



2014 Annual Report  
Garfield County  
Cooperative Mosquito  
Control Program  
October 2014

Colorado Mosquito Control, LLC

7000 North Broadway, Suite 108  
Denver, CO 80211

Email: [info@comosquitocontrol.com](mailto:info@comosquitocontrol.com)  
Website: [www.comosquitocontrol.com](http://www.comosquitocontrol.com)

## On the Cover:

### *A face only a mother could love.*

*A female Culex tarsalis mosquito with its distinct white banded proboscis became the face of West Nile Virus transmission in Colorado over the past decade. Although 2014 wasn't a particularly bad year for West Nile Virus in the state of Colorado the threat continues. As always CMC remains vigilant and looks toward the future to continue to successfully control mosquito annoyance and reduce the risk of West Nile Virus transmission.*

# GARFIELD COUNTY COOPERATIVE MOSQUITO CONTROL PROGRAM

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## ***GARFIELD COUNTY MOSQUITO CONTROL PROGRAM MISSION STATEMENT***

Garfield County completed its 10th year of cost effective Integrated Mosquito Management operations in 2014. Many communities across Colorado recognize the need to control mosquito annoyance and the risk of mosquito-borne disease associated with flood irrigation practices, urban development, and snow-melt runoff. Integrated mosquito management operations that utilize environmentally-sensitive controls and new technologies can greatly enhance the outdoor experience without negatively impacting the environment.

The need to protect residents and visitors from the health risks, severe annoyance and discomfort associated with biting mosquitoes is a chronic annual problem. The primary objective of the Garfield County Mosquito Control Program is to suppress populations of larval mosquitoes in aquatic habitats. CMC technicians utilize bacterial larvicides that reduce mosquito populations without harming non-target organisms. Additionally, monitoring of adult mosquito populations is an essential component of an Integrated Mosquito Management (IMM) program. Surveillance trapping performed in the Garfield County Cooperative program provides data used to assess West Nile Virus Infection Rates, as well as the need for adult mosquito control measures. Data driven response with mosquito adulticide ULV technology can reduce the threat of disease transmission and annoyance associated with mosquitoes, while reducing the necessity for large amounts of products to be applied.

### ***CMC OBJECTIVES***

With over 10 years of experience monitoring West Nile Virus in Colorado, it is clear that limiting exposure to mosquito bites is the best way to reduce the risk of disease. A well-developed mosquito management operation is only part of the picture, and CMC also emphasizes the need for personal action and protection through our educational outreach programs. *Culex Tarsalis*, the primary WNV vector in the state, is more abundant today than in the past, due to current land use practices. CMC is committed to providing top quality service, via education outreach and data driven management in an effort to minimize West Nile Virus risk and reduce mosquito annoyance in the communities where we operate and also live.

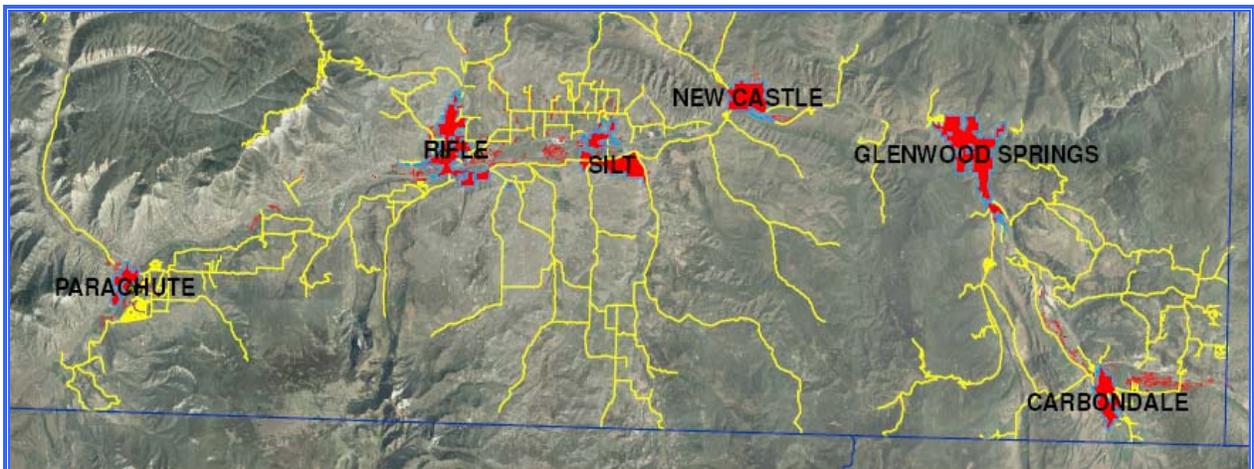
### **Colorado Mosquito Control, LLC**

Colorado Mosquito Control, LLC (CMC) is a large-scale contractor specializing in complete integrated mosquito control services. CMC utilizes an aggressive preemptive Integrated Pest Management (IPM) approach to controlling mosquito populations within contracted areas. CMC was established in 1986, is the largest private company specializing in mosquito control in Colorado, and is the only company in Colorado offering complete IPM mosquito control services.

## Cooperating Entities

CMC currently has programs across the state of Colorado including: Homeowners Associations, Incorporated Cities and Towns, Mosquito Control Districts, Counties, Indian Reservations, and others. Geographically, CMC reaches from the Ute Mountain Ute Reservation in the southwest corner of the state to Fort Morgan in northeastern Colorado. CMC has programs in several mountain areas including Aspen, the Gunnison Valley, the Roaring Fork Valley, and parts of the upper Colorado River valley.

Since the inception of Garfield County Cooperative Mosquito Control Program, efficacy of the established program has been improved with the inclusion of areas adjacent to or surrounded by previously participating areas. Current municipal participants in the Garfield County Cooperative Program are: Carbondale, Glenwood Springs, New Castle, Silt, Rifle, Parachute, Battlement Mesa and Unincorporated Garfield County. CMC has also continued to provide top quality mosquito control programs in several other Western Slope and Mountain accounts for the past 10 years and for front-range communities for almost 30. In addition, CMC has rapidly expanded to provide service to other municipalities as new mosquito control programs are initiated. CMC will maintain its commitment to provide top quality service, in an effort to minimize the threat of West Nile Virus to citizens and to reduce mosquito annoyance in Garfield County and surrounding areas.

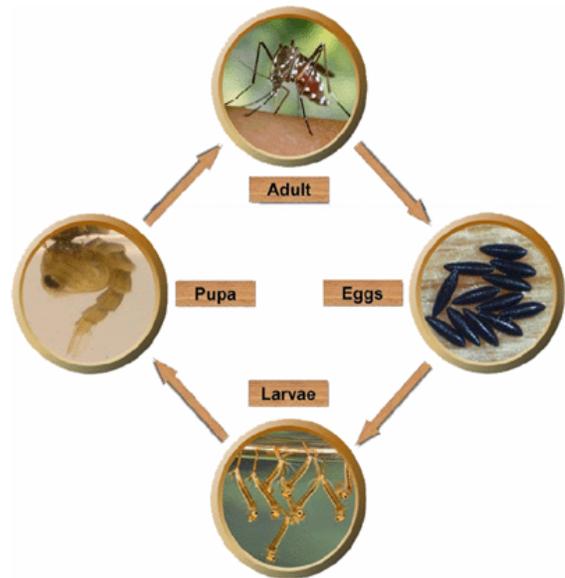


## 2014 SEASON PERSPECTIVE

At CMC 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 and control; 2014 was typical in that respect.

The 2014 mosquito season started fast with close to average June temperatures and above average snowmelt runoff, relatively few significant precipitation events and many 90+ degree days. (See Chart "2014 Garfield County Climate Data"). Area snow pack levels were above average with runoff rapidly filling many larval mosquito breeding sites in the early spring. Water levels were high through mid June and then began to drop slowly throughout July.

The majority of the mosquitoes encountered during the 2014 season were of the genus *Aedes/Ochlerotatus*. They are associated with newly applied floodwater via rain or areas of irrigation. Older standing stagnant water will often produce mosquitoes of the genus *Culex*. These are also common in most areas of the state and are the primary vector for West Nile Virus. Mosquito population trends are almost always dependent on either heavy rains (over 0.5in) or the agricultural flooding of fields for irrigation. With an above average snow pack in 2014 snowmelt runoff was a big factor in early season mosquito production, later seasonal rains throughout July and August led to increased mosquito activity in some areas that haven't been productive in several years. Due to the warm summer temperatures combined with seasonal rains and irrigation 798.9 acres required treatment within the service area of the Garfield County Cooperative Mosquito Control Program in 2014 compared with 663.8 acres in 2013. (See *Site Comparison by Year* in the Appendix).



Throughout the month of August there were many small rain events and cooler temperatures than average. This led to increased mosquito activity as water levels were constantly changing and many breeding areas remained wet longer than a typical year. Mosquito larval production in containers and other man made habitat filled by the rains and holding standing water was another challenge this season brought on by steady light precipitation that wasn't much of an issue last year. Anticipating and understanding snowmelt runoff and significant rainfall events and the resulting effect it will have on mosquito populations is one of CMC's primary objectives to tailor the perfect program for Garfield County .

Although precipitation was above average the cool temperatures in September resulted in a major decrease of mosquito populations by late in the month. The season came to a close on September 30<sup>th</sup> as daytime temperatures often dipped into the 60's and 70's with night time temperatures dropping into the 30s throughout the control area.

## 2014 Field Activities

Field activities began in March for the 2014 season. The earliest activity of the season involved updating and revising all GIS maps. In addition, new site identification and mapping was a priority that included mapping several areas that had not previously been included in larval control operations. Mapping larval sites is an ongoing process; every year citizen reports of new areas of standing water, new construction and site destruction result in new sites being added or removed from the existing larval inspection routes.

Hiring of seasonal technicians began in April, and continued into May. As the CMC service area continues to grow, hiring an adequate number of top quality field technicians has become a challenge. For the Garfield County office, over 25 applicants were interviewed with 8 full-time technicians being hired; three of which were returning technicians from last year.

CMC's Annual Field Technician Classroom Training Day took place on Monday, May 19th with over 75 new and returning field technicians in attendance. Field training by CMC management and veteran employees lasted throughout May, with a few late hires being trained during early June. By the end of May, CMC was fully staffed and had full daytime and evening shift crews fully trained and in the field. During the early June to mid September time period, field mosquito control operations were in full swing. The final day for larval inspections and control was Thursday, September 18th. However, several adult control measures were required through the end of September to control a few small "hot spots" where mosquitoes were still active.

Mosquito trapping was planned through September 5th; however cool temperatures and an overall decrease in adult populations effectively eliminated the final week of trapping and associated adult spraying operations. By the second week of September, mosquito annoyance calls declined to zero.

