2014 Operational Review & Plans for 2015

Annual Report to the Technical Advisory Board

Metropolitan Mosquito Control District

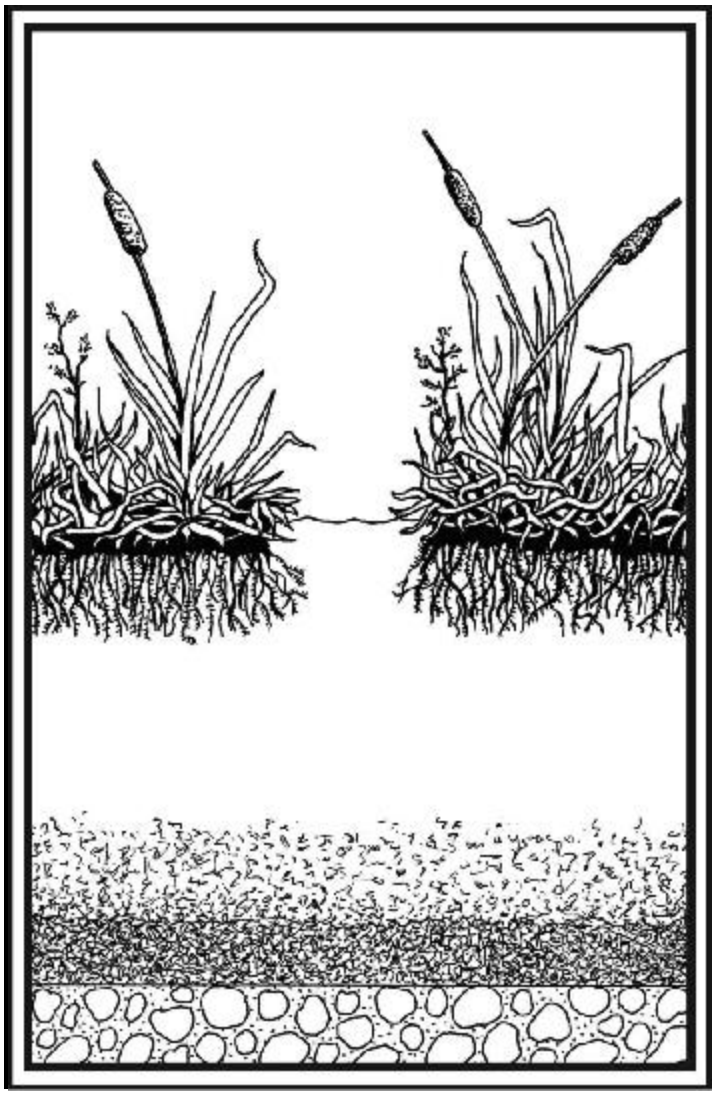

Illustration by Martyn Kirkman

Metro Counties Government Center ~ 2099 University Avenue West ~ St. Paul, MN 55104-3431
www.mmcd.org

Metropolitan Mosquito Control District

Mission

The Metropolitan Mosquito Control District's mission is to promote health and well-being by protecting the public from disease and annoyance caused by mosquitoes, black flies, and ticks in an environmentally sensitive manner.

Governance

The Metropolitan Mosquito Control District, established in 1958, controls mosquitoes and gnats and monitors ticks in the metropolitan counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington. The District operates under the eighteen-member Metropolitan Mosquito Control Commission (MMCC), composed of county commissioners from the participating counties. An executive director is responsible for the operation of the program and reports to the MMCC.

Metropolitan Mosquito Control Commission 2015

Julie Braastad	Anoka County
Rhonda Sivarajah	Anoka County
Robyn West	Anoka County
James Ische	Carver County
Tom Workman	Carver County
Thomas Egan	Dakota County
Mike Slavik	Dakota County
Liz Workman	Dakota County
Jan Callison	Hennepin County
Jeff Johnson	Hennepin County
Randy Johnson	Hennepin County
Blake Huffman	Ramsey County
Mary Jo McGuire	Ramsey County
Janice Rettman	Ramsey County
Dave Menden	Scott County
Tom Wolf	Scott County
Gary Kriesel	Washington Co.
Fran Miron	Washington Co.

Technical Advisory Board

The MMCC formed the TAB in 1981 to provide annual, independent review of the field control programs, to enhance inter-agency cooperation, and to facilitate compliance with Minnesota State Statute 473.716.

Technical Advisory Board Members 2014-2015

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Vicki Sherry	US Fish & Wildlife Service

Metropolitan Mosquito Control District Contributing Staff

Stephen Manweiler	Executive Director
Sandy Brogren	Entomologist
Diann Crane	Assistant Entomologist
Janet Jarnefeld	Technical Services/Tick
Kirk Johnson	Vector Ecologist
Carey LaMere	Technical Services
Mike McLean	Public Affairs
Nancy Read	Technical Services Coordinator
Mark Smith	Tech. Serv./Control Materials
John Walz	Technical Services/Black Fly

Minnesota Department of Transportation
395 John Ireland Blvd.
Saint Paul, MN 55101

April 10, 2015

Commissioner Robyn West, Chair
Metropolitan Mosquito Control Commission
2099 University Avenue West
St. Paul, MN 55104

Dear Commissioner West,

The Technical Advisory Board (TAB) held its annual meeting on February 10, 2015 to review and discuss MMCD operations in 2014 and plans for 2015. Since the Board's formation in 1981, the member representatives have met at least once per year to provide independent review of field control programs and to enhance inter-agency cooperation. These meetings provide an excellent opportunity for TAB members to meet and interact with MMCD staff and so develop a comfort level with their work.

After an excellent interchange of questions and information between the TAB and MMCD staff, the TAB approved the following resolutions.

1. That the TAB commends MMCD for their efforts to do non-target impact studies, and that studies be continued in 2015 to answer remaining questions. These studies may be done by in-house staff, in consultation with the TAB subcommittee.
2. That the TAB commends MMCD for their sensitivity towards honeybees and other pollinators and encourages continued efforts to conserve pollinator populations and minimize non-target impacts.
3. That the TAB commends MMCD for its continued and expanding sustainability efforts.

Sincerely,

Sarma Straumanis

Sarma Straumanis
Chair, Technical Advisory Board
MN Dept. of Transportation

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Executive Summary

The Metropolitan Mosquito Control District (MMCD or the District) strives to provide cost-effective service in an environmentally sound manner. This report presents MMCD staff efforts to accomplish that goal during 2014 through mosquito, black fly and tick surveillance, disease monitoring, mosquito and black fly control, new product testing, data management, and public information. It also presents plans for 2015 as we continue to provide an integrated mosquito management program for the benefit of metro area citizens.

Surveillance

The June rainfall total of 11.26 inches made it the second wettest June in history. Rain fell on over half of the days during the month, and several locations recorded daily records. In addition to flooded farm fields, basements, and roads, this resulted in flooded mosquito habitats and widespread larval hatching. There were 13 rainfall events sufficient to produce mosquito broods – 4 large broods and 9 small to medium sized broods. Some weeks had multiple rain events and broods.

District lab staff identified 23,448 larval mosquito samples during 2014, a significant increase over 2013 and higher than the 23-year average. Our adult mosquito surveillance showed that the average number of summer *Aedes* collected in the evening sweep net collections was the highest of the past four years, and twice the 10-year average. The wet spring resulted in above average numbers of spring *Aedes* adults. Populations of the cattail mosquito *Cq. perturbans* remained very low, well below the 10-yr average. Collections of the West Nile vector *Culex tarsalis* were close to average levels.

The District continued to sample the distribution of ticks in the metro area. The long-term trend of *Ixodes scapularis* becoming more widespread in the District was seen again in 2014, and initial results show a record high number of *I. scapularis* per mammal collected.

Disease

District staff provides a variety of disease surveillance and control services, as well as public education, to reduce the risk of mosquito-borne illnesses such as La Crosse encephalitis (LAC), western equine encephalitis (WEE), eastern equine encephalitis (EEE), and West Nile (WNV) encephalitis, as well as tick-borne illnesses such as Lyme disease and human granulocytic anaplasmosis (HGA). WNV was confirmed in 21 Minnesota residents, eight of these cases were recorded in the metro area. There were four LAC cases recorded in Minnesota, two in District residents. As part of our efforts to reduce risk of LAC, more than 21,000 used tires were collected and recycled.

To help educate the public about risk of tick-borne illness, MMCD continues to use a "Tick Risk Meter" which is updated regularly on www.mmcd.org and on MMCD's Facebook page. Signs are also posted in several metro-area dog parks to educate the public about tick-borne disease risk, and to remind people about MMCD's tick identification service.

Control

MMCD's program focuses on control of mosquitoes while they are in the larval stage, and uses the insect growth regulator methoprene, the bacteria *Bacillus thuringiensis* var. *israelensis* (*Bti*) and *B. sphaericus*, and the bacterial product spinosad. Due to the extensive rainfall and flooding of larval habitats, larvicide treatments hit a record in 2014 (318,427 acres), surpassing the previous record set in 2010. A cumulative total of 240,266 catch basin treatments were made in three rounds to control vectors of WNV. Adulticide acreage also increased to deal with adult mosquito numbers and related customer requests. In 2015, staff will continue to review MMCD's program to ensure effective resource use and minimize possible non-target effects. We will continue to focus adulticide efforts where there is potential disease risk, as well as provide service in high-use park and recreation areas and for public functions, and respond to areas where high mosquito numbers are affecting citizens.

To control black flies in the metro area, MMCD treated 26 small streams sites with *Bti* when the *Simulium venustum* larval population met the treatment threshold. MMCD also treated 64 large rivers sites with *Bti* when the larval population of the target species met the treatment threshold. Heavy June rains resulted in flood-level flows on the large rivers from late June until early July; sampling and treatments were suspended during this time on four of the five large rivers due to safety concerns and lost samplers.

□roduct and □quipment Testing

Quality assurance processes focused on product efficacy, new product evaluations, equipment, and waste reduction. Efficacy monitoring results showed good control of mosquito larvae with *Bti*. Tests of the larvicides Natular G and G30 on cattail mosquitoes showed good potential control. We also began conducting non-target studies on Natular G in spring wetland habitats, in conjunction with members of the Technical Advisory Board (TAB). Testing continued on adulticides permethrin and Onslaught, with a focus on control of vector species.

Equipment calibration continued to be a priority. Due to a recent EPA label change, we conducted droplet spectrum evaluations on our barrier spray units and tested new equipment that allows us to modify our backpacks to meet the new requirements.

MMCD continued to use the MN Dept. of Agriculture's pesticide container recycling program, and collected 6,148 jugs. We are working toward purchasing more material in bulk containers that can be sent back to manufacturers for re-use. We also arranged for manufacturer's re-use of hardwood pallets used for material delivery.

In 2015, we plan to continue tests of Natular against cattail and spring mosquitoes, and repeat tests of MetaLarv S-PT against spring *Aedes*. Non-target sampling will be continued as indicated by the TAB. We also will continue tests of adulticides, emphasizing vector control and effectiveness of barrier treatments.

Data Management and Public Information

The District values data-based decision making and is continually improving data and mapping systems. In 2014, we completed transition of larval habitat inspection and treatment records to a web-based system, and will continue the transition of other data entry systems in 2015. We provide treatment data to the public through our web site, and provide data in compliance with the National Pollutant Discharge Elimination System (NPDES) and other regulatory requirements.

Calls, e-mails, and other contacts from citizens are important ways to identify areas of high service demand, as well as support disease control through requests for tire disposal and dead bird reporting. In June 2014, the number of calls requesting treatment reached an all-time high. With increasing public concern about the loss of pollinators, MMCD has also increased its efforts to contact beekeepers to get bee hive locations and ensure that mosquito control activity has minimal effect on bees.

In 2014, MMCD continued to refine its sustainability strategy. We established specific quantifiable sustainability goals in each of these areas: 1) reducing energy usage; 2) reducing waste; 3) identifying and using renewable resources; and 4) social responsibility/health and wellness. The 2014 Sustainability Report is available through our website, www.mmcd.org.

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Chapter 1 *Mosquito Surveillance*

2014 Highlights

- Rainstorms produced four major mosquito broods
- Very wet, late spring. Wet May and June, dry after July.
- June had near record rainfall, 11.26 inches
- Major mosquito peak occurred in June
- Identified over 23,447 larval samples
- Collected 3 *Culex erraticus* adults, similar to 7 in 2013, down from 599 in 2012
- *Aedes albopictus* larvae and adults found at tire recycling facility in Savage

2015 Plans

- Evaluate placement of CO_2, gravid, and New Jersey traps
- Continue to monitor and study *Ae. japonicus*
- Maintain surveillance for *Ae. albopictus* and remain aware of other potential invasive species
- Continue to refine *Cs. melanura* surveillance

Background

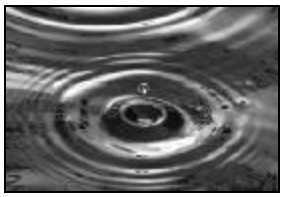
The Metropolitan Mosquito Control District (MMCD or the District) conducts larval and adult mosquito surveillance to determine levels of mosquitoes present, measure annoyance, and to detect the presence of disease vector species. A variety of surveillance strategies are used because different mosquito species have different habits and habitat preferences. The District strives to obtain a complete picture of the mosquito population by weekly monitoring of host-seeking, resting, egg laying, and larval mosquitoes. By knowing which species are present in an area, and at what levels, the District can effectively direct its control measures.

There are 51 known mosquito species in Minnesota, all with a variety of host preferences. Forty-five species occur in the District, 24 of which are human-biting. Other species prefer to feed on birds, large mammals, reptiles, or amphibians. Mosquitoes differ in their peak activity periods and in how strongly they are attracted to humans or trap baits (e.g., light or CO_2); therefore, a variety of adult mosquito collection methods is used to capture targeted species.

The District focuses on four major groups of human-biting mosquito species: spring *Aedes*, summer *Aedes, Coquillettidia perturbans,* and disease vectors. Snowmelt induces spring *Aedes* (15 species) eggs to hatch in March and April and adults emerge in late April to early May. These species have one generation each season and adults can live for three months. Rainfall and warmer temperatures prompt the summer *Aedes* (five species) to begin hatching in early May. These species can have several generations throughout the summer and adults can live up to two weeks. *Coquillettidia perturbans*, the cattail mosquito, develops in cattail marshes. There is one generation per year, with peak emergence in early July. Disease vectors include *Aedes triseriatus*, *Culiseta melanura*, and *Culex* mosquitoes (*Cx. pipiens*, *Cx. restuans*, *Cx. salinarius*, and *Cx. tarsalis*). Adults are evident in early summer and they can produce multiple generations per year. Appendix A contains a species list and detailed descriptions of the mosquitoes occurring in the District.

2014 Surveillance

□ainfall



Rainfall surveillance is an important tool used to estimate the amount of larval production and to determine where to dispatch work crews following a rain event. Generally, an inch or more of rain can produce a hatch of floodwater mosquitoes. Historically, the District has operated a network of rain gauges from May to September. In 2011, April and October readings were added to detect precipitation events that could influence mosquito development at the beginning and end of the season. The May-September rainfall will continue to be used as the average to compare with previous years.

In 2012, MMCD joined the Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network, a group of thousands of volunteers throughout the country who input their precipitation data into one database. By joining this network we were able to eliminate some MMCD gauges that were difficult to monitor, fill gaps with observers in CoCoRaHS, and share data in a timely manner. Data from 118 gauges were used for summaries in this document.

Average rainfall in the District from the weeks of May 5 through September 22, 2014 was 23.60 inches, which is 4.22 inches above the 55-year District average of 19.38 inches. The majority of the precipitation occurred from April to mid-June (Figure 1.1). April precipitation was in the form of snow and rain. Precipitation decreased by mid-July and was significantly lower in August. September had a few rain events but remained below average. This is the third year of drought conditions starting in August.

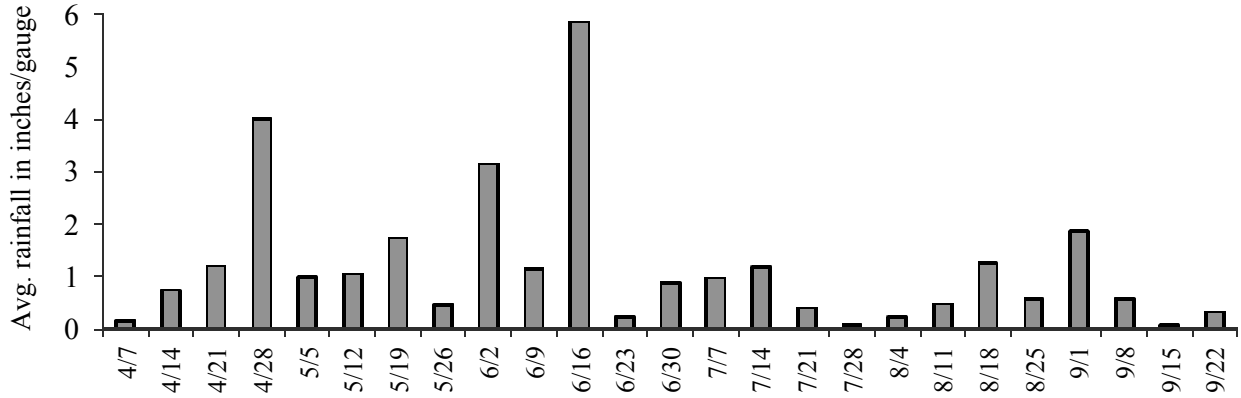


Figure 1.1 Average rainfall amounts per gauge per week (Saturday – Friday), 2014. The number of gauges varied from 57-92. Dates represent the Monday of each week.

Typically, spring *Aedes* mosquitoes larvae develop over a period of months (mid-March to early May), and summer species develop over a period of days (7-10). March and April had below average temperatures and above normal precipitation (Fig. 1.2). Water temperature influences how quickly larvae develop in sites. The cool spring weather conditions delayed the start of the mosquito season and prolonged larval development.

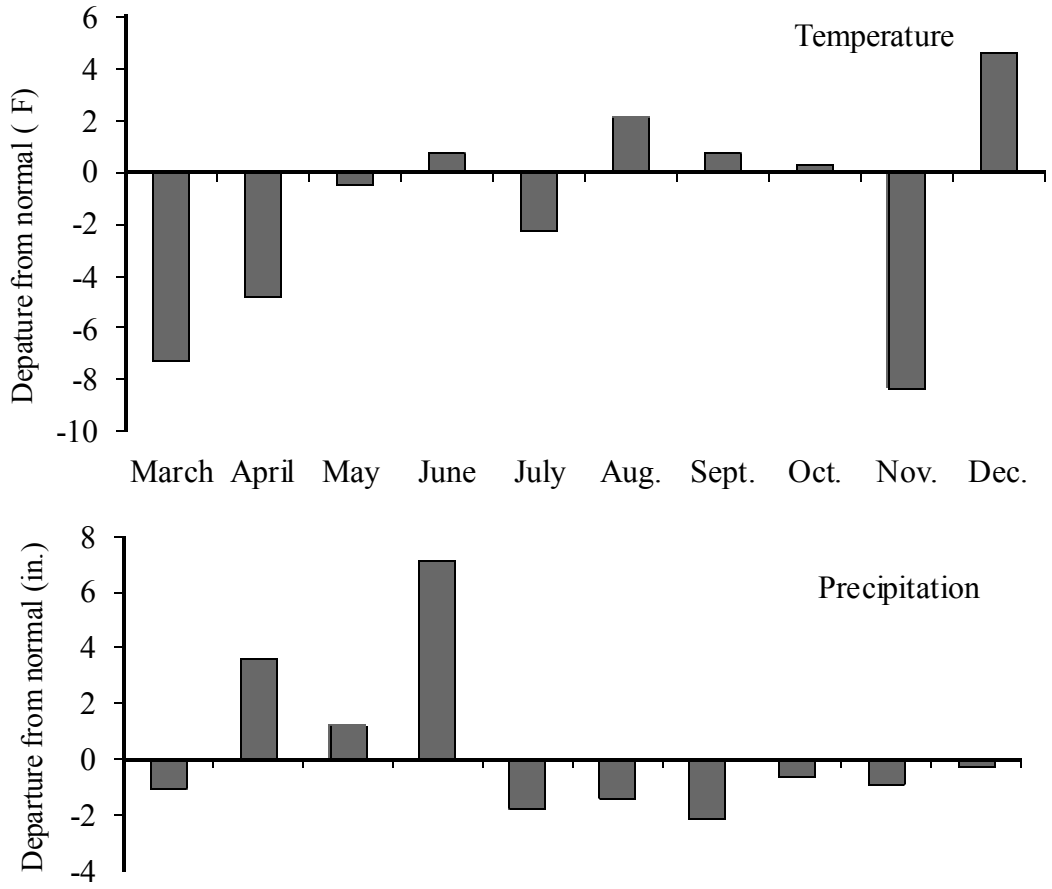


Figure 1.2 Monthly departures from normal for temperature and precipitation March-December, 2014 (source: National Weather Service, Twin Cities Station).

The first larval sample in 2014 was taken on April 8, one day earlier than 2013, but 27 days later than in 2012. This spring's snow melt and rain storms resulted in multiple hatching events of spring *Aedes* species. Many larval development areas were flooded above the 100% wet level.

April was among the fifth wettest of all time in the Twin Cities. The Freshwater Society declared ice-out on Lake Minnetonka on April 24, later than normal but earlier than the May 2 date last year. Though June temperatures were near normal, rainfall was far from it. The June rainfall total of 11.26 inches at Minneapolis/St. Paul (MSP) Airport made it the second wettest June in history, trailing the 11.67 inches in 1874. Rain fell on over half of the days during the month of June, and several locations had record-setting daily values including MSP airport with 4.13 inches on June 19. The impacts of the heavy June rainfall were flooded farm fields and delayed field work, flooded basements, mudslides and flooded roads leading to transportation disruptions, and flooding mosquito development areas, resulting in widespread larval hatching. Wind was also an issue with peak speeds exceeding 50 mph in many places on June 15 and June 16, causing some tree damage.

In 2014, there were 13 rainfall events sufficient to produce mosquito broods – four large broods and nine small to medium sized broods. Brood size is determined by the amount of area affected by rainfall, the amount of rainfall received, and the amount of mosquito production that resulted.

Figure 1.3 depicts the geographic distribution and magnitude of weekly (Saturday-Friday) rainfall received in District gauges from April through September 2014. Some weeks had multiple rain events and broods. The cumulative weekly rainfall does not identify individual rain events however.

As is typical, there was one large spring *Aedes* brood. The spring *Aedes* brood was immediately followed by a large summer floodwater *Aedes* brood that hatched in response to rainstorms on May 12 and May 19. Rainfall in June produced two large broods. The fourth large brood was a late-season hatch resulting from rain over the Labor Day weekend.

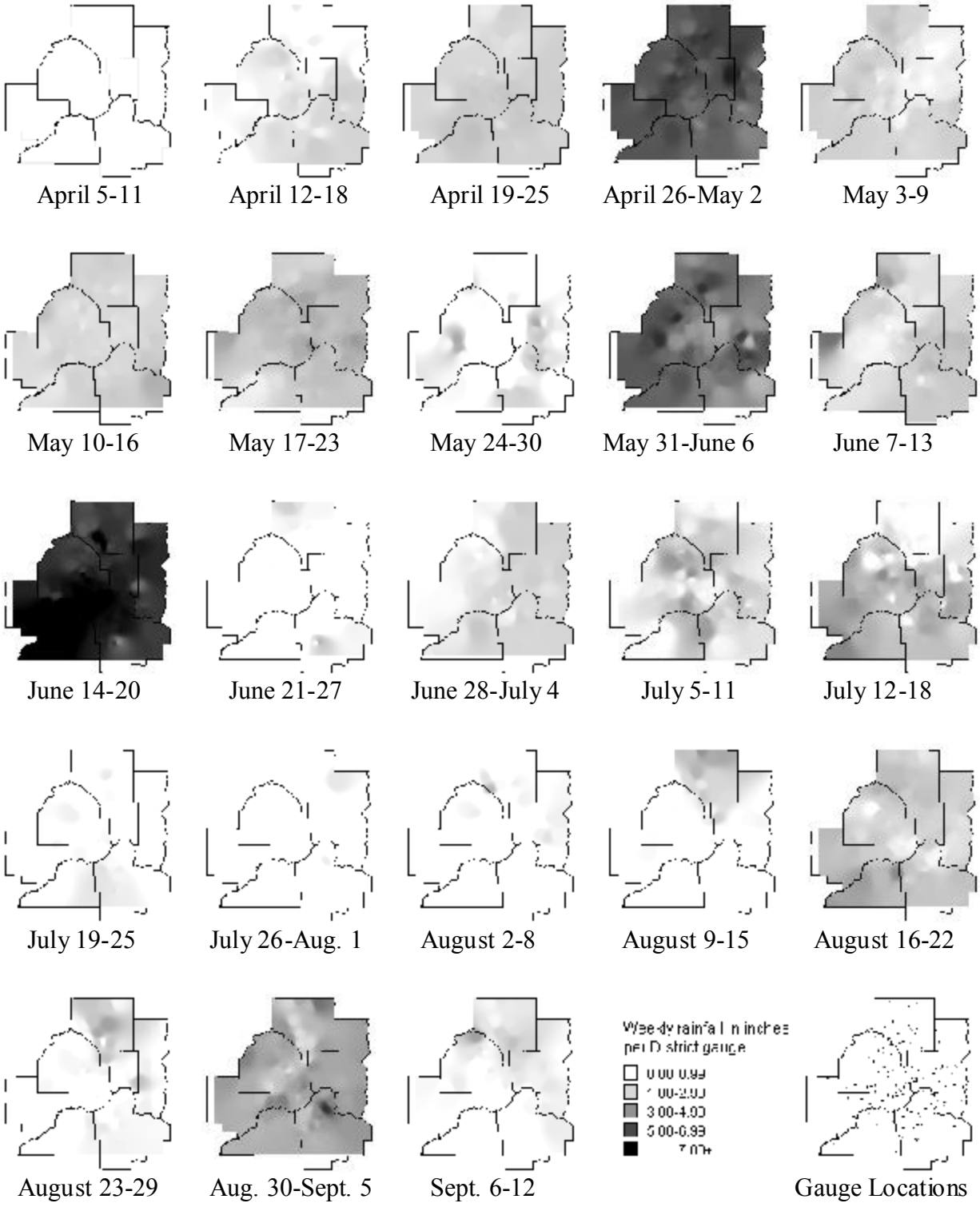


Figure 1.3 Weekly rainfall in inches per District gauge, 2014. The number of gauges varied from 57-92. A map of the rain gauge locations is included. Inverse distance weighting was the algorithm used for shading of maps.

□arval Collections

Larval mosquito inspections are done to determine if targeted species are present at threshold levels or to obtain species history in development sites. A variety of habitats is inspected to monitor the diverse fauna. Habitats include wetlands for *Aedes* and *Culex*, catch basins and stormwater structures for *Cx. pipiens* and *Cx. restuans*, cattail marshes for *Cq. perturbans*, tamarack bogs for *Cs. melanura*, and containers, tires, and tree holes for *Ae. triseriatus*, *Ae. albopictus*, and *Ae. japonicus*. The majority of larval collections are taken from floodwater sites using a standard four-inch dipper. Threshold levels are determined by counting the number of larvae in each dip. Larvae are placed in sample vials, and sent to the Entomology Lab for species identification.

To accelerate the identification of samples from sites to be treated by helicopter, larvae are identified to genus only, except for *Culex* larvae, which are identified to species to differentiate vectors. Staff process lower priority samples as time permits and those are identified to species. In 2014, lab staff identified 23,447 larval samples, which is above the 24-year average (Fig. 1.4).

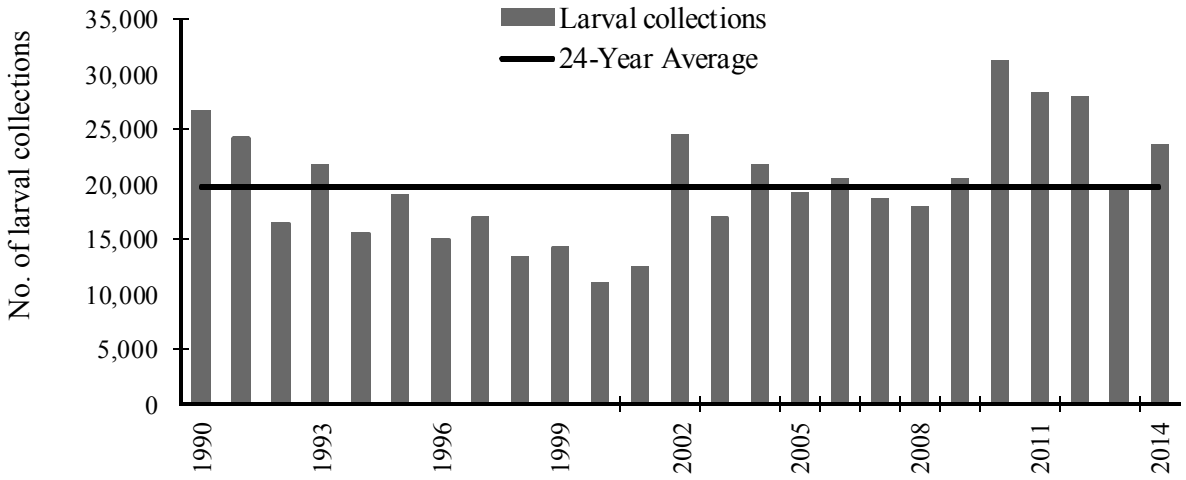


Figure 1.4 Yearly total larval collections, 1990-2014, and 24-year average.

The results of the 9,916 samples identified to species, calculated as the percent of samples in which the species was present, is shown in Table 1.1. Most larval sampling takes place in natural wetlands but a significant amount of sampling is done in catch basins, stormwater structures, and other man-made features (e.g., swimming pools, culverts, artificial ponds). Those results are displayed separately (shaded column) from the natural wetlands results in Table 1.1.

The most frequently collected species from natural development areas was *Ae. vexans,* occurring in 44.3% of the samples (Table 1.1). The non human-biting species, *Culex territans*, was the second place winner in 18.6% of the samples. *Aedes cinereus*, which occurs in the spring and summer, is in third place. The fourth place winner was *Culex restuans* and the spring species, *Ae. stimulans* was fifth.

Table 1.1 Percent of samples where larval species occurred in wetland collections by facility and District total, and the District total for structure samples, 2014; the total number of samples processed to species is in parentheses.

