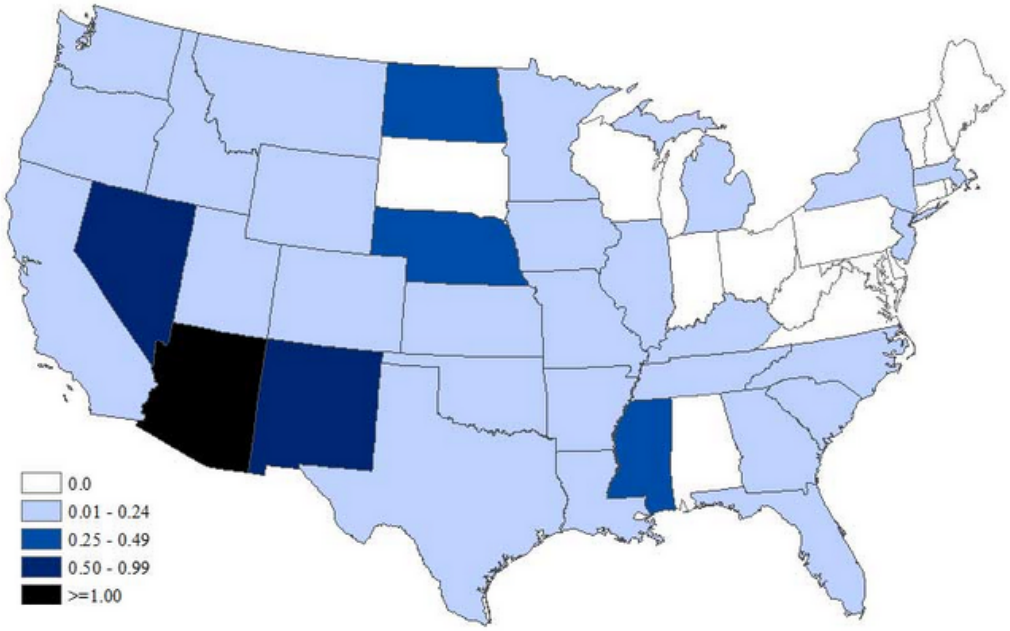
West Nile Virus Season

Since the introduction of West Nile virus to the United States in 1999, the virus has made a complete westward expansion to the West Coast. Starting in the Northeastern parts of the United States, the virus steadily spread through the South, the Midwest, the Rocky Mountain region, and to the Western States. This extensive distribution is due to the ability of WNv to establish and persist in the wide variety of ecosystems present across the country. WNv has been detected in 65 different mosquito species in the U.S., though it appears that only a few *Culex* species drive epizootic and epidemic transmission (WNv Guidelines, CDC 2013). Although West Nile virus has been endemic to the United States since 1999, researchers continue to seek an understanding for some of the factors which contribute to region specific spikes in vector abundance and human risk. We still do not understand why some humans develop West Nile fever while other infections develop into more serious West Nile encephalitis or West Nile meningitis cases. Additionally, physicians and researchers continue to seek answers to the variable recovery times and occurrence of deaths that result with some infections. WNv has expanded to the point that it can now be found in all 48 contiguous states and since its introduction has produced two additional, large nationwide epidemics in 2003 and 2012 (WNv Guidelines, CDC 2013).

As of September 24th, 2019, a total of 46 states and the District of Columbia have reported West Nile virus infections in people, birds, or mosquitoes. Overall, 543 cases of West Nile virus disease in people have been reported to CDC. Of these, 355 (65%) were classified as neuroinvasive disease (such as meningitis or encephalitis) and 188 (35%) were classified as non-neuroinvasive disease.