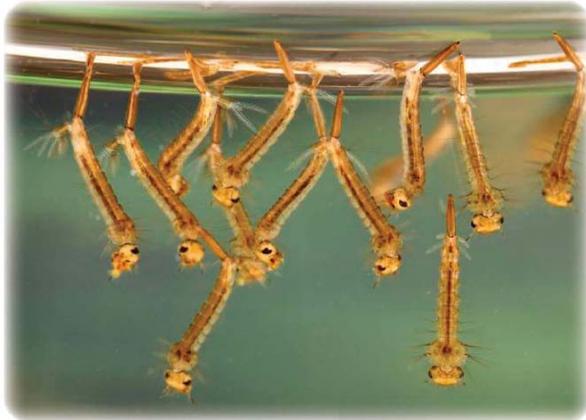


# WEST NILE VIRUS

## *Background*

West Nile Virus (WNV) was first identified in Uganda in 1937. Since that time, activity has been documented throughout Africa, Europe, West and Central Asia, and areas of the Middle East. The virus made its first appearance to North America in 1999 when it was documented in New York City. WNV comes from a family of viruses known as Flaviviridae and is closely related to other viruses which can have severe effects on both humans and animals such as Japanese Encephalitis and St. Louis encephalitis.

WNV has a wide range of symptoms which can range from mild flu like symptoms to death. Of humans affected, nearly 80% will show no symptoms at all. The majority of people who do show symptoms will usually suffer from flu like symptoms. However, approximately 1% of people will develop much more severe symptoms including meningitis (inflammation of the linings surrounding the brain and spinal cord), encephalitis (inflammation of the brain), or very rarely poliomyelitis which can cause paralysis in parts of the body.



Since the introduction of WNV to the United States in New York City 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 progressed through the South, the Midwest, the Rocky Mountain region, and now the Western States. WNV activity has been documented in all US states except Alaska and Hawaii.

Colorado first saw activity of the virus late in the summer of 2002. In 2003 Colorado was the hardest hit state compiling 2,947 human cases and 63 deaths most of which occurred along the Front

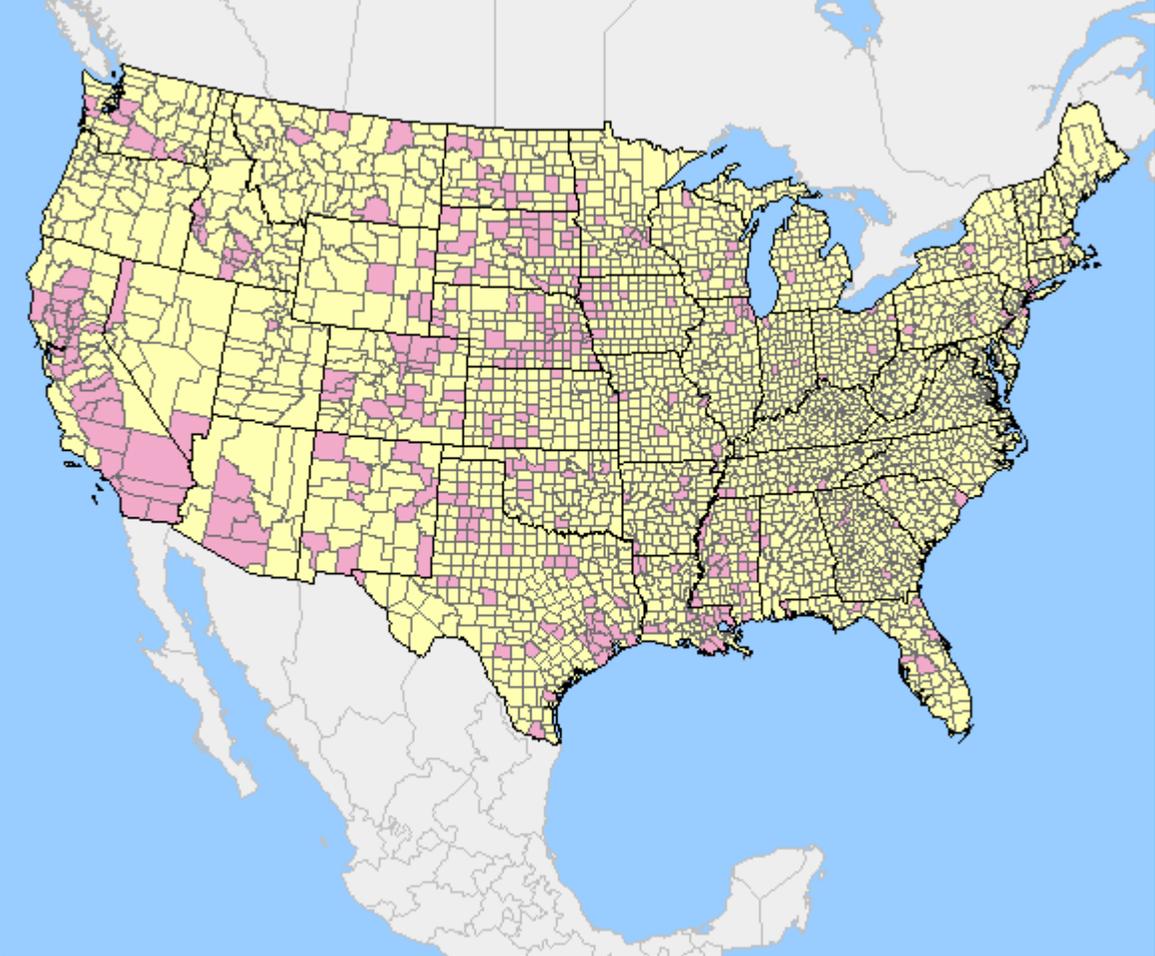
Range. By 2004 the majority of the cases shifted to the Western Slope and the state totaled 291 cases with 4 deaths (Mesa County).

## *West Nile Virus 2014*

Cases of West Nile Virus have been seen throughout a large portion of the United States in 2014. States with the most reported West Nile Virus cases include: California, Texas, Louisiana and Colorado. As of September 30<sup>th</sup> there were a total of 1177 cases in the United States this year compared to 2469 total for last year.

In Colorado in 2004 and 2005 West Nile activity was spread throughout the state with no particular clustering in any one region. This season in spite of a high rate of West Nile Virus detected in adult mosquito populations in Colorado the number of human cases was relatively low. However, there were still a significant number of cases reported to state and local health departments. Counties reporting the highest numbers of human cases were located along the Colorado Front Range but people were also infected in Mesa, Delta and Montrose Counties on the western Slope of Colorado. There have been no positive human or animal cases reported in Garfield, Eagle, or Pitkin Counties at the time of this report. As of September 30<sup>th</sup> there have been 90 confirmed human cases (most of which were observed in adults between 35 and 70yrs old) and 2 deaths in Colorado. The 2014 West Nile infection rate was lower than what we saw in 2013, with 322 human cases and 7 deaths in Colorado reported to the CDC.

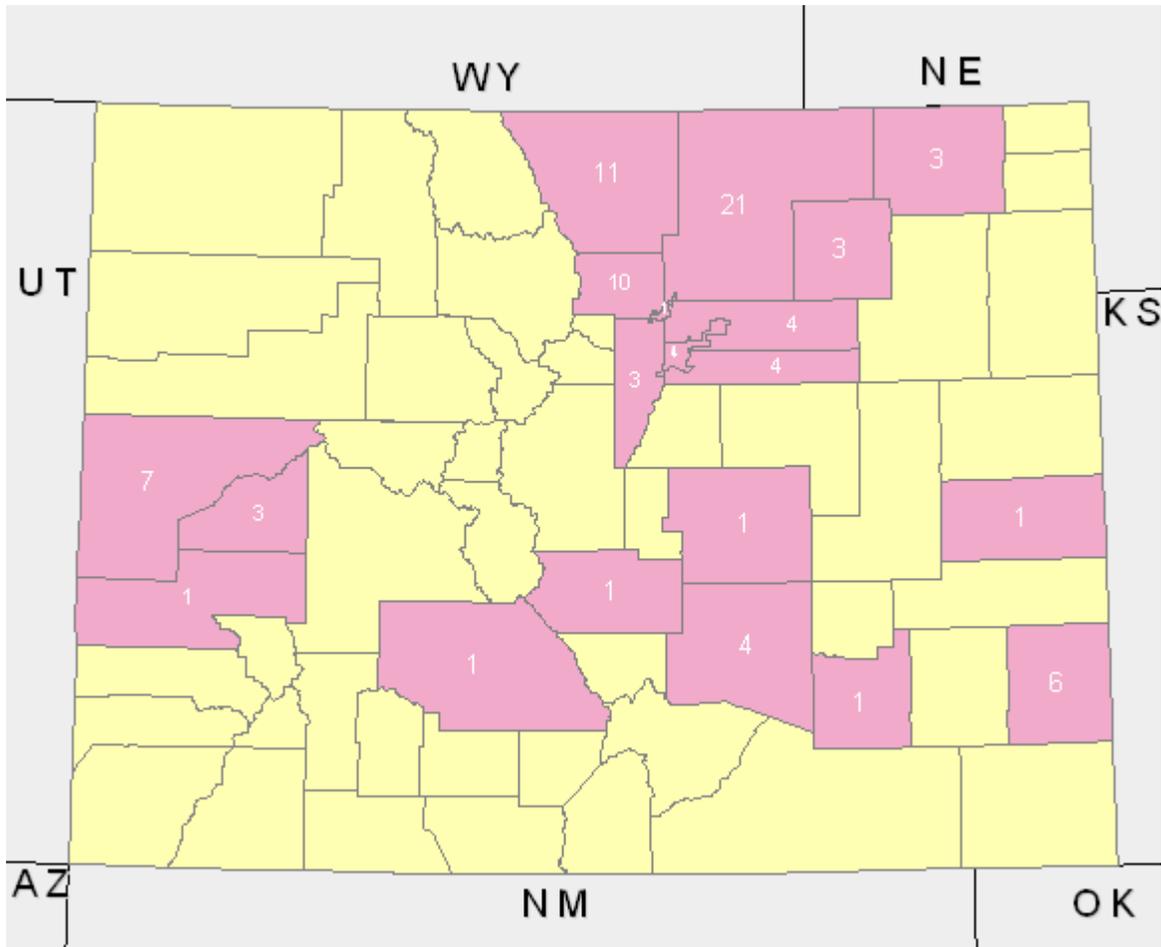
**COUNTIES WITH HUMAN WEST NILE VIRUS (WNV) CASES REPORTED TO ARBONET, BY STATE, UNITED STATES, 2014 (AS OF OCTOBER 1, 2014)**



Source: [http://diseasemaps.usgs.gov/wnv\\_us\\_human.html](http://diseasemaps.usgs.gov/wnv_us_human.html)