	Percent of samples where species occurred by facility							
??????	North (1,213)	East (1,904)	South Rosemount (3,109)	South Jordan (1,014)	West Plymouth (822)	West Maple Grove (658)	Wetland Total (8,720)	Structures Total (1,196)
Aedes abserratus	0.7	0.6	0.1	0.1	0.5		0.3	
atropalpus								<
aurifer		0.2			0.1		<	
canadensis	0.7	0.8	2.4	0.9	0.4	0.3	1.3	0.2
cinereus	31.9	24.8	9.6	13.1	21.3	16.3	18.0	0.8
communis								
dorsalis			<		0.1	0.5	<	
euedes			<				<	
excrucians	7.9	10.9	4.4	2.3	6.6	4.3	6.3	
fitchii	4.0	3.6	2.5	0.5	0.6	3.0	2.6	
flavescens								
hendersoni								
implicatus	1.2	0.3	0.5	0.3	2.4	2.3	0.8	
intrudens								
japonicus			0.2	0.2		0.3	0.1	5.4
nigromaculis								
punctor	0.5	0.9	<	0.1	0.4	0.2	0.3	
riparius	0.8	0.9	0.1	0.3	2.1	1.7	0.7	
spencerii	<			0.1		0.2	<	
sticticus	2.7	0.5	0.7	0.6	0.5	2.1	1.0	
stimulans	13.0	11.2	11.6	8.6	11.2	12.0	11.4	
provocans	2.4	1.5	0.4		0.1	0.5	0.8	
triseriatus			0.2	0.2			<	2.3
trivittatus	1.2	1.9	5.9	11.5	3.3	1.7	4.5	0.7
vexans	44.9	34.5	48.5	48.6	48.0	40.9	44.3	15.9
Ae. species	41.1	25.8	27.3	20.0	16.2	28.7	27.1	5.5
Anopheles earlei								
punctipennis	1.3	0.5	0.3	0.5	0.5	0.3	0.5	1.0
quadrimaculatus	<	0.1	<	0.1			<	
walkeri		0.2					<	
An. species	2.5	2.3	0.9	1.3	0.6	0.2	1.4	2.7
Culex erraticus								
pipiens	1.7	0.9	0.9	0.5	4.9	3.0	1.5	23.0
restuans	6.8	10.0	14.7	15.0	18.6	9.7	12.6	72.0
salinarius	0.3	0.2	<	0.1			0.1	0.4
tarsalis	1.7	1.5	1.9	4.2	6.3	5.2	2.7	3.8
territans	17.8	25.2	14.4	24.9	10.0	21.9	18.6	19.4
Cx. species	1.5	1.5	3.4	2.6	4.6	2.4	2.7	43.7
Culiseta inornata	3.5	6.1	7.9	4.5	6.3	5.2	6.4	1.8
melanura								
minnesotae	0.2	1.0	0.1			0.9	0.4	<
morsitans	<	0.3	<				<	
Cs. species	0.5	2.5	0.3	0.3	0.2	0.6	0.8	0.3
Ps. columbiae								
ferox	<	0.1	0.5	0.7			0.3	
horrida		<	<				<	
Ps. species		0.2	0.5	0.5	0.2	0.2	0.3	
Ur. sapphirina	6.3	5.7	3.5	4.2	1.8	3.6	4.3	0.6

< = percent of total is less than 0.1%

Adult Mosquito Collections

As stated earlier, the District employs a variety of surveillance strategies to target different behaviors of adult mosquitoes. Sweep nets are used to survey the mosquitoes attracted to a human host. We use carbon dioxide-baited (CO_2) traps with small lights to monitor host-seeking, phototactic species. New Jersey (NJ) light traps monitor only phototactic mosquitoes. Large hand-held aspirators are used to capture mosquitoes resting in the understory of wooded areas in the daytime. Gravid traps with liquid bait are used to attract and capture egg-laying *Culex* and *Aedes* species and ovitraps are used to collect eggs of container-inhabiting vector species (i.e., *Ae. triseriatus, Ae. japonicus, Ae. albopictus*). The information obtained from sampling is used to direct control activities and to monitor vector populations and disease activity (i.e., specimens collected are tested for disease). Treatment thresholds are discussed in Chapter 3: Mosquito Control.

M□□□□□N □□□□N □□□ □□□ The sweep net and CO_2 trap data reported here are weekly collections referred to as the Monday night network. Employees took two-minute sweep net collections and/or set overnight CO_2 traps in their yards every Monday night from May - September. To achieve a District-wide distribution of CO_2 traps, other locations such as parks or wood lots are chosen for surveillance as well. Figure 1.5 shows the sweep net and CO_2 trap locations and their uses (i.e., general monitoring, virus testing, eastern equine encephalitis (EEE) vector monitoring). CO_2 traps were operated once weekly for 20 weeks, starting the same week as the sweeps and continuing three weeks later.

Most of the mosquitoes collected are identified to species, but in some cases, species are grouped together to expedite sample processing. *Aedes* mosquitoes are grouped by their seasonal occurrence (spring, summer). Others are grouped because species-level separation is very difficult (e.g., *Ae. abserratus/punctor*, *Cx. pipiens/restuans*). Generally, the most abundant species captured in sweep nets and CO_2 traps are the summer *Aedes*, *Cq. perturbans*, and spring *Aedes*. *Culex tarsalis*, unlike the other *Culex* species that prefer birds as hosts, is also attracted to mammals and is important in the transmission of West Nile virus (WNV) to humans.

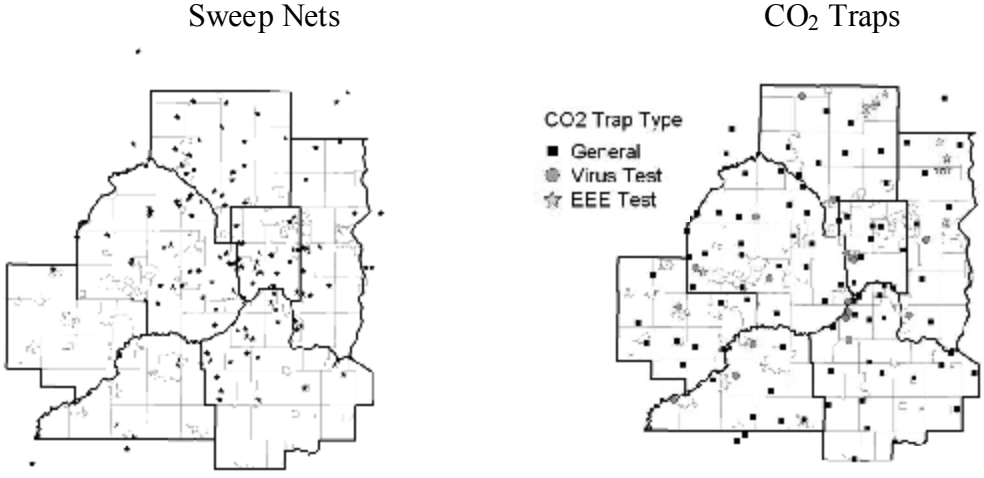


Figure 1.5 Locations of weekly sweep net and CO_2 traps locations used to monitor general mosquito populations and disease vectors (virus test and EEE test), 2014.

Sweep Net The District uses sweep net collections to monitor mosquito annoyance to humans during the peak mosquito activity period, which is 35-40 minutes after sunset for most mosquito species. The number of collectors varied from 65-107 per evening.

In 2014, staff took 1,485 collections containing 4,042 mosquitoes. The average number of summer *Aedes* collected in the evening sweep net collections was the highest of the past four years, and twice the 10-year average (Table 1.2). Populations of *Cq. perturbans* remained very low, well below the 10-yr average. The wet spring resulted in above average numbers of spring *Aedes* adults. *Culex tarsalis,* which are infrequently collected in sweep net samples, were close to average levels.

Table 1.2 Average number of mosquitoes collected per evening sweep net collection within the District, 2010-2014 and 10-year average, 2004-2013 (±SE)

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2010	1.10	0.10	0.13	0.009
2011	1.54	0.38	0.23	0.007
2012	1.63	0.75	0.02	0.004
2013	1.87	0.12	0.03	0.005
2014	2.33	0.12	0.20	0.008
10-yr Avg.	1.17 (±0.10)	0.26 (±0.02)	0.13(±0.02)	0.007 (±0.0003)

CO_2 Trap CO_2 traps baited with dry ice are used to monitor host-seeking mosquitoes and the presence of disease vector species. The standard placement for these traps is approximately 5 ft off the ground, the level where *Aedes* mosquitoes fly. In 2014, we placed 130 traps at 117 locations to allow maximum coverage of the District (Figure 1.5). The "General" trap type locations are used to monitor non-vector mosquitoes. Thirteen locations have the low traps paired with elevated traps placed in the tree canopy (~25 ft above ground) to collect *Culex* species, which are active where birds are resting. All *Culex* specimens collected from those locations and an additional 16 locations (5 ft elevation) are tested for WNV (Figure 1.5, "Virus Test" trap type); however, *Cx. tarsalis* from all locations are tested. Ten trap locations in the network, one also with an elevated trap, have historically captured *Cs. melanura,* and are used to monitor this vector's populations and to obtain specimens for EEE testing (Figure 1.5, "EEE Test" trap type).

A total of 1,969 trap collections taken contained 587,803 mosquitoes. The total number of traps operated per night varied from 99-108. Summer *Aedes* was the predominant species collected in CO_2 traps, the second highest of the past four years and above the 10-year average (Table 1.3). *Coquillettidia perturbans* populations were the same as last year, less than half the average.

More spring *Aedes* were captured than last year but were below the 10-year average. *Culex tarsalis* numbers were below the 10-year average and are discussed later in the vector surveillance section of this chapter.

Table 1.3 Average numbers of mosquitoes collected in CO_2 traps within the District, 2010-2014 and 10-year average, 2004-2013 (± 1 SE)

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2010	191.4	15.3	9.4	4.6
2011	181.0	110.0	5.1	1.4
2012	215.8	68.0	2.3	1.0
2013	303.6	22.5	5.7	2.4
2014	255.4	22.4	7.9	1.9
10-yr Avg.	162.1 (±36.8)	46.2 (±9.3)	8.2 (±1.7)	2.2 (±0.5)

Geographic Distribution The weekly geographic distributions of the three major groups of nuisance mosquitoes (i.e., spring *Aedes*, summer *Aedes*, and *Cq. perturbans*) collected in CO_2 traps are displayed in Figures 1.6, 1.7, and 1.8. The computer software extrapolates the data between collection points, so some dark areas are the result of one collection without another close by. What little populations of spring *Aedes* we had were confined to a few locations on the outer edges of the District or in localized areas (Figure 1.6). The trap collections of summer *Aedes* were above threshold throughout most of the District for one week in May, three weeks in June, and the first week of July. After the week of July 7, the summer was mostly below threshold with occurrences of some locally high populations (Figure 1.7). *Coquillettidia perturbans* populations occurred in their usual hot spots in the northern District borders and in Carver, Scott, and southwest Hennepin counties (Figure 1.8).

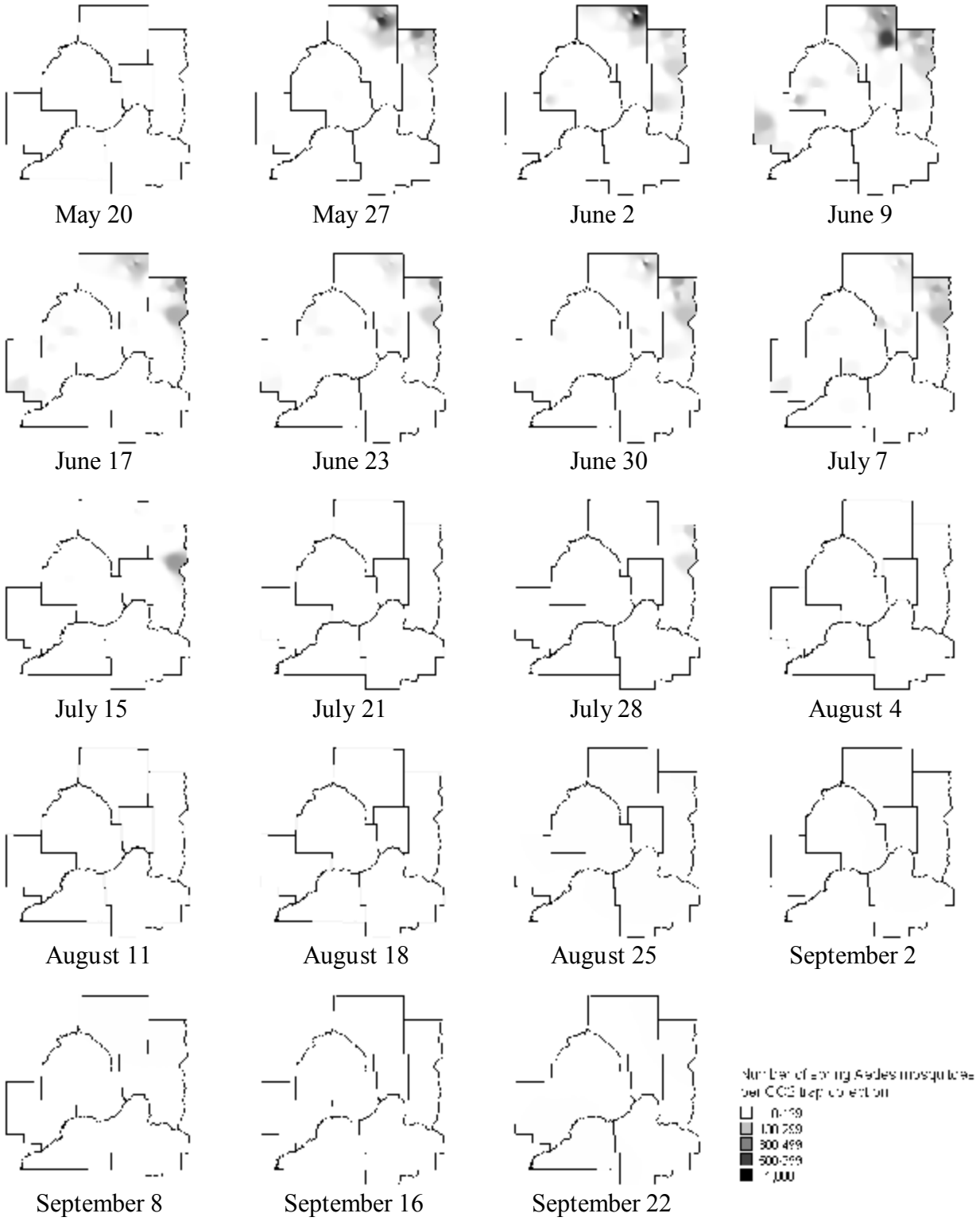


Figure 1.6 Number of spring *Aedes* in District low (5 ft) CO_2 trap collections, 2014. The number of traps operated per night varied from 99-108. Inverse distance weighting was the algorithm used for shading of maps. Treatment threshold is >130 mosquitoes/trap night

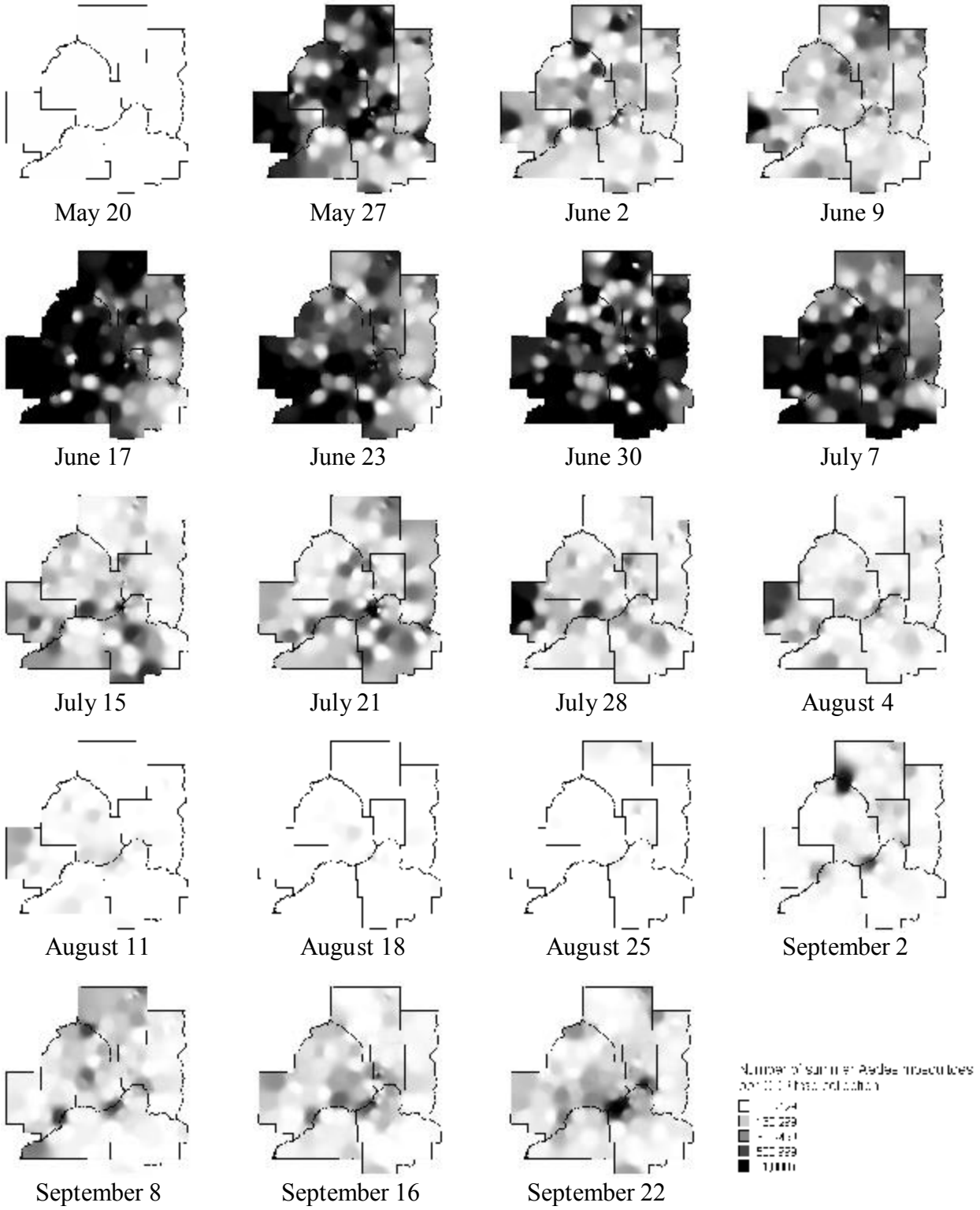


Figure 1.7 Number of summer *Aedes* in District low (5 ft) CO_2 trap collections, 2014. The number of traps operated per night varied from 99-108. Inverse distance weighting was the algorithm used for shading of maps. Treatment threshold is >130 mosquitoes/trap night.

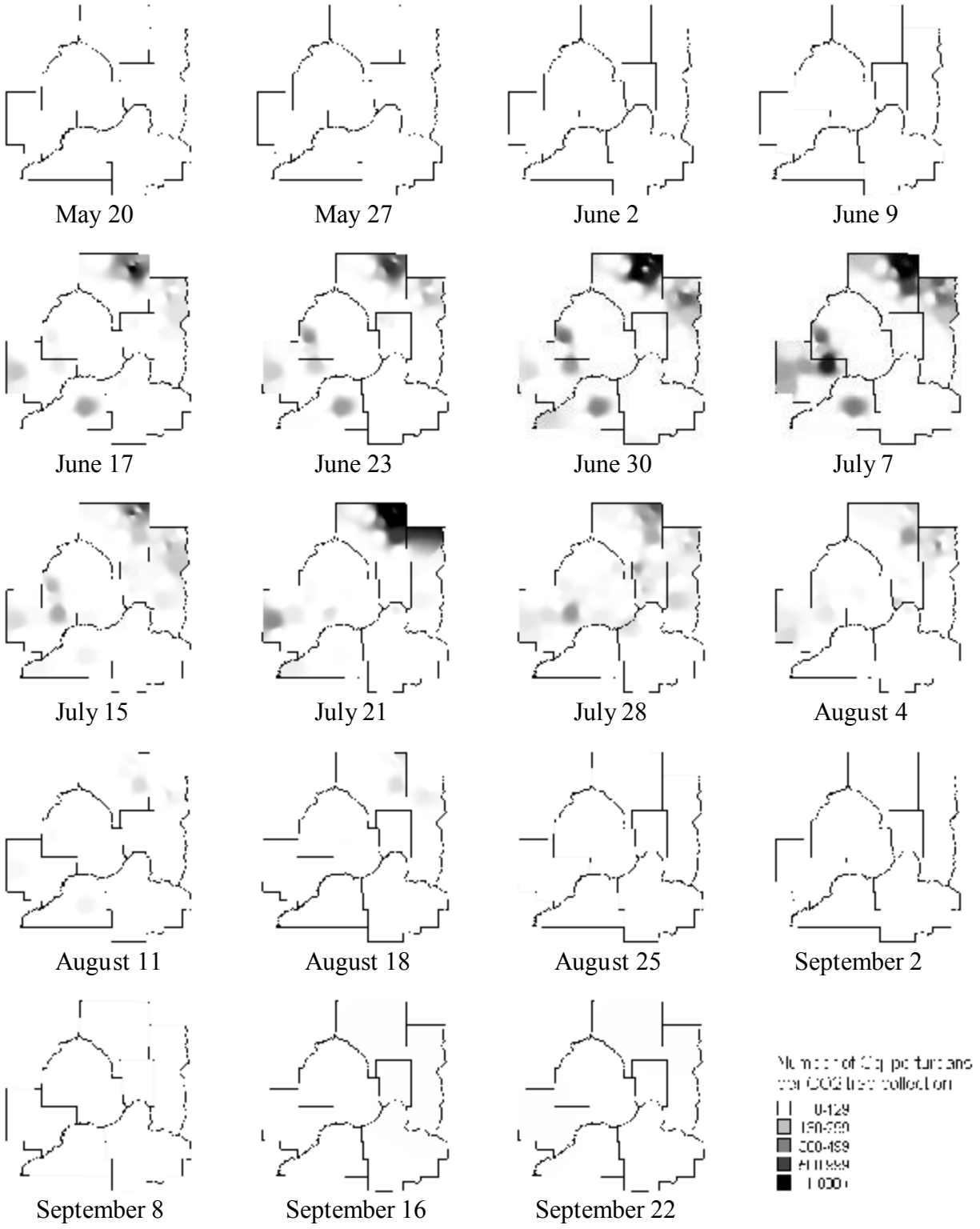


Figure 1.8 Number of *Cq. perturbans* in District low (5 ft) CO_2 trap collections, 2014. The number of traps operated per night varied from 99-108. Inverse distance weighting was the algorithm used for shading of maps. Treatment threshold is >130 mosquitoes/trap night.

Seasonal Distribution As described earlier, spring *Aedes*, summer *Aedes,* and *Cq. perturbans* have different patterns of occurrence during the season based on their phenology and the surveillance method used. Additionally, temperatures below 55 °F inhibit mosquito flight activity. It appears that mosquito activity was affected by cooler temperatures on sampling nights, July14 and September 15 (Fig. 1.9).

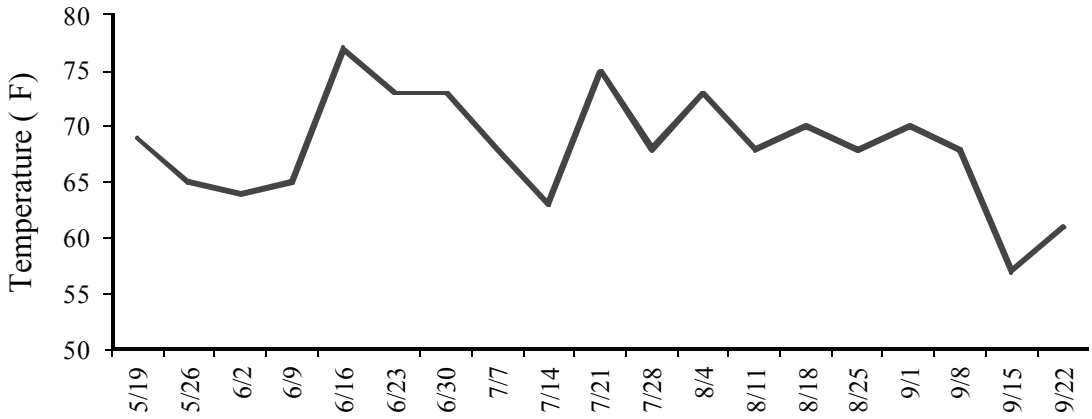


Figure 1.9 Temperature at 9:00 P.M. on Monday night surveillance dates, 2014.

Figure 1.10 shows the seasonal distribution of the three major groups of mosquitoes from mid-May through early September, detected by sweep netting and CO_2 traps. The peak of spring *Aedes* activity was detected on June 9 in both the sweeps and CO_2 traps, later than usual due to the delayed emergence. The long-lived spring *Aedes* were present until early August.

Summer *Aedes* populations detected in CO_2 traps peaked on June 16, one week after the spring *Aedes* peak (Figure 1.10). The peak of summer *Aedes* in sweep collections was not until June 30. The peak for *Cq. perturbans* in sweep nets on July 7 coincided with the CO_2 trap *Cq. perturbans* peak. Mosquito presence was greatly diminished by mid-August. There was a slight increase in activity resulting from rain events in September. The end date for the sweep net collections is earlier than the CO_2 traps (September 9 for sweeps and September 30) due to the availability of seasonal staff to perform the sweep collections.

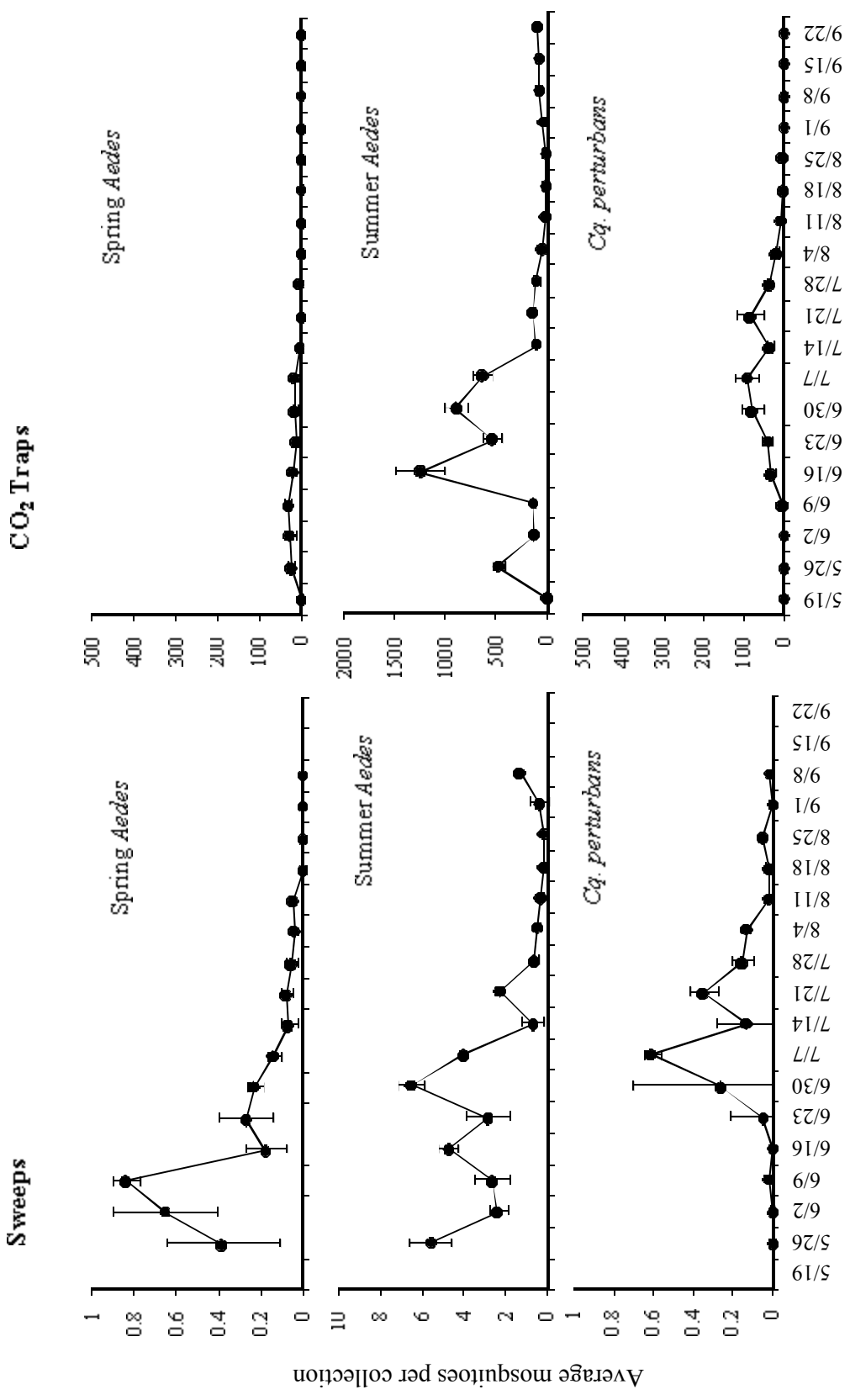


Fig. 1.10 Average number of spring *Aedes*, summer *Aedes*, and *Cq. perturbans* per sweep net and CO_2 trap, 2014. Bars equal ± 1 standard error of the mean.

N□□ □□□□□□ □N □□T □□□□ For many years, mosquito control districts used the NJ light trap as their standard surveillance tool. The trap uses a 25-watt light bulb to attract mosquitoes and many other insects as well, making the samples messy and time-consuming to process. The number of traps used by the District has varied over the years; in the early 1980s, the District operated 29 traps. After a western equine encephalitis (WEE) outbreak in 1983, the District reduced the number to seven to alleviate the regular workload due to the shift toward disease vector processing.

The number of locations and traps has fluctuated since then. The District currently operates seven NJ light traps at the following locations: trap 1 in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap CA1 in the Carlos Avery State Wildlife Management Area, trap AV at the Minnesota Zoo in Apple Valley, and trap MN in Minnetrista (Figure 1.11). Trapping occurs nightly for 20 weeks from May through September and staff identify all adult female mosquitoes to species. Traps 1, 9, 13, and 16 have operated each year since 1965. A comparison of the major species collected from 1965-2014 from those four traps is shown in Appendix B.