West Nile Virus Neuroinvasive Disease Incidence by State – United States, 2019 (as of September 17, 2019)



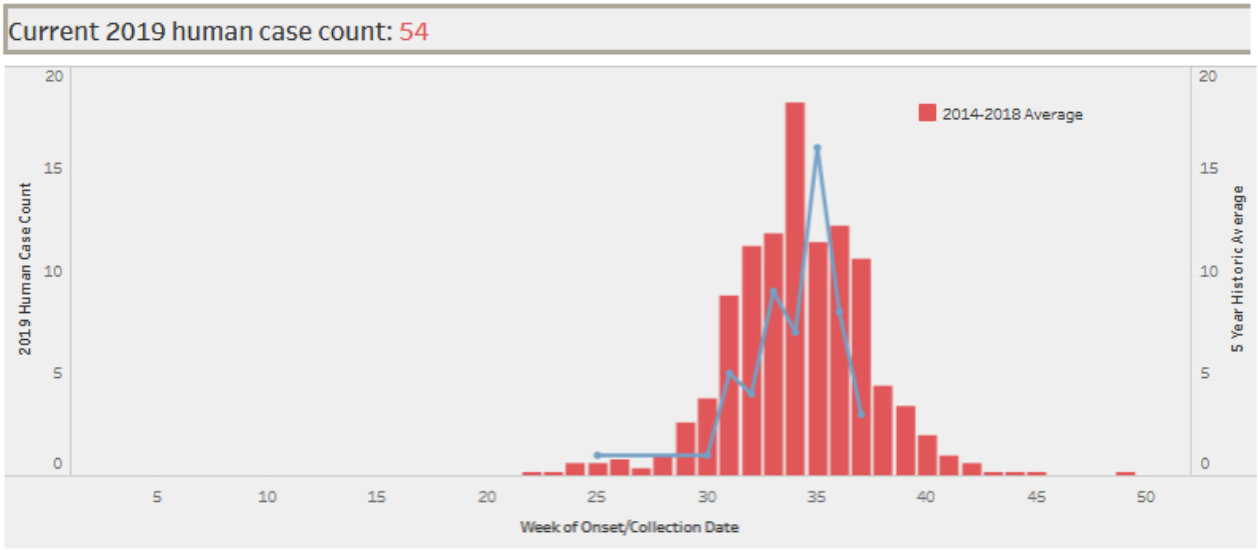
This map shows the incidence of human West Nile virus neuroinvasive disease (e.g., meningitis, encephalitis, or acute flaccid paralysis) by state for 2019 with shading ranging from 0.01-0.24, 0.25-0.49, 0.50-0.99, and greater than 1.00 per 100,000 population.

Colorado 2019

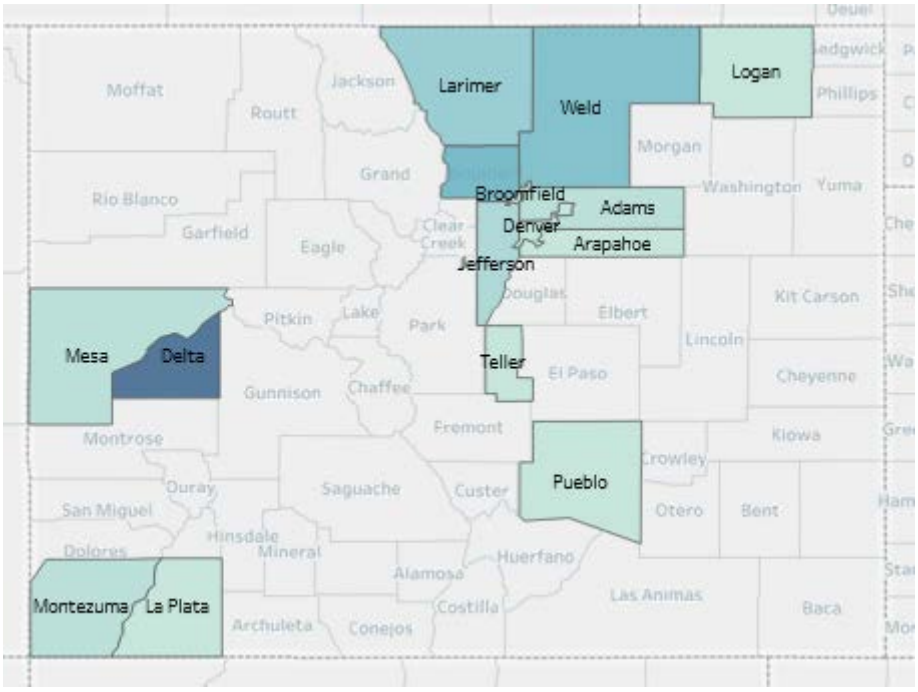
As of September 24th, the Centers for Disease Control has reported 37 cases of human West Nile virus (WNv) infections from the state of Colorado. Seven of these cases were neuroinvasive including symptoms of meningitis or encephalitis (including meningoencephalitis), and fifteen were non-neuroinvasive which includes cases where individuals are non-symptomatic or present with fever and other minor symptoms. To date, there have been no deaths associated with West Nile virus infections from Colorado in 2019.