# Human West Nile Virus Infections: Colorado 2014

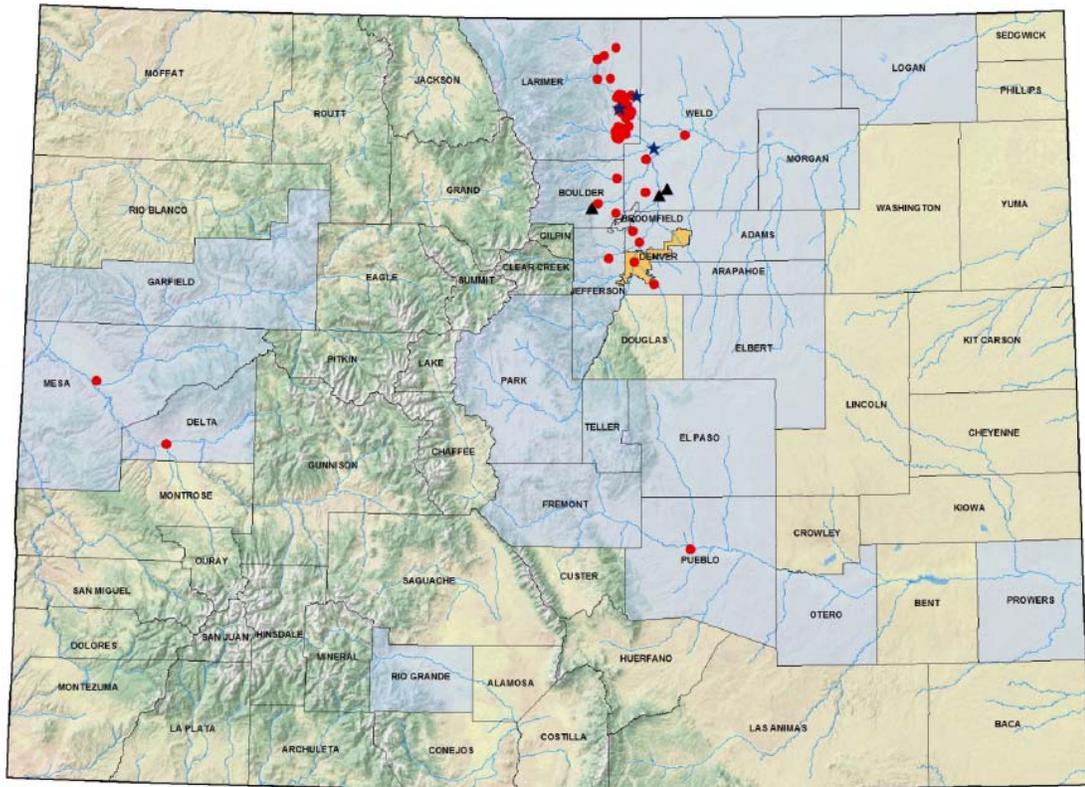
Updated October 1, 2014



Source: <http://diseasemaps.usgs.gov>

# ADULT MOSQUITO SAMPLING AND WEST NILE TESTING 2014

## West Nile Virus Mosquito and Animal Surveillance in Colorado



**201 West Nile Virus Positive Specimens**

- Mosquito
- ★ Bird
- ▲ All Other Specimens

Counties Testing Mosquitoes Only
Counties Testing Specimens

Source: [www.colorado.gov](http://www.colorado.gov)

## Human West Nile Virus Infections: Colorado, September 19, 2014

County of Residence	Clinical Diagnosis			Total Cases	Total Deaths
	Fever	Meningitis	Encephalitis		
Adams	1	1	1	3	
Arapahoe	3	1		4	
Boulder	7	3		10	
Broomfield			1	1	
Delta	2			2	
Denver	1	1	1	3	1
El Paso			1	1	
Fremont	1			1	
Jefferson		2	1	3	
Larimer	10	1		11	
Logan	1	1	1	3	
Mesa	2	4	1	7	
Montrose		1		1	
Morgan	1	1	1	3	
Prowers	3			3	
Pueblo	1		1	2	1
Saguache	1			1	
Weld	14	1	5	20	
<b>COLORADO TOTAL</b>	<b>48</b>	<b>17</b>	<b>14</b>	<b>79</b>	<b>2</b>

*Counties not listed have no verified human cases of WNV*

Source: [www.colorado.gov](http://www.colorado.gov)

## LARVAL MOSQUITO CONTROL

Years of research and practical experience have shown that the most effective way to control mosquito populations is through an aggressive Integrated Pest Management (IPM) approach. This approach aims at using a variety of concepts, tools, and products to reduce a pest population to tolerable levels. Translating these ideas to mosquito control, CMC has found the most environmentally and economically sound approach is through targeting the aquatic larval stage of the mosquito. Targeting this stage prevents the emergence of the adult mosquito and thus the inevitable result of disease and nuisance. Over 90% of Colorado Mosquito Control, LLC (CMC) operational efforts are focused on larval control.

Larval mosquito control can be achieved in several ways including biological, biochemical, chemical and mechanical means. Although there are a variety of methods for reducing larval populations, some options may have greater consequences than benefits. Mechanical or habitat modification is a technique which may be used, but the area to be modified and the extent to which the work will affect the surrounding area must be carefully assessed. Permanent ecological damage may occur if extensive habitat change has taken place. True biological controls may also have non-target effects that outweigh the benefits of their control capacity. The biological control agent, if not carefully selected and evaluated may cause an imbalance in the natural ecological community, as well as threaten population levels of other organisms.



This was the case with the introduced mosquito fish (*Gambusia affinis*), an introduced species, while an effective predator on mosquito larvae it may have much larger dangers to native fish of Colorado waters. The *Gambusia* fish are very aggressive eaters and rapidly reproduce and often out-compete their native counterparts. For these reasons the Colorado Division of Wildlife (CDOW) has placed restrictions on the stocking and use of *Gambusia*. However, CMC has made fathead minnows (*Pimephales promelas*), a native Colorado species, available to the public to stock in irrigation and retention ponds. In general however, predatory fish and other biological controls such as birds and bats do not provide sufficient control of mosquito populations to be used as the sole mechanism. Other measures need to be used to gain adequate larval mosquito reductions.

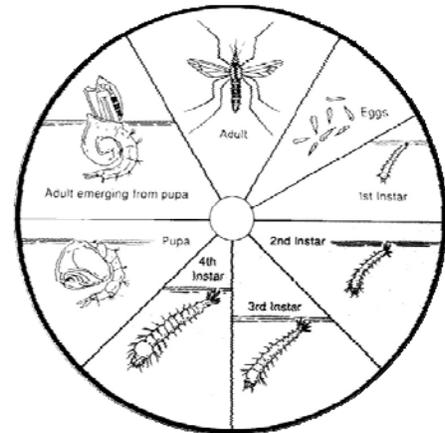
CMC's favored method of larval mosquito control is through bacterial bio-rational products. The main product used by CMC is a variety of bacteria (*Bacillus thuringiensis var. israeliensis*). *Bti* as it is known has become the cornerstone of mosquito control programs throughout the world. The benefits include its efficacy and lack of environmental impacts. When used properly successful control without impact to aquatic invertebrates, birds, mammals, fish, amphibians, reptiles or humans can be achieved. 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)*. In addition to all of the benefits of *Bti*, *Bs* is by definition a true biological control agent in that it remains in the system through multiple broods, or generations, of mosquitoes. Unfortunately the residual benefit of the control comes at a cost in price of approximately three times that of *Bti*.

Other larval control products include a growth regulator (methoprene), a mineral oil and an organophosphate (Abate). Methoprene is a synthetic copy of a juvenile growth hormone in larval mosquitoes. The hormone prevents normal development of the adult mosquito in the pupal stage eventually causing death. While a good control product, the cost is prohibitive to be the predominant product in a large scale program. Abate, the one chemical larval control product CMC uses, serves as an effective product, but label restrictions limit its use in many areas. CMC limits the use of chemical larvicides to areas with little biodiversity, such as road side ditches, or areas which chronically

produce large amounts of mosquitoes and use them only as a last resort when other solutions are not present. The benefits of these products are the availability of 30 and 150 day formulations. Mineral oil is the only product effective on the pupal stage and therefore is an essential tool when pupae are found.

All of the fore mentioned methods and products represent the essential ingredients of Integrated Pest Management. Mosquitoes are very well adapted and can be found in many different habitat types from a cattail marsh to a cup littered on the side of the road. A variety of tools must be used to prevent resistance and ensure the best method will be available for any given situation.

Larval control began the first week of April and continued though the second week of September. Steady production was seen throughout the summer with significant increases in larval production/treatment coinciding with minor precipitation events and local irrigation practices. During the 2014 season, there were 4,409 site inspections with 86.3% (3,807) of them wet. Of the 3,807 wet sites 57.4% (2,205) of them required treatment totaling 798.9 acres treated in Garfield County.



**Colorado Mosquito Control, Inc.**

## Larval Data - Summary

by REPORT DATE: 4/1/2014 to 9/30/2014

by ACCOUNT: BM, CD, GF, GW, NC, PR, RF, SI

	Total Site Inspections	Wet Sites	% Wet	Sites Treated	Percentage Breeding*	Acres Treated	Total Kill (Millions)
Battlement Mesa	78	74	94.9 %	42	56.8 %	17.3	37.1
Carbondale, Town of	555	520	93.7 %	230	43.5 %	58.3	62.1
Garfield County Unincor	2,250	1,887	83.9 %	1,171	61.6 %	495.8	1,092.2
Glenwood Springs, City	77	63	81.8 %	22	34.9 %	8.2	13.0
New Castle, Town of	351	312	88.9 %	158	50.6 %	30.8	56.3
Parachute, Town of	150	142	94.7 %	110	77.5 %	51.1	136.7
Rifle, Town of	801	680	84.9 %	386	56.0 %	110.4	521.4
Silt, Town of	147	129	87.8 %	86	66.7 %	27.1	42.6
	<b>4,409</b>	<b>3,807</b>	<b>86.3 %</b>	<b>2,205</b>	<b>57.4 %</b>	<b>798.9</b>	<b>1,961.5</b>

CMC constantly strives to improve its operations. Most recently CMC has implemented several high tech solutions to what historically has been a particularly low tech operation. CMC's "CMMS" (Computerized Mosquito Management System) utilizes historical data to analyze and identify areas and sites of particular importance. Additionally, a sample of larvae from sites found to be breeding is collected and brought back to the lab for identification purposes. This allows for a specific knowledge of each site especially in the event of a disease outbreak where a particular species has been found to be the vector. Targeted inspections then allow for resources to be allocated efficiently.

## CMC SURVEILLANCE LABORATORY

Information on mosquito abundance and species identity is critical in the operation of a successful mosquito management program. Over the past few years identifying, packaging and sending *Culex* mosquito pool samples to the CDPHE or CSU labs for West Nile Virus testing has also become critically important in the battle against WNV and other mosquito-borne diseases. The Colorado Mosquito Control Surveillance Laboratory, managed by Dr. Michael "Doc" Weissmann, has become the largest single source of adult and larval mosquito surveillance data in the state of Colorado. Specifically, CMC has 4 stereo zoom binocular microscopes, 94 CDC dry-ice baited Light Traps, 21 Reiter Gravid Traps and all associated equipment and hardware.