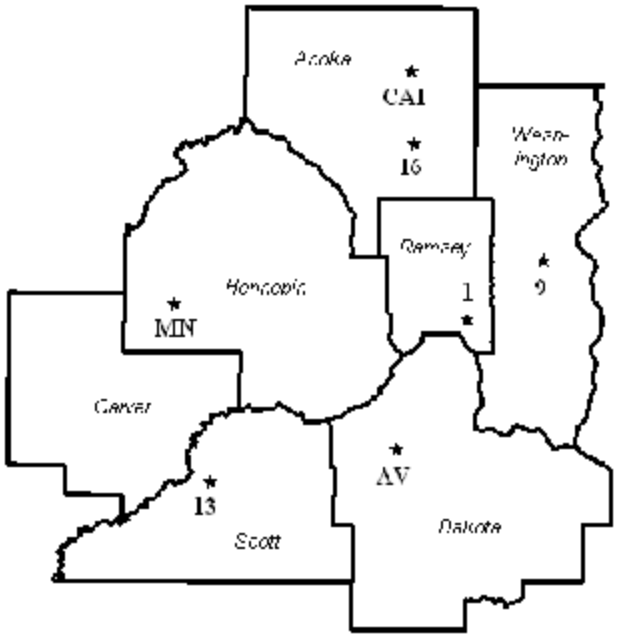


Figure 1.11 NJ light trap locations, 2014

The most numerous species collected in NJ traps was *Ae. vexans*, whose total was 75% of all female mosquitoes captured (Table 1.4). The Minnestrista trap contributed 57% and the Carlos Avery trap comprised 19% of all *Ae. vexans* captured. *Coquillettidia perturbans* ranked second and comprised 10% of the females captured. The Carlo Avery trap, placed within many acres of untreatable cattail habitat, contributed 59% of the overall *Cq. perturbans* collected. *Aedes cinereus*, which occurs in the spring and summer, came in third place at 3% of females. *Uranotaenia sapphirina*, a nonhuman-biting species readily attracted to light, had a good year in fourth place. The combination of *Cx. pipiens* and *Culex restuans* came in fifth place, followed closely by the spring *Aedes* species combo of *Ae. abserratus* and *Ae. punctor* (*Ae. abs/punct*) in sixth. *Anopheles quadrimaculatus* were down this year but *An. walkeri* was collected in high numbers in the Carlos Avery trap.

The first collection of *Ae. japonicus* in a NJ light trap was in 2009 (Minnetrista). Since then, *Ae. japonicus* has increased in frequency of occurrence and has been found in six of seven NJ traps, most frequently in the Minnetrista trap. In 2014, *Ae. japonicus* was only collected at three NJ trap locations, St. Paul, Lake Elmo, and Minnetrista, but the number captured was the highest on record.

Table 1.4 Total number and frequency of occurrence for each species collected in New Jersey light traps, May 10-September 26, 2014

	Trap Code, Location, and Number of Collections							Summary Statistics		
	1	9	13	16	CA1	AV	MN	Season		
	St. Paul	Lk. Elmo	Jordan	Lino Lakes	Carlos	Apple Valley	Minnetrista	Total	% Female	Avg per
Species	140	139	140	138	138	139	140	974	Total	Night
Ae. abserratus	0	3	0	2	306	1	3	315	0.30%	0.32
atropalpus	1	0	0	0	0	0	0	1	0.00%	0.00
aurifer	0	0	0	0	0	0	0	0	0.00%	0.00
canadensis	1	1	0	0	3	0	25	30	0.03%	0.03
cinereus	38	28	3	112	2,234	3	496	2,914	2.74%	2.99
dorsalis	0	0	0	0	0	0	0	0	0.00%	0.00
excrucians	2	7	0	1	187	0	12	209	0.20%	0.21
fitchii	3	2	0	0	8	0	0	13	0.01%	0.01
flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
implicatus	0	0	0	0	0	0	0	0	0.00%	0.00
japonicus	27	12	0	0	0	0	68	107	0.10%	0.11
nigromaculus	0	0	0	1	0	0	0	1	0.00%	0.00
punctor	2	0	0	2	260	0	1	265	0.25%	0.27
riparius	1	0	0	0	7	0	7	15	0.01%	0.02
spencerii	0	0	0	1	0	0	0	1	0.00%	0.00
sticticus	18	26	57	3	622	6	24	756	0.71%	0.78
stimulans	2	5	0	1	15	0	23	46	0.04%	0.05
provocans	0	0	0	0	0	0	0	0	0.00%	0.00
triseriatus	9	43	4	6	0	1	107	170	0.16%	0.17
trivittatus	95	131	15	4	19	31	134	429	0.40%	0.44
vexans	10,087	5,088	542	2,342	14,788	1,587	44,790	79,224	74.60%	81.34
abserratus/punctor	5	4	0	7	1,169	1	11	1,197	1.13%	1.23
Aedes species	20	20	3	8	107	25	610	793	0.75%	0.81
Spring *Aedes*	4	6	0	4	30	1	16	61	0.06%	0.06
Summer *Aedes*	13	2	1	0	2	5	2	25	0.02%	0.03
An. barberi	0	0	0	0	0	0	0	0	0.00%	0.00
earlei	0	0	0	0	0	0	0	0	0.00%	0.00
punctipennis	61	26	3	3	56	1	70	220	0.21%	0.23
quadrimaculatus	20	29	2	1	18	1	5	76	0.07%	0.08
walkeri	13	25	2	21	1,068	0	74	1,203	1.13%	1.24
An. species	1	0	0	0	29	0	3	33	0.03%	0.03
Cx. erraticus	0	0	0	0	0	0	0	0	0.00%	0.00
pipiens	0	0	0	0	0	0	0	0	0.00%	0.00
restuans	505	132	2	62	132	18	371	1,222	1.15%	1.25
salinarius	1	1	2	2	1	0	9	16	0.02%	0.02
tarsalis	73	7	8	25	53	1	40	207	0.19%	0.21
territans	69	71	8	15	35	19	546	763	0.72%	0.78
Cx. species	97	11	0	5	17	7	54	191	0.18%	0.20
Cx. pipiens/restuans	425	75	2	36	96	7	291	932	0.88%	0.96
Cs. inornata	164	32	1	15	32	18	57	319	0.30%	0.33
melanura	0	0	0	0	0	0	0	0	0.00%	0.00
minnesotae	14	3	0	27	176	0	10	230	0.22%	0.24
morsitans	150	51	0	10	77	0	63	351	0.33%	0.36
Cs. species	8	4	0	4	2	0	9	27	0.03%	0.03
Cq. perturbans	352	668	10	184	6,177	8	3,070	10,469	9.86%	10.75
Or. signifera	1	0	0	0	0	0	0	1	0.00%	0.00
Ps. ferox	0	0	0	0	0	0	0	0	0.00%	0.00
horrida	1	0	0	0	0	0	0	1	0.00%	0.00
Ps. species	0	0	0	0	0	0	0	0	0.00%	0.00
Ur. sapphirina	290	474	2	24	119	20	1353	2,282	2.15%	2.34
Unidentifiable	55	10	1	19	73	6	922	1,086	1.02%	1.11
Female Total	12,628	6,997	668	2,947	27,918	1,767	53,276	106,201	100.00%	109.04
Male Total	2,481	2,641	201	981	13,727	307	13,946	34,284		
Grand Total	15,109	9,638	869	3,928	41,645	2,074	67,222	140,485		

R□□D□□□□□□□□ *Culex erraticus,* considered rare in the District, was first detected in NJ traps in 1988. This species occurred sporadically since then in low numbers and in recent years has been collected in CO_2 traps more frequently (Fig. 1.12). In 2012, we were surprised to collect them in extremely high numbers throughout the District. In 2013, we were just as surprised to collect them in such low numbers. Only three *Cx. erraticus* were captured in 2014. Their name is

truly descriptive of their occurrence. The reason for the 2012 peak remains a mystery. *Culex erraticus* is common in southern United States, with the District at the northern edge of its range. The unusually warm spring and summer in 2012 may have resulted in favorable conditions conducive to their large population expansion. Because *Cx. erraticus* is usually extremely rare, it has not been targeted for control. It is, however, a competent vector of eastern equine encephalitis and a suspected maintenance vector of West Nile virus, so it is still worthy of our attention.

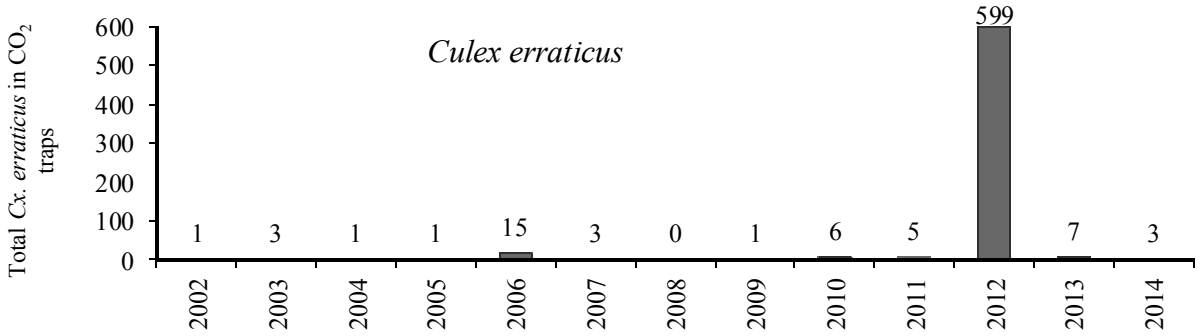


Fig. 1.12 Yearly total of *Culex erraticus* in CO_2 traps, 2002-2014.

Anopheles quadrimaculatus is notable because it is a WNV maintenance vector and capable of transmitting dog heartworm and malaria. Historically, it is rare in the District, but in recent years, it has occurred in traps throughout the District more frequently than in the past (Fig. 1.13). Since 2002, *An. quadrimaculatus* has appeared with increasing frequency, reaching the highest amount ever in 2012, down slightly in 2013, and very low in 2014. We will continue to determine the reasons for this fluctuation in occurrence. *Anopheles quadrimaculatus* are known to bite humans, but are not directly targeted for larval control or included in the adult threshold. In each of the last four years, adults were collected in 5% of the sweep collections. If they were included in the adult threshold, only 0.08% more samples would have reached threshold.

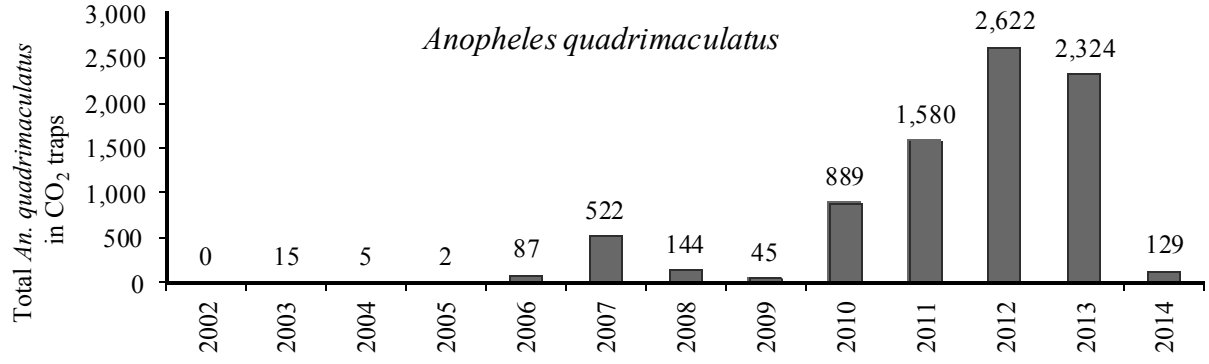


Fig. 1.13 Yearly total *Anopheles quadrimaculatus* in CO_2 traps, 2002-2014.

Targeted □ector Mosquito Surveillance

Aedes triseriatus Staff use a mechanical aspirator (pictured at left) to sample the understory for resting mosquitoes in the daytime. This method is used primarily for *Ae. triseriatus,* the La Crosse encephalitis (LAC) vector, which can be difficult to capture by other methods. The aspirator is also used to collect *Ae. japonicus* and *Ae. albopictus*, two invasive mosquito vectors. Sampling began during the week of May 26 and continued through the week of September 22.

Cool spring temperatures delayed the emergence of the season's first *Ae. triseriatus* generation until the second week of June (Figure 1.14). The peak rate of capture of 2.0 *Ae. triseriatus* per sample occurred during the first week of July. Frequent rain in June and July allowed for nearly continuous hatching of *Ae. triseriatus* larvae and daily emergence of adults from mid-June through the first week of August. The population remained slightly above average for most of that period.

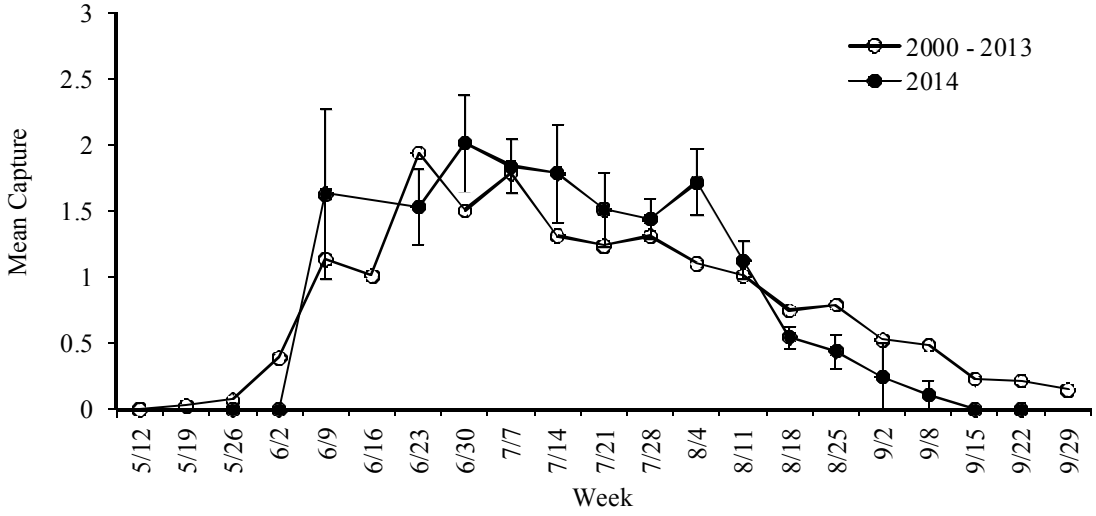


Figure 1.14 Mean number of *Ae. triseriatus* adults in 2014 aspirator samples plotted by week compared to mean captures for the corresponding weeks of 2000-2013. Dates listed are Monday of each week. Error bars equal ± 1 standard error of the mean.

Culiseta melanura *Culiseta melanura*, the enzootic vector of eastern equine encephalitis (EEE), feeds primarily on birds. Locally, the most common larval habitat is spruce-tamarack bog or other acidic habitat. Larvae can occur in caverns in sphagnum moss supported by tree-roots. Overwintering is in the larval stage with adults emerging in late spring. There are multiple generations per year, and the late summer cohort supplies the next year's first generation. Most adults disperse a short distance from their larval habitat, although a few may fly in excess of five miles from their larval habitat.

District staff monitored adult *Cs. melanura* at 10 locations using 11 CO_2 traps. Five sites are in Anoka County, four sites are in Washington County, and one site is in Hennepin County.

Culiseta melanura have been collected from each location in the past. Two traps are placed at the Hennepin County location – one at ground level and one elevated 20 ft into the tree canopy, where many bird species roost at night.

The first *Cs. melanura* adult was collected in a CO_2 trap on May 27 (Figure 1.15). The population remained low throughout the season with a maximum capture of 1.5 per trap on July 21.

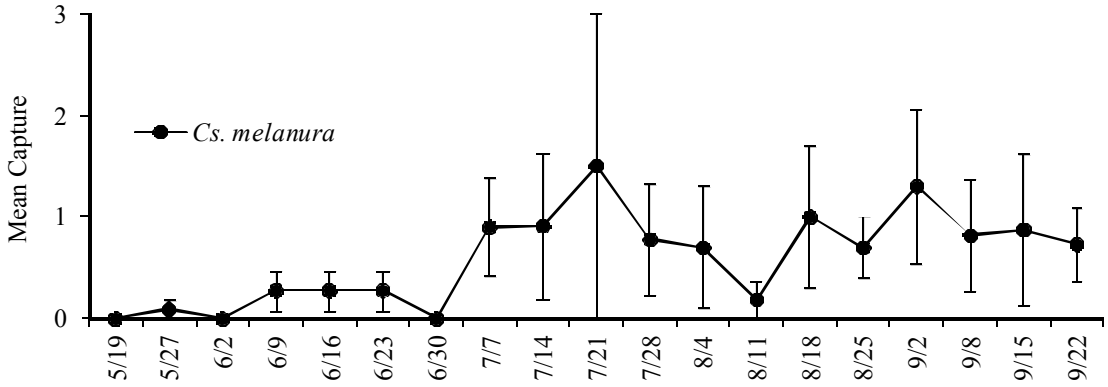


Figure 1.15 Mean number of *Cs. melanura* adults in CO_2 traps from selected sites, 2014. Dates listed are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean.

District staff collected 116 *Cs. melanura* in 200 aspirator collections in wooded areas near bog habitats. The first aspirator collections targeting *Cs. melanura* were collected on June 13; one of eight samples from that date contained two *Cs. melanura.* Only one specimen was collected in 48 samples over the next four weeks. The population grew to detectable levels by aspirator but stayed low from the middle of July until the end of surveillance (Figure 1.16).

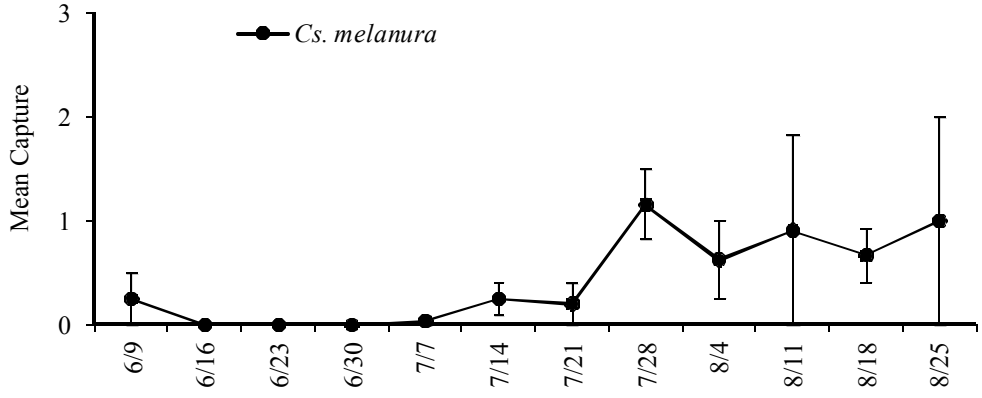


Figure 1.16 Mean number of *Cs. melanura* in aspirator collections, 2014. Error bars equal ± 1 standard error of the mean.

Culiseta melanura develop in a narrow range of aquatic habitats in the District, and larvae are difficult to collect. In April, May and June of 2014, 12 sites were inspected for *Cs. melanura*. Larval samples were collected from seven sites; there were no *Cs. melanura* in the samples.

***Culex* S□□□□□□** *Culex* species are important for the amplification and transmission of WNV and WEE virus in our area. The District uses CO_2 traps to monitor host-seeking *Culex* mosquitoes and gravid traps to monitor egg-laying *Culex* mosquitoes. Many *Culex* specimens collected in the network were tested for WNV. Concentrations of *Culex* in the District as detected through gravid trap monitoring are displayed in Figure 1.17.

Culex tarsalis is the most likely vector of WNV for human exposures in our area. *Culex tarsalis* specimens from Monday night CO_2 traps were tested for WNV in 2014 (see Chapter 2, Table 2.3). Collections of *Cx. tarsalis* in CO_2 traps increased rapidly in 2014 following heavy June rainfall and widespread flooding. The peak capture of 14.7 *Cx. tarsalis* per trap occurred on July 7 (Figure 1.18). Over the next four weeks collections ranged from 2.4 to 4.4 *Cx. tarsalis* per CO_2 trap. The capture rate fell steadily from mid-August until surveillance ended. Few *Cx. tarsalis* were collected by gravid trap, as is typical since the bait used is not particularly attractive to the species.

Culex restuans is another important vector of WNV in Minnesota. The species is largely responsible for the early season amplification of the virus and for season-long maintenance of the WNV cycle, as well. Low numbers of *Cx. restuans* were collected in CO_2 traps in 2014 (Figure 1.19). The CO_2 trap captures peaked early in the season on June 2 at 43.1 per trap. Gravid trap collections of *Cx. restuans* were moderate in 2014, the peak capture occurred during the week of July 7 at 11.1 per trap.

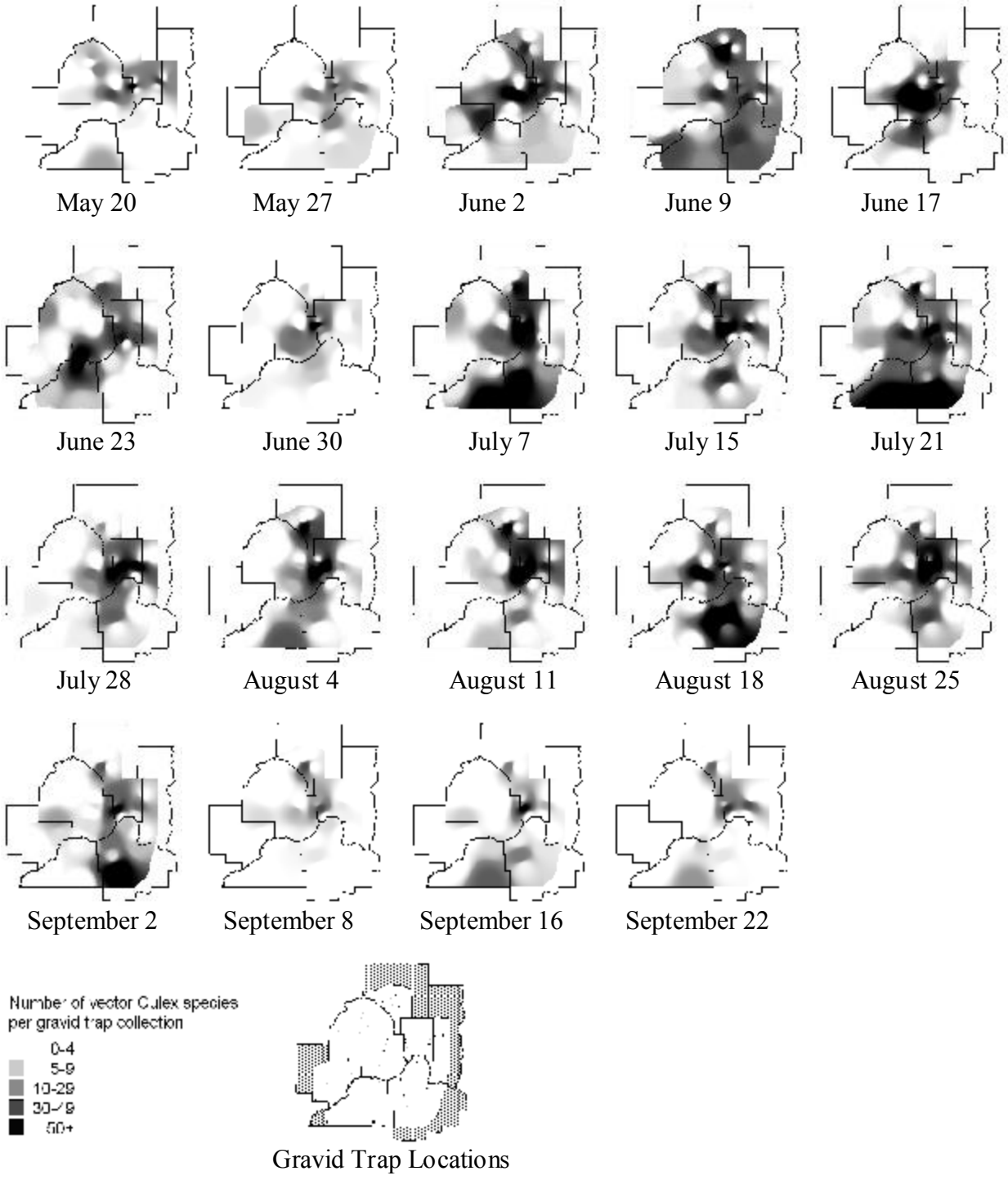


Figure 1.17 Number of vector *Culex* species in District gravid trap collections, 2014. The number of traps operated per week varied from 27-36. Inverse distance weighting was the algorithm used for shading of maps within an area of the District near the traps. A map of the gravid trap locations showing the area of District used to generate the weekly maps is also included.

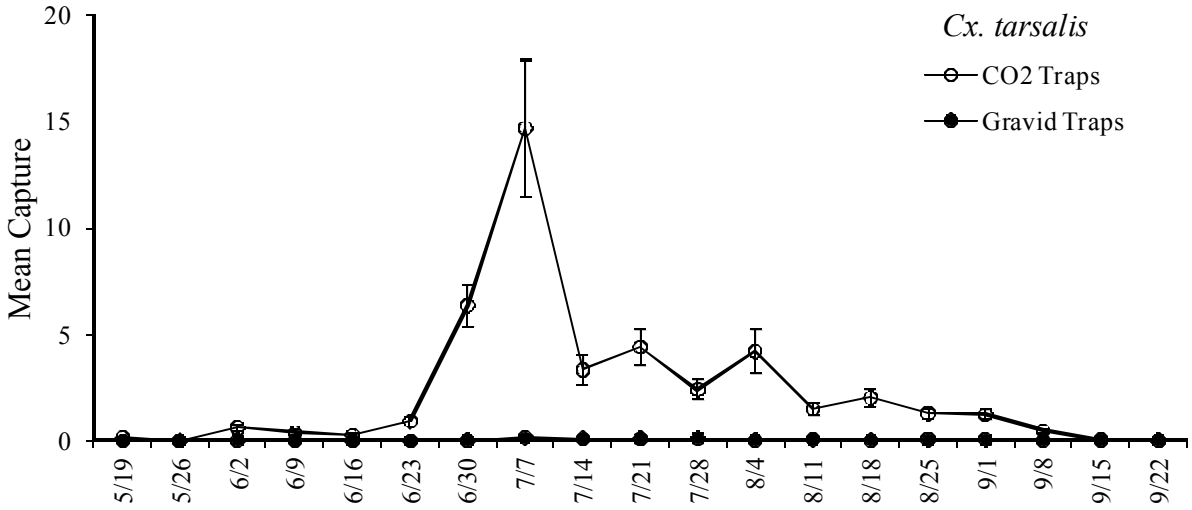


Figure 1.18 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2014. Dates are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean.

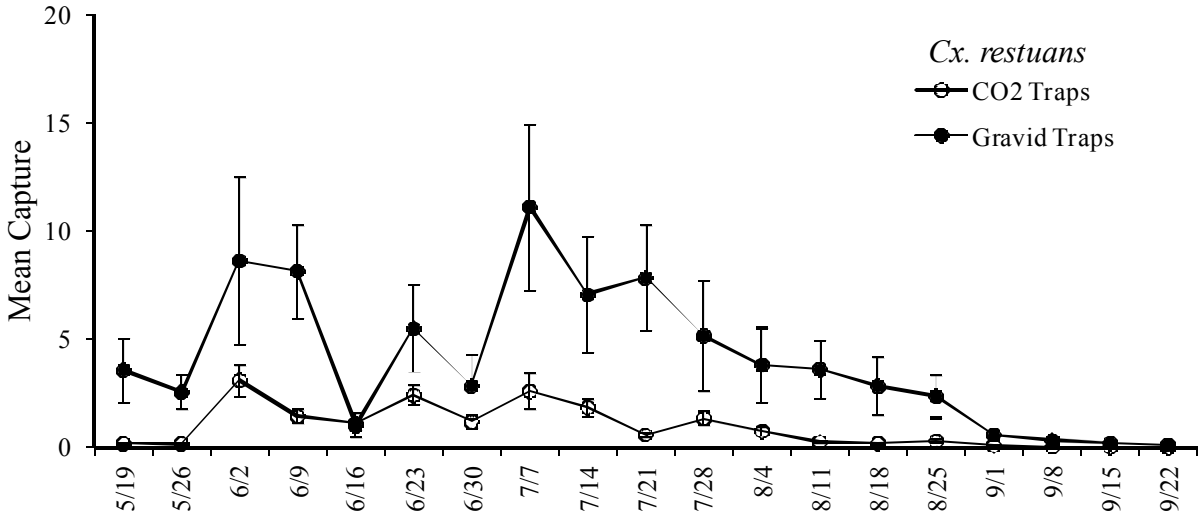


Figure 1.19 Average number of *Cx. restuans* in CO_2 traps and gravid traps, 2014. Dates are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean.

Culex pipiens has been an important vector of WNV in much of the United States. The species prefers warmer temperatures than *Cx. restuans*; therefore, populations of *Cx. pipiens* in the District tend to remain low and peak late in the summer when temperatures are typically warmer. Both gravid traps and CO_2 traps collected low numbers of *Cx. pipiens* in 2014 (Figure 1.20). Temperatures from the end of June through the middle of August remained near or below average thereby reducing *Cx. pipiens* feeding and oviposition activities. Larval surveillance targeting *Cx. pipiens* and *Cx. restuans* such as in catch basins and other stormwater structures also indicated that the *Cx. pipiens* population was lower in 2014 than during the past two years.

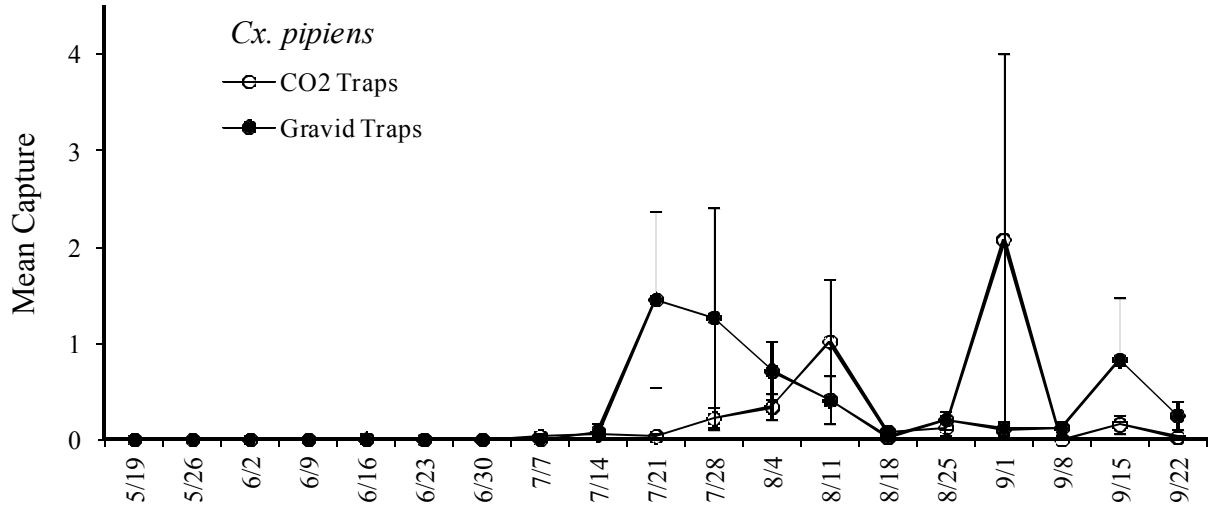


Figure 1.20 Average number of *Cx. pipiens* in CO_2 traps and gravid traps, 2014. Dates are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean.