The Colorado Department of Health and Environment reports a total of 54 human cases of West Nile virus infection from the state of Colorado. In Northern Colorado, 5 human cases are reported from Larimer County, 8 from Boulder County, and 7 from Weld County. While we have passed the historical peak of WNv risk these numbers are expected to rise as there is often a delay in onset of symptoms, diagnosis and reporting. Please note that the additional cases reported by CDPHE will also be reported to the Centers for Disease Control.

Fifteen Counties across the state of Colorado have reported human West Nile virus infection. These include Adams, Arapahoe, Boulder, Broomfield, Delta, Denver, Jefferson, La Plata, Larimer, Logan, Mesa, Montezuma, Pueblo, Teller, and Weld.



Distribution of Human WNv Cases in Colorado – 2019



Larval Mosquito Control

Larval mosquito control is the foundation of the Water Valley Mosquito Control program and can be an extremely effective way to manage mosquitoes, thereby reducing the number of potential disease vectors and annoyances associated with biting adults. Years of research and practical experience have shown that the most effective way to control mosquito populations is through an aggressive Integrated Mosquito Management (IMM) approach. This approach aims at using a variety of concepts, tools, and products to reduce a pest population to a tolerable level.

Pre-season larval control work involved ground truthing GIS maps and remapping areas where new development or flooding had altered the landscape. VDCI began larval site inspections in many areas mid-April. Hiring of seasonal field technicians began in March and continued into May. VDCI's Annual Field Technician Classroom Training Day took place on May 20th with over 50 new and returning field technicians in attendance. Field training by VDCI management and veteran employees lasted through May and full-time field activities were in force by mid-June.

In 2019, Vector Disease Control field technicians performed 1,223 larval site inspections within Windsor and Water Valley, of which 997 (80.9%) were wet upon inspection, 509 (51.1%) were producing mosquito larvae. To prevent these larvae from emerging as adult mosquitoes, VDCI applied 3,248.65 lbs. of VectoBac (Bti), and 0.28 gallons of BVA mineral oil to 648.1 acres of land.

Larval mosquito control can be achieved in several ways including biological, biochemical, chemical, and mechanical means. No single larvicide product will work effectively in every habitat where mosquito larvae are found, so a variety of products and methods should be employed. Additionally, although there are a variety of methods for reducing larval populations, some may have negative consequences that outweigh their benefits. Mechanical

or physical habitat modification is a technique which VDCI uses on relatively small scale projects, as the area to be modified must be carefully reviewed.

VDCI's favored method of larval mosquito control is through the use of bacterial bio-rational products. The main product used by VDCI is a variety of bacteria (*Bacillus thuringiensis var. israeliensis*). *Bti,* as it is known, has become the cornerstone of mosquito control programs throughout the world. The benefits include its efficacy and lack of environmental impacts. When used in accordance with its label, successful control of mosquito larvae can be achieved without impact to non-target species such as other aquatic invertebrates, birds, mammals, fish, amphibians, reptiles, or humans. A broad label allows for the use of the product in the majority of the habitats throughout the service area. Another bacterial product closely related to *Bti* is *Bacillus sphaericus (Bs)*. *BS* provides similar benefits to *Bti* while also providing residual control of certain species of mosquitoes. It is used specifically in difficult to treat areas where *Culex* are the predominant species due to its limitations and high cost.