The CDC light trap 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<sub>2</sub>, the mosquitoes are lured by a small light to a fan that pulls them into a net for collection. The Gravid Trap uses 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 identified by technicians trained to recognize the Colorado mosquito species.



In 2014, Colorado Mosquito Control LLC monitored a statewide network of CO<sub>2</sub> baited light traps in which all adult mosquitoes were counted and identified to species by the CMC Surveillance Laboratory. 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 Laboratory at Colorado Mosquito Control, LLC are trained to provide accurate species-level identification of mosquito specimens, for both adults and larvae. More than 50 mosquito species are believed to occur in Colorado, many of which were identified from samples processed during the 2014 season across the state.



Additionally, the CMC Surveillance Laboratory conducts an intensive larval identification program with over 8,000 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 effectiveness 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 which helps illustrate the threat of mosquito-borne disease amplification and transmission.
- Determining where adult control efforts were necessary. While mosquito eradication is impossible, significant population reduction is achievable. In places where larval control was insufficient, especially in neighborhoods where adult mosquitoes migrated in from larval sources outside of the control area, it may be necessary to use adulticide methods such as ULV truck fogging or barrier sprays of nearby harborage areas. Trap counts that were in excess of an acceptable threshold for the area would trigger adult control measures.
- Surveillance for Mosquito-borne Disease. Historically, CMC 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. Additionally, a majority of the *Culex* specimens collected in the CMC traps during the 2014 season were sent to the CO State Health Department laboratory or one of the regional county laboratories to be tested for West Nile Virus and other mosquito-borne diseases.

## CDC Surveillance Light Trap Data Comparison

In 2014, 11 surveillance light trap locations monitored adult mosquito populations within Garfield County weekly. Weather permitting, CDC battery-operated "light traps" were set in each location to provide adult mosquito population data for seasonal comparisons. Surveillance trapping began the first week of June and was concluded on August 27<sup>th</sup> when the final specimens were sent to the lab for identification.

In 2014, 11 surveillance light traps were set within Garfield County, which collected 166937 total mosquitoes. The average number of mosquitoes collected per trap per night was 127 and the average number of *Culex* mosquitoes collected per trap per night was 42. The percent composition of mosquitoes collected in 2014 is as follows: 64.7% (10802) *Aedes/Oc. Spp*, 33.1% (5520) *Culex*, 1.9% (311) *Culiseta*. Please refer to the CDC Light Trap Details for species composition and seasonal trends by individual surveillance trap location.

### 2014 Garfield CDC Trap Composite Data

Total number of trap/nights set:	131
Total number of mosquitoes collected:	16,693
Average mosquitoes per trap/night:	127
Average Culex per trap/night:	42

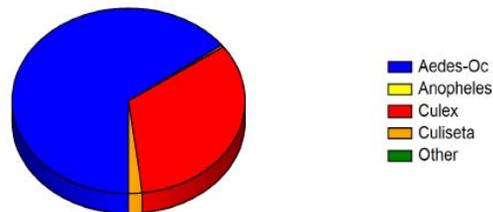
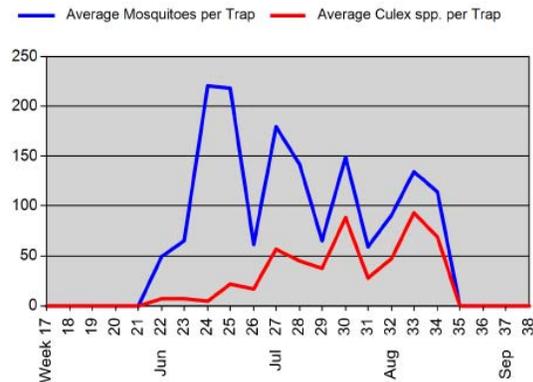
#### Species collected and abundance:

<i>Aedes (Oc.) campestris</i>	9	0.1 %
<i>Aedes (Oc.) dorsalis</i>	436	2.6 %
<i>Aedes (Oc.) fitchii</i>	5	0.0 %
<i>Aedes (Oc.) hendersoni</i>	6	0.0 %
<i>Aedes (Oc.) increpitus</i>	127	0.8 %
<i>Aedes (Oc.) intrudens</i>	1	0.0 %
<i>Aedes (Oc.) melanimon</i>	1141	6.8 %
<i>Aedes (Oc.) nigromaculis</i>	4	0.0 %
<i>Aedes (Oc.) spencerii idahoensis</i>	110	0.7 %
<i>Aedes (Oc.) trivittatus</i>	5	0.0 %
<i>Aedes cinereus</i>	7	0.0 %
<i>Aedes vexans</i>	8942	53.6 %
<i>Aedes/Ochlerotatus spp</i>	9	0.1 %
<i>Anopheles earlei</i>	2	0.0 %
<i>Anopheles hermsi</i>	58	0.3 %
<i>Culex arthropothorax</i>	2559	15.3 %

#### Genus proportions:

Genus	Number	Percent of Total
<i>Aedes/Ochlerotatus</i>	10,802	64.7 %
<i>Anopheles</i>	60	0.4 %
<i>Culex</i>	5,520	33.1 %
<i>Culiseta</i>	311	1.9 %
Other	0	0.0 %

#### Seasonality



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## 2014 ADULT CONTROL

The goal of Colorado Mosquito Control, LLC is to provide all residents of Garfield County with the best options for safe, effective, modern mosquito management. The primary emphasis of the program is to control mosquitoes in the larval stage, using safe biological control products. This environmentally focused program maintains adulticiding applications as a final resort when mosquito populations surpass nuisance or risk thresholds. Mosquito surveillance trapping results are used to make data-driven decisions regarding areas that need to be sprayed for adult mosquito control. Adult mosquito control spraying is targeted to specific sectors determined by this trap data, thereby reducing the area sprayed and the frequency of spraying in each sector.

The Garfield County Mosquito Control Program uses all available data from CDC light traps, gravid traps, Mosquito Hotline annoyance calls and field technician reports to focus adult mosquito control efforts to specific, very limited "targeted" areas. In parts of the community where high numbers of mosquito annoyance calls are received, "floater" CDC light traps are set to evaluate adult population levels and species make-up. In many cases, a direct correlation is evident between areas with high complaint calls and high trap counts. While this correlation allows us to focus adult control in these areas, the emphasis is placed on finding the larval habitat sources of the trapped adults and continued larval control measures.

Colorado Mosquito Control, LLC uses state of the art technology, calibrated application timing and least-toxic products to minimize 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.

During the 2014 season adult mosquito control measures were regularly required in specific problem areas within the Garfield County Cooperative service area. The product Evoluer 4-4 ULV was used when an Ultra Low Volume (ULV) "fogging" application was deemed necessary. Its active ingredient permethrin is highly effective against mosquitoes and has proven that this is the right choice for the main adulticide portion of the Integrated Mosquito Management Program. Another important product used within Garfield County was Talstar P which was applied as a barrier treatment to harborage in specific limited areas, as requested by local municipalities to protect special outdoor events. The active ingredient in Talstar P (Bifenthrin) provides a longer lasting residual treatment compared to ULV applications. Barrier sprays are only used when mosquito annoyance is high, the possibility of West Nile Virus transmission is elevated, and ULV applications have been insufficient or cannot be carried out in the problem area.

As we look towards the 2015 season, we will continue to evaluate treatment areas and new control products coming to the market. As always we will listen to the goals and needs of our customers so as to continue to provide an effective program that minimizes environmental impacts.

Our adult mosquito spray "notification and shutoff" program was again in place and updated throughout 2014. This service allows residents to request a notification of when adult mosquito control treatments will take place in their area, "shutting off" the sprayer in the vicinity of their address, or both. This service provides residents with up to date information on when and where adult mosquito spraying will take place.

# TECHNOLOGY

Colorado Mosquito Control, LLC has strived to improve the programs offered to its customers with novel and progressive advancements, continually evaluating and implementing new products and new technologies, not only with regard to control efforts but also for data processing and information reporting. CMC shares the belief that timely information should be accessible to customers and residents, so that the people who fund the programs can access the work that is being performed. CMC also believes that the ability to access the data will improve both the resident's and municipality's ability to stay informed about West Nile Virus risk in their community.

## CMC WEBSITE

Our website, [www.comosquitocontrol.com](http://www.comosquitocontrol.com) is the leading website in the State of Colorado when it comes to providing up-to-date, factual and comprehensive information on, and links to, mosquito biology and control, mosquito-borne diseases, pesticide toxicology information and a wealth of topics relating to mosquitoes. Our website continues to be an integral tool for the dissemination of operational data to the citizens we serve, minimizing the resource and time required by the city and its employees for answering or fielding public inquiries.

**Colorado Mosquito Control, Inc.**  
Environmental Solutions to Nature's little problems  
Protecting Colorado from Annoyance and Disease Since 1986

**Home Page**

**Colorado Mosquito Control, Inc.** is a large-scale mosquito control contractor and consultant established in 1986. CMC specializes in full service Integrated Mosquito Management programs designed to control nuisance and disease vector mosquitoes while protecting our Colorado environment. CMC employs multiple wildlife Biologists, a PhD Entomologist, 10 state certified "Qualified Supervisors", and over 100 Entomology, Biology and Public Health technicians to serve over 80 county, municipal, commercial and residential HOA clients throughout the State of Colorado.

**Large-scale Mosquito Control Program Services include;**

- Survey & Digital Mapping Featuring **ArcGIS®** (Geographic Information System)
- Comprehensive "Computer Targeted" Wetland Site Inspection
- Adult Mosquito Population Surveillance
- Aerial and Ground-based Biological Larval Mosquito Control
- Aerial and Ground-based ULV Adult Mosquito Control
- Full Taxonomic Identification & Laboratory Services
- Computer-based Record Keeping and Database Services
- Public Health Emergency Large Scale Control Applications

**Small-scale Mosquito Control Services include;**

- Residential Homeowner Maintenance Contracts
- Special Event Adult Mosquito Control Applications
  - Fairs, Concerts & Special Events
  - Corporate Events
  - Backyard Weddings, Parties & Barbeques
- Adult & Larval Mosquito Spot-treatments

**Professional Consulting Services (available World-wide)**

**Green Power PARTNERS**

## PUBLIC OUTREACH & DATA DISSEMINATION

For almost 30 years, CMC has demonstrated that strong public outreach programs, quality data dissemination and outstanding customer service standards are the keys to success in providing large-scale municipal mosquito control programs. Citizen feedback, inquiry and satisfaction surveys aid in evaluating the effectiveness of our program. CMC constantly looks for ways to better serve the communities we work with and appreciates the citizen involvement in improving the programs we offer. We have clearly demonstrated this commitment by proactively incorporating numerous innovative programs, activities and services into the Garfield County Mosquito Control Program.