When *Cx. pipiens* and *Cx. restuans* are difficult to distinguish from each other, they are grouped together and identified as *Cx. pipiens/restuans* (Figure 1.21); when only a genus level identification can be made, they are classified as *Culex* species (Figure 1.22). Both groups usually consist largely of *Cx. restuans* during the early and middle portions of the season with *Cx. pipiens* contributing more to the collections during the middle and later portions of the season.

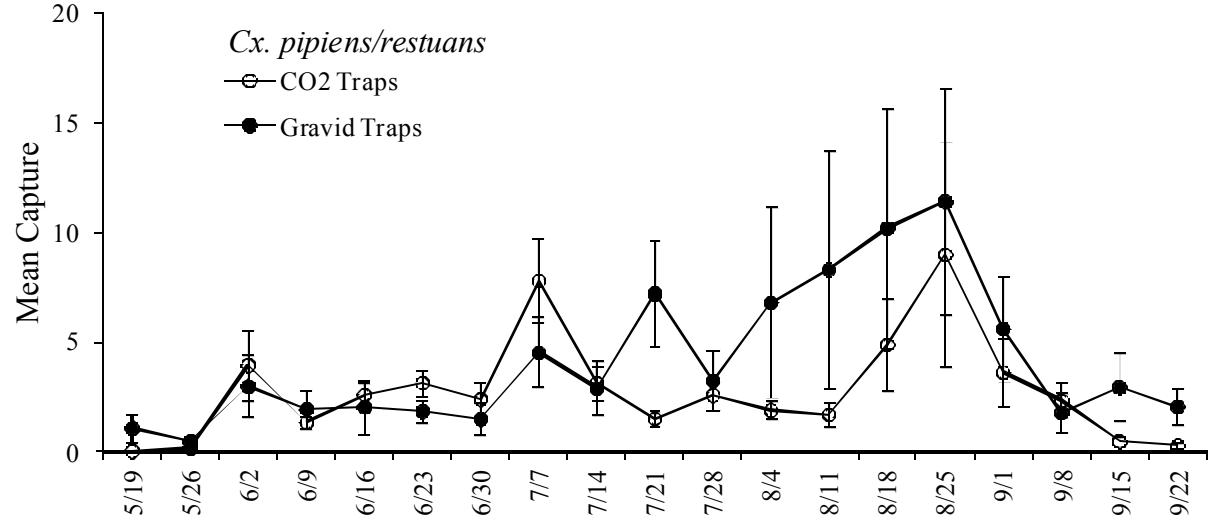


Figure 1.21 Average number of *Cx. pipiens/restuans* in CO_2 traps and gravid traps, 2014. Dates are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean.

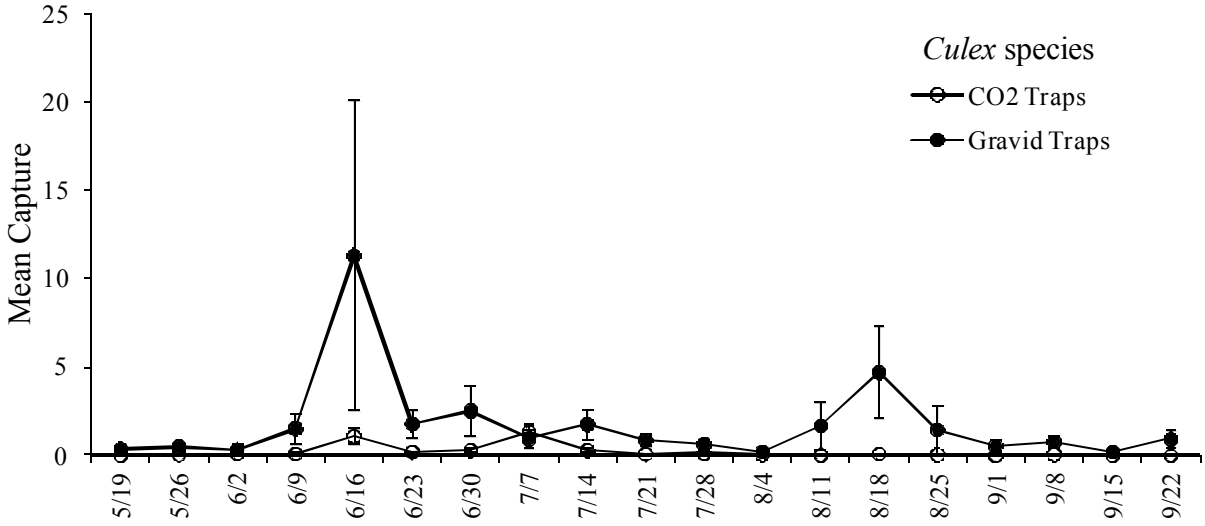


Figure 1.22 Average number of *Culex* species in CO_2 traps and gravid traps, 2014. Dates are the Monday of each sampling week. Error bars equal ± 1 standard error of the mean

E□□□□S□□□□□ Each season, MMCD conducts surveillance for exotic or introduced mosquito species. There are also opportunities to collect unexpected species through a variety of surveillance techniques used to monitor local mosquito species. MMCD laboratory technicians are trained to recognize exotic species in their adult and larval forms so that the mosquitoes can be spotted in any of the tens of thousands of samples processed each year.

The two exotic species most likely to be found here are *Ae. albopictus* and *Ae. japonicus*. Both are native to Asia and have adapted to use artificial larval habitats such as tires and other containers and are thus easily transported as eggs or larvae. *Aedes albopictus*, first collected in the United States in 1985, are established in many states south and east of Minnesota and are occasionally introduced to the District in shipments of used tires or by transport of other water-holding containers. *Aedes japonicus* were first collected in the eastern United States in 1998, and were first found in the District in 2007. They are now commonly collected throughout the District.

Aedes albopictus *Aedes albopictus* were collected in seven samples in 2014, all from near a tire recycling facility in Savage. Specimens were captured four times from the same gravid trap sampling location (6/17, 6/23, 8/11 & 8/25). Two ovitrap samples, both collected on August 6 and one larval sample collected on June 30 also contained *Ae. albopictus*. The larval sample was collected in response to the two June gravid trap collections. The larvae came from tires that had just been off-loaded at the recycling facility. MMCD staff ascertained from driver who hauled the tires that the shipment had originated in Texas. It is apparent that the recycling facility's customer base has expanded deeper into areas of the United States that are infested with *Ae. albopictus* and we should expect frequent introductions of this and possibly other container inhabiting species in the future.

This was the eleventh year since 1991 when *Ae. albopictus* were collected by MMCD staff. *Aedes albopictus* have been found in four Minnesota counties: Carver, Dakota, Scott, and Wright. The species has not successfully overwintered at any of the Minnesota locations where previously discovered.

Aedes japonicus Since their arrival in the District in 2007, *Ae. japonicus* have spread throughout the District and they are commonly found in areas with adequate habitat. The species is routinely collected through a variety of sampling methods. Our preferred surveillance methods when targeting *Ae. japonicus* are container/tire/tree hole sampling for larvae, and aspirator sampling of wooded areas for adults.

Aedes japonicus larvae were found in 774 samples. Most were from containers (531) and tires (186). Larvae were found in other habitats as well, including: artificial or ornamental ponds (21), catch basins (12), wetlands (11), stormwater structures (5), tree hole (1), and seven from unspecified habitats. We observed a slight increase in the total number of larval samples collected and the frequency in which *Ae. japonicus* were found in container, tire, and tree hole habitats over 2013, but with similar frequency to the findings in 2012 (Table 1.5).

Table 1.5 Percentage of samples from containers, tires, and tree holes containing *Ae. japonicus* larvae, 2009 – 2014

Habitat type	2009	2010	2011	2012	2013	2014
Containers	4.2%	23.5%	36.2%	39.4%	35.7%	39.2%
Tires	2.9%	15.5%	21.3%	26.7%	21.2%	26.3%
Tree holes	0	8.8%	9.3%	4.7%	1.8%	2.0%

Aedes japonicus adults were identified in 299 samples. They were found in 190 aspirator samples, 34 CO_2 trap samples, 30 gravid trap samples, 28 NJ trap samples, and 17 two-minute sweep samples. *Aedes japonicus* were collected from 338 District sections (one square mile) in 2014 (Fig. 1.23).

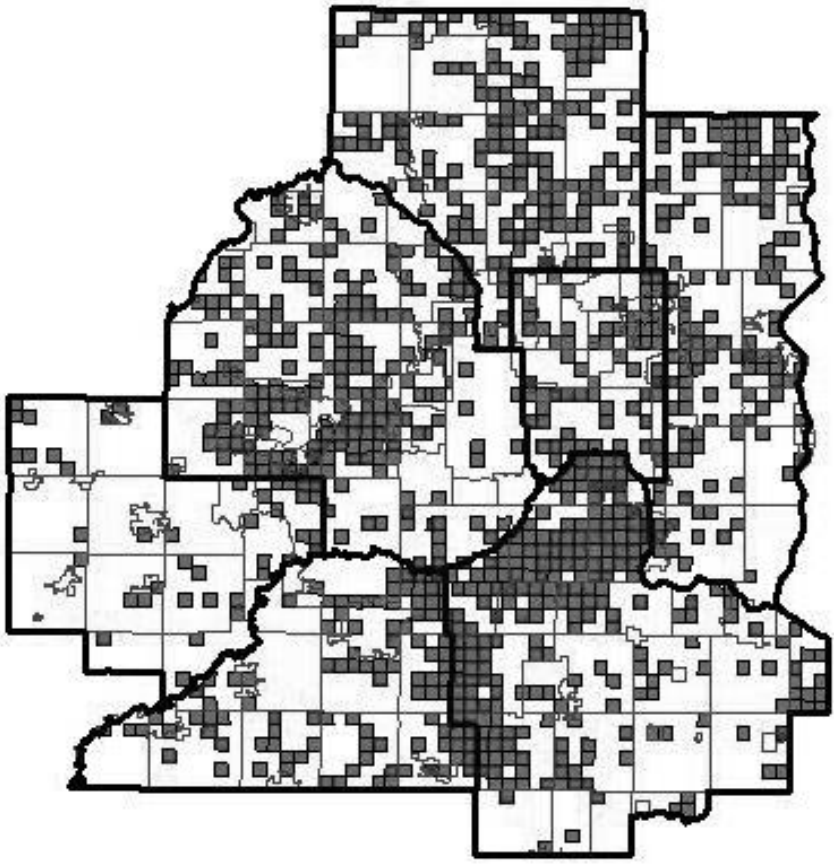


Figure 1.23 Locations of *Ae. japonicus* collections. Red shaded areas are square mile sections where *Ae. japonicus* were collected in 2014. Gray shaded areas represent sections where the species occurred in previous years, but not in 2014.

Sustainability

The Entomology Lab replaced eighteen existing fiber optic microscope light sources with more energy efficient and economical LED ring lights. The fiber optic bulbs have a 40-hour life and cost $25 and the LED ring light bulbs have a 20-year life and cost $165. This retrofit qualified MMCD for a $1,500 rebate from Xcel Energy.

2015 □lans – Surveillance

Surveillance will continue as in past years with possible adjustments to monitor disease vector presence in the District, including refining *Cs. melanura* surveillance. The placement of CO_2, gravid, and New Jersey traps will be evaluated.

Chapter 2 *Vector-borne Disease*

2014 Highlights

- There were four La Crosse encephalitis cases in Minnesota, two in District residents
- WNV illness confirmed in 21 Minnesotans,8 cases in District residents
- WNV detected in 21 District mosquito samples
- Collected and recycled 21,109 waste tires
- Average *I. scapularis* per mammal was 1.2, a new record high
- *Amblyomma americanum:* 0 reports MMCD, 1 report MDH
- Signs posted in dog parks to educate & facilitate tick collections from the public
- 2014 tick-borne disease case totals not available (source MDH)
- Tick Risk Meter estimates posted weekly at mmcd.org & on Facebook

Background

District staff provides a variety of disease surveillance and control services, as well as public education, to reduce the risk of mosquito-borne illnesses such as La Crosse encephalitis (LAC), western equine encephalitis (WEE), eastern equine encephalitis (EEE), and West Nile (WNV) encephalitis, as well as tick-borne illnesses such as Lyme disease and human granulocytic anaplasmosis (HGA). Past District efforts have also included determining metro-area risk for infections of Jamestown Canyon virus (JC), babesiosis, Rocky Mountain spotted fever, and Sin Nombre virus (a hantavirus).

La Crosse encephalitis prevention services were initiated in 1987 to identify areas within the District where significant risk of acquiring this disease exists. High-risk areas are defined as having high populations of the primary vector *Aedes triseriatus* (eastern tree hole mosquito), *Aedes japonicus* (Japanese rock pool mosquito) a possible vector, or a history of LAC cases. MMCD targets these areas for intensive control including public education, larval habitat removal (e.g., tires, tree holes, and containers), and limited adult mosquito treatments. Additionally, routine surveillance and control activities are conducted at past LAC case sites. Surveillance for the invasive species *Aedes albopictus* (Asian tiger mosquito) routinely occurs to detect infestations of the potential disease vector.

The District collects and tests *Culex tarsalis* to monitor WEE activity. Western equine encephalitis can cause severe illness in horses and humans. The last WEE outbreak in Minnesota occurred in 1983.

Culex tarsalis and other *Culex* species are vectors of WNV, a virus that arrived in Minnesota in 2002. Since then MMCD has investigated a variety of mosquito control procedures to enhance our comprehensive integrated mosquito management strategy to prevent West Nile illness. We do limited in-house testing of birds and mosquitoes for WNV, and use that information along with other mosquito sampling data to make mosquito control decisions.

2015 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Continue to improve surveillance and control of *Ae. japonicus*
- Continue catch basin larvicide treatments to manage WNV vectors
- Communicate disease prevention strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Continue to monitor for *Ae. albopictus* and other exotic species
- Continue *Cs. melanura* surveillance and evaluate control options for EEE prevention
- Continue *I. scapularis* surveillance at 100 sampling locations
- Continue with tick-borne disease education, tick identifications, and homeowner consultations
- Continue to update the Tick Risk Meter and provide updates on Facebook
- Continue to post signs at dog parks and expand to additional locations
- Continue to track collections of *A. americanum* or other new or unusual tick species
- New - collaborative study testing nymphal *I. scapularis* from 1990 forward for tick-borne disease exposure

The first occurrence of EEE in Minnesota was in 2001. Since then, MMCD has conducted surveillance for *Culiseta melanura*, which maintains the virus in birds. A "bridge vector" such as *Cq. perturbans* can acquire the virus from a bird and pass it to a human in a subsequent feeding.

On the tick front, in 1989 the state legislature mandated the District "*to consult and cooperate with the MDH in developing management techniques to control disease vectoring ticks*." The District responded by beginning tick surveillance and forming the Lyme Disease Tick Advisory Board (LDTAB) in 1990. The LDTAB includes MMCD and Minnesota Department of Health (MDH) staff, local scientists, and agency representatives who offer their expertise to the tick-borne effort.

MMCD initiated tick surveillance to determine the range and abundance of the black-legged tick (*Ixodes scapularis*, also known as the deer tick) and the Lyme disease spirochete, *Borrelia burgdorferi,* within the District. To date, MMCD has mapped the current distribution of black-legged ticks (545 total sites sampled) and continues to monitor their populations in the metropolitan area. Additionally, District employees have assisted the University of Minnesota with spirochete and anaplasmosis studies. All collected data are summarized and presented to the MDH for their risk analysis.

Because wide-scale tick control is neither ecologically nor economically feasible, tick-borne disease prevention is limited to public education activities which emphasize tick-borne disease awareness and personal precautions. District employees continue to provide tick identifications upon request and are used as a tick referral resource by agencies such as the MDH and the Minnesota Department of Natural Resources (MnDNR).

As described in this and prior operational reports, the MMCD uses sophisticated surveillance techniques to determine the geographic distribution and estimated population levels of both mosquito and tick vectors in the metropolitan area. We continue to modify our surveillance efforts as new or different diseases and disease vectors are detected. This information is used to direct vector control and public education where needed. However, knowing the location and population levels of the vectors is only one part of the vector-borne disease cycle; understanding where vector-borne disease pathogens

may be circulating is also important. Because MMCD lacks the equipment to test vectors or reservoir hosts for tick-borne and most mosquito-borne pathogens, samples are sent to MDH for testing.

In 2009, MMCD began examining ways to expand its programs to be more proactive in the area of vector-borne diseases. We contacted various agencies and held a Lyme Disease Tick Advisory Board meeting to solicit technical expertise. We would ultimately like to increase our ability to serve metro citizens given that in recent years we have received reports of rarely detected vector-borne illnesses (EEE, Powassan, Jamestown Canyon, Rocky Mountain spotted fever). Additionally, we frequently detect invasive vector species (*Ae. albopictus*, *Ae. japonicus*, *Amblyomma americanum*). *Aedes japonicus* are now established throughout the District.

2014 Mosquito-borne Disease Services

Source □eduction

Water-holding containers such as tires, buckets, tarps, and even plastic toys provide developmental habitat for many mosquito species including the LAC vector *Ae. triseriatus*, the invasive species *Ae. albopictus,* and *Ae. japonicus*, and the WNV vectors *Cx. restuans* and *Cx. pipiens*. Eliminating these container habitats is an effective strategy for preventing mosquito-borne illnesses. In 2014, District staff recycled 21,109 tires that were collected from the field (Table 2.1). Since 1988, the District has recycled 612,212 tires. In addition, MMCD eliminated 3,297 containers and filled 478 tree holes in 2014. This reduction of larval habitats occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities, including the 2,135 property inspections by MMCD staff.

Table 2.1 Number of tire, container, and tree hole habitats eliminated during each of the past ten seasons

Year	Tires	Containers	Tree holes	Total
2005	10,614	2,656	1,008	14,278
2006	10,513	2,059	228	12,800
2007	14,449	1,267	107	15,823
2008	16,229	1,615	93	17,937
2009	39,934	8,088	529	48,551*
2010	23,445	5,880	275	29,600
2011	17,326	3,250	219	20,795
2012	21,493	3,908	577	25,978
2013	17,812	2,410	386	20,608
2014	21,109	3,297	478	24,884

*Intensified property inspections in response to introduction of *Ae. japonicus*

La Crosse Encephalitis (LAC)

La Crosse encephalitis is a viral illness that is transmitted in Minnesota by *Ae. triseriatus*. *Aedes albopictus* and *Ae. japonicus* are also capable of transmitting the La Crosse virus. Small mammals such as chipmunks and squirrels are the vertebrate hosts of LACV; they amplify the virus through the summer months. The virus can also pass transovarially from one generation of mosquitoes to the next. Most cases of La Crosse encephalitis are diagnosed in children under the age of 16. In 2014, there were 72 La Crosse illnesses documented in the United States.

***Aedes triseriatus* Surveillance and Control** *Aedes triseriatus* will lay eggs in water-holding containers, but the preferred natural habitat is tree holes. MMCD staff use an aspirator to sample wooded areas in the daytime to monitor the diurnal adults. Results are used to direct adult and larval control activities.

Cool spring conditions delayed the emergence of the first generation of *Ae. triseriatus* adults until the week of June 9. Thereafter, aspirator collections of *Ae. triseriatus* were above average for all but one week through mid-August (see Chapter 1, Fig. 1.14).

In 2014, MMCD staff collected 2,543 aspirator samples to monitor *Ae. triseriatus* populations. Inspections of wooded areas and surrounding residential properties to eliminate larval habitat were provided as follow-up service when *Ae. triseriatus* adults were collected. Six hundred thirty-four samples met the District's adulticide treatment threshold (≥ 2 adult *Ae. triseriatus* per aspirator collection). Adulticides were applied to wooded areas in 321 of those cases. Adult *Ae. triseriatus* were captured in 953 of 2,131 wooded areas sampled. This ratio, as well as the mean number of *Ae. triseriatus* captured per sample have generally been rising since the dry seasons of 2006-2009 (Table 2.2).

Table 2.2 *Aedes triseriatus* aspirator surveillance data, 2000 – 2014

Year	Total areas surveyed	No. with *Ae. triseriatus*	Percent with *Ae. triseriatus*	Total samples collected	Mean *Ae. triseriatus* per sample
2000	1,037	575	55.4	1,912	1.94
2001	1,222	567	46.4	2,155	1.32
2002	1,343	573	42.7	2,058	1.70
2003	1,558	470	30.2	2,676	1.20
2004	1,850	786	42.5	3,101	1.34
2005	1,993	700	35.1	2,617	0.84
2006	1,849	518	28.0	2,680	0.78
2007	1,767	402	22.8	2,345	0.42
2008	1,685	495	29.4	2,429	0.64
2009	2,258	532	24.0	3,125	0.56
2010	1,698	570	33.6	2,213	0.89
2011	1,769	566	32.0	2,563	0.83
2012	2,381	911	38.3	3,175	1.10
2013	2,359	928	39.3	2,905	1.22
2014	2,131	953	44.7	2,543	1.45

L□C□□□□E□□□□□□□□□□M□□□□□□□ There were four LAC cases reported in Minnesota in 2014. Two cases occurred in residents of the District: one in a child who has dual residency in Hennepin County and Scott County and one in a resident of Carver County. Outside the District, one case occurred in Wright County and one case occurred in an Olmsted County resident with the exposure to LACV possibly occurring in Wabasha County. Since 1970, the District has had an average of 2.2 LAC cases per year (range 0 – 10, median 2). Since 1990, the mean is 1.6 cases per year (range 0 – 8, median 1).

While *Ae. triseriatus* is known as the primary vector of LAC, the role *Ae. japonicus* might play in the LAC cycle is less understood. *Aedes japonicus* is a competent vector of LAC virus in laboratory settings, but has not been implicated as a vector in nature. The species was collected near the two LAC case sites investigated while mosquitoes were still active, one where multiple sites in Hennepin and Scott counties were investigated by MMCD and at one Wright County site investigated by MDH. In 2014, MMCD submitted 85 pools of *Ae. japonicus* to MDH to be tested for LAC virus as well as WNV. All of the samples were negative for LAC and WNV.

MMCD L□C□□□□C□□□R□□□□□□□ MMCD was alerted to the Hennepin County/Scott County LAC case on August 20 by a parent of the child. The case was later confirmed by MDH. The District's field response was initiated on August 21 and continued through mid-September. There are three suspected exposure locations: a residential area in Shorewood, a residential area in Louisville Township near Shakopee, and an industrial property in Sand Creek Township outside of Jordan. Extensive inspections occurred in all three areas. *Aedes triseriatus* larvae were found at each location. *Aedes japonicus* larvae were collected from the Louisville Township and Shorewood locations. *Aedes triseriatus* adults were collected from all three locations and *Ae. japonicus* adults were collected from the Shorewood location.

From August 21 through August 25, eight residential properties and four woodlots were inspected in the Louisville Township neighborhood. Twelve tires, 33 containers and two tree holes were eliminated. Staff located an additional 28 tires that were not immediately removed. Twenty-four larval mosquito samples were collected from the neighborhood. Twelve of the samples contained *Ae. triseriatus* and eight of the samples contained *Ae. japonicus*. Two of the *Ae. japonicus* larval samples and five of the *Ae. triseriatus* larval samples were sent to MDH for LACV analysis. The LAC virus was not detected.

On August 22, nine residential properties and ten woodlots were inspected in Shorewood in the area surrounding the child's residence. Four tires and 27 containers were eliminated. Twenty larval mosquito samples were collected from the neighborhood. All 20 samples contained *Ae. japonicus*, seven of the samples contained *Ae. triseriatus*. Thirteen of the *Ae. japonicus* larval samples and five of the *Ae. triseriatus* larval samples were sent to MDH for LACV analysis. Additionally, 12 pools of *Ae. japonicus* and 10 pools of *Ae. triseriatus* from aspirator samples were submitted to MDH for LACV analysis. Results were not available at the time of this printing.

On August 22 and again on August 26, the industrial property in Sand Creek Township near Jordan was inspected. Six tires, five containers and one tree hole were eliminated. Another 28 tires were located but not immediately removed. Two larval samples were collected, both

contained *Ae. triseriatus*. One of the samples was submitted to MDH for LACV analysis. The LAC virus was not detected.

On November 19, MMCD was informed of the Carver County LAC case. MDH has been unable to contact the child's parents which is necessary to obtain permission to release case details to other parties; therefore, little information regarding the case is available to MMCD. We will work with MDH to direct 2015 LAC surveillance and control activities to the portion of Carver County where exposure to LACV might have occurred in this case.

□astern □quine □ncephalitis □□□□□

Eastern equine encephalitis is a viral illness of humans, horses and some other domestic animals such as llamas, alpacas, and emus. The EEE virus circulates among mosquitoes and birds and is most common in areas near the habitat of its primary vector, *Cs. melanura*. These habitats include many coastal wetlands, and in the interior of North America, tamarack bogs and other bog sites. The first record of EEE in Minnesota was in 2001 when three horses were diagnosed with the illness, including one from Anoka County. Wildlife monitoring by the Minnesota Department of Natural Resources (MnDNR) has routinely detected antibodies to the EEE virus in wolves, moose, and elk in northern Minnesota.

In 2014, the EEE virus was reported to CDC by 18 states. There were eight human illnesses diagnosed: three in New Hampshire, two in New York, and one each in Alabama, Maine and Michigan. There were 139 veterinary reports of EEE illnesses in domestic animals, primarily horses, from 16 states. The nearest reports of EEE activity were a human illness in southwest Michigan and six veterinary reports of illness in southeast Michigan.

***Culiseta melanura* S□□□□□□□□□□□** *Culiseta melanura* are relatively rare in the District and are restricted to a few bog-type larval habitats. The greatest concentration of this type of habitat is in the northeast part of MMCD in Anoka and Washington counties. Still, *Cs. melanura* specimens are occasionally collected in other areas of the District.

The *Cs. melanura* population remained low in 2014 with a season total of only 109 adult females collected by CO_2 trap from designated surveillance locations (see Chapter 1, Figure 1.5). Fourteen pools containing 77 *Cs. melanura* were submitted to MDH for viral analysis. The EEE virus was not detected.

□ estern □quine □ncephalitis □□ □□□

Western equine encephalitis circulates among mosquitoes and birds in Minnesota. Occasionally, the virus causes illness in horses and less frequently in people. *Culex tarsalis* is the species most likely to transmit the virus to people and horses. In both 2004 and 2005, the virus was detected in *Cx. tarsalis* specimens collected in southern Minnesota. The virus has not been detected in Minnesota since then. *Culex tarsalis* collections were relatively high in late June and early July (see Ch 1, Fig. 1.18) and while 267 samples were tested for West Nile virus using the RAMP® test, there were no samples tested for WEE.

□amesto□n Canyon □irus □□C□

MDH confirmed four JC illnesses in Minnesota in 2014. The first was in a Dakota County resident who became ill at the end of May. While a Dakota County exposure cannot be ruled out in this case, an exposure in Pine County is more plausible since the individual spent an extensive amount of time outdoors there prior to becoming ill. The other Minnesota cases include a Waseca County resident who may have been exposed in Carlton County, a Goodhue County resident, and a Carlton County resident. The most likely exposure site for each of the cases is in a county bordering Wisconsin, the state where JC cases have been most frequently identified in the recent past. Nationally, there were 10 JC illnesses confirmed, five of which occurred in Wisconsin.

□ est □ile □irus □□ □□□

West Nile virus circulates among many mosquito and bird species. It was first detected in New York in 1999 and has since spread through the continental U.S., much of Canada, Mexico, Central America, and South America. The virus causes many illnesses in humans and horses each year. West Nile virus was first detected in Minnesota in 2002. It is transmitted locally by several mosquito species, but most frequently by *Cx. tarsalis*, *Cx. pipiens*, and *Cx. restuans*.

□ NV □□ □□□U□□□□□ S□□□□□ Forty-seven contiguous states documented West Nile virus transmission in 2014. Maine was the only state of the lower 48 not to record WNV activity. The U.S. Centers for Disease Control and Prevention received reports of 2,085 West Nile illnesses from 43 states and the District of Columbia. There were 84 fatalities attributed to WNV infections. California had the greatest number of cases with 780, Texas reported 345. Nationwide screening of blood donors detected WNV in 337 individuals from 31 states. Of the 337 presumptively viremic blood donors, 31 eventually developed clinical illnesses and are also included in the confirmed cases reported to CDC. Additionally, West Nile illness was diagnosed in 140 domestic animals, mainly horses, from 34 states.

□ NV □□M□□□□□□□ MDH reported 21 WNV illnesses from 15 Minnesota counties. There were no WNV fatalities in Minnesota in 2014. The earliest onset of a WNV illness in the state was June 1. There were five presumptively viremic blood donors reported from Minnesota. Additionally, there were two reports of WNV illness in horses from two Minnesota counties. Twenty-one mosquito samples from five counties and two birds from two counties also returned positive results for WNV.

□ □□□N□□ □□ □□□D□□□□□ There were eight WNV illnesses reported in residents of the District – three in Hennepin County, two in Dakota County, two in Washington County, and one in Scott County. Two cases (one Hennepin County and one Dakota County) may have been exposed outside of Minnesota. Since WNV arrived in Minnesota, the District has experienced an average of 9.9 WNV illnesses each year (range 0 – 25, median 8). When cases with suspected exposure locations outside of the District are excluded, the mean is 7.4 cases per year (range 0 – 17, median 6).

S□□□□□□□□□□□□□□ NV Cool spring and early summer conditions resulted in a slow start to the mosquito season, and ultimately hindered WNV transmission in 2014. The earliest detection of WNV in the District was from a mixed pool of *Cx. pipiens/Cx. restuans* collected in a Scott County gravid trap on June 25. The first WNV detection in a bird was from an American crow collected in Carver County on July 8.

Several mosquito species from 42 CO_2 traps (13 elevated into the tree canopy) and 36 gravid traps were tested for viral analysis each week. In addition, we processed *Cx. tarsalis* collected by any of the CO_2 traps in our Monday night network for viral analysis. MMCD tested 724 mosquito pools using the RAMP® method, 21 of which were positive for WNV. We also submitted 14 *Cs. melanura* pools, one *Ae. albopictus* pool, and 48 *Ae. japonicus* pools to MDH for WNV analysis by PCR. Table 2.3 is a complete list of mosquitoes MMCD processed for WNV analysis.

Table 2.3 Number of MMCD mosquito pools tested for WNV and minimum infection rate (MIR) by species, 2014

Species	Number of mosquitoes	Number of pools	WNV+ pools	MIR per 1,000
Aedes albopictus	5	1	0	0
Aedes japonicus	282	50	0	0
Culex pipiens	313	9	0	0
Culex restuans	1,447	56	0	0
Culex salinarius	104	8	0	0
Culex tarsalis	4,117	267	5	1.21
Culex species	2,443	120	5	2.05
Culex pipiens/restuans	5,744	262	11	1.92
Culiseta melanura	77	14	0	0
Total	14,532	787	21	1.45

The first WNV positive result of 2014 was from a pool of *Cx. pipiens/restuans* collected by a gravid trap in Shakopee on June 25. The next four WNV positive mosquito samples were *Cx. tarsalis* collected in Eagan CO_2 traps during the first eight days of July. Even though surveillance indicated that the *Cx. tarsalis* population persisted in the moderate range for the District (see Figure 1.18), only one of the last 124 samples of the species tested returned a positive result for WNV. That was collected on August 12 in St. Lawrence Township in Scott County. All other pools returning positive results for WNV were mixed pools of *Cx. pipiens* and *Cx. restuans* or pools identified as *Culex* species.