Other larval control products include the insect growth regulator methoprene (Altosid), and light mineral oils (BVA 2 larvicide oil). Methoprene is a synthetic version of a juvenile growth hormone in larval mosquitoes. The hormone prevents the normal development of larval mosquitoes into pupae and adults, eventually causing death. VDCI limits the use of chemical larvicides to areas with little biodiversity, such as road side ditches, or areas that chronically produce high mosquito populations. They are only used after a thorough assessment has been made of any habitat where their use is being considered. Mineral oil is the only product effective in controlling mosquito pupae and therefore is an essential tool when pupae are present.

VDCI Surveillance Laboratory

Information about mosquito abundance and species diversity is essential to integrated program. Vector Disease Control International utilizes two kinds of traps to monitor mosquito populations. The most commonly used is the CDC light trap which uses carbon-dioxide from dry ice as bait to attract female mosquitoes seeking a blood meal from a breathing animal. Once attracted by the CO_2, the mosquitoes are lured by a small light to a fan that pulls them into a net for collection. The second type of trap VDCI uses is called a gravid trap. Gravid traps use a tub of highly-organic water as bait to attract female mosquitoes that are looking for a place to lay their eggs. A fan placed close to the water surface forces mosquitoes that come to the water into a collection net. Once back in the laboratory, the contents of the trap nets are counted and speciated by trained technicians.

In 2019, Vector Disease Control International monitored a statewide network of hundreds of weekly trap sites, collecting adult mosquitoes that were counted and identified to species by the VDCI Surveillance Laboratories. While individual traps provide only limited information, trap data is interpreted in the context of historical records for the same trap site, going back in time more than a decade. Individual traps are also compared to other traps from around the region that were set on the same night and therefore exposed to similar weather conditions. Technicians working in the Surveillance Laboratories at Vector Disease Control International are trained to provide accurate species-level identification of both larval and adult mosquitoes.

Additionally, the VDCI Surveillance Laboratory conducts an intensive larval identification program with larval mosquito samples collected by I&L technicians prior to larviciding being identified to species. This information is now invaluable in targeting mosquito control efforts as we gain a greater understanding of the habitat types preferred by Colorado mosquito species and the seasonality of these habitats as sites for mosquito development.

Specimens and data collected from these traps and larval identification are used in:

- Determining the effect of larval control efforts. Each mosquito species prefers specific kinds of habitats for larval development. If a trap includes large numbers, it could indicate the presence of an unknown larval habitat and, based on the species identification and known habitat preference for that species, direct field technicians as to possible sources of the mosquitoes collected.

- Determining larval and adult mosquito species. This helps to illustrate the threat of mosquito-borne disease amplification and transmission because different mosquito species can vector different diseases to people and animals.

- Determining where adult control efforts were necessary. While mosquito eradication is impossible, significant population reduction is achievable. In places where larval control is insufficient, such as neighborhoods where adult mosquitoes have migrated in from outside of the control area, it may be necessary to use adulticide methods, such as ULV truck fogging or barrier sprays of harborage areas. Trap counts that exceed an acceptable threshold for an area may trigger adult control measures.

- Surveillance for Mosquito-borne Disease. Historically, VDCI efforts were targeted primarily at controlling mosquito nuisance problems with limited disease surveillance. However, since the arrival of the West Nile virus in Colorado in August of 2002, the paradigm has shifted toward disease prevention and control. Accurate species identification of the mosquitoes in the traps is important when monitoring species population trends. It also is necessary for evaluating whether a population spike represents an actual increase in disease transmission potential or only an increased nuisance level.