### CALL NOTIFICATION & SHUTOFF SYSTEM

CMC maintains a comprehensive Call Notification & Shutoff database, and will notify residents on this list whenever ULV adulticide spray applications will be conducted within 2 blocks of their property or within the effective ULV spray drift distance (300-500 ft depending on wind speed and direction). All Shutoff locations are mapped in ArcView GIS and updated annually. Call & Shutoff forms are available online and may be submitted via the CMC website or by mail.

### FLOATER TRAP PLACEMENT

For annoyance reports at resident homes in locations away from standard trapping sites, to determine adult populations and whether threshold levels are met for ULV Adulticide applications.

### MONTHLY & ANNUAL REPORTS

Detailed monthly reports are distributed to each municipality participating in the mosquito control program, and a comprehensive annual report detailing the season and with suggestions for program improvements for future years.



## SUMMARY

We have learned a lot since the inception of Garfield County Cooperative Mosquito Control Program, and have made some great improvements; with both nuisance control and mosquito borne disease information. Work will always continue in the arena of public education, notification and dissemination of information about personal protection and the mosquito control program itself. The Colorado Mosquito Control, LLC website continues to be successful based on the number of "hits," favorable e-mails and requests for more information received from program residents.

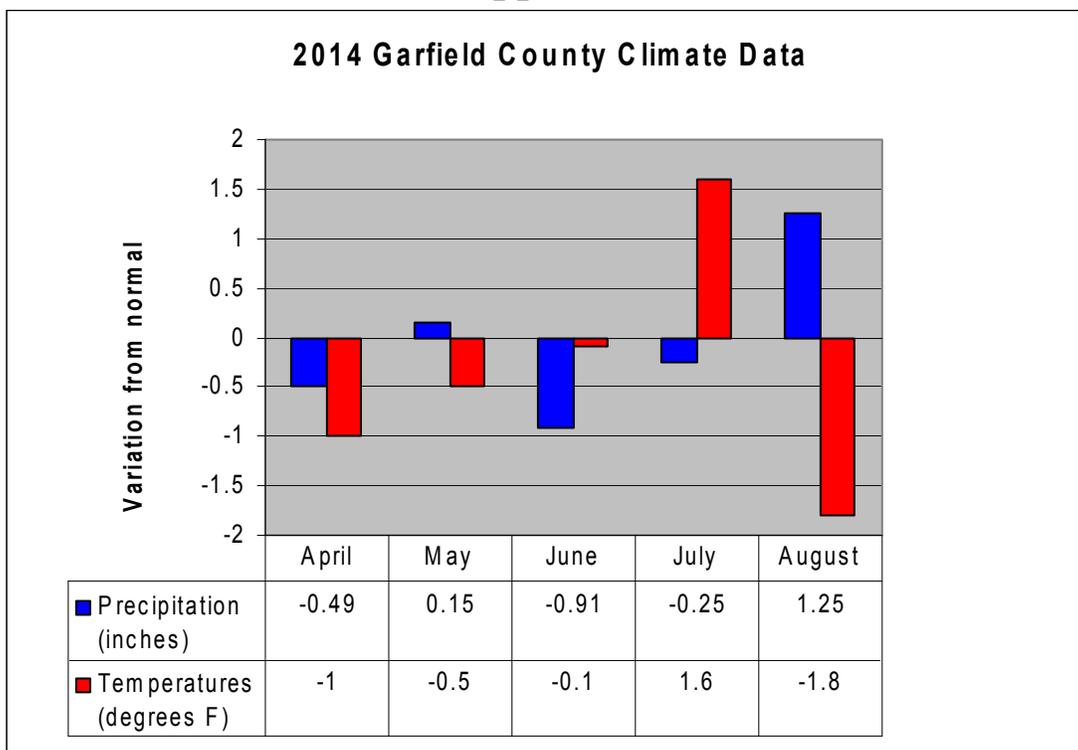
The 2014 season could be described as a fairly challenging season for the mosquito control industry throughout the state. Due to the fact that Colorado experienced above average snowfall in the mountains last winter there was higher than average runoff filling mosquito larval sites along the Colorado River and its tributaries to levels not seen in several years. Additionally the high water levels led to more irrigation water in fields, ponds, and ditches, which then combined with sustained warm temperatures and sporadic rains to produce almost ideal conditions for mosquito activity. Although it was a challenging season, the overall number of West Nile vector mosquitoes (genus Culex) was lower in the 2014 season than it was in 2013, and in fact lower than the past six seasons. This success in 2014 was due in a large part to CMC's concerted effort to use new techniques and additional control measures in areas that have been historically shown to produce Culex mosquitoes during times when the threat of West Nile Virus is the highest. These positive results were especially evident after reviewing and comparing the mosquito surveillance data accumulated over the past 10 years.

It is difficult to predict what challenges and obstacles will present themselves in the coming seasons. With that in mind we here at Colorado Mosquito Control will continue to improve and stay adaptive to whatever conditions the future holds.

Colorado Mosquito Control, LLC continues to effectively serve the residents of Garfield County using Integrated Mosquito Management technology to reduce mosquito nuisance and the related potential for disease transmission including West Nile Virus. CMC continues to promote a responsible IPM approach to mosquito management, fully utilizing all available biological control techniques while minimizing the use of chemical pesticides and maintaining an efficient cost effective program.

Colorado Mosquito Control, LLC would like to thank Garfield County for their support and business over the past ten years; and we look forward to working with Garfield County in the future.

## Appendix



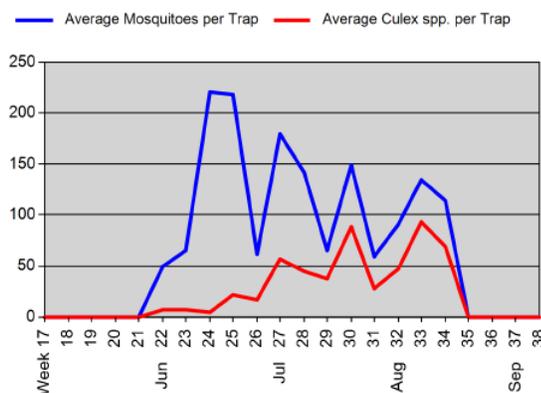
### 2014 Garfield County Light Trap Composite Data

Total number of trap/nights set: 131  
 Total number of mosquitoes collected: 16,693  
 Average mosquitoes per trap/night: 127  
 Average Culex per trap/night: 42

**Species collected and abundance:**

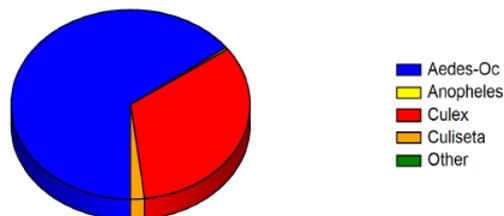
<i>Aedes (Oc.) dorsalis</i>	436	2.6 %
<i>Aedes (Oc.) increpitus</i>	127	0.8 %
<i>Aedes (Oc.) melanimon</i>	1141	6.8 %
<i>Aedes (Oc.) spencerti idahoensis</i>	110	0.7 %
<i>Aedes (Oc.) increpitus</i>	127	0.8 %
<i>Aedes vexans</i>	8942	53.6 %
<i>Aedes/Ochlerotatus spp</i>	46	0.3 %
<i>Anopheles earlei</i>	2	0.0 %
<i>Anopheles hermsi</i>	58	0.3 %
<i>Culex erythrorhox</i>	2559	15.3 %
<i>Culex pipiens</i>	21	0.1 %
<i>Culex salinarius</i>	227	1.4 %
<i>Culex tarsalis</i>	2713	16.3 %
<i>Culiseta incidens</i>	7	0.0 %
<i>Culiseta inornata</i>	304	1.8 %

#### Seasonality



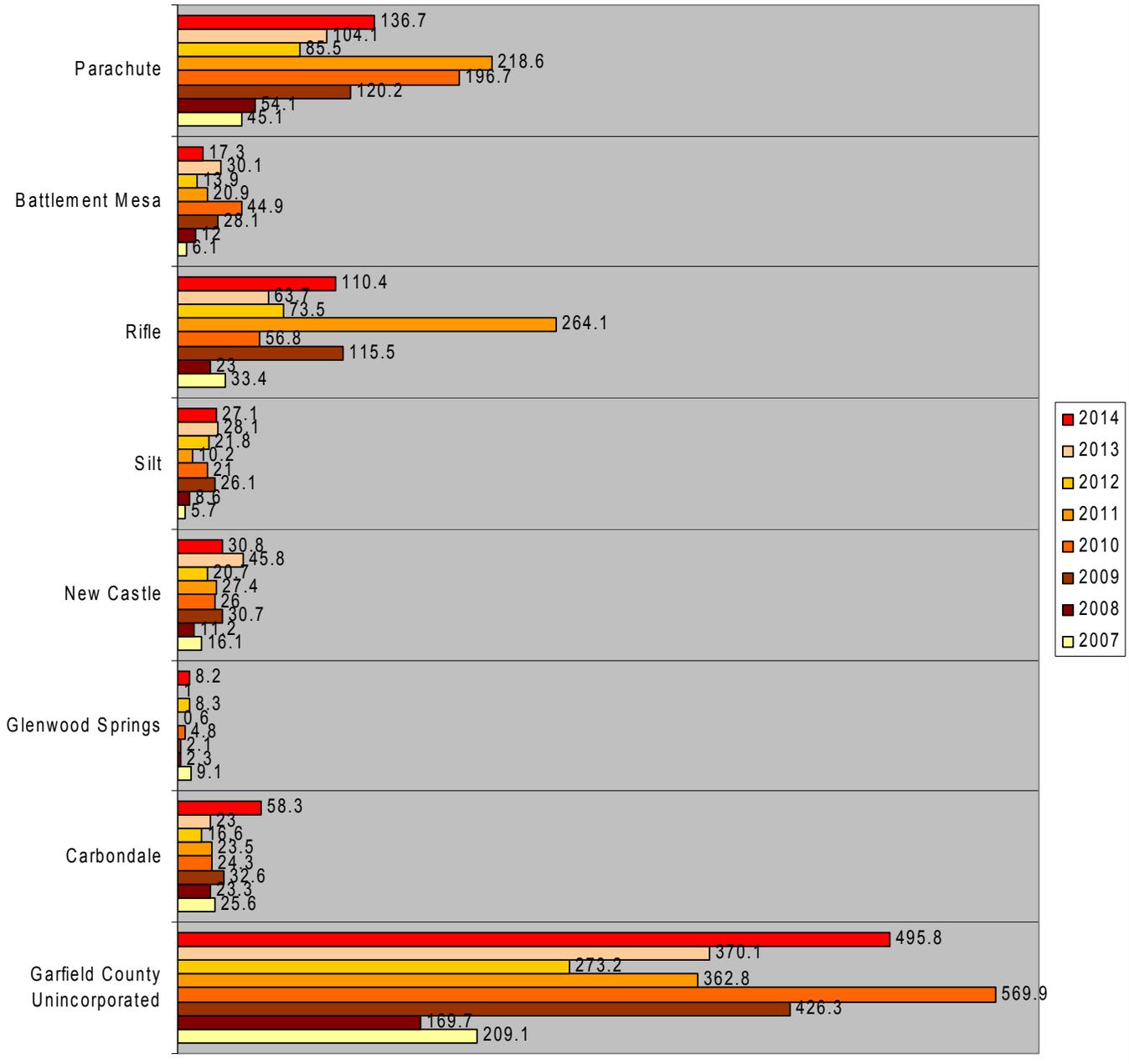
**Genus proportions:**

Genus	Number	Percent of Total
<i>Aedes/Ochlerotatus</i>	10,802	64.7 %
<i>Anopheles</i>	60	0.4 %
<i>Culex</i>	5,520	33.1 %
<i>Culiseta</i>	311	1.9 %
Other	0	0.0 %