Nine of the 21 WNV mosquito samples were collected in Ramsey County. Seven WNV positive samples were collected in Dakota County, two in Hennepin County, two in Scott County and one in Anoka County. Fourteen of the 21 WNV positive samples were collected by gravid traps, seven by CO_2 traps.

The generally cooler temperatures of the summer of 2014 negatively impacted WNV transmission. A notably cool stretch during the week of July 14 helped suppress the infection rate

in *Culex* species (Figure 2.1). Amplification of WNV increased steadily in August and peaked during the week of September 15 at 5.6/1,000 mosquitoes. This is the same week when the infection rate peaked in 2013; however, then it was nearly three times higher at 15.4/1,000.

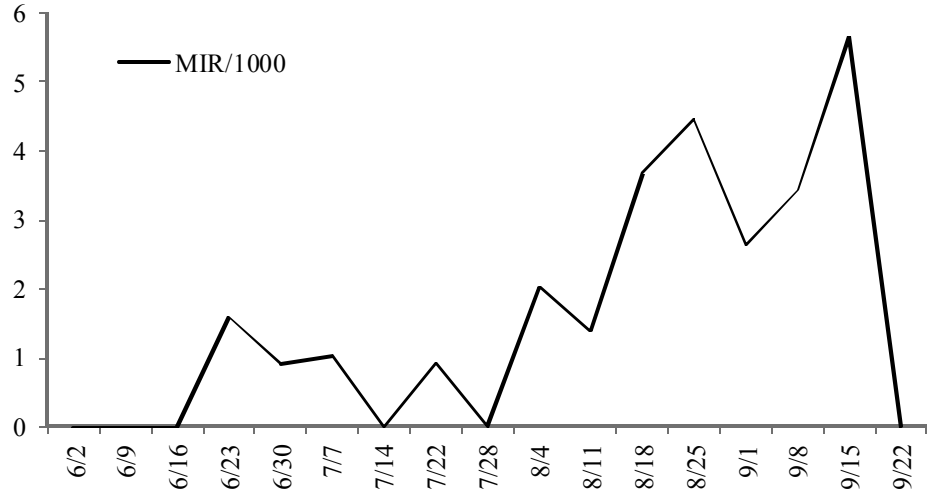


Figure 2.1 Weekly minimum WNV infection rates (MIR) per 1,000 *Culex* specimens tested in 2014. Dates listed are the Monday of each sampling week.

The first bird tested by MMCD in 2014 was positive for WNV by RAMP® test. It was an American crow found near Waconia on July 8. The District modified its bird surveillance plan in 2013 for more efficient use of reported information. We determined that we would stop collecting birds after the first WNV positive result. Seventy-six reports of dead birds were received by telephone, internet, or from employees in the field, 203 fewer than in 2013. Six of the reports were of dead blue jays, 45 were American crows. All other reports were of non-corvids.

□arval *Culex* Surveillance

Culex mosquitoes lay rafts of eggs on the surface of standing water in both natural and man-made habitats. Detecting *Culex* mosquitoes can be challenging since larvae will not be present in a wet habitat unless adult, egg-laying females have been recently active, the area was wet and attractive for oviposition, and the characteristics of the site allow for survival of newly hatched mosquitoes. *Culex* are also less abundant than other types of mosquitoes in our area. Furthermore, in large wetlands larvae can disperse over a wide area or they may clump together in small, isolated pockets. They are generally easier to locate in small habitats (i.e., catch basins, stormwater management structures, etc.) where greater concentrations of larvae tend to be more evenly dispersed.

S□□□□ □ □□□□M □□□□□□ □□□S□□□□□□□□□□□ O□□□□M □□ M□□□H□□□□□□□ Since 2006, MMCD field staff have been working to locate stormwater structures, evaluate habitat, and provide larval control. A classification system was devised to categorize potential habitats. Types

of structures include culverts, washouts, riprap, risers (pond level regulators), underground structures, swimming pools, ornamental ponds, and intermittent streams.

Staff made 4,107 inspections of 3,404 structures in 2014. Mosquito larvae were found in 691 of the 2,675 habitats that were wet on the date of inspection. Inspectors collected 449 larval samples from stormwater structures and other constructed habitats. *Culex* vectors were found in 74.4% of the samples, which is similar to previous seasons (Table 2.4). *Culex pipiens* were collected less frequently from stormwater structures in 2014 than during the past four years. *Culex restuans*, *Cx. salinarius* and *Cx. tarsalis* were observed about as frequently as they have been in other years.

Table 2.4 Frequency of *Culex* vector species collected from stormwater management structures and other constructed habitats 2010 – 2014

	Yearly percent occurrence				
Species	2010 (N=2,020)	2011 (N=1,567)	2012 (N=1,080)	2013 (N=877)	2014 (N=449)
Cx. pipiens	31.8	13.7	39.8	29.8	8.9
Cx. restuans	64.2	65.3	53.1	66.0	66.6
Cx. salinarius	0.0	0.1	0.6	0.5	0.2
Cx. tarsalis	4.5	3.8	3.4	3.9	4.2
Any *Culex* vector spp.	77.4	76.6	74.5	78.6	74.4

M□□□□□□ C□□□□□□□ U□□□□□□□□□□ S□□□□ □ □□□□S□□□□□□□□ Many stormwater management systems include large underground chambers to trap sediments and other pollutants. There are several designs in use that vary in dimension and name, but collectively, they are often referred to as BMPs from *Best Management Practices for Stormwater* under the US Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES). MMCD has worked with city crews to survey and treat underground BMPs since 2005.
In 2014, we continued the cooperative mosquito control plan for underground habitats. Nineteen municipalities volunteered their staff to assist with material applications (Table 2.5). Altosid® XR briquets were used at the label rate of one briquet per 1,500 gallons of water retained. Briquets were placed in 675 underground habitats.

Prolific mosquito development has been documented in local underground BMPs. The majority of mosquitoes found in BMPs are *Culex* species and successfully controlling their emergence from underground habitats will remain an objective in MMCD's comprehensive strategy to manage WNV vectors. We plan to continue working with municipalities to limit mosquito development in stormwater systems.

Table 2.5 Cities that assisted in treating underground stormwater habitats in 2014; 675 structures were treated and a total of 766 briquets were applied

City	Structures treated	Briquets used	City	Structures treated	Briquets used
Arden Hills	6	6	Minneapolis	166	166
Bloomington	86	103	New Brighton	5	8
Brooklyn Park	4	15	New Hope	6	12
Columbia Heights	8	12	Prior Lake	56	56
Crystal	5	14	Richfield	8	20
Eden Prairie	12	20	Roseville	11	14
Lauderdale	13	13	Savage	12	22
Lino Lakes	10	10	Spring Lake Park	2	2
Maplewood	190	190	Woodbury	40	40
Mendota Heights	35	43			

L S C B Catch basin larval surveillance was delayed due to cool weather and frequent rainfall in May and early June. By late June, weather conditions were more favorable for larval development in catch basins.

Larval surveillance, primarily in St. Paul catch basins, began the week of May 19 and ended the week of August 25 (Figure 2.2). There were no catch basin inspections during the week of June 16 due to flushing rainfall that week. Larvae were found during 360 of 606 catch basin inspections (59.4%) in 2014.

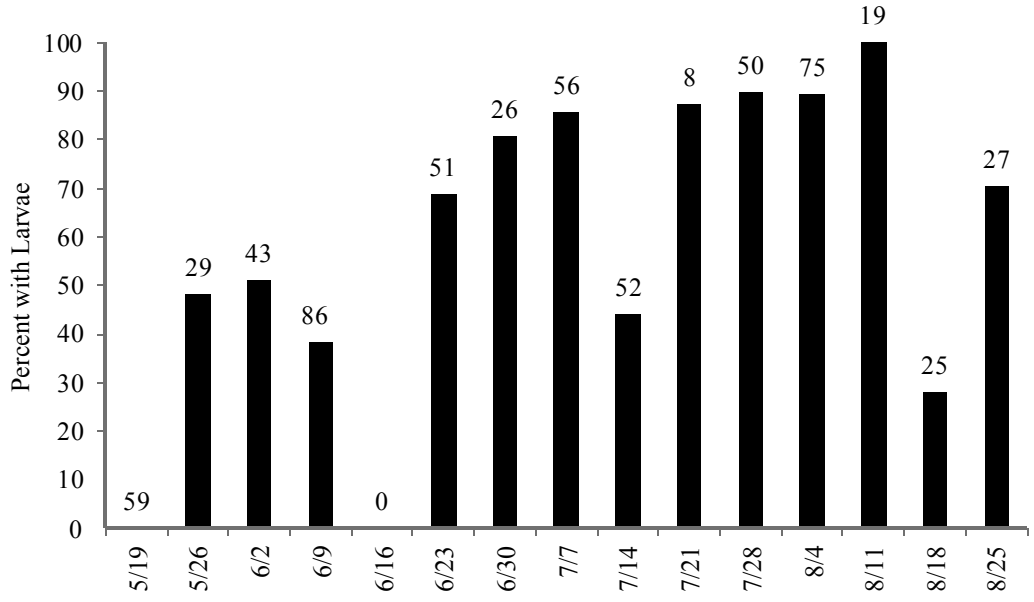


Figure 2.2 Percent of catch basins inspected with mosquitoes present in 2014. Bars are labeled with the number of inspections occurring during the week.

Mosquito larvae were identified from 358 catch basin samples. *Culex restuans* were found in 86.3% of catch basin larval samples (Figure 2.3). *Culex pipiens* were found in 36.6% of samples.

At least one *Culex* vector species was found in 99.2% of samples. *Culex pipiens* were less prevalent in catch basins in 2014 than during the previous two seasons. They were found in 73.1 percent of catch basin samples in both 2012 and 2013. *Culex restuans* were encountered more frequently in catch basin samples in 2014 than the past two seasons when they were found in 67.4 percent (2012) and 67.9 percent (2013) of catch basin samples.

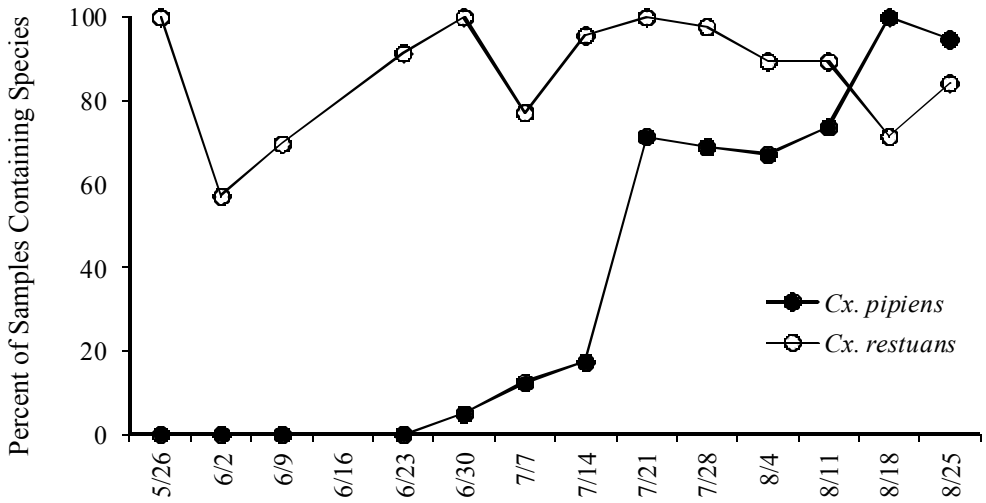


Figure 2.3 Occurrence of *Cx. pipiens* and *Cx. restuans* in catch basin larval samples by week.

2015 □lans – Mosquito-borne Disease

District staff will continue to provide mosquito surveillance and control services for the prevention of La Crosse encephalitis. Preventive measures include *Ae. triseriatus* adult sampling, adult control and, especially, tree hole and container habitat reduction. Eliminating small aquatic habitats will also serve to control populations of *Ae. japonicus*.

The District will continue to survey aquatic habitats for *Culex* larvae for use in design and improvement of larval control strategies. The WNV and WEE vector *Cx. tarsalis* will remain a species of particular interest. Cooperative work with municipalities within the District to treat underground stormwater structures that produce mosquitoes will continue. District staff will continue to target *Culex* larvae in catch basins in our efforts to reduce WNV amplification.

MMCD will continue to conduct surveillance for WNV, JC, and EEE vectors and for other mosquito-borne viruses in coordination with MDH and others involved in mosquito-borne disease in Minnesota. We plan to work with other agencies, academia, and individuals to improve vector-borne disease prevention in the District, as well as to serve as a resource for others in the state.

2014 Tic□-borne Disease Services

Ixodes scapularis Distribution Study

The District continued to sample the network of 100 sites set up in 1991-1992 to monitor potential changes in tick distribution over time. As in previous years, the primary sampling method involved capturing small mammals from each site and removing any attached ticks. Collections from the northeastern metropolitan area (primarily Anoka and Washington counties) have consistently detected *Ixodes scapularis*, and in 1998 *I. scapularis* was detected in Hennepin and Scott counties for the first time. We collected at least one *I. scapularis* from all seven counties that comprise our service area for the first time in 2007. Since then we have continued to detect *I. scapularis* with greater frequency in sites located south of the Mississippi River and they appear to be prevalent now in many wooded areas south of the river. The 2014 report will be available on our website (www.mmcd.org) in June. Following are some 2014 highlights.

The average number of *I. scapularis* collected per mammal (1.213) in 2014 is a new record high but it is comparable to the averages we have come to expect in recent years; averages in the years 2000 – 2002, 2004, 2005, 2007, 2009, 2010, 2012 and 2014 were all $\geq$ 0.806 (Table 2.5).

The overall positive site total for 2014 was a new record high of 75, compared with a yearly positive site total typically in the 50s since 2000. The previous high of 71 sites occurred in 2012; the first time there was a site total of 70 or more occurred in 2010. As has occurred in all years since 2007, except 2011, we collected at least one *I. scapularis* from all seven counties that comprise our service area. *Ixodes scapularis* was collected at 45 sites north of the Mississippi River (Anoka, Washington, and Ramsey counties), and at 30 sites south of the Mississippi River (Dakota, Hennepin, Scott, and Carver counties).

T□□-□□□□D□□□□– L□□ □D□□□□ □□□ H□□ □□ A□□□□□ □□□ The Minnesota Department of Health (MDH) has been documenting record-setting human tick-borne disease case totals since 2000. Pre-2000, the highest Lyme case total was 302 but since 2000 the Lyme totals have ranged from 463 to 1,431 cases and now typically average >1,000 per year. Human anaplasmosis (HA) cases have also been on the rise. After averaging roughly 15 cases per year through 1999 the total HA case numbers ranged from 78 to 186 from 2000 – 2006 then increased into the range of the 300s. The all-time high, statewide Lyme disease case record (1,431) was set in 2013 with the all time high HA record of 782 set in 2011. There were 627 HA cases in 2013. Case totals from 2014 were not available as of this printing, but the MDH anticipated that 2014 case totals may be lower than the 2013 totals.

Table 2.6 Total number of mammals trapped and tick species collected by life stage and year, and the number of *I. scapularis* collected per mammal 1990-2014. The number of sites sampled was 250 in 1990, 270 in 1991, 200 in 1992, and 100 from 1993 to present.

			Dermacentor variabilis		*Ixodes scapularis*			
Year	No. mammals	Total ticks collected	No. larvae	No. nymphs	No. larvae	No. nymphs	No. other species[b]	Ave. *I. scap* / mammal
1990 [a]	3651	9957	8289	994	573	74	27	0.177
1991	5566	8452	6807	1094	441	73	37	0.092
1992	2544	4130	3259	703	114	34	20	0.058
1993	1543	1785	1136	221	388	21	19	0.265
1994	1672	1514	797	163	476	67	11	0.325
1995	1406	1196	650	232	258	48	8	0.218
1996	791	724	466	146	82	20	10	0.129
1997	728	693	506	66	96	22	3	0.162
1998	1246	1389	779	100	439	67	4	0.406
1999	1627	1594	820	128	570	64	12	0.390
2000	1173	2207	1030	228	688	257	4	0.806
2001	897	1957	1054	159	697	44	3	0.826
2002	1236	2185	797	280	922	177	9	0.889
2003	1226	1293	676	139	337	140	1	0.377
2004	1152	1773	653	136	901	75	8	0.847
2005	965	1974	708	120	1054	85	7	1.180
2006	1241	1353	411	140	733	58	11	0.591
2007	849	1700	807	136	566	178	13	0.876
2008	702	1005	485	61	340	112	7	0.644
2009	941	1897	916	170	747	61	3	0.859
2010	1320	1553	330	101	1009	107	6	0.845
2011	756	938	373	97	261	205	2	0.616
2012	1537	2223	547	211	1321	139	5	0.950
2013	596	370	88	42	147	92	1	0.401
2014	1396	2427	580	149	1620	74	4	1.213

[a] 1990 data excludes one *Tamias striatus* with 102 *I. scapularis* larvae and 31 nymphs
[b] other species mostly *Ixodes muris.* 1999—second adult *I. muris* collected

□pdates – □e□ Strategies 2014

P□□□□□ S□□□□D□□P□□□□ Since the initial suggestion of the Technical Advisory Board (TAB) in 2010, we have visited dog parks and vet offices as part of our outreach and have posted signs in approximately 21 dog parks with additional signs posted in active dog walking areas, including at Stubbs Bay Park, Luce Line Trail Entrance. We have also continued to work on expanding our sign placements into additional metro locations.

T□□□□□□□ E□□□□□□□□M□□□□□□□D□□□□□□□□□□□□ Brochures, tick cards, and/or posters were delivered to approximately 270 locations (city halls, libraries, schools, child care centers, retail establishments, vet clinics, parks) across the metro area as well as distributed at fair booths and city events, with many more mailed upon request.

***Amblyomma americanum* □L□□□S□□□T□□□□** *Amblyomma americanum* is an aggressive human biter and can transmit human monocytic ehrlichiosis (HME), among other potential pathogens. Both the tick and HME are more common to the southern US, but *A. americanum*'s range is known to be moving northward. *Amblyomma* ticks have been submitted to MMCD from the public on a rare, sporadic basis. This species was first collected by MMCD in 1991 via a road kill examination of a white-tailed deer (*Odocoileus virginianus*). In 2009, however, citizens from Minneapolis and Circle Pines submitted *Amblyomma* specimens to MDH and MMCD. This trend continued in 2010; *Amblyomma* were submitted to MMCD from Eagan, Mound, and the Orono/Lake Minnetonka areas of the metro. In 2011, the MDH had submissions of adults from Shakopee, Lindstrom, and an unconfirmed location in Hennepin County) and in 2012, three more *Amblyomma* were submitted to the MDH: Eden Prairie or Burnsville, Bloomington, and Rice County. MMCD did not receive any *Amblyomma* in 2011 or 2012. In 2013, the MDH did not receive any reports but MMCD received three *Amblyomma* (Afton, Scandia, and western Wisconsin). We notified the Wisconsin Department of Health and mailed the western Wisconsin tick to them. In 2014, MMCD did not receive any reports but the MDH received one report from the Zumbrota, MN area.

R□□□□□□□B□□□□□P□□□□ Dr. Roger Moon (UM-St. Paul) was able to rear some bot fly pupae into adults. It is a rare event to see this particular bot fly species alive as an adult and we are happy to report that a flying live adult has been viewed, in person, by MMCD staff!

Tic□ □dentification Services□□utreach

The overall scope of tick-borne disease education activities and services were maintained in 2014 using previously described methods and tools, including weekly updates to our Tick Risk Meter on our website and MMCD's Facebook page.

2015 □lans for Tic□-borne Disease Services

Metro Surveillance

The metro-based *I. scapularis* distribution study that began in 1990 is planned to continue unchanged.

Tic□ □dentification Services□□utreach

E□□□□□□□□□S□□□□□M□□□□ We plan to maintain our tick-borne disease education activities and services (including tick identifications and homeowner consultations) using previously described methods and tools, including weekly website and Facebook updates of the Tick Risk Meter as well via social media. Because our *I. scapularis* collections as well as the MDH's

tabulated human tick-borne disease case totals remain elevated, we will continue to stock local parks and other appropriate locations with tick cards, brochures and/or posters and signs along with targeting specific metro townships based on higher human case totals and/or numbers of *I. scapularis* collected. We will also distribute materials at local fairs and the Minnesota State Fair, set up information booths at events as opportunities arise, and continue to offer an encompassing slide presentation.

P□□□□□□ S□□□□ We will continue to post at dog parks and high traffic dog walking paths and plan to expand to additional areas. As in past years, signs will be posted in the spring and removed in late fall after *I. scapularis* activity ceases for the year.

***Amblyomma americanum* □N□□ □□U□□□□□T□□□S□□□□□□** MMCD and MDH continue to discuss possible strategies that would enable both agencies to detect possible establishment of *A. americanum* in Minnesota. MMCD will continue to monitor this tick in our surveillance and to track collections turned in by the public as part of our tick identification service. Both MMCD and MDH will continue to notify each other when *A. americanum* or other new or unusual tick species is found.

Additional □ro□ects

B□□□□R□□□□□ As we have done since 2013, each facility will attempt to collect roughly 20 pupal bot flies. The pupae will be given to Dr. Roger Moon (UM-St. Paul) for rearing to adulthood. Adult flies are needed for bot fly species identification.

C□□□□□□□□□□S□□□□ – T□□□□□□ N□□ □□□□D□□□T□□□□ MMCD is providing *I. scapularis* nymphs to Steve Bennett (UM-St Paul) to be tested for exposure to several tick-borne disease agents. Nymphs from 1990 and at least through 2014 will be tested and any changes over time will be documented.

Chapter 3 Mosquito Control

2014 Highlights

- Record rainfall led to record amounts of larvicide treatments in 2014 (318,427 acres), surpassing the previous record from 2010 (297,092 acres)
- 113,804 more acres worth of larvicides were applied to wetlands in 2014 than in 2013
- A cumulative total of 240,266 catch basin treatments were made in three rounds to control vectors of WNV
- 8,302 more acres worth of adulticides were applied in 2014 than in 2013

2015 Plans

- Conduct large scale tests of MetaLarv™ S-PT to control spring *Aedes as a* prehatch
- Increase September Vectolex® CG treatments as part of our cattail mosquito control program
- Work closely with MPCA to fulfill the requirements of a NPDES permit
- Continue tests of Onslaught® and other alternate barrier adulticides; specifically target vector mosquitoes
- Continue to increase vector surveillance and control in response to the observed geographic expansion of *Ae. japonicus* within the District

Background

The mosquito control program targets the principal summer pest mosquito *Aedes vexans*, several species of spring *Aedes*, the cattail mosquito *Cq. perturbans*, and several disease vectors including *Ae. triseriatus* and the *Culex*4 (*Cx. tarsalis, Cx. pipiens, Cx. restuans, Cx. salinarius*). *Aedes japonicus,* another potential vector species, arrived on the scene in 2007 and has also increased control needs.

Due to the large size of the metropolitan region (2,975 square miles), larval control was considered the most cost-effective control strategy in 1958 and remains so today. Consequently, larval control is the focus of the control program and the most prolific mosquito habitats (over 77,000 potential sites) are scrutinized for all human-biting mosquitoes.

Larval habitats are diverse. They vary from very small, temporary pools that fill after a rainfall to large wetland acreages. Small sites (ground sites) are three acres or less, which field crews treat by hand. Large sites (air sites) are treated by helicopter only after certain criteria are met: larvae occur in sufficient numbers (threshold), larvae are of a certain age (instar), and larvae are the target species (human biting or disease vector).

The insect growth regulator methoprene and the soil bacterium *Bacillus thuringiensis* var *israelensis* or *Bti*, are the primary larval control materials. These active ingredients are used in the trade-named materials Altosid® and MetaLarv™ (methoprene) and VectoBac® (*Bti*). Other materials being integrated into the larval control program are *B. sphaericus* (VectoLex® CG) and *Saccharopolyspora spinosa* or "spinosad" (Natular™ G30). Adult control augments the larval control program when necessary.

The District uses priority zones to focus service in areas where the highest number of citizens benefit (Figure 3.1). Priority Zone 1 (P1) contains the majority of the population of the Twin Cities metropolitan area and has boundaries similar to the Metropolitan Urban Service Area (MUSA, Metropolitan Council). Priority Zone 2 (P2) includes sparsely

populated and rural parts of the District. We consider small towns or population centers in rural areas as satellite communities and they receive services similar to P1. Citizens in P1 receive full larval and adult vector and nuisance mosquito control. In P2, the District focuses on vector control and provides additional larval and adult control services as appropriate and as resources allow.

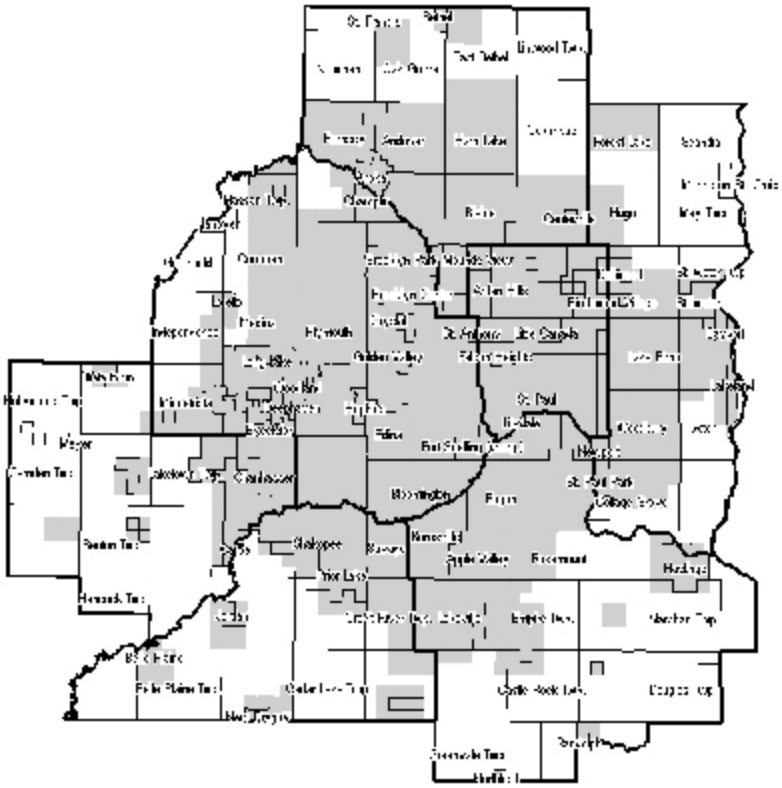


Figure 3.1 Priority Zones: P1 (shaded) and P2 (white), with District county and city/township boundaries, 2014.

To supplement the larval control program, adulticide applications are performed after sampling detects mosquito populations meeting threshold levels, primarily in high use park and recreation areas, for public events, or in response to citizen mosquito annoyance reports. Special emphasis is placed on areas where disease vectors have been detected, especially if there is also evidence of virus circulation.

Three synthetic pyrethroids are used: resmethrin, permethrin, and sumithrin. Sumithrin (Anvil®) and two formulations of natural pyrethrins, Pyrenone® and Pyrocide®, can be used in agricultural areas. A description of the control materials is found in Appendix C. Appendix D indicates the dosages of control materials used by MMCD, both in terms of amount of formulated (and in some cases diluted) product applied per acre and the amount of active ingredient (AI) applied per acre. Appendix E contains a historical summary of the number of acres treated with each control material (2006-2014). Pesticide labels are located in Appendix F.

2014 Mosquito Control

□arval Mosquito Control

T□□□□□□□□ *Bti* treatments in small ground sites are only done when larvae are present, as measured by taking 10 dips with a standard 4-inch diameter dipper. Treatments with materials formulated for application prior to flooding and egg hatch ("prehatch materials") are applied to sites with a history of larvae present. For helicopter *Bti* treatments in "air sites", the average number of larvae per 10 dips must be over a threshold value to warrant treatment. P1 and P2 areas have different thresholds to help focus limited time and materials on productive sites near human population centers (Table 3.1). Spring *Aedes*, which tend to be long-lived, aggressive biters, have lower thresholds. In 2011, we increased the spring *Aedes* threshold to conserve larvicides. After mid-May, when most larvae found are floodwater summer species, thresholds are increased. If *Aedes* and *Culex* are both present in a site and neither meet threshold, the site can be treated if the combined count meets the threshold. We increased the *Culex*4 threshold in 2012, primarily because many of these larvae are *Cx. restuans* (an amplifying vector) rather than bridge vectors (*Cx. tarsalis*, *Cx. salinarius*).

Table 3.1 Air site larval thresholds (average number of larvae per ten dips) for aerial treatments in P1 and P2

	Spring *Aedes*		Summer*		*Culex*4**	
Year	P1	P2	P1	P2	P1	P2
2010	0.1	0.5	2.0	5.0	1.0	1.0
2011	0.5	1.0	2.0	5.0	1.0	1.0
2012-2014	0.5	1.0	2.0	5.0	2.0	2.0

* Summer = Summer *Aedes* or *Aedes* + *Culex* 4

** *Culex* 4 = *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*

S□□□□□ O□□□□□□□ The 2014 season began very much like 2013. Staff detected the first spring *Aedes* larvae on April 8, one day earlier than in 2013. Aerial pellet treatments (spring *Aedes* pre-hatch) began on April 22. *Bti* treatments to control spring *Aedes* began on April 25 (thirteen days earlier than in 2013). The mosquito species composition switched to *Aedes vexans* (summer floodwater) on May 12, a more typical date (one week earlier than in 2013); after that time the summer threshold was used.

Record rainfall in April and, especially, June induced many repeated periods of larval mosquito development. By June 10, 149,124 acres of *Bti* treatments had been completed (Figure 3.2), which is comparable to the 2013 season total of 149,845 acres. We responded by lowering our aerial *Bti* dosage to 5 lb/acre to conserve remaining control materials while maintaining good control. As we progressed into July and August, the rain events decreased and were more isolated. Significant rainfall in September stimulated enough larval floodwater mosquito development to justify 18,290 acres of aerial *Bti* treatments in September. On September 16, we made VectoLex treatments to 3,063 acres of cattail sites in which cattail mosquito larvae recently were detected by inspectors. These late summer treatments will decrease the cattail treatment pressure in late spring 2015, when weather and concurrent floodwater mosquito broods can complicate treatment efforts.