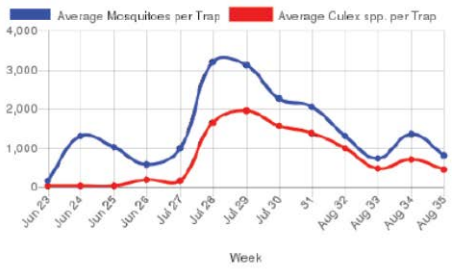
2019 Windsor Trap Composite Data

Total number of trap/nights set:	169
Total number of mosquitoes collected:	18,926.0
Average mosquitoes per trap/night:	112.0
Average Culex per trap/night:	56.4

Species collected and abundance:

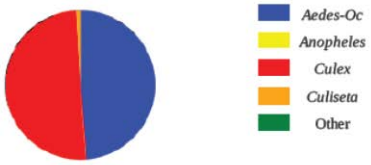
Aedes dorsalis	460.0	2.4%
Aedes increpitus	41.0	0.2%
Aedes melanimon	195.0	1.0%
Aedes trivittatus	5.0	0.0%
Aedes vexans	8,527.0	45.1%
Anopheles freeborni	4.0	0.0%
Culex pipiens	321.0	1.7%
Culex tarsalis	9,212.0	48.7%
Culiseta inornata	161.0	0.9%

Seasonality



Genus Proportions:

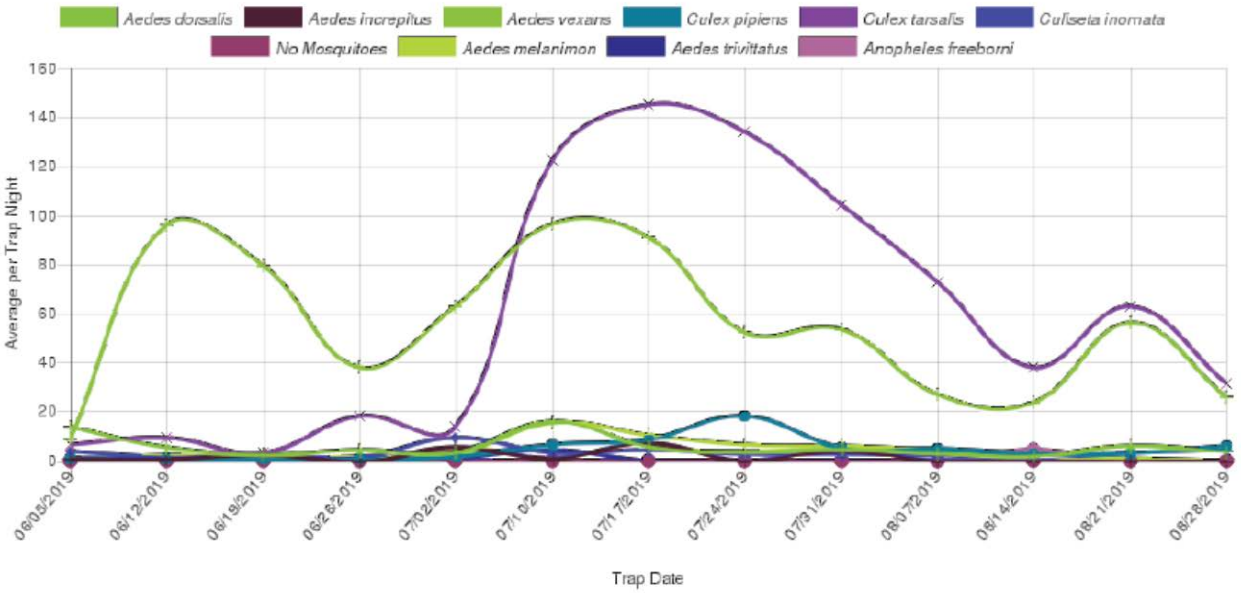
Genus	Number	Percent of Total
Aedes/Ochlerotatus	9,228	48.8%
Anopheles	4	0.0%
Culex	9,533	50.4%
Culiseta	161	0.9%
Other	0	0.0%