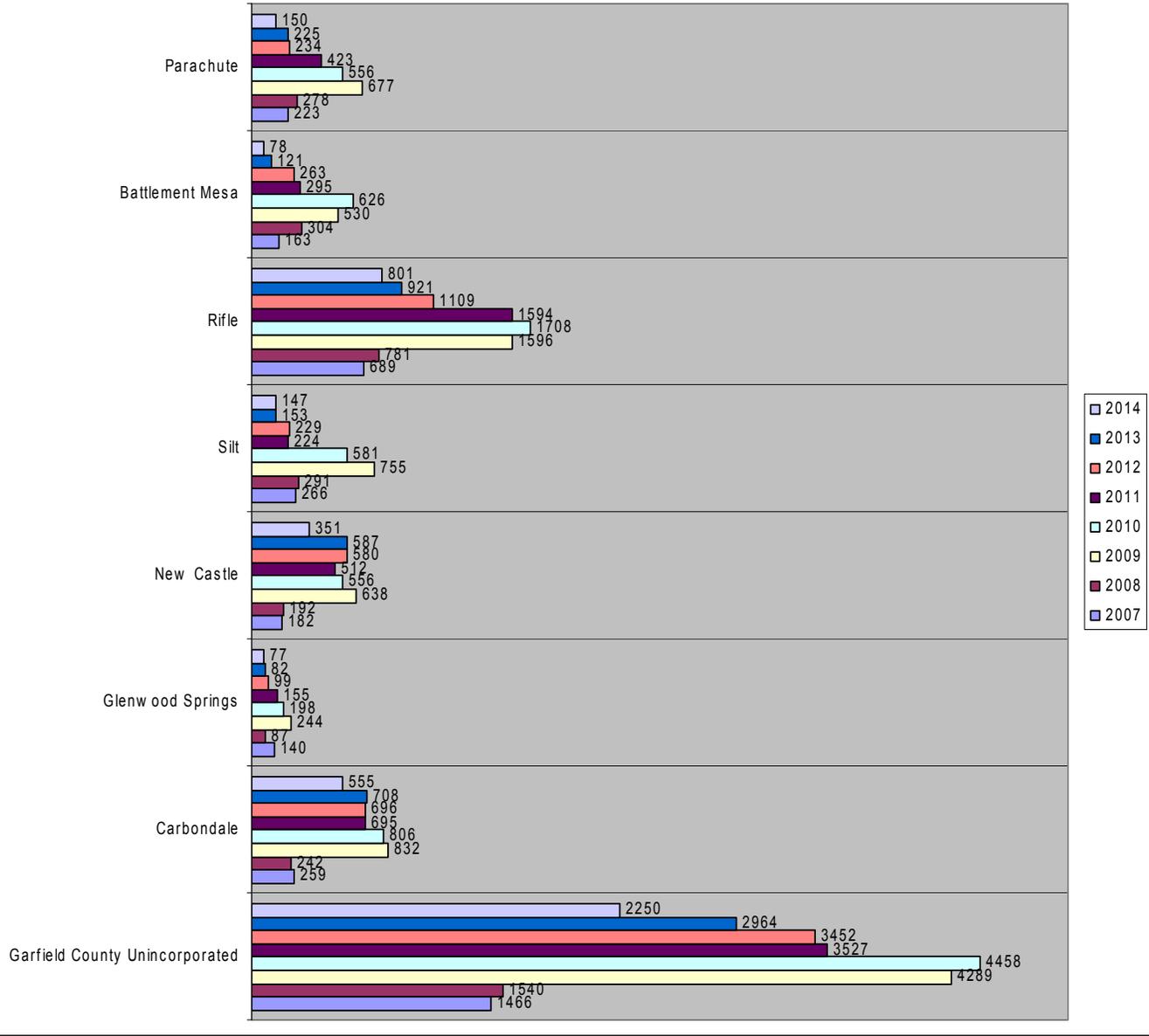


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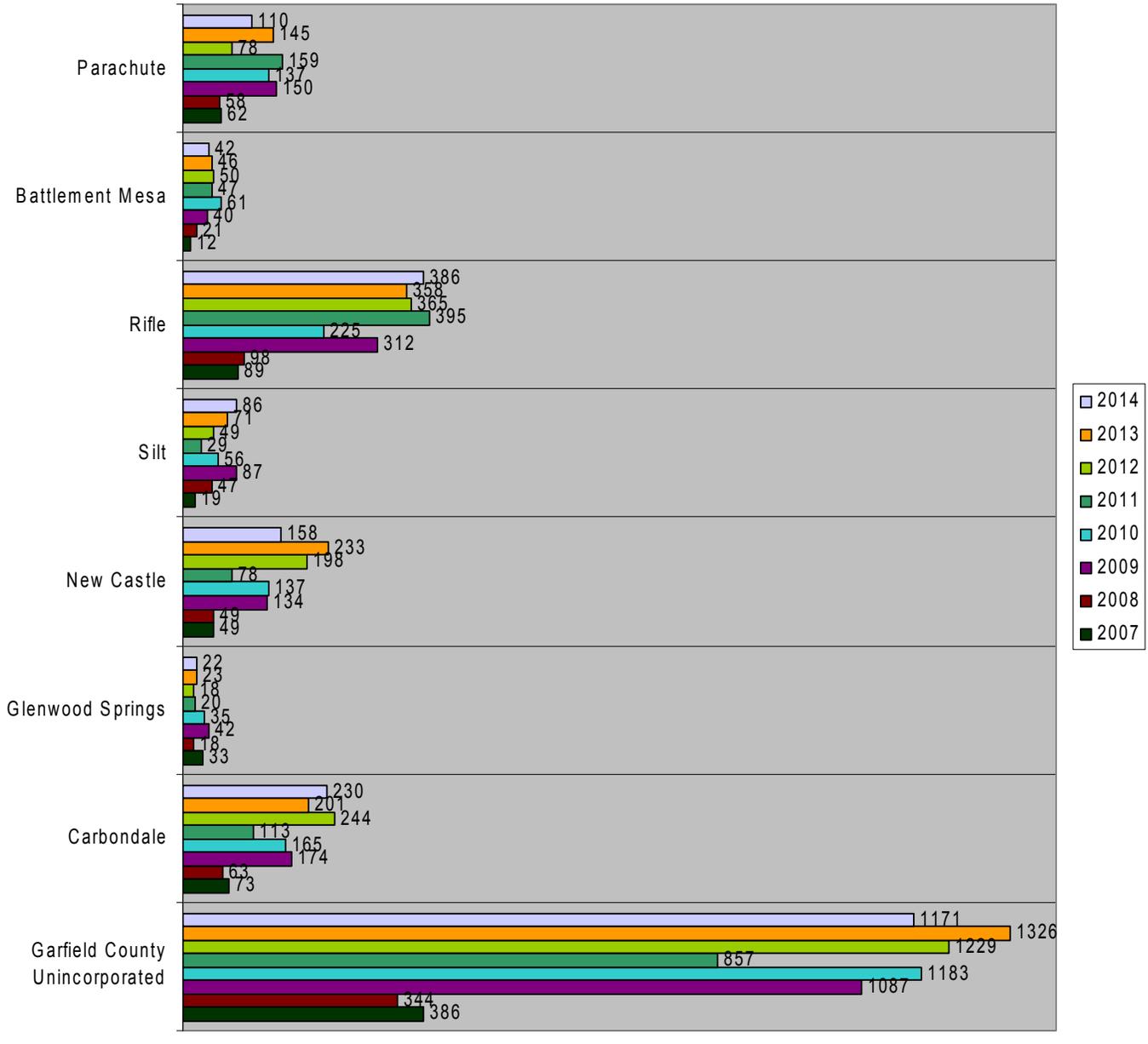
## Garfield County Total Acres Treated (2007-2014)



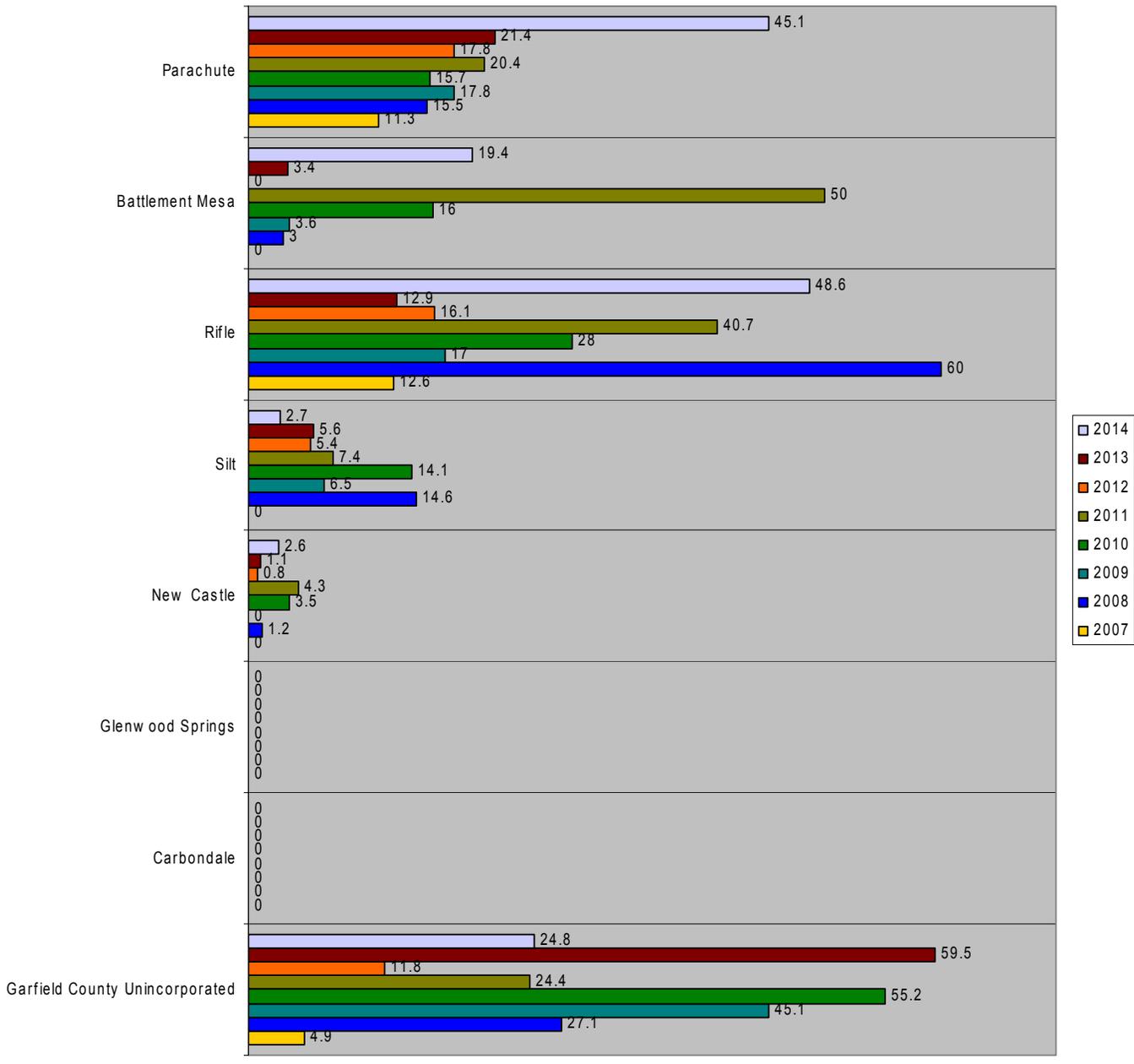
## Garfield County Site Inspections by Year (2007-2014)