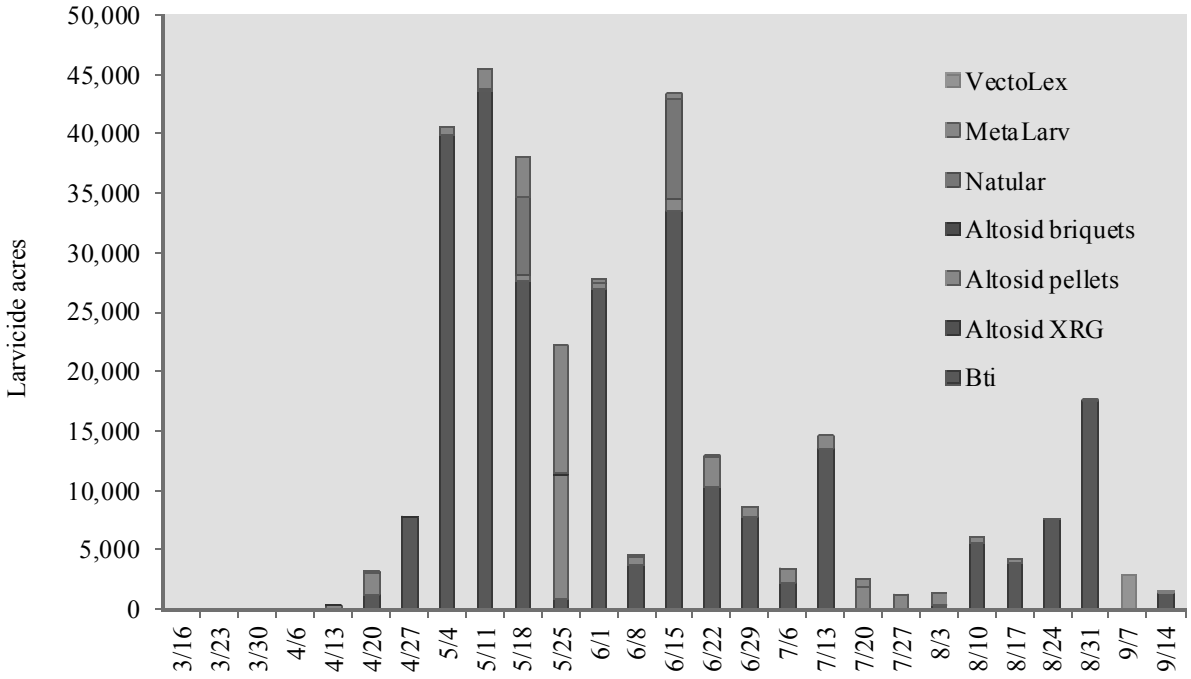


Figure 3.2 Acres treated with larvicide and each week (March-September 2014). Date represents start date of week.

While the mosquito season began as late in 2014 as in 2013, intense mosquito production continued much later essentially doubling the season length in 2014 (21 weeks: late April through mid-September) compared to 2013 (11 weeks: early May through mid-July). This resulted in one large brood of spring *Aedes* and four large and nine small-medium broods of *Aedes vexans* (typical season has four large broods). Total larval control material use in 2014 was much higher than 2013 (Table 3.2). Stormwater catch basin treatments to control *Culex* mosquitoes began in early June and ended in early September. Most catch basins were treated three times with Altosid pellets (3.5 grams per catch basin) from June through mid-September (Table 3.2).

We continued to work with Minnesota Pollution Control Agency (MPCA) to satisfy the requirements of our National Pollution Discharge Elimination System (NPDES) permit. We submitted our 2013 treatment report to MPCA in early 2014. Our report contained site-specific larval surveillance and larvicide treatment records and GIS-encoded locations of sites (more details included in Chapter 6). We plan to submit a similar report of 2014 activities in early 2015.

Table 3.2 Comparison of larval control material usage in wetlands (including stormwater structures other than catch basins) and in stormwater catch basins for 2013 and 2014 (research tests not included).

	2013		2014	
Material	Amount used	Area treated	Amount used	Area treated
Wetlands				
Altosid briquets	252.26 cases	189 acres	256.4 cases	193 acres
Altosid pellets	45,072.53 lb	15,813 acres	84,056.6 lb	26,179 acres
Altosid XR-G	69,480.00 lb	6,948 acres	520.00 lb	52 acres
VectoLex CG	34,950.00 lb	2,330 acres	43,999.79 lb	3,064 acres
Natular G30	75,000.00 lb	15,000 acres	74,981.13 lb	14,950 acres
MetaLarv S-PT	40,012.54 lb	14,063 acres	48,491.51 lb	18,073 acres
VectoBac G	1,157,073.68 lb	150,280 acres	1,730,131.00 lb	255,916 acres
Larvicide subtotals		204,623 acres		318,427 acres
Catch basins				
Altosid briquets	1.70 cases	375 CB[1]	1.99 cases	437 CB[1]
Altosid pellets	1,956.18 lb	245,925 CB	1,984.39 lb	239,829 CB
Natular XRT	0.00 cases	0 CB	0.00 cases	0 CB
VectoLex CG	0.00 lb	0 CB	0.00 lb	0 CB
CB subtotals		246,300 CB		240,266 CB

[1]CB=catch basin treatments

Adult Mosquito Control

T□□□□□□□□ Adult mosquito control operations are considered when mosquito levels rise above established thresholds for nuisance (*Aedes* spp. and *Cq. perturbans*) and vector species (Table 3.3). Staff conducted a study in the early 1990s that measured people's perception of annoyance while simultaneously sampling the mosquito population (Read et.al., 1994). Results of this study are the basis of MMCD's nuisance mosquito thresholds. The lower thresholds for vector species are designed to interrupt the vector/virus transmission cycle.

Table 3.3 Thresholds levels by sampling method for important nuisance and vector species detected in MMCD surveillance. *Aedes* spp. and *Cq. perturbans* are considered nuisance mosquitoes; all other species listed are disease vectors.

		Total number of mosquitoes			
Species	Date implemented	2-min sweep	CO_2 trap	Aspirator	2-day gravid trap
Aedes triseriatus	1988			2	
Aedes spp. & *Cq. perturbans*	1994	2[*]	130		
*Culex*4[**]	2004	1	5	1[***]	5
Ae. japonicus	2009	1	1	1	1
Cs. melanura	2012		5	5	

[*]2-minute slap count may be used

[**]*Culex*4=*Cx. tarsalis*, *Cx. restuans*, *Cx. pipiens*, and *Cx. salinarius*

***Aspirator threshold only for *Cx. tarsalis*

S□□□□□ O□□□□□□□ In 2014, adult mosquito levels rose abruptly at the end of May and remained high until early July; at those times, counts over threshold were fairly widespread (Figure 3.3). In 2014, MMCD applied 8,302 more acres worth of adulticides than in 2013 (Table 3.4, Appendix E). Figure 3.3 shows weekly adulticide acres treated (line). The peaks in late May through early July reflect a response to primarily widespread *Ae. vexans* emergence and increasing numbers of *Culex* (WNV vectors). The number of traps over the vector threshold remained high through early August with lower levels through September. A greater proportion of ULV and barrier treatments later in the summer targeted vector mosquitoes. Customer calls related to mosquito annoyance dropped from 2,804 during May through June to 568 in July and August.

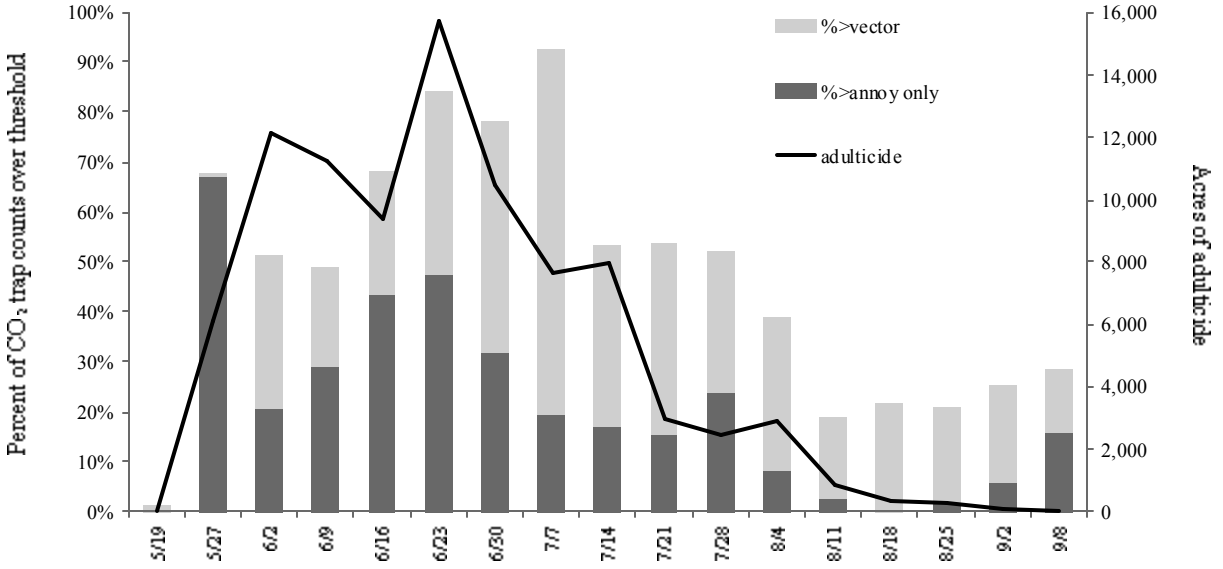


Figure 3.3 Percent of Monday CO_2 trap locations with counts over threshold (date is day of CO_2 trap placement), showing subtotals by annoyance or vector thresholds (*Culex*, *Ae. triseriatus*, *Ae. japonicus*), with acres of adulticides applied, 2014.

Table 3.4 Comparison of adult control material usage in 2013 and 2014

	2013		2014	
Material	Gallons used	Acres treated	Gallons used	Acres treated
Permethrin	1,761.67	9,020	1,722.09	8,887
Resmethrin	435.98	37,204	525.82	44,890
Sumithrin*	843.76	36,000	735.48	31,381
Pyrocide*	0.00	0	62.91	5,338
Total		82,224		90,526

* Products labeled for use in agricultural areas

References

Read, N., J.R. Rooker, and J. Gathman. 1994. Public perception of mosquito annoyance measured by a survey and simultaneous mosquito sampling. J. Am. Mosq. Control Assoc. 10(1): 79-87.

2015 Plans for Mosquito Control Services

Integrated Mosquito Management Program

In 2015, MMCD will review all aspects of its integrated mosquito management program to ensure that budgetary resources are being used as effectively as possible with the goal of maximizing mosquito control services per budget dollar and complying with all NPDES-related permit requirements. Further discussion regarding the Clean Water Act's NPDES permit requirements is in Chapter 6. Our Control Materials budget in 2015 will be increased slightly compared to 2014. Most of the increase will be used to support larval control.

Larval Control

Cattail Marsh Control In 2015, control of *Cq. perturbans* will use a strategy similar to that employed in 2014. MMCD will focus control activities on the most productive cattail marshes near human population centers. Altosid briquet applications will start in early March to frozen sites (e.g., floating bogs, deep water cattail sites, remotely located sites). Largely because of control material prices, a greater proportion of acres will be treated with Altosid pellets and MetaLarv S-PT to minimize per-acre treatment costs. Beginning in late May, staff will apply MetaLarv S-PT (3 lb/acre) and Altosid pellets (4 lb/acre) aerially. Ground sites will be treated with Altosid pellets (4 lb/acre) and MetaLarv S-PT (3 lb/acre). Staff will increase (compared to previous years) late summer VectoLex CG applications (15 lb/acre) into our cattail mosquito control program based upon site inspections completed between mid-August and mid-September.

Non-Cattail Control The primary control material will again be *Bti* corn cob granules. Larvicide needs in 2015, mainly *Bti* - VectoBac G, Altosid pellets, Natular G30, and MetaLarv S-PT (tested in 2010 and 2011 as VBC-60215), are expected to be similar to the five-year average larvicide usage (240,337 acres). As in previous years, to minimize shortfalls, control material use may be more strictly rationed during the second half of the season, depending upon the amount of the season remaining and control material supplies. Regardless of annoyance levels, MMCD will maintain sufficient resources to protect the public from potential disease risk.

Staff will treat ground sites with methoprene products (Altosid pellets, Altosid briquets, MetaLarv S-PT), Natular G30 or *Bti* corncob granules. During a wide-scale mosquito brood, sites in highly populated areas will receive treatments first. The District will then expand treatments into less populated areas where treatment thresholds are higher. We will continue with the larval treatment thresholds used in 2014 (Table 3.1).

Each year staff review ground site histories to identify those sites that produce mosquitoes most often. This helps us to better prioritize sites to inspect before treatment, sites to pre-treat with Natular G30 or methoprene products before flooding and egg hatch, and sites not to visit at all. The ultimate aim is to provide larval control services to a larger part of the District by focusing on the most prolific sites.

V□□□□□M□□□□□□□□□ Employees will routinely monitor and control *Ae. triseriatus*, *Ae. japonicus, Ae. albopictus, Cs. melanura*, *Cx. tarsalis*, *Cx. pipiens*, *Cx. restuans*, and *Cx. salinarius* populations (See Chapter 2).

MMCD has expanded control to four *Culex* species since the arrival of WNV in 2002. Ground and aerial larvicide treatments of wetlands have been increased to control *Culex*. Catch basin treatments control *Cx. restuans* and *Cx. pipiens* in urban areas. Most catch basins will be treated with Altosid pellets. Catch basins selected for treatment include those found holding water, those that potentially could hold water based on their design, and those for which we have insufficient information to determine whether they will hold water. Treatments could begin as early as the end of May and no later than the third week of June. We tentatively plan to complete a first round of pellet treatments by June 25 with subsequent Altosid pellet treatments every 30 days.

We intend to continue working cooperatively with cities to treat underground stormwater management structures (see Chapter 2) and slowly expand the kinds of structures we treat with larvicides beyond pond level regulators.

Intensive surveillance for *Ae. japonicus* and *Cs. melanura* will continue in 2015 to determine abundance and common larval habitats and identify potential larval control methods.

Adult Mosquito Control

Staff will continue to review MMCD's adulticide program to ensure effective resource use and minimize possible non-target effects. Adulticide budget amounts in 2015 are based on 2014 use. We will continue to focus efforts where there is potential disease risk, as well as provide service in high-use park and recreation areas and for public functions, and respond to areas where high mosquito numbers are affecting citizens.

Additional plans are:

- to use Anvil (sumithrin) as needed to control WNV vectors in agricultural areas because the updated label now allows applications in these areas;
- to evaluate possible adulticide use in response to *Ae. japonicus* and *Cs. melanura*;
- to continue testing additional ULV adulticides (see Chapter 5) to replace Scourge® (resmethrin), which has not been re-registered; and
- to ensure all employees who may apply adulticides have passed applicator certification testing, in preparation for a shift in label status of permethrin to Restricted Use (certified applicators only).

Chapter 4 Black Fly Control

2014 Highlights

- Treated 26 small streams sites with *Bti* when the *Simulium venustum* larval population met the treatment threshold; a total of 26.7 gallons of *Bti* was used for these treatments
- Treated 64 large rivers sites with *Bti* when the larval population of the target species met the treatment threshold; a total of 4,324 gallons of *Bti* was used for these treatments
- Heavy rains in June resulted in flood-level flows on the large rivers from late June until early July; sampling and treatments were suspended during this time on 4 of the 5 large rivers due to safety concerns and lost samplers
- Monitored adult populations using overhead net sweeps and CO_2 traps
- Sorted, counted and identified invertebrates collected in the 2013 Mississippi River non-target monitoring samples

2015 Plans

- Monitor larval black fly populations in the small streams and large rivers; the treatment thresholds will be the same as previous years
- Monitor adult populations by the overhead net sweep and CO_2 trap methods
- Collect Mississippi River non-target monitoring samples

Background

The goal of the black fly control program is to reduce pest populations of adult black flies within the MMCD to tolerable levels. Black flies develop in clean flowing rivers and streams. Larval populations are monitored at more than 170 small stream and at 28 large river sites using standardized sampling techniques during the spring and summer. Liquid *Bti* is applied to sites when the target species reach treatment thresholds in accordance with MMCD's permit from the Minnesota Department of Natural Resources (MnDNR).

The small stream treatment program began in 1984. The large river program began with experimental treatments and non-target impact studies in 1987. A full-scale large river treatment program did not go into effect until 1996. The large river treatment program was expanded in 2005 to include the South Fork Crow River in Carver County. Large river and small stream monitoring/treatment locations are shown in Figure 4.1.

2014 Program

Small Stream Program—*Simulium venustum* Control

Simulium venustum is the only human-biting black fly species that develops in small streams in the MMCD area that is targeted for control. It has one generation in the spring.

In April and May, 177 larval monitoring samples were collected from the small streams within the MMCD to determine larval abundance using the standard grab sampling technique developed by the MMCD. The treatment threshold was 100 *S. venustum* per sample. A total of 26 sites on 11 streams met the threshold and were treated once with VectoBac® 12AS *Bti*. A total of 26.7 gallons of VectoBac was used for the treatments (Table 4.1). The average annual amount of *Bti* used to treat the small stream sites during 1996-2013 was 27.1 gallons.

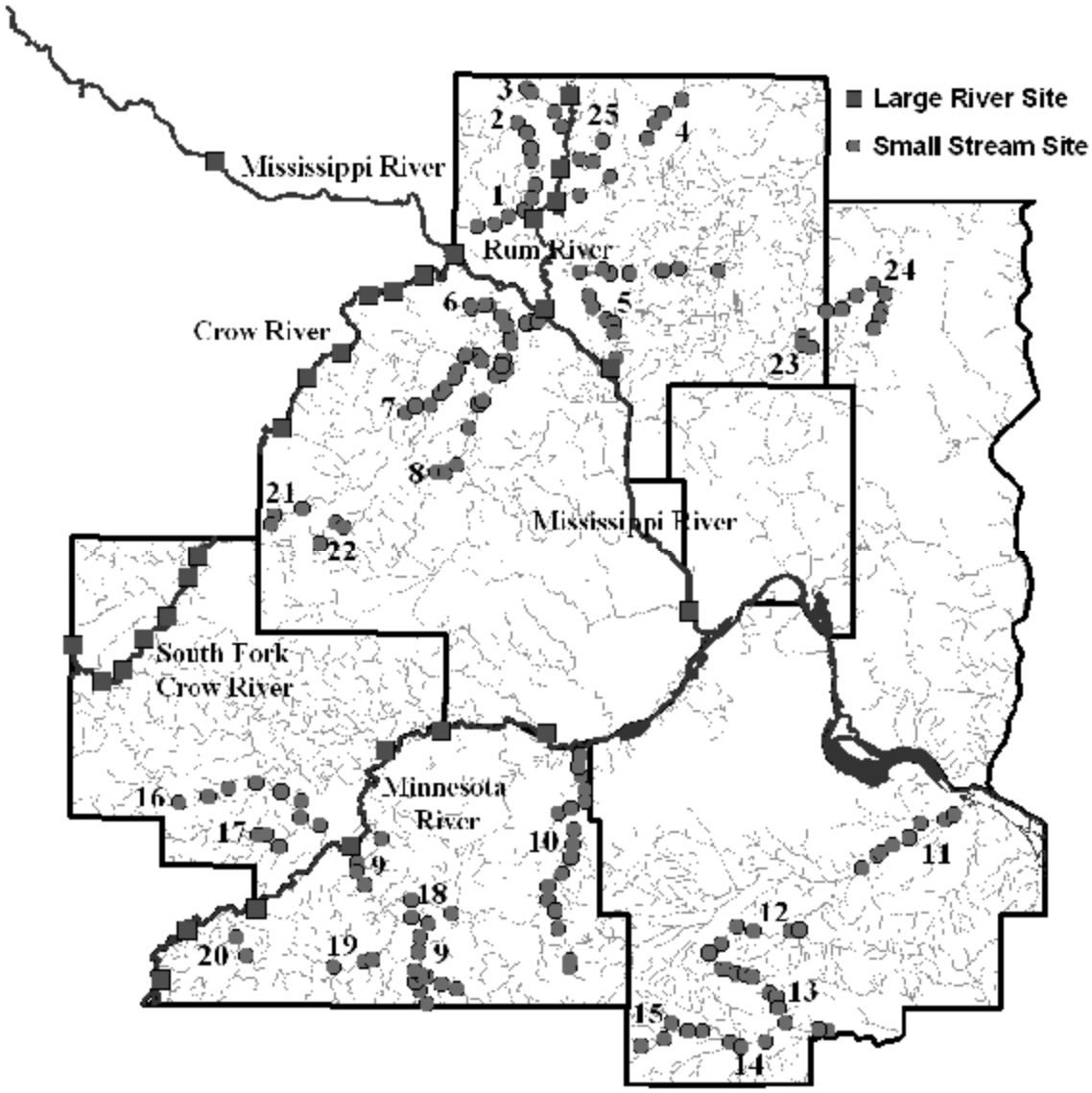


Figure 4.1 Large river and small stream black fly larval monitoring/treatment locations, 2014. Note: the large river site located outside the District on the Mississippi River is for monitoring only. Since 1991 more than 450 of the more than 600 original small stream treatment sites have been eliminated from the annual small stream sampling program. This is both due to the increased treatment threshold as well as our findings from years of sampling that some sites do not produce any, or very few, *S. venustum*. New sites are added periodically if larval monitoring confirms elevated *S. venustum* populations. The numbers on the map refer to the small stream names listed below:

1=Trott	6=Diamond	11=Vermillion	16=Bevens	21=Pioneer
2=Ford	7=Rush	12=Vermillion So. Branch	17=Silver	22=Painter
3=Seelye	8=Elm	13=Chub No. Branch	18=Porter	23=Clearwater
4=Cedar	9=Sand	14=Chub	19=Raven W. Br.	24=Hardwood
5=Coon	10=Credit	15=Dutch	20=Robert	25=Ditch 19

Table 4.1 Summary of *Bti* treatments for black fly control by the MMCD in 2013 and 2014

	2013			2014		
Water body	No. sites treated	Total no. treatments	Gallons of *Bti* used	No. sites treated	Total no. treatments	Gallons of *Bti* used
Small Stream Totals	34	34	14.6	26	26	26.7
Large River						
Mississippi	2	10	1,337.3	2	8	1,090.0
Crow	3	6	114.4	1	2	55.0
South Fork Crow	6	14	95.0	5	8	140.0
Minnesota	7	19	2,160.3	7	29	2,795.1
Rum	3	20	172.5	4	17	243.9
Large River Totals	21	69	3,863.5	19	64	4324.0
Grand Total	55	103	3,878.1	45	90	4,350.7

□arge □iver □rogram

MMCD targets three large river black fly species for control with *Bti*. *Simulium luggeri* larvae occur mainly in the Rum and Mississippi rivers, although they also occur in smaller numbers in the Minnesota and Crow rivers. Depending on river flow, *S. luggeri* is abundant from mid-May through September. *Simulium meridionale* and *Simulium johannseni* larvae occur primarily in the Crow, South Fork Crow, and Minnesota rivers. These species are most abundant in May and June, although *S. meridionale* populations may remain high throughout the summer if river flow is also high.

The large river black fly larval populations were monitored weekly between May and mid-September using artificial substrate samplers (Mylar tapes) at the 28 sites permitted by the MnDNR on the Rum, Mississippi, Crow, South Fork Crow, and Minnesota rivers to determine if the treatment threshold was met. The treatment threshold for *S. luggeri* was an average of 100 larvae/sampler at each treatment site location. The treatment threshold for *S. meridionale* and *S. johannseni* was an average of 40 larvae/per sampler at each treatment site location. These were the same treatment thresholds used since 1990.

A total of 373 larval monitoring samples were collected from the 28 permitted sites in 2014. The treatment threshold was met in 64 of these samples at 19 of the permitted sites and the associated sites were treated with *Bti*. A total of 4,324 gallons of VectoBac 12AS *Bti* was used in the 64 treatments in 2014 (Table 4.1). The average amount of *Bti* that has been used to treat the large rivers annually between 1997 and 2013 was 3,010 gallons. The *Bti* treatments resulted in high mortality of larval black flies in 2014, as it has in past years as well. The average post-*Bti* treatment larval mortality measured at least 250 m downstream of the point of the *Bti* application in 2014 was 100% on the Mississippi River, 84% on the Minnesota River, 96% on the Rum River, 65% on the Crow River, and 88% on the South Fork Crow River.

The discharge on each of the five large rivers was more than 100% above their long-term averages between April and September due to above normal precipitation. Extremely heavy rains in late June led to flood-level flows resulting in a suspension of the larval monitoring and treatment program from late June to early July on the Mississippi, Minnesota, Crow and South Fork Crow rivers due to safety concerns and loss of sampling equipment. Because of the high flows during the treatment season, the amount of *Bti* used to treat the large rivers in 2014 was the largest since 1997.

Adult Population Sampling

D **S** **N** **C** The adult black fly population was monitored at 53 standard stations using the District's standard black fly over-head net sweep technique that was established in 1984. Samples were taken once weekly from early May to mid-September, generally between 8:00 A.M. and 10:00 A.M. The average number of all species of adult black flies captured in 2014 was 0.75 (Table 4.2). The average number of adult black flies captured per sample from the start of the District's operational large river larval black fly control program in 1996 through 2013 was 1.51 (±0.75 S.D.). Between 1984 and 1986 before any *Bti* treatments were done on the large rivers the average net sweep count was 14.80 (± 3.04 S.D.).

Table 4.2 Mean number of black fly adults captured in over-head net sweeps in samples taken at standard sampling locations throughout the MMCD between mid-May and mid-September; samples were taken once weekly beginning in 2004 and twice weekly in previous years.

Large River *Bti* Treatment Status[1,2,3,4]	Time Period	Mean ± S.D.			
		All Species[5]	*Simulium luggeri*	*Simulium johannseni*	*Simulium meridionale*
No treatments	1984 to 1986	14.80 ± 3.04	13.11 ± 3.45	0.24 ± 0.39	1.25 ± 0.55
Experimental treatments	1987 to 1995	3.63 ± 2.00	3.16 ± 2.05	0.10 ± 0.12	0.29 ± 0.40
Operational treatments	1996 to 2013	1.51 ± 0.75	1.22 ± 0.73	0.02 ± 0.05	0.15 ± 0.12
	2014	0.75	0.30	0.02	0.33

[1] 1988 was a severe drought year and limited black fly production occurred.
[2] The first operational treatments of the Mississippi River began in 1990 at the Coon Rapids Dam.
[3] 1996 was the first year of operational treatments (treatment of all MnDNR-permitted sites) on the large rivers.
[4] Expanded operational treatments began in 2006 when permits where received from the MnDNR for treatments on the So. Fork Crow River.
[5] All species includes *S. luggeri*, *S. meridionale*, *S. johannseni*, and all other species collected.

The most abundant black fly collected in the overhead net-sweep samples in 2014 was *S. meridionale*, comprising 43.51% of the total captured with an average of 0.33 per sample. The second most abundant black fly species captured was *S. luggeri,* comprising 40.00% of the total captured with an average of 0.30 per net sweep sample. 2014 was only the second year since the black fly control program began in 1984 that *S. luggeri* was not the most abundant black fly captured in the net sweep samples. The other year was 2004 when 40.31% of the adults captured were *S. meridionale* and 35.55% were *S. luggeri*. The likely reason for the high population of *S. meridionale* were above normal flows in the Crow, South Fork Crow and Minnesota rivers from May through September due to above average rainfall, particularly in June.

The highest number of black flies captured among the seven counties of the MMCD in 2014 in the net sweep samples was in Anoka County where an average of 2.52 (all species) were captured. *Simulium luggeri* was the most abundant black fly captured in Anoka County, as it has been since black fly adult monitoring began in 1984, with an average of 1.98 per sample. The second highest number of black flies captured per sample was in Carver County with an average of 0.90 per sample. *Simulium meridionale* was the most abundant species captured in Carver County with an average of 0.75 per sample. The high number of *S. luggeri* captured in Anoka County versus other areas of the MMCD each year is most likely due to the prime *S. luggeri* larval habitat in the nearby Rum and Mississippi rivers. Likewise, the higher number of *S. meridionale* captured in Carver County was most likely due to the prime larval habitat for this species in the nearby Minnesota and Crow rivers.

B□□□□ □□S□□□□□□□CO$_2$ T□□□ C□□□□□□□□□□ Adult black fly populations were monitored in 2014 between mid-May and mid-June with CO_2 traps at four stations each in Scott and Anoka counties, and five stations in Carver County. These sites have been monitored since 2004 with CO_2 traps when larval treatments were started on the South Fork Crow River. Black flies captured in the CO_2 traps are preserved in alcohol to facilitate species identification.

Table 4.3 lists the percentage of black flies captured in the CO_2 traps yearly since 2004. The most abundant species captured since the CO_2 trapping program began have been *S. johannseni*, *S. meridionale*, and *S. venustum.* 95% of the black flies captured in 2014 were from Carver County of which *S. johannseni* was the most abundant species captured comprising 74% of the total collected. *Simulium meridionale* was the second most abundant species captured at 20% of the total (Table 4.3). As discussed previously, the high number of *S. johannseni* and *S. meridionale* captured in 2014 was likely due to the fact that the preferred larval habitat of these species is in the Crow, South Fork Crow and Minnesota Rivers.

M□□□□□N□□□□CO$_2$ T□□□ H□□ □C□□□□□□□□□ Black flies captured in District-wide CO_2 traps operated weekly for mosquito surveillance (see Chapter 1) were counted and identified to family level in 2014. Because these traps are operated for mosquito surveillance, samples are not placed in ethyl alcohol making black fly species-level identification difficult. Results are represented geographically in Figure 4.2. The areas in dark gray and black represent the highest numbers collected, ranging from 250 to more than 500 per trap. The highest number of black flies was observed in June and July in parts of Carver, Scott, Dakota, and Hennepin counties (Figure 4.2). The results in Scott and Carver counties are similar to those obtained from the standard black fly CO_2 trap sampling.