Adult Mosquito Surveillance Summary

Start Date: 05/01/2019 **End Date:** 09/27/2019

Windsor

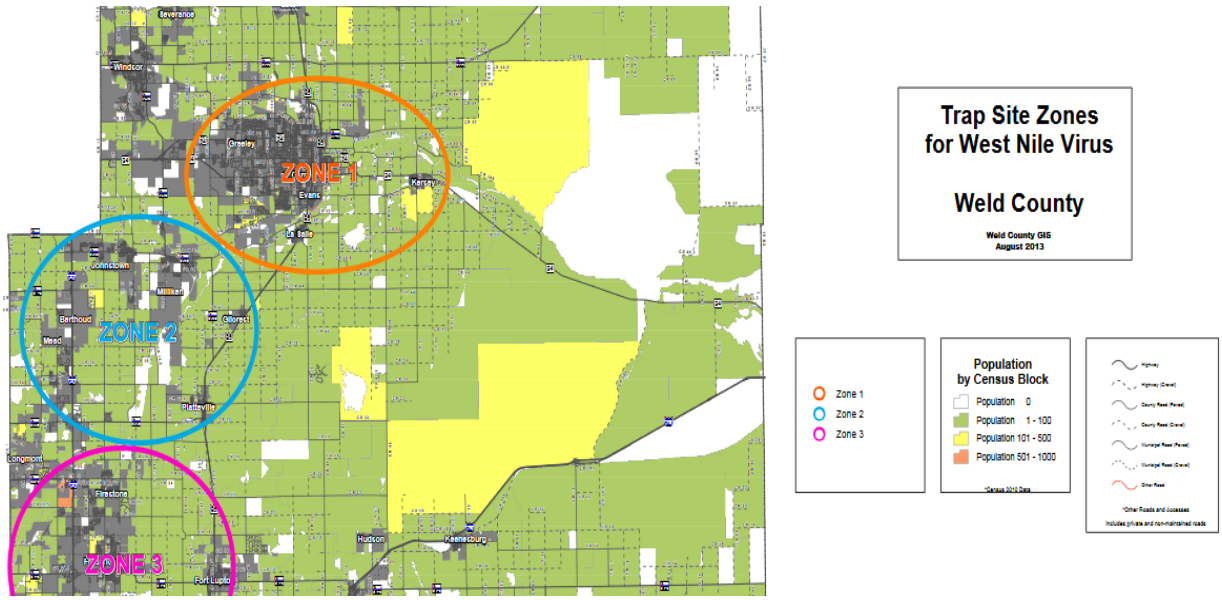


Vector Disease Control International
7000 N. Broadway, Suite 108
Denver, CO 80221

CDPHE West Nile Virus Mosquito Sample Testing Results – Weld County

In 2019 CDPHE tested mosquito pools samples submitted for West Nile virus testing from mosquitoes collected in Weld County from all three sentinel zones. There were 23 confirmed positive samples.

Vector Index Log			
Week	**Zone 1**	**Zone 2**	**Zone 3**
June 9-15	0	0	0
June 16-22	0	0	0
June 23-29	0	0	0
June 30-July 6	0	0	0
July 7-13	0	0	0
July 14-20	0	0	0
July 21-27	0	0	0
July 28-August 3	0.33	0	0
August 4-10	0.41	0.23	0.19
August 11-17	0,74	0.19	0.20
August 18-24	0	0	0.20
August 25-31	0.64	0.94	0.46



CSU West Nile Virus Mosquito Sample Testing Results - Larimer County

Many local health departments have moved towards mosquito-based surveillance indicators to assess the weekly risk of West Nile transmission and guide response decisions for adult mosquito control applications. The vector index and infection rate is derived by testing the mosquitoes VDCI collects for the presence of West Nile virus. This value is closely monitored by the CDPHE and local health departments to evaluate the risk posed by the vector mosquito population.

As defined in the CDC guidelines for West Nile virus surveillance, prevention and control, the vector index (VI) is an estimate of the number of West Nile virus infected mosquitoes in an area. This number can serve as a human health risk value. An operational value of 0.5, which was derived from the comparison of historical data for human infections, as well as relative abundance and infection in mosquitoes, serves as an indicator of high risk for West Nile virus transmission to humans in the corresponding area. As the value of the vector index increases there is a corresponding risk of human disease and this value can be used to offset epidemics.

As stated on the CDPHE website, the seasonal variation of West Nile virus risk can change throughout a summer and it is best to assume you have some risk for WNV if you have mosquitoes.