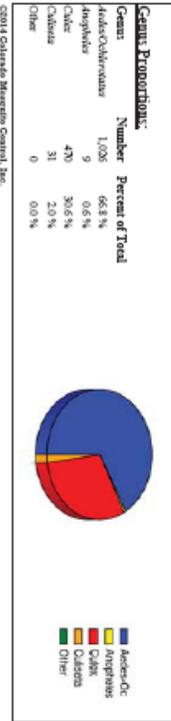
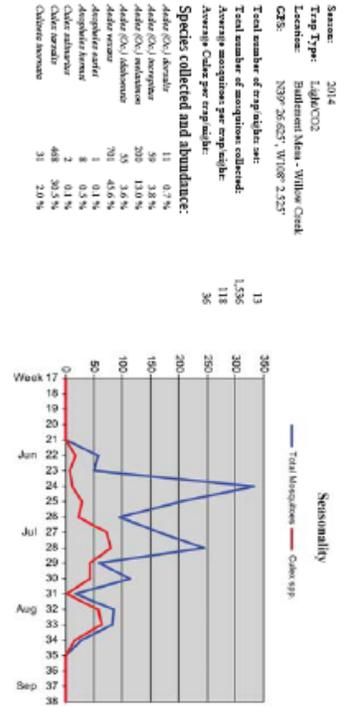
## Garfield County Site Treatments (2007-2014)



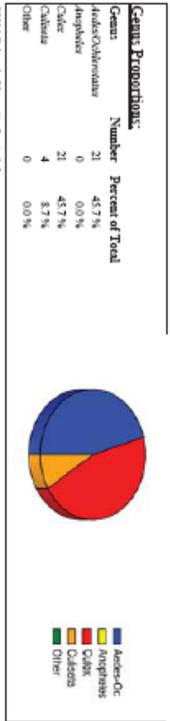
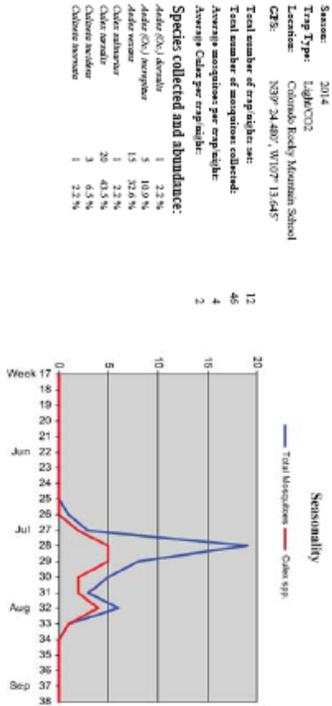
### Garfield County Total ULV Truck Miles (2007-2014)



### BM-09: Willow Creek

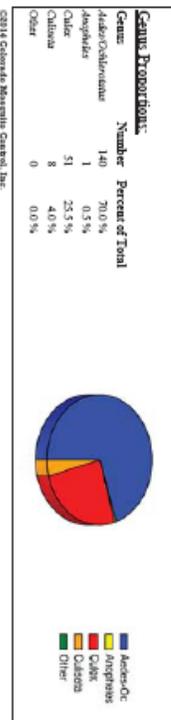
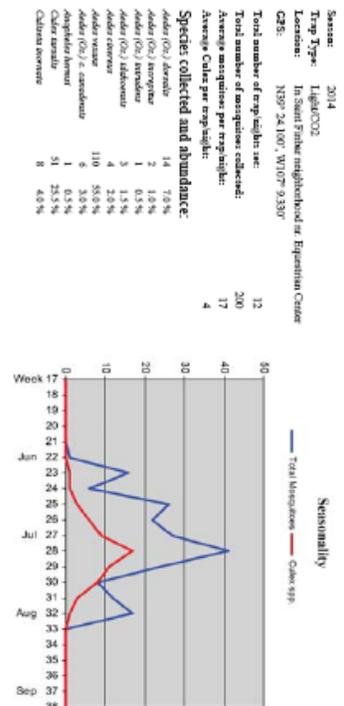


### CD-11: Carbondale CRMS

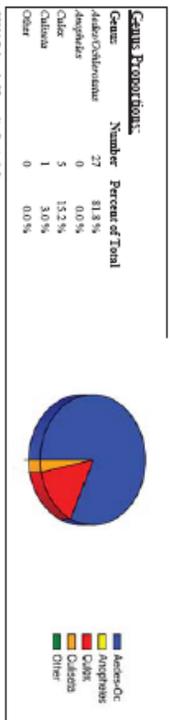
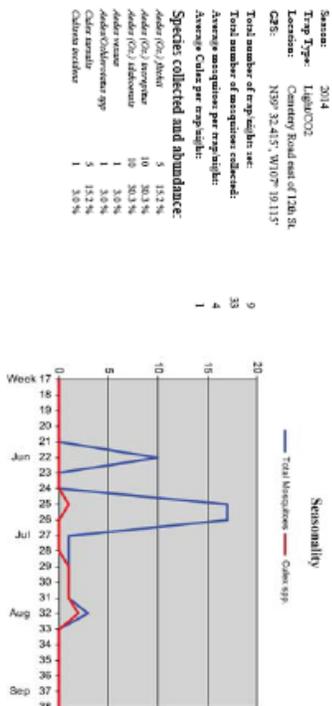


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### CD-02: East Carbondale Saint Finbar



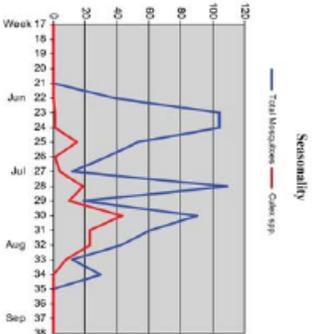
### GW-09: Glenwood Springs Cemetery



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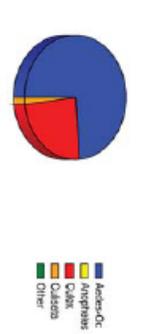
### NC-03: New Castle Elk Creek Elem. School

Season: 2014  
 Trap Type: Light/CO2  
 Location: In tree between Hwy 6 and Elk Creek school bus  
 GPS: N39° 34.29N, W107° 32.50W



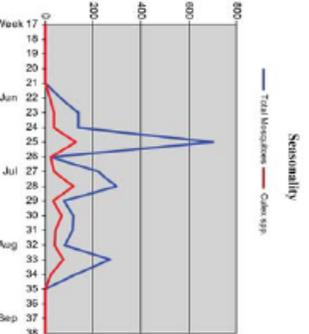
**Genus Proportions:**

Genus	Number	Percent of Total
Aedes/Culiseta	466	73.8%
Anopheles	147	24.1%
Culex	11	1.8%
Other	0	0.0%



### RF-01: Rifle Lyons Park Rest Area

Season: 2014  
 Trap Type: Light/CO2  
 Location: next to ranch south of Lyons Park Rest Area  
 GPS: N39° 31.51N, W107° 47.14W



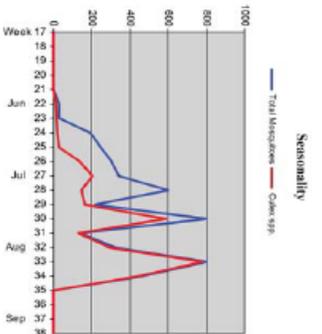
**Genus Proportions:**

Genus	Number	Percent of Total
Aedes/Culiseta	1,376	70.4%
Anopheles	1	0.0%
Culex	623	27.8%
Other	38	1.7%
Other	0	0.0%



### PR-01: Parachute - Cottonwood Park

Season: 2014  
 Trap Type: Light/CO2  
 Location: west of Cottonwood Park next to fishing ponds  
 GPS: N39° 26.69N, W107° 2.89W



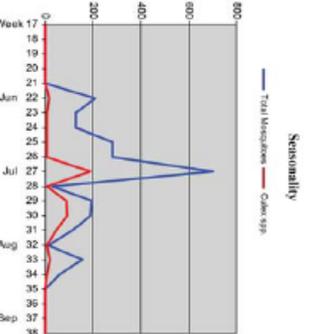
**Genus Proportions:**

Genus	Number	Percent of Total
Aedes/Culiseta	1,475	32.8%
Anopheles	11	0.2%
Culex	2,973	66.0%
Other	44	1.0%
Other	0	0.0%



### RF-15: Rifle - Mile Pond Road

Season: 2014  
 Trap Type: Light/CO2  
 Location: pull-off/Canal NE of Adams Storage Facility  
 GPS: N39° 32.14N, W107° 45.34W