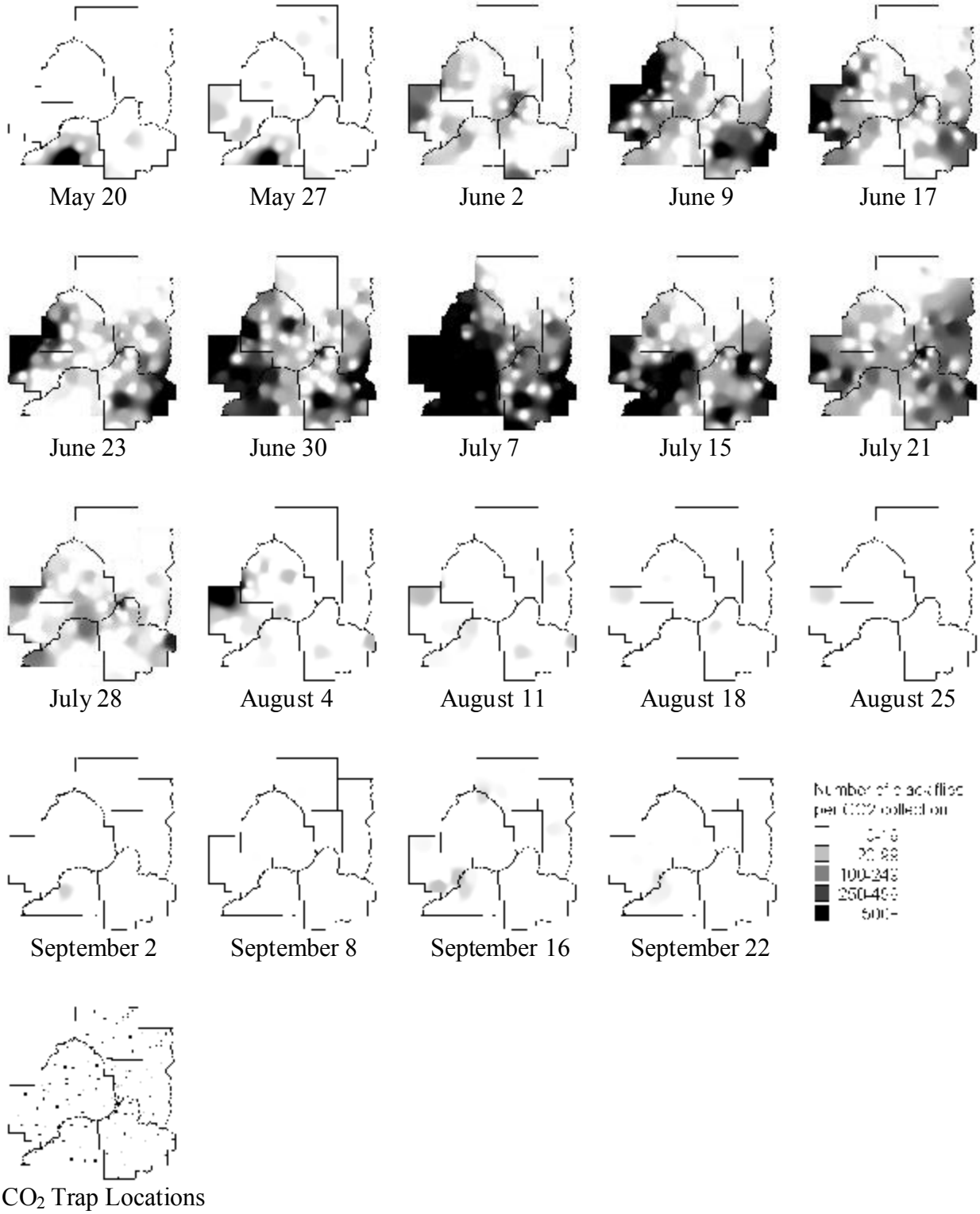


Figure 4.2 Number of black flies collected in mosquito surveillance District low (5 ft) and elevated (25 ft) CO_2 traps, 2014. The number of traps operated per night varied from 109-119. Inverse distance weighting was the algorithm used for shading of maps.

Table 4.3 Percentage of *S. venustum*, *S. johannseni*, and *S. meridionale* from the total number black flies captured in CO_2 traps set twice weekly between May and mid-June in Anoka, Scott, and Carver counties between 2004 and 2014

		Simulium venustum			*Simulium johannseni*			*Simulium meridionale*			All other black fly species[1]		
Year	Total Number Captured	Anoka	Scott	Carver	Anoka	Scott	Carver	Anoka	Scott	Carver	Anoka	Scott	Carver
2004	26,750	0.41	0.14	0.07	0.09	0.84	7.32	16.36	1.42	73.24	0.08	0.00	0.01
2005	15,477	0.88	0.52	0.26	0.90	0.01	31.36	5.01	0.28	59.53	0.02	0.20	0.03
2006	17,230	7.94	1.18	0.63	0.07	13.26	34.39	0.26	3.66	37.45	0.78	0.34	0.00
2007	55,725	3.71	3.45	9.51	0.02	3.15	14.17	0.10	16.71	48.82	0.31	0.02	0.02
2008	43,541	1.21	21.03	18.70	0.01	1.85	10.54	0.06	6.89	39.58	0.07	0.04	0.01
2009	84,693	0.95	12.37	26.60	0.02	1.18	2.25	0.04	5.13	51.33	0.03	0.10	0.00
2010	41,767	2.08	4.27	9.22	0.00	0.59	26.26	0.00	24.60	32.45	0.49	0.02	0.00
2011	274,925	0.13	0.97	0.88	0.04	4.49	33.38	0.01	4.99	4.88	0.01	0.05	0.17
2012	28,205	0.39	0.85	0.07	0.15	12.75	28.96	0.02	37.93	18.80	0.06	0.02	0.00
2013	16,657	2.89	0.61	0.31	0.23	0.97	3.03	0.00	22.08	69.68	0.17	0.01	0.00
2014	26,680	1.12	1.39	0.91	0.28	1.02	73.76	0.11	1.04	20.31	0.04	0.01	0.01

[1]Other black flies captured include *Simulium vittatum*, *Simulium luggeri*, *Simulium aureum*, *Simulium verecundum*, *Stegopterna mutata*, *Cnephia ornithophilia*, *Cnephia invenusta*, and *Prosimulium* sp.

□on-target Monitoring

The District has conducted biennial monitoring of the non-target invertebrate population in the Mississippi River as part of its MnDNR permit requirements since 1995. The monitoring program was designed as a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. Results from the monitoring work done between 1995 and 2011 indicate that there have been no large-scale changes in macroinvertebrate community in the *Bti*-treated reaches of the Mississippi River. Monitoring samples were collected from the Mississippi River as scheduled in 2013. Sample processing is finished; a report will be submitted to the MnDNR when data analysis is completed, which is expected to be in late spring 2015. Monitoring samples will be collected from the Mississippi River in 2015.

2015 □lans – Blac□ □ly □rogram

2015 will be the 31st year of black fly control in the District. The primary goal in 2015 will be to continue to effectively monitor and control black flies in the large rivers and small streams. The larval population monitoring program and thresholds for treatment with *Bti* will continue as in previous years. The 2015 black fly control permit application will be submitted to the MnDNR in February. Non-target invertebrate monitoring samples will be collected from the Mississippi River in 2015. A report on the non-target monitoring sampling conducted in 2013 is scheduled for completion in 2015. Program development will continue to emphasize improvement in program effectiveness, surveillance, and efficiency.

Chapter 5 *Product & Equipment Tests*

2014 Highlights

- Both 8- and 5-lb/acre dosages of VectoBac G *Bti* achieved good control of *Ae. vexans* in air sites
- Permethrin and Onslaught (barrier) controlled mosquitoes including WNV vectors for up to one week in woodlots

2015 Plans

- Increase late summer cattail treatments of VectoLex CG to control the cattail mosquito
- Repeat tests of MetaLarv S-PT against spring *Aedes* to evaluate its effectiveness as a spring pre-hatch larvicide
- Continue tests of Natular G and G30 against spring *Aedes* and the cattail mosquito to explore control potential (including non-target sampling in spring sites)
- Continue tests of adulticides in different situations emphasizing control of vectors and effectiveness of barrier treatments

Background

Evaluation of current and potential control materials and equipment is essential for MMCD to provide cost-effective service. MMCD regularly evaluates the effectiveness of ongoing operations to verify efficacy. Tests of new materials, methods, and equipment enable MMCD to continuously improve operations.

2014 Projects

Quality assurance processes focused on product evaluations, equipment, and waste reduction. Before being used operationally, all products must complete a certification process that consists of tests to demonstrate how to use the product to effectively control mosquitoes. The District continued certification testing of two larvicides and two new adulticides. The larvicides and adulticides have been tested in different control situations in the past. Our goal is to determine that different larvicides can control two or more target mosquitoes in multiple control situations. One adulticide was tested as an alternative ULV material and the other as an alternative barrier material. These additional control materials will provide MMCD with more operational tools.

Control Material Acceptance Testing

Laboratory Analysis of Control Products Warehouse staff collected random product samples from shipments received from manufacturers for active ingredient (AI) content analysis. MMCD contracts an independent testing laboratory, Legend Technical Services, to complete the AI analysis. Manufacturers provide the testing methodologies. The laboratory protocols used were CAP No. 311, "Procedures for the Analysis of S-Methoprene in Briquets and Premix", CAP No. 313, "Procedure for the Analysis of S-Methoprene in Sand Formulations", VBC Analytical Method: VBC-M07-001.1 Analytical Method for the Determination of (S)-Methoprene by High Performance Liquid Chromatography and Clarke Analytical Test Method SP-003 Revision #2

"HPLC Determination of Spinosad Content in Natular G30 Granules."

Altosid briquets underwent a formulation change in 2013. The carrier matrix changed from a black carbon plaster-based product to a white silica-based briquet. This formulation did not alter the active ingredient release characteristics, field life, or its mode of action. The resulting change increased shelf stability and produced a product that did not chip or break as easily. Field staff appreciated that this product was less dusty and much cleaner to apply.

All 2014 samples were within acceptable values of the label claim of percent AI (Table 5.1). Independent lab samples of the Altosid briquets were analyzed and results were found to be higher than the label claim. Technical Services notified the manufacturer, Central Life Sciences, and the company initiated an investigation. The manufacturer's certificates of analysis at the time of manufacture were all within acceptable limits.

Table 5.1 AI content of Altosid® (methoprene) briquets, pellets, and sand; MetaLarv S-PT granules (methoprene); and Natular G30 granule (spinosad)

	No. samples	AI content		
Product evaluated	analyzed	Label claim	Analysis average	SE
Altosid XR-briquet	12	2.10%	2.94%	0.0123
Altosid pellets	12	4.25%	4.25%	0.0659
MetaLarv S-PT granules	12	4.25%	4.23%	0.0689
Natular G30 granules	12	2.50%	2.52%	0.0403

A□□□M□□□□□□C□□□□□P□□□□□□ MMCD requests certificates of AI analysis from the manufacturers to verify product AI levels at the time of manufacture. MMCD has incorporated AI analysis as part of a product evaluation procedure and will submit randomly selected samples of adulticide control materials to an independent laboratory for AI level verification. This process will assure that all adulticides (purchased, formulated, and/or stored) meet the necessary quality standards. In 2014, MMCD sampled but did not analyze adulticide products and saved voucher samples for analysis in 2015. Technical Services will submit adulticides samples of stored and newly purchased products in 2015 to continue to monitor and build our adulticide database.

□fficacy of Control Materials

V□□□B□□® VectoBac G brand *Bti* (5/8 inch mesh size corncob granules) from Valent BioSciences was the primary *Bti* product applied by helicopter in 2014. Aerial *Bti* treatments began April 25 (thirteen days earlier than in 2013). We applied 8 lb/acre to control spring *Aedes* and *Ae. vexans*. In 2014, aerial *Bti* treatments achieved an average of 90.4% control (Table 5.2). Effectiveness was lowest early in the season when temperatures were lowest (May 8 and earlier). Effectiveness increased after May 8 with the 8 lb/acre rate achieving slightly better control than the 5 lb/acre rate.

Table 5.2 Efficacy of aerial VectoBac G applications in 2014 (8 lb and 5 lb/acre) (SE=standard error)

Year, dosage rate	n	Mean mortality	±SE
2014, 8 lb/acre (April 26 – May 8)	169	86.5%	2.4%
2014, 8 lb/acre (May 12 – June 6)	212	94.9%	1.2%
2014, 5 lb/acre (June 11 – July 21)	193	88.7%	1.9%
2014, all rates (April 26 – July 21)	574	90.4%	1.1%

□e□ Control Material □valuations

The District, as part of its Continuous Quality Improvement philosophy, strives to continually improve its control methods. Testing in 2014 was designed to evaluate how different segments of mosquito control programs can be modified to deliver more mosquito control services to a greater part of the District area using existing resources. Much testing has focused upon controlling multiple mosquito species including potential vectors of WNV.

□arval Control

The record levels of mosquito development and control service demand significantly impacted control material evaluations. Largely because of high water levels in April through June we were unable to collect sufficient mosquito pupae to evaluate effectiveness of larvicides containing methoprene such as Valent MetaLarv™ S-PT to control spring *Aedes*. We will need to repeat those tests in 2015.

***Coquillettidia perturbans* C□□□□□□** *Coquillettidia perturbans* is an abundant pest that lays its eggs in mid- to late summer and overwinters as larvae attached to aquatic vegetation, primarily cattail roots. Our current control strategy includes large-scale ground and aerial treatments for this single brood mosquito in late May, just prior to its emergence. We have tested larvicides containing biorational actives (e.g., VectoLex CG) other than methoprene to determine which others we might be able to add to our control program.

N□□□□□™ □ □□ □ □□□□□ S□□□ Results of a double-blind efficacy evaluation of this corncob-based formulation of spinosad that include non-target organisms of interest are described in Chapter 6.

C□□□□N□□□□□ □ □□3□—E□□□ □□□□T□□□□ □□□ In 2012, we completed a very small test of Natular G30 (10 lb/acre). Results were disappointing (62% control) but the sample size was very small and mosquito emergence in the untreated control was low (see 2012 Operational Review and Plans for 2013 for details).

On June 6, 2014 we treated four ground cattail sites with Natular G30 (5 lb/acre), four sites with Natular G (5 lb/acre) and reserved four sites as untreated controls. Five emergence cages were placed in each of these 12 sites immediately after the treatments were completed. All adult mosquitoes captured by emergence cages were removed twice each week beginning on June 9

and ending on July 24. High water levels damaged cages in two sites treated with Natular™ G30 and two treated with Natular G, which reduced our final sample size.

Emergence of adult *Cq. perturbans* from untreated sites was high enough to reveal a clear impact of the Natular G30 and Natular G treatments. (Figure 5.3, Table 5.4). The percentage of cages in which *Cq. perturbans* emerged was not significantly lower in Natular G30 and Natular G treated sites than in untreated sites which probably is due to the reduced number of cages that remained undamaged by high water levels (Table 5.4). These results suggest that Natular formulations can effectively control *Cq. perturbans.* More tests are required to verify these results.

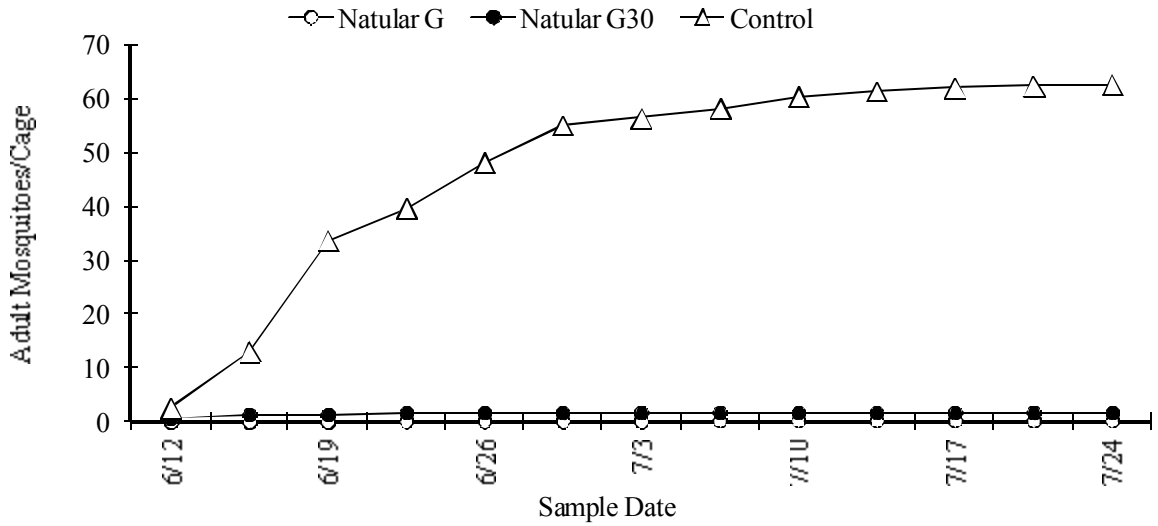


Figure 5.3 Mean cumulative emergence of *Cq. perturbans* in cages in sites treated with Natular G30, Natular G and in untreated sites, June – July 2014.

Table 5.4 Emergence of *Cq. perturbans* in sites treated with Natular G30, Natular G and untreated sites, June-July 2014

Treatment	Total cages	No. positive cages	% positive cages	MCE[§]	% control	Fisher Exact p-value*
Control	20	8	40.0	62.7	N/A	N/A
Natular G30	10	1	10.0	1.7	97.3	0.088
Natular G	10	2	20.0	0.20	99.7	0.189

* Untreated control compared to Natular G30 or Natular G

§ MCE, mean cumulative emergence per cage

Adulticide Tests

Beginning in 2008, research focused upon evaluating how effectively barrier and ULV (cold fogging) treatments controlled mosquitoes, especially West Nile virus vectors. This research is partially in response to recommendations by the Technical Advisory Board that MMCD demonstrate vector-specific efficacy, especially for barrier permethrin treatments that pose the greatest potential risk to non-target organisms in treated areas.

P□□ □□□□□ □□□ O□□□□□□□ B□□□□□ As in previous years, tests were conducted in woodlots where operational permethrin treatments could potentially be made and all tests included untreated woodlots. All tests included CO_2 trap data. CO_2 traps (two of each per woodlot) were placed 24 hours before treatment, 30 minutes after treatment, 24 hours after treatment, and one week after treatment. Efficacy was evaluated using Mulla's equation (a correction that accounts for natural changes in the untreated control site, as well as the treatment site). The goal of all tests was to better evaluate the duration and consistency of control achieved by barrier treatments and to include vector-specific efficacy evaluations.

One test was completed July 30 – August 6, 2014 in a pair of woodlots in Hennepin County that had a history of high adult mosquito abundance. Onslaught achieved significant control of all mosquitoes within 24 hours of treatment (Table 5.5). Control declined thereafter but was still detectable (56%) one week after treatment. Efficacy lasted one week in both of those tests (Table 5.5).

Sufficient *Culex* vectors were captured to evaluate effectiveness. Onslaught effectively suppressed vectors, 24 hours and one week after treatment (Table 5.5). None of the CO_2 traps captured enough *Ae. triseriatus* or *Ae. japonicus* to evaluate effectiveness.

Between 2006 and 2013, we completed 18 barrier tests that included permethrin. Permethrin effectively controlled adult mosquitoes within 24 hours after treatment in most tests (Table 5.6). Permethrin also effectively controlled vector mosquitoes within 24 hours after treatment in most tests where enough vectors were captured to evaluate efficacy. One week after treatment permethrin effectively controlled adult mosquitoes in only about half of those tests (Table 5.6). (see 2006, 2007, 2008, 2010 and 2011 Operational Reviews for details).

We completed nine barrier tests that included Onslaught between 2007 and 2014. The proportion of tests in which Onslaught was able to effectively control adult mosquitoes was similar to permethrin. Onslaught is able to control *Culex* vectors within 24 hours after treatment with control persisting up to one week. Insufficient data are available to evaluate effectiveness against *Ae. triseriatus* (Table 5.6) (see 2006, 2007, 2008, 2010, 2011 and 2012 Operational Reviews for details).

In the future, we plan to continue barrier adulticide tests. Our goal is to collect as much vector-specific data (includes *Culex*, *Ae. triseriatus*, *Ae. japonicus*) as possible. We plan to explore causes of inconsistent efficacy, especially more than 24 hours after treatment, perhaps by comparing efficacy in smaller and larger scale treatments (different sized treatment areas).

Table 5.5 Barrier Onslaught treatment efficacy: (7/30 – 8/6): Efficacy percent calculated using Mulla's formula*

T□□□1	Collection	All mosquito species		*Culex* 4**	
		CO_2 trap catch§	Efficacy	CO_2 trap catch§	Efficacy
Onslaught	Pre-treat	173 (±23)	---	13.5 (±5.5)	---
	Post-treat	31 (±8)	77%	3.5 (±0.5)	---
	Post-24 h	41 (±14)	21%	2.5 (±0.5)	75%
	Post-7 day	34 (±20)	56%	0.0 (±0.0)	100%
Untreated control	Pre-treat	42 (±13)	---	2.0 (±2.0)	---
	Post-treat	32 (±1)	---	0.0 (±0.0)	---
	Post-24 h	13 (±5)	---	1.5 (±1.5)	---
	Post-7 day	19 (±5)	---	0.5 (±0.5)	---

* Mulla's formula incorporates untreated control trap counts to correct for changes in the treated traps that are not due to the treatment

** *Culex*4=*Cx. tarsalis*, *Cx. restuans*, *Cx. pipiens*, and *Cx. salinarius*

§ Mean (±SE), n=2 (CO_2 traps)

Table 5.6 Permethrin and Onslaught barrier tests with high efficacy (>80% control using Mulla's equation). Tests occurred from 2006-2013 for permethrin and 2007-2014 for Onslaught

Material used and number of tests*	Target mosquitoes	No. tests with high efficacy (% tests with high efficacy) 24-48 hours after treatment	7 days after treatment
Permethrin (2006-2013)			
18	All species	16 (89%)	7 (39%)
9	*Culex* (WNV)	7 (78%)	4 (44%)
2	*Ae. triseriatus* (LAC)	2 (100%)	1 (50%)
Onslaught (2007-2014)			
9	All species	5 (56%)	3 (33%)
5	*Culex* (WNV)	4 (80%)	3 (60%)
1	*Ae. triseriatus* (LAC)	0 (0%)	0 (0%)

* Number of tests in which sufficient mosquitoes of a particular species group were captured to evaluate efficacy.

No tests of ULV adulticides were completed successfully in 2014.

□quipment □valuations

H□□□□□□□S□ □□□ A□□□□□□□ C□□□□□□□□ P□□□□□□□□ □□□L□□□□□□□□ Technical Services and field staff conducted six aerial calibration sessions for dry, granular materials during the 2014 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so each helicopter's dispersal characteristics are optimized. Sessions were held at the municipal airport in LeSueur, MN. Staff completed calibrations for seven different operational and experimental control materials. In total, eight helicopters were calibrated and each helicopter was configured to apply an average of four different control materials.

D□□□□□A □□□□□□□□□□□□ □□□□□□-□□□□□□ S□□□□E □□□□□□ □□□□ During October 2014, Technical Services and the East Region staff used our 20 ft x 40 ft indoor spray booth to evaluate adulticide application equipment. This self-contained booth collects the adulticide spray droplets, which minimizes their release into the air following the calibration process, thus limiting any environmental effects. Technical Service staff optimized 47 ultra-low-volume (ULV) insecticide generators (truck-mounted, ATV-mounted, or handheld) using the KLD Model DC-III portable droplet analyzer. Staff uses this analyzer to fine-tune equipment to produce an ideal droplet spectrum of 8-24 microns. Adjusting the ULV sprayers to produce a more uniform droplet range maximizes efficacy by creating droplets of the correct size to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and swath coverage throughout the District.

P□□□ □□□□□□□ B□□□□□□□ D□□□□□□E □□□□□□□□□□ Technical Services conducted backpack droplet spectrum evaluations of our barrier spray units. These evaluations were completed due to a recent EPA label change during the product re-registration process. The droplet size requirement was significantly increased to reduce the risk of product drifting off the targeted site. The new label requires a droplet size of 150-300 microns.

A new prototype wand and new 2014 backpack was sent to Dr. Jonathan Hornby, Lee County Mosquito Control District in Fort Myers, Florida to be evaluated by their Insitec Laser Measurement System. This laser measurement device precisely evaluates the droplet spectrum and was used to characterize the prototype wand. This evaluation confirmed that we can modify our packs to meet the label requirements. Technical Services will continue to develop a modification that meets the droplet size requirement for our Stihl backpacks.

Table 5.7 Characterization of the droplet spectrum of a Permethrin 5.7% barrier backpack with prototype wand demonstrating proper size range of product label

Replicate	$D_{v(10)}$	$D_{v(50)}$	$D_{v(90)}$	Mean VMD
1	60.61	194.61	429.10	
2	66.64	187.62	423.73	
3	57.40	181.03	352.85	194.074
4	57.30	189.44	472.00	
5	72.16	217.67	472.01	

□ptimi□ing □fficiencies and □ aste □eduction

E□□□□□□□□ □□T□□□□□□□□□□□□ O□□□□□□□□C□□□□□□M□□□□□□□□ Over the past three seasons, the District has reviewed methods for transporting pallets of control materials to helicopter landing sites. Large flatbed trucks have been the operational standard but these vehicles are expensive, can require additional licensing, and are not used extensively in the off-season. Facilities are reviewing a less expensive combination of a one-ton pickup truck and flatbed trailer. This equipment combination has more operational versatility, fewer restrictions, and can significantly reduce overall costs. In 2014, the District purchased two new trailers and

heavy duty pickups for use in our air work support operations. Staff will continue to evaluate this helicopter support system to determine its best effective use.

R□□□□□□□ P□□□□□□□C □□□□□□□□ MMCD continued to use the Minnesota Department of Agriculture's (MDA) pesticide container recycling program. This project focuses on properly disposing of agricultural pesticide waste containers, thereby protecting the environment from related pesticide contamination of ground and water.

Field offices collected their empty, triple-rinsed plastic containers at their facility and packaged them in large plastic bags for recycling. Each facility delivered their empty jugs to our Rosemount warehouse for pickup by the MDA contractor, Consolidated Container. MMCD prearranged two semi-trailer pickups during the treatment season and staff assisted the contractor with loading of the recycled packaging materials. MMCD also assists other small regional users to properly recycle their pesticide containers in conjunction with these collections.

MMCD staff collected 6,148 jugs for this recycling program. The control materials that use plastic 2.5 gallon containers are sumithrin (304 jugs), *Bti* liquid (1,822 jugs), Altosid pellets (3,974 jugs), MGK Pyrocide (16 jugs) and other materials (32 jugs).

The District started purchasing Permethrin 57% OS concentrate in returnable drums. The manufacturer arranged to pick up the empty containers for reuse. In addition, these drums do not have to be triple-rinsed and thus, reduces the District's overall generation of waste products.

MMCD also purchases products in 55-gallon drums and refills the 5-gallon steel cans of the same-labeled material thereby reducing the need for new packaging, thus lowering the amount of packaging waste generated by the District. In addition, the warehouse triple-rinsed and recycled numerous plastic drums and steel containers this past season. These 30- or 55-gallon drums were brought to a local company to be refurbished and reused.

The District's warehouse purchased mineral oil in 275 gallon bulk containers. Staff was able to reduce the overall number of 55-gallon drums purchased by 15 drums. These returnable containers do not have to be triple-rinsed and thus, reduces the District's overall generation of waste products.

R□□□□□□□ P□□□□□□□P □□□□□ In 2014, MMCD produced over 1,235 empty hardwood pallets used in control material transportation. Technical Services worked with our vendors to uniquely mark their company's pallets and arrange for their return to the manufacturer for re-use. In doing so, MMCD reduces the need for the production of new pallets and helps to maintain lower control material costs for the District.

B□□ P□□□□□□□ □C □□□□M□□□□□□ MMCD continued the development of reusable packaging containers into our operations. The focus is to reduce the packaging waste of the various high use materials. MMCD can produce over 40,000 empty bags in an average year. MMCD would like to eliminate a significant portion of these pesticide bags that cannot be recycled. Staff is attempting to keep these bags out of a landfill and direct them to a garbage burner to receive some public benefit of the generated waste.

There are two projects being worked on by staff to reduce packaging waste. The first project is using a large refillable tote that could be adaptable to our helicopter loading operations. This container would hold 1,600 lb and reduce our packaging use by 40 bags per tote. In 2014, MMCD received a tote prototype to evaluate and use under field conditions. In conjunction, Technical Services and East Region staff developed the "Quick-40" capsule to accurately pre-measure quantities to load a helicopter in the field. In 2015, staff will use this equipment (tote and capsule) operationally for one of our pre-hatch larval control materials and thus, saving 1,280 bags from entering the waste stream.

The second project is using a bulk 1,600 lb bags for *Bti* ground work at our Maple Grove facility. The Maple Grove staff purchased a small silo to safely manage this bulk control material and dispense the insecticide into reusable 40 lb seed bags. In 2014, Maple Grove successfully utilized this new system and reduced their waste by 40 bags. Staff is reviewing how to implement their findings into our other field facilities and to expand their ideas to other control materials.

H□□□□□□□□ □□□□C□□□□□□□□ In 2014, MMCD worked with the MDA to provide two regional sites for hazardous waste collection. The MDA designates a day each year that the public can properly dispose of any small quantity of hazardous waste free of charge. The District's Andover and Jordan facilities were used as collection points and MDA staff managed the safe handling of these materials. MMCD will continue to support this important public service to protect the environment.

2015 □lans – □roduct and □quipment Testing

Quality assurance processes will continue to be incorporated into the everyday operations of the regional process teams. Technical Services will continue to support field operations to improve their ability to complete their responsibilities most effectively. A primary goal will be to continue to assure the collection of quality information for all evaluations so decisions are based upon good data. We will continue to improve our calibration techniques to optimize all of our mosquito control equipment.

In 2015, we plan to continue tests of Natular G30 and Natular G against the cattail mosquito to explore control potential. We plan to test Natular G and to repeat tests of MetaLarv S-PT against spring *Aedes* to evaluate the effectiveness of both products as a spring pre-hatch larvicide. Non-target sampling will be included in the Natular G tests in cattail sites. We also will repeat tests of adulticides, emphasizing vector (*Culex*, *Ae. triseriatus*, *Ae. japonicus,* and others) control and effectiveness of barrier treatments.

eferences Cited

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Mulla's Formula: Percent Efficacy = 100 - $\left(100 \times \left(\frac{\text{Cntl Pre}}{\text{Trt Pre}}\right) \times \left(\frac{\text{TrtPost}}{\text{CntlPost}}\right)\right)$

CntlPre = Mean pretreatment count of untreated control
CntlPost = Mean post treatment count of untreated control
TrtPre = Mean pretreatment count of treated group
TrtPost = Mean post treatment count of treated group

Chapter 6 Supporting Work

2014 Highlights

- Completed transition to web data entry for both air and ground larval data
- With guidance from TAB subgroup, designed and carried out first year of non-target study for spinosad (Natular G)
- Conducted outreach with beekeepers
- Began integrating sustainability into all District team operations
- Citizen requests for adulticide treatment were highest in 10 years, almost 2x usual

2015 Plans

- Transition container inspection and adult control data to web data entry
- Continue spinosad (Natular) study as directed by TAB
- Continue with sustainability efforts

2014 □ro□ects

Data System Transition

This year marked two major milestones for our web-based data system: we automated aerial treatment recording using helicopter GPS tracks, and by the end of the summer, all ground-based larval treatments were being entered through the new web application. With these systems in place we now have very quick access to all larval treatment data, while improving data quality as well.