As of Sept 18th, 2019 Colorado State University's Department of Microbiology, Immunology and Pathology, has tested a total of 1,224 mosquito pools from Larimer County. A total of 48 mosquito pool samples have tested positive for WNv with 6 of those being collected from Loveland and 42 from the City of Fort Collins. Testing of these mosquitoes for West Nile virus is paid for by the City of Fort Collins, and Loveland. It's important to note that the large number of WNv positive sample pools reported from Fort Collins is highly correlated with the fact they test all mosquitoes with the potential for transmitting disease versus just a subset of the population.

Adult Mosquito Control

The goal of Vector Disease Control International is to provide our customers with the best options for safe, effective, modern mosquito management. The primary emphasis of the Water Valley Mosquito Management Program is to control mosquitoes in the larval stage, using safe biological control products. VDCI uses EPA and CDC approved adulticides to reduce mosquito populations. During the 2019 season a total of 16.0 miles of roads and access paths within Water Valley were fogged using AquaKontrol3030.

Backpack barrier applications, utilizing long term residual mosquito control products (Talstar Professional), were performed in Eastman Park and Boardwalk Park.

Please see Appendix 1 for Ground Adulticide Application Data

VDCI uses state of the art technology, calibrated application timing, and least-toxic products to minimize non-target impacts. All adult mosquito control is accomplished using Ultra Low Volume (ULV) fogging equipment and performed after dusk when the majority of mosquito species are most active. This type of equipment produces droplets averaging 12 microns in diameter and allows for a minimal amount of product to be put into the environment. These treatments take place in the evening when mosquitoes are flying in greater numbers and non-target insect activity (for example, day-flying pollinators like bees) is greatly reduced. Using this application technique, the overall goal of minimal environmental impact and effective adult control is achieved in the targeted area.

Public Relations and Education

VDCI is dedicated to providing strong Public Outreach and Education Programs to residents in all of our communities. Citizen complaints, inquiry, information and satisfaction surveys can aid in evaluating the effectiveness of a program. VDCI constantly looks for ways to better serve the communities we work with and encourages both the citizen and local media involvement in order to increase the effectiveness of our programs. We have clearly demonstrated that commitment and belief by proactively serving Water Valley (and all of our contracted communities) with numerous innovative programs, activities and services.

Customer service is always a high priority for VDCI. We take pride in training each and every technician so that they have the knowledge to provide residents with the correct answers to their questions. Each field technician spends part of their day responding to resident concerns in their work area. This in-field customer service personalizes the mosquito control program, provides VDCI with local information on mosquito activity and presents a valuable opportunity to educate our residents about mosquito biology and control.

MosquitoLine™

VDCI maintains a toll-free telephone line (877-276-4306) and local line to the Northern Colorado Office (970-278-9977) at no cost to the customer. This service can be utilized to accept calls from the public concerning:

- Information about mosquito biology and source reduction of mosquito habitats
- information on program components, operations and monitoring
- Seasonal West Nile virus activity
- Personal protection options for mosquito annoyances and West Nile virus risk
- Reports about mosquitoes and possible larval mosquito habitats
- Requests to perform larvicide applications and/or opt-out of any adulticide spraying via a shut-off list
- Request notification when adulticide spraying is planned in their neighborhood
- Request health and safety information about mosquito control operations and pesticide products used

VDCI has provided Mosquito Hotlines to the residents in communities which we are contracted to also reduce workload by municipal personnel. This enables direct communication and response by mosquito control employees to resident's concerns about West Nile virus and larval site activity and treatment. VDCI maintains a log of calls received and will summarize call activity in monthly and annual reports.

In 2019, VDCI received 4 phone calls or emails from the residents of Water Valley. VDCI received 1 call from residents reporting mosquito annoyance problems, technicians were dispatched to check out the complaint areas. VDCI received 3 requests from residents asking that their information be added or changed in VDCI's spray notification list so they could be notified of spraying in their area.

VDCI Participated in the Windsor's Public Safety Fair and Awareness day on May 22nd to help educated residents of mosquito control activities within the town and how to prevent mosquito bites using the 4 D's (Drain, Dress, Dawn/Dusk and DEET).