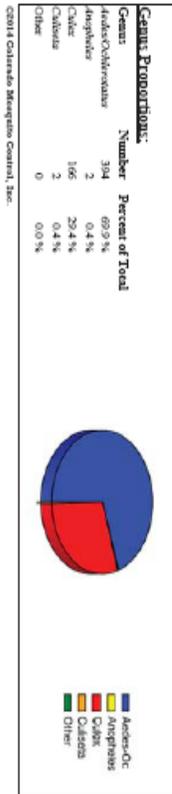
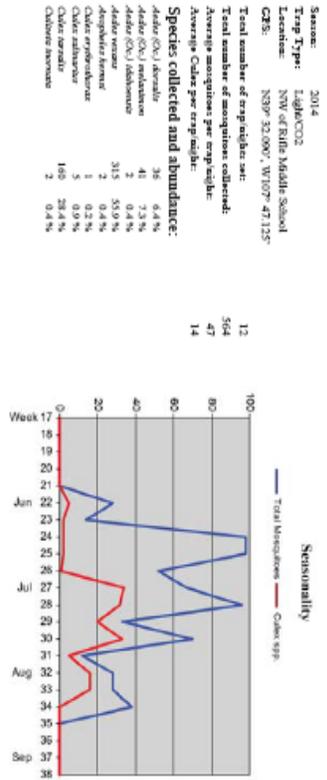


**Genus Proportions:**

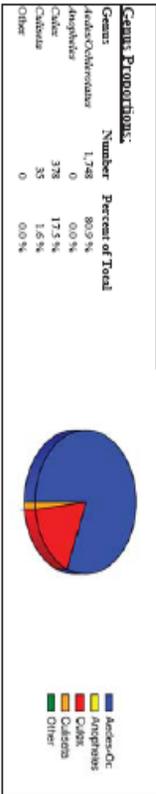
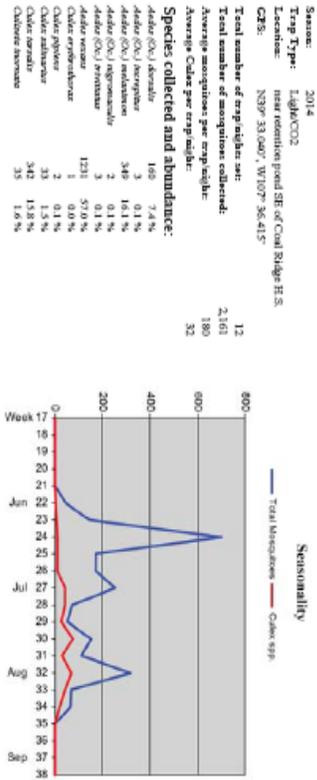
Genus	Number	Percent of Total
Aedes/Culiseta	1,525	73.5%
Anopheles	29	1.4%
Culex	490	23.6%
Other	31	1.5%
Other	0	0.0%



### RF-16: Rifle - Middle School

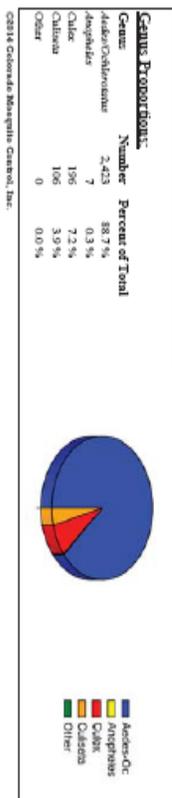
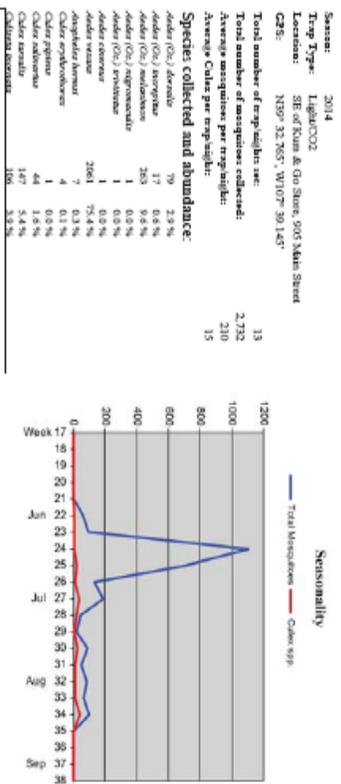


### SI-10: Silt Coal Ridge High School



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### SI-09: Silt Kum & Go



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# Adulticide Application Data Summary



**Colorado Mosquito Control, Inc.**

Customer Date	Subdiv/Area	Material Equipment	Start Time	End Time	Miles
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## Battlement Mesa

Truck ULV

06/18/2014	WILLOW CREEK	Evolver	20:59:00	21:14:00	2
06/19/2014	TAMARISK MEADOWS	Evolver	20:41:00	21:08:00	3.7
06/24/2014	ANGELICA CIRCLE	Evolver	20:24:00	20:37:00	2.3
06/24/2014	MONUMENT	Evolver	20:40:00	21:14:00	6.1
07/10/2014	WILLOW CREEK	Evolver	22:14:00	22:29:00	1.8
07/17/2014	WILLOW CREEK	Evolver	21:37:00	21:49:00	1.7
07/31/2014	WILLOW CREEK	Evolver	21:15:00	21:29:00	1.8
		Truck ULV			
				<b>Sum</b>	<b>19.4</b>
				Avg	4.85
				Min	1.7
				Max	6.1

## New Castle, Town of

Truck ULV

06/15/2014	ELK CREEK	Evolver	20:15:00	20:23:00	0.9
06/20/2014	ELK CREEK	Evolver	21:21:00	21:29:00	0.9
07/16/2014	ELK CREEK	Evolver	21:17:00	21:28:00	0.8
		Truck ULV			
				<b>Sum</b>	<b>2.6</b>
				Avg	0.866667
				Min	0.8
				Max	0.9

## Parachute, Town of

Backpack Barrier

07/24/2014	GRAND VALLEY DAYS	Talstar	09:34:00	09:49:00	0.3
		Backpack Barrier			
				<b>Sum</b>	<b>0.3</b>
				Avg	0.3
				Min	0.3
				Max	0.3

Truck ULV

06/18/2014	COTTONWOOD PARK	Evolver	21:27:00	21:54:00	4.8
06/25/2014	COTTONWOOD PARK	Evolver	21:14:00	21:44:00	4.8
06/25/2014	PARACHUTE TOWN	Evolver	21:52:00	21:59:00	1
07/10/2014	COTTONWOOD PARK	Evolver	21:50:00	22:07:00	2.5
07/17/2014	COTTONWOOD PARK	Evolver	21:55:00	22:37:00	5
07/25/2014	COTTONWOOD PARK	Evolver	22:13:00	23:08:00	2.6
07/31/2014	COTTONWOOD PARK	Evolver	20:39:00	21:07:00	4.2

08/10/2014	COTTONWOOD PARK	Evolver	22:14:00	22:39:00	3.8
08/14/2014	COTTONWOOD PARK	Evolver	21:04:00	21:27:00	4
08/21/2014	COTTONWOOD PARK	Evolver	20:56:00	21:22:00	3.7
08/28/2014	COTTONWOOD PARK	Evolver	22:57:00	23:18:00	3.3
09/08/2014	COTTONWOOD PARK	Evolver	19:46:00	20:10:00	5.4
		Truck ULV		<b>Sum</b>	<b>45.1</b>
				Avg	3.758333
				Min	1
				Max	5.4

#### **Rifle, Town of**

Truck ULV					
06/02/2014	West Rifle Hot Spot	Evolver	20:11:00	20:20:00	0.2
06/11/2014	WEST RIFLE US6	Evolver	20:28:00	20:35:00	1.4
06/11/2014	RIFLE REST STOP	Evolver	20:44:00	20:57:00	2
06/19/2014	RMS	Evolver	21:44:00	21:57:00	1.5
06/29/2014	RIFLE REST STOP	Evolver	22:42:00	23:00:00	1.6
06/30/2014	2ND AND WEST 6	Evolver	20:28:00	20:38:00	1.1
07/01/2014	RIFLE SOUTH	Evolver	22:00:00	22:10:00	4.5
07/01/2014	RMS	Evolver	22:24:00	22:38:00	2.1
07/08/2014	RIFLE REST STOP	Evolver	21:29:00	21:43:00	2.3
07/17/2014	RMS	Evolver	23:19:00	23:31:00	2
07/17/2014	RIFLE REST STOP	Evolver	23:00:00	23:11:00	1.7
	RMS AND				
07/30/2014	FAIRGROUNDS	Evolver	23:17:00	23:42:00	4.9
07/30/2014	RIFLE SOUTH	Evolver	22:25:00	22:36:00	2.1
07/30/2014	RIFLE REST STOP	Evolver	21:35:00	21:53:00	2.5
08/05/2014	RIFLE REST STOP	Evolver	21:01:00	21:20:00	2.5
08/21/2014	RMS	Evolver	22:01:00	22:12:00	1.5
08/21/2014	RIFLE REST AREA	Evolver	21:43:00	21:56:00	2
08/28/2014	RIFLE REST STOP	Evolver	23:43:00	23:53:00	1.7
09/17/2014	JOYCE PARK	Evolver	19:49:00	20:05:00	2
09/17/2014	DEERFIELD PARK	Evolver	19:21:00	19:44:00	3.8
09/17/2014	WEST 16th ST	Evolver	20:07:00	20:24:00	2.1
09/24/2014	DEERFIELD PARK	Evolver	19:49:00	20:08:00	3.1
		Truck ULV		<b>Sum</b>	<b>48.6</b>
				Avg	2.209091
				Min	0.2
				Max	4.9

#### **Garfield County Unincorporated**

06/04/2014	MILE POND	Evolver	20:22:00	20:37:00	2
06/15/2014	MILE POND	Evolver	21:04:00	21:19:00	2.5
06/29/2014	MILE POND	Evolver	22:25:00	22:37:00	2.2
07/13/2014	MILE POND	Evolver	23:22:00	23:37:00	2.5
07/30/2014	MILE POND	Evolver	21:59:00	22:12:00	2.3
08/10/2014	MILE POND	Evolver	23:00:00	23:14:00	2.6
08/21/2014	MILE POND	Evolver	22:20:00	22:35:00	2.5
06/20/2014	CRHS	Evolver	20:57:00	21:08:00	2
07/01/2014	CRHS	Evolver	21:08:00	21:23:00	2
07/29/2014	CRHS	Evolver	22:46:00	23:00:00	1.8

08/14/2014	CRHS	Evolver	22:01:00	22:15:00	2.4
				<b>Sum</b>	<b>24.8</b>
				Avg	2.254545
				Min	1.8
				Max	2.6

Silt, Town of

Truck ULV

06/18/2014	KUM AND GO MARSH	Evolver	22:35:00	22:41:00	0.9
06/29/2014	KUM AND GO MARSH	Evolver	23:04:00	23:10:00	0.9
07/13/2014	KUM AND GO MARSH	Evolver	23:51:00	23:57:00	0.9
		Truck ULV		<b>Sum</b>	<b>2.7</b>
				Avg	0.9
				Min	0.9
				Max	0.9

<b>Garfield County Cooperative Total</b>					<b><u>143.5</u></b>
					<b>Miles</b>