Automating aerial treatment records has been a goal since the AgNav GPS systems were introduced in 2006. After working with manual file handling for a number of years, we developed a web-based map upload system in 2010 and have continued to expand its capabilities. There have been a number of challenges in the process of turning point "on" and "off" records into meaningful treatment data related to MMCD sitecode polygons. Through continued discussions with Scott's Helicopter Services we reached agreement on how points can be assigned to sitecodes, added up to represent treatment amounts, and used to generate official reports for Minnesota Department of Agriculture (MDA). This entire process has now been automated, and includes MMCD staff review, pilot approval and automated signature, submission to accounting staff, and insertion into MMCD's database. This has eliminated hours of work by MMCD staff producing manual forms in triplicate and entering data, and enabled us to reduce the number of staff needed at landing sites during the busiest times of the season. It speeded reporting for air work coordination, inventory tracking, payments, and public data access, and took less time for pilots to complete review at the end of the day. It also made it easier to get high-accuracy reports. Aerial treatments account for 90% of our larval material use (lbs).

After testing phone-based web data entry for fall cattail inspections for several years, we were able to expand phone entry this year to include all types of larval inspections and treatments.

Implementation was done in phases, and by the end of the summer all field staff were doing all larval entries through the web-based app.

In the process of expanding use, we discovered that we needed to increase server capacity. A temporary increase was done mid-season, and a complete upgrade to a larger (and less expensive) cloud-based server was completed at the end of the year. Program development and server maintenance is done by Houston Engineering Inc. (HEI).

In 2015, we are working on developing web-based data entry for container inspections, and hope to transition adult sampling and treatment data entry as well, which would allow us to retire our hard-working PDA technology.

Mapping

□ □□□□□□ M□□□□□□ Keeping our wetland habitat maps up-to-date is an essential task for MMCD staff members. We track about 70,000 wet areas that serve as potential larval mosquito habitat. We appreciate that Scott, Carver, and Dakota counties have chosen to share their 2013 aerial photography through a Web Map Service at MnGeo, the state Geospatial Information office. These services make it very easy for MMCD's staff to make use of these excellent photos. We are also working on getting access to aerial photography taken by Hennepin and Anoka counties.

In addition to wetlands, MMCD staff members map locations of many stormwater structures, such as street catch basins, large culverts or separators, and pond water level regulators, which provide larval habitat for species such as *Culex* vectors of West Nile virus and for *Ae. japonicus*. Over 24,000 structures are now mapped, in addition to 280,000 catch basins.

P□□□□□ □□ M□□ MMCD continues to make wetland locations and multi-year larval treatment history available through a public web map available at www.mmcd.org. Larval treatment records are automatically updated daily. The site was developed by HEI and uses the MetroGIS Geocoder, basemap information from MetroGIS (Metropolitan Council), and aerial photos from MnGeo (Minnesota Geospatial Information Office).

□IS C□□ □ □□□□ MMCD staff continue to participate in MetroGIS, and helped support adoption of open data policies by counties in the metro and in Greater Minnesota. As a regional unit of government, MMCD benefits greatly from not just availability of data but also the use of standard open formats, and we continue to work to promote open standards use in products such as the state Geospatial Commons.

Climate Trends – Spring Degree Day Study

We have continued to look trends in spring temperatures and their effect on control activities using degree-day (DD) accumulations. The DD model used daily maximum and minimum air temperature (MSP airport) to compute a daily average. The difference between the average and the chosen base temperature of 40 °F (no larval growth per day) gave the 'heat units'

accumulated each day for that base (DD_{base}). These were then summed from an assumed start date of January 1.

$$SumDD_{to\_date,\ base} = \sum_{(start\_date,\ to\_date)} (T_{avg} - baseT) \quad \text{where } T_{avg} = [(T_{max} + T_{min})/2]$$

Figure 6.1 shows the cumulative sum of DD_{40F} from Jan 1 by week of the year (value at end of week), for each year from 1993-2014. Week numbers were based on standard CDC weeks (week starts on Sunday, week 1 = first week with four or more days, modified so that all dates after Jan. 1 were in week 1 or higher, not in previous year's week 52).

The week totals with an outlined box mark the first week with ≥ 200 DD. This number was chosen empirically from these data as an apparent indicator of when spring *Aedes* larvae have sufficiently developed to warrant aerial treatment. The year 2013 had one of the latest dates for (DD_{40F} from Jan 1) >200 in the last 20 years, and this was essentially repeated in 2014.

First week with CumDD40 > 200 | Aerial Treatments for Spring spp. (many or few) | Treatment on CumDD40 > 200 week

Week #	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	
2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	
3	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	
4	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	
5	0	0	0	0	0	0	0	0	0	2	2	0	6	0	0	0	0	0	0	2	0	0	
6	0	0	0	0	0	0	0	0	0	2	2	0	6	0	0	0	1	0	0	2	0	0	
7	0	0	0	0	0	1	0	0	0	2	2	0	6	0	0	0	1	0	0	2	0	0	Last date
8	0	0	0	0	0	17	0	20	0	8	2	0	6	0	0	0	1	0	0	2	0	0	in week
9	0	4	0	0	0	17	0	39	0	8	2	2	6	0	0	0	1	0	0	2	0	0	(2014)
10	0	4	5	0	0	17	0	104	0	8	2	2	13	4	0	0	1	4	0	18	0	0	
11	0	9	61	12	0	17	2	104	0	8	10	2	13	4	20	2	30	49	6	135	0	2	
12	8	22	69	12	0	72	8	150	0	8	55	56	13	4	54	2	54	70	7	306	0	3	Mar 22
13	17	32	72	12	20	95	83	184	0	16	85	81	68	27	148	2	54	174	12	358	7	3	Mar 29
14	26	41	79	12	80	158	143	209	23	16	104	132	187	58	156	30	64	236	70	450	10	14	Apr 5
15	44	100	100	37	80	234	181	233	66	75	146	209	300	209	162	34	166	366	134	497	21	87	Apr 12
16	106	199	129	81	100	335	231	268	115	220	233	292	405	318	281	82	249	461	144	564	21	102	Apr 19
17	185	245	184	109	102	436	350	388	213	243	327	385	424	416	415	173	328	576	200	640	63	167	Apr 26
18	331	310	273	158	225	571	486	586	367	295	439	492	508	521	566	213	460	646	271	786	146	196	May 3
19	474	448	385	220	312	753	601	710	494	356	537	611	607	629	740	321	567	719	411	913	267	302	May 10
20	564	627	515	347	373	930	754	809	600	440	664	746	735	762	914	487	765	896	554	1112	434	378	May 17
21	689	796	637	482	490	1114	899	973	778	539	775	848	869	951	1075	545	923	1146	692	1280	570	527	May 24
22	791	977	810	627	616	1310	1060	1111	910	755	930	1006	1050	1205	1274	690	1071	1341	905	1442	733	748	
23	990	1152	970	753	811	1545	1290	1305	1060	913	1093	1204	1292	1417	1467	873	1292	1512	1121	1681	868	944	
24	1158	1392	1192	967	1017	1658	1424	1462	1276	1117	1273	1388	1500	1633	1752	1059	1482	1721	1316	1881	1067	1111	

Figure 6.1 Cumulative Degree Days (base 40 °F, 4.4 °C) from January 1, MSP Airport.

Gray boxes in Fig. 6.1 indicate in which weeks helicopter treatments for spring *Aedes* were done each year. In addition to being timed to match mosquito abundance, aerial treatments are not started until a sufficient number of sites are over threshold, and cannot happen until seasonal inspectors are hired and helicopters calibrated (usually early April). In 2014 we again delayed hiring due to snow cover and cool temperatures that inhibited larval hatch.

We are continuing to examine multi-year trends in biology and their implications for control techniques and budget. We also continue to participate in the Minnesota Climate Adaptation Partnership (formerly known as the Minnesota Climate Change Adaptation Working Group) to keep up with work done in other agencies, and presented at their fall Climate Adaptation conference.

Storm□ater Management□□ etland Design□and Mosquitoes

MMCD staff works to maintain awareness of mosquito issues within the stormwater design and regulatory community. For example:

Staff participated in a Rain Garden/Rain Barrel education event related to master water steward certification (www.masterwaterstewards.org).

The "Stormwater and Mosquitoes" page on the MMCD web site has typically received almost 1,000 hits per year (MMCD's Stormwater Management webpage address changed as a result of a change in site management software. The new address is http://www.mmcd.org/resources/storm-water-management/). This page includes information on rain barrels, rain gardens, and wetland design. Late season monthly web stats continue to show consistent interest in these topics.

The web-based Minnesota Pollution Control Agency (MPCA) Stormwater Manual has information regarding mosquito prevention at http://stormwater.pca.state.mn.us/index.php/Mosquito_control_and_stormwater_management We plan to work with MPCA help keep this resource updated.

□valuating □ontarget □is□s

S□□□□□□ □N □□□□□□N □□□□□□□R□□ I□□□□ □□□□ MMCD and TAB members continued steps evaluating nontarget risk for Natular products, which use the biological control material spinosad (see Appendix C). Natular has been registered by the U.S. EPA as a "Reduced Risk Pesticide" and is OMRI Listed® (Organic Materials Review Institute). MMCD uses Natular G30, an extended release (30 day) formulation, as an option for larval control in summer *Aedes* sites, as it has both a different mode of action and different manufacturer than *Bti* or methoprene.

At the 2014 TAB meeting, Dr. Nancy Read presented a brief background on MMCD's efficacy testing and use of Natular, and on efforts by staff, TAB members, and the manufacturer, Clarke, to assemble useful information and address concerns about possible nontarget effects (2013-2014 TAB Report, Chapter 6). The importance of cost and efficacy as well as nontarget effects was discussed, along with MMCD's plan to test a less expensive seven-day formulation, Natular G. Dr. Roger Moon presented proposals from a TAB subgroup regarding nontarget testing of Natular in vernal pools, using local studies to check a broader range of species than has currently appeared in the literature. The TAB decided that the work could be done in-house by MMCD staff if the treatments were done double-blind, and members of the subgroup agreed to assist.

A draft protocol based on the TAB subgroup proposal was developed by MMCD staff in collaboration with subgroup members (Moon, Montz, Moriarty, Oberhauser) and circulated to TAB members by the end of March. Field work began shortly thereafter. It was agreed that the primary purpose of the study in 2014 was to test methods and look for any large changes, and

that follow up should be done in 2015. The organisms of interest chosen were physid snails, fingernail clams (sphaeriids), fairy shrimp, and scuds (amphipods).

For the study, staff chose 10 small (< 3 acres) sites relatively close to each other with a history of producing spring *Aedes*. Of these, five were treated with Natular G and five were treated with blank material, and it was unknown to those doing the treatment or later sampling which contained active ingredient. Sites were sampled for nontargets one time prior to treatment and again at one week and two weeks after treatment. On each sampling date, one column sample and one bottom sample were collected per site, at different randomly selected locations in the site in the near shore emergent vegetation zone. Each sample was taken with a 500 micron D-net and covered a 6 ft (2 meter) transect. D-net contents were preserved in 80% alcohol and brought back to the lab for processing. Lab Inspector staff picked each sample (twice) to ensure all targeted organisms and mosquitoes were removed. Samples were checked for quality assurance. Lab staff sorted and identified the organisms, entered the data, and sent the raw data to TAB subgroup members. Roger Moon will reveal the double blind coding indicating which sites were treated with Natular and will perform the analysis to try to detect any treatment effects. Results were presented to TAB members for review prior to continuation of the study in 2015 and are found in Appendix I.

P□□□□□□L□□□□□□□N□□□□□□□ Earlier publications and reports on Wright County Long-term Study and other studies on *Bti* and methoprene done under the direction of the Scientific Peer Review Panel (SPRP) continue to be available on the MMCD web site, mostly as PDF files. The new address is http://www.mmcd.org/non-target-studies-bti/ Recent totals for the SPRP Final Report showed 264 downloads from July through the end of 2014. Download totals for the first half of 2014 were unavailable due to changes in information storage procedures at our internet service provider.

P□□□□□□□□□□□M□□□□□□C□□□□□ With increasing public concern about the loss of pollinators (e.g. honeybees, native bees, butterflies, flies, etc.), the Metro Mosquito Control District has increased its efforts to locate honeybee hives and ensure that mosquito control activity has minimal effect on honeybees and pollinators in general. Neighboring states register hive locations through Drift Watch; however, MN does not require bee keepers to register through this centralized system (mn.driftwatch.org/map). However, many cities require permits for beekeeping. We are working to get hive locations recorded in our database/mapping system, and exploring methods to keep the information up-to-date, given that hives may be moved frequently for different forage conditions. MMCD staff members have met with local beekeeper associations to initiate discussions avoiding possible adverse impacts, and have had talks about pollinator protection at staff training events. The pyrethroids we use as fog or barrier spray on vegetation to control adult mosquitoes, used according to label, are relatively low risk for bees. However, knowing where and when bees are active can reduce the chance of exposure and decrease risk further. Our biological controls for mosquito larvae in wet areas pose no risk to bees.

Permits and Treatment Plans

NPDES Pesticide General Permit A Clean Water Act - National Pollutant Discharge Elimination System (NPDES) permit is required for most applications of mosquito control pesticides to water, and MPCA procedures for Pesticide NPDES Permits are described at http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-permits-and-forms/pesticide-npdes-permit/pesticide-npdes-permit-program.html. The checklist for mosquito control permits is given at http://www.pca.state.mn.us/index.php/view-document.html?gid=15671

In 2012 MMCD submitted a Pesticide Discharge Management Plan (PDMP) to the MPCA that described contact people, target pests and data sources, thresholds and management, and steps to be taken to respond to various types of incidents, submitted a Notice of Intent (NOI), and paid permit fees. This was renewed 2013 and again in 2014.

Comprehensive treatment listings have been prepared for the MPCA in fulfillment of the permit requirements and submitted annually. The listings included site-specific treatment history and a geospatial file of treatment locations. This is the same information that MMCD makes available for public view on MMCD's web site.

US Fish & Wildlife Service – Minnesota Valley Refuge MMCD works with the US Fish & Wildlife Service (FWS) regarding mosquito surveillance on and near FWS lands within the District. If rainfall, river levels, or other nearby surveillance indicates a need for sampling, work in the Minnesota Valley National Wildlife Refuge (MVNWR) is conducted following the stipulations of a Special Use Permit updated annually by the Refuge Manager. "Emergency Response Procedures" and "Pesticide Use Proposals" for the larvicide *Bacillus sphaericus* (VectoLex) and the adulticide sumithrin (Anvil) prepared in 2009 by FWS staff allow treatment of disease vectors if "a mosquito-borne disease human health emergency exists in vicinity of the Refuge" (agreed on by MDH, FWS, and MMCD) and such treatment "is found to be appropriate".

Surveillance for mosquito larvae and adults occurred on or near USFWS lands in 2014 in accordance with our sampling permit. Following heavy spring and summer rainfall and subsequent flooding of the Minnesota River valley, MMCD conducted larval mosquito surveillance in much of the MVNWR from July 24 through July 29. Staff targeted *Cx. tarsalis* and successfully captured the species in ¼ of the samples collected. Adult surveillance with CO_2 traps near the Blackdog, Wilkie, and Rapids Lake units of MVNWR collected moderate to high numbers of *Ae. vexans* from the end of May to early July and moderate to low numbers thereafter. Adult *Cx. tarsalis* collections were high near the Wilkie Unit, especially from late June through the end of July. Collections of *Cx. tarsalis* were moderate near the Rapids Lake Unit and low near the Black Dog Unit. Collections of *Coquillettidia perturbans* were low at all three locations. MMCD staff report these surveillance findings annually to FWS.

Public Communication

Notification of Adulticiding The District continues to post daily adulticide information on its website (www.mmcd.org) and on its "Bite Line" (651-643-8383), a pre-recorded telephone

message interested citizens can call to hear the latest information on scheduled treatments. Aerial larvicide treatment schedules are also posted on the web site and on the "Bite Line" as they become available. Information on how to access daily treatment information is regularly posted on Facebook and Twitter.

C□□□R□□□□□□□S□□□□□ Call volume in 2014 was characterized by an unprecedented spike in early season activity with more than 1,000 requests for treatment occurring just after the Memorial Day weekend (Figure 6.2). Calls tapered off to more normal levels even as mosquito abundance remained high due to heavy rains early in June. After the Fourth of July weekend, call volume continued to drop and began to more closely track mosquito annoyance as measured by Monday night sweep counts.

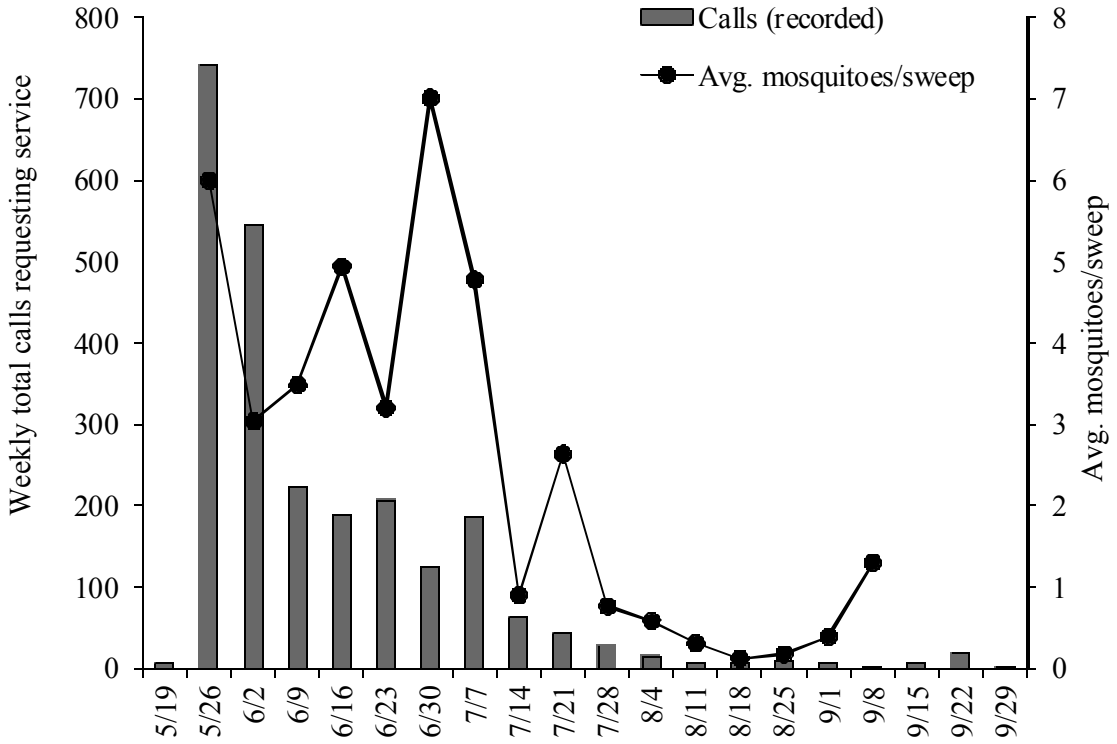

Figure 6.2 Calls requesting treatment of adults, and sweep net counts, by week, 2014.

Total requests for adult mosquito treatment increased tremendously in 2014 (Table 6.1) reaching an all-time high early in the season. While mosquito numbers remained high for several weeks in June, the number of new callers requesting treatment dropped off rather quickly. Calls requesting site checks for larval mosquitoes also increased. Calls requesting treatment for public events increased as did calls requesting tire removal. Late-season emphasis on mosquito-borne disease prevention, as public awareness of West Nile virus and La Crosse encephalitis risk increases, continues to drive requests to pick up and dispose of used tires. A sharp increase in requests for limited or no treatment reflects a season-long emphasis on finding and mapping bee hive locations in the metro area.

Table 6.1 Yearly total citizen calls (including e-mails), by service request type

	Number of calls by year										
Citizen concern	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Check a larval site	984	633	610	393	220	197	164	626	539	609	1,068
Request adult treatment	2,506	1,094	854	867	1,375	594	1,384	1,291	1,413	1,825	2,454
Public event, request treatment	135	100	72	60	109	250	78	68	61	70	93
Request tire removal	255	242	170	208	257	253	335	316	419	351	434
Request or confirm limited or no treatment	38	36	[a]171	49	66	61	55	56	54	[b]151	[c]150

Note: 2013 call numbers corrected since previous TAB report
[a] Years where confirmation postcards sent to confirm restricted access property status
[b] Historic restriction "calls" moved into new system
[c] Bee hive locations added into call system to track restrictions

C□□□□□□□□ □□ S□□□□□□ MMCD continued to deliver "Mosquito Mania," a three-day curriculum for upper elementary and middle school students. This curriculum was introduced to metro-area schools during the 2005-2006 school year. "Mosquito Mania" builds on MMCD's relationship with schools by offering a standards-based approach to the subject of mosquitoes and their relationship to the environment. Main Office and regional facility staff made presentations to 7,130 students in 61 schools during 2014. We continue to monitor changes in middle-school learning standards and make the adjustments necessary to keep the curriculum relevant and useful. Nearly one quarter of students reached by MMCD's school presentations visited learning stations set up as part of multi-school field days where a variety of public agencies gave short, science-based presentations throughout the day.

S□□□□□M□□□ As part of an ongoing effort to notify residents when and where treatment is to take place, MMCD continues to build a presence on Facebook and Twitter. Anyone can sign up to receive MMCD tweets (@metromosquito). People can also "friend" Metropolitan Mosquito Control District on Facebook. MMCD currently has 210 Twitter followers (up from 184 a year ago), and 354 "Likes" on Facebook (up from 199 Likes in 2013).

MMCD currently uses the service "GovDelivery" to give advance notification to District residents of adult mosquito treatments. In 2014, GovDelivery will continue to manage MMCD's direct treatment notification email lists. MMCD also works with GovDelivery to make efficient use of social media to reach people who are interested in finding out more about District treatment activities.

Sustainability □nitiative

Ongoing impacts from decreasing natural resources and climate change have served to deepen MMCD's longstanding commitment to sustainability and social responsibility.

In 2014, MMCD continued to integrate sustainable practices into each team's key functions and transitioned the sustainability steering committee into an established District team. The team established work groups to address the following focus areas:

reducing energy usage
reducing waste
identifying and using renewable resources
social responsibility/health and wellness

A guiding Sustainability document for the District is updated yearly, and can be found at www.mmcd.org/resources/technical-reports.

Professional Association Support

American Mosquito Control Association MMCD staff members continued to provide support for the national association. In particular, Diann Crane provides editorial assistance with the AMCA Annual Meeting Program, and was honored for that work with an award at the 2014 AMCA Meeting in Seattle.

North American Blackfly Association John Walz served as President and Program Chair for this group again in 2014 and with Carey LaMere maintains the association's web site, http://www.nabfa-blackfly.org.

North Central Mosquito Control Association Mark Smith and Sandy Brogren serve on the Board of Directors of this regional association focused on education, communication, and promoting interaction between various regional organizations and individuals in Minnesota, North Dakota, South Dakota, Wisconsin, Iowa, and the Central Provinces of Canada. Mark and Sandy attended the 2014 annual meeting in Fargo, ND. MMCD is hosting the 2015 annual meeting.

Scientific Presentations Posters and Publications

MMCD staff attends a variety of scientific meetings throughout the year. Following is a list of papers and posters presented during 2014 and talks that are planned in 2015. Also included are publications that have MMCD staff as authors or co-authors.

2014 Publications

No published papers.

2014 Presentations and Posters

Brogren, S. 2014. Adult mosquito surveillance: trap types, thresholds, adulticiding efficacy, ramp tests. North Central Mosquito Control Association Annual Meeting in Fargo, ND.

Crane, D., S. Brogren, K. Johnson, and C. LaMere. 2014. West Nile virus in Minnesota: Program adaptations over 10-plus years. Poster: American Mosquito Control Association Annual Meeting in Seattle, WA.

Griemann, L. 2014. Fleet vehicle management and sustainability. Presentation: American Mosquito Control Association Annual Meeting in Seattle, WA.

Johnson, K. 2014. Mosquito surveillance and control in MMCD catch basins. Presentation: Michigan Mosquito Control Association Annual Meeting in Lansing, MI.

Johnson, K. 2014. "New" mosquito-borne illnesses. Presentation: Minnesota Department of Agriculture Pesticide Application Recertification Workshop. St. Paul, MN.

Manweiler, S. and M. Smith. 2014. Potential long-term budget impacts due to climate change. Presentation: Michigan Mosquito Control Association Annual Meeting in Lansing, MI.

Read, N. and B. Fischer. 2014. Enterprise mobile web app in the cloud – making buzzwords a reality. Presentation: American Mosquito Control Association Annual Meeting in Seattle, WA.

Read, N. and M. McLean. 2014. Bees, please: keeping track of pollinator locations. Presentation: Minnesota Geographic Information Systems / Land Information Systems (MN GIS/LIS) Annual Conference in Rochester, MN.

Neitzel, D. and N. Read, 2014. Impacts on human health: diseases carried by ticks and mosquitoes. Presentation: MN Climate Adaptation Partnership conference "Building Minnesota's Capacity for Climate Adaptation" in Minneapolis, MN.

Smith, M. and S. Manweiler. 2014. Strategies for managing your control material budget under variable climatic conditions. Presentation: American Mosquito Control Association Annual Meeting in Seattle, WA.

Walz, J. and C. LaMere. 2014. Metropolitan Mosquito Control District (MMCD) Black Fly Control Program update. Presentation: North American Black Fly Association Annual Meeting in Athens, GA.

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Brogren, S. 2015. Entomology training techniques: "keys" to success. Presentation: Michigan Mosquito Control Association Annual Meeting in Traverse City / Bellaire, MI.

Herrman, C. 2015. GoPro video of MMCD black fly control operations. Presentation: North American Black Fly Association Annual Meeting in Athens, GA.

Lemke, L. 2015. Sustainability: the use of bulk material and the elimination of forty-pound bags in the ground treatment process. Presentation: American Mosquito Control Association Annual Meeting in New Orleans, LA.

Manweiler, S. and M. McLean. 2015. Aligning mosquito control operations and pollinator protection. Presentation: Michigan Mosquito Control Association Annual Meeting in Traverse City / Bellaire, MI and American Mosquito Control Association Annual Meeting in New Orleans, LA.

Smith, M. 2015. Strategic use of pre-hatch larvicides can improve your mosquito control program. Presentation: American Mosquito Control Association Annual Meeting in New Orleans, LA.

A□□□□D□C□S

A□□□□D□□ A Mosquito and Blac□ □ly Biology and Species □ist

Mosquito Biology

There are 51 species of mosquitoes in Minnesota. Forty-five species occur within the District. Species can be grouped according to their habits and habitat preferences. For example, the District uses the following categories when describing the various species: disease vectors, spring snow melt species, summer floodwater species, permanent water species, the cattail mosquito, and invasive or rare species.

Disease □ectors

Aedes triseriatus Also known as the eastern treehole mosquito, *Ae. triseriatus*, is the vector of La Crosse encephalitis (LAC). Natural oviposition sites are tree holes; however, adult females will also oviposit in water-holding containers, especially discarded tires. Adults are found in wooded or shaded areas and stay within ¼ to ½ miles from where they emerged. They are not aggressive biters and are not attracted to light. Vacuum aspirators are best for collecting this species.

Aedes japonicus This non-native species was first detected in Minnesota in 2007. By 2008, they were established in the District and southeast Minnesota. Larvae are found in a wide variety of natural and artificial habitats (containers), including rock holes and used tires. Preferred sites usually are shaded and contain organic-rich water. Eggs are resistant to desiccation and can survive several weeks or months under dry conditions. Overwintering is in the egg stage. Wild-caught specimens have tested positive for the La Crosse encephalitis (Camille Harris, April 2015. Emerging Infectious Diseases), thus, it is another potential vector of LAC in Minnesota.

Culex tarsalis *Culex tarsalis* is the vector of western equine encephalitis (WEE) and a vector of West Nile virus (WNV). In late summer, egg laying spreads to temporary pools and water-holding containers, and feeding shifts from birds to horses or humans. MMCD monitors this species using New Jersey light traps and CO_2 traps.

O□□□*Culex* Three additional species of *Culex* (*Cx. pipiens, Cx. restuans,* and *Cx. salinarius*) are vectors of WNV. All three use permanent and semi-permanent sites for larval habitat, and *Cx. pipiens* and *Cx. restuans* use storm sewers and catch basins as well. These three *Culex* vector species plus *Cx. tarsalis* are referred to as the *Culex*4.

Culex erraticus *Culex erraticus* normally a southern mosquito, has been increasing in our area over the past decade. In 2012 (a very warm spring and summer period), there were very high levels of adult *Cx. erraticus* in the District, and larvae were found for the first time since 1961 in permanent water sites with no emergent vegetation and edges with willow. *Culex erraticus* is a potential vector of eastern equine encephalitis (EEE).

Culiseta melanura *Culiseta melanura* is the enzootic vector of EEE. Its preferred larval habitat is spruce tamarack bogs, and adults do not fly far from these locations. A sampling strategy developed for both larvae and adults targets habitat in northeastern areas of the District, primarily in Anoka and Washington counties. Several CO_2 trap locations are specific for obtaining *Cs. melanura*; adult females collected from those sites are then tested for EEE.

□lood□ater Mosquitoes

S□□□□□*Aedes* Spring *Aedes* mosquito (12 species) eggs inundated with snowmelt runoff hatch from March through May; they are the earliest mosquitoes to hatch in the spring. Larvae develop in woodland pools, bogs, and marshes that are flooded with snowmelt water. There is only one generation per year and overwintering is in the egg stage. Adult females live throughout the summer, can take up to four blood meals, and lay multiple egg batches. There is only one generation per year as the eggs require freezing conditions prior to egg hatch. These mosquitoes stay near their oviposition sites, so localized hot spots of biting can occur both day and night. Our most common spring species are *Ae. abserratus, Ae. punctor*, *Ae. excrucians,* and *Ae. stimulans*. Adults are not attracted to light, so human (sweep nets) or CO_2-baited trapping is recommended.

S□□ □ □□□□□□□ □□□□*Aedes* Eggs of summer floodwater *Aedes* (15 species) can hatch beginning in late April and early May. These mosquitoes lay their eggs at the margins of grassy depressions, marshes, and along river flood plains; floodwater from heavy rains (greater than one inch) stimulate the eggs to hatch. Overwintering is in the egg stage. Adult females live about three weeks and can lay multiple batches of eggs, which can hatch during the current summer after flooding, resulting in multiple generations per year. Most species can fly great distances and are highly attracted to light. Peak biting activity is as at dusk. The floodwater mosquito, *Ae. vexans* is our most numerous pest. Other summer species are *Ae. canadensis*, *Ae. cinereus*, *Ae. sticticus,* and *Ae. trivittatus*. New Jersey light traps, CO_2-baited traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans This summer species is called the "cattail mosquito" because it uses cattail marshes for larval habitat. Larvae of this unique mosquito obtain oxygen by attaching its specialized siphon to the roots of cattails