CALL NOTIFICATION & SHUTOFF SYSTEM

VDCI continues to maintain a comprehensive Call Notification & Shutoff database and will notify residents on the list when conducting ULV adulticide spray applications within Water Valley & Pelican Lakes.

DAILY POSTING OF ULV SPRAY ZONES are maintained and updated online daily at http://www.vdci.net/colorado

Appendix 1: Ground Adult Mosquito Control Application Data

Ground Adulticide Applications

Start Date: 05/01/2019 **End Date:** 09/27/2019

Windsor

Month	Date	Municipality	Chemical	Mix Ratio	Trip Miles	Spray Miles	Spray Acres	Gallons Sprayed
WR WV South Spray Zone Applications								
August 2019	08/01/2019	N/A	Aqua Kontrol 30-30 (73748-11)	1:5	10.9	8.3	300.3	2.3
	08/29/2019	N/A	Aqua Kontrol 30-30 (73748-11)	1:5	8.8	7.7	280.0	2.1
						Total Aqua Kontrol 30-30 Applied:		*4.5*
				WR WV South Spray Zone Totals:	***19.7***	***16.0***	***580.3***	***4.5***
				Grand Totals:	***19.7***	***16.0***	***580.3***	***4.5***

Vector Disease Control International
1320 Brookwood Drive Suite H
Little Rock, AR 72202

Appendix 2: Individual Light Trap Summaries

WR-17

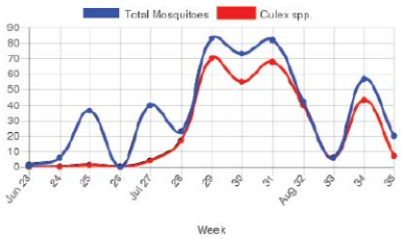
Season: 05/01/2019 - 09/27/2019
Trap Type: CDC Light Trap
Location: Water Valley North
GPS: 40.46040652709987, -104.89776637405157

Total number of trap/nights set:	13.0
Total number of mosquitoes collected:	469.0
Average mosquitoes per trap/night:	36.1
Average Culex per trap/night:	23.9

Species collected and abundance:

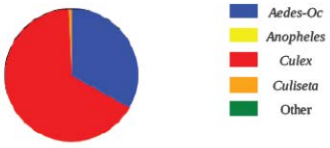
Aedes dorsalis	11.0	2.3%
Aedes vexans	144.0	30.7%
Culex pipiens	24.0	5.1%
Culex tarsalis	287.0	61.2%
Culiseta inornata	3.0	0.6%

Seasonality



Genus Proportions:

Genus	Number	Percent of Total
Aedes/Ochlerotatus	155.0	33.0%
Anopheles	0.0	0.0%
Culex	311.0	66.3%
Culiseta	3.0	0.6%
Other	0.0	0.0%



WR-18

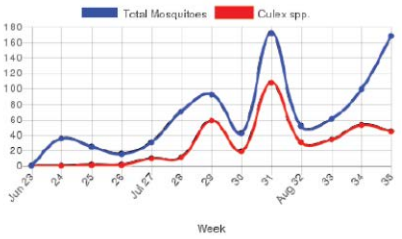
Season: 05/01/2019 - 09/27/2019
Trap Type: CDC Light Trap
Location: Water Valley South
GPS: 40.447143012577776, -104.89546068012714

Total number of trap/nights set:	13.0
Total number of mosquitoes collected:	860.0
Average mosquitoes per trap/night:	66.2
Average Culex per trap/night:	28.5

Species collected and abundance:

Aedes dorsalis	31.0	3.6%
Aedes increpitus	6.0	0.7%
Aedes melanimon	20.0	2.3%
Aedes trivittatus	1.0	0.1%
Aedes vexans	419.0	48.7%
Culex pipiens	12.0	1.4%
Culex tarsalis	359.0	41.7%
Culiseta inornata	12.0	1.4%

Seasonality



Genus Proportions:

Genus	Number	Percent of Total
Aedes/Ochlerotatus	477.0	55.5%
Anopheles	0.0	0.0%
Culex	371.0	43.1%
Culiseta	12.0	1.4%
Other	0.0	0.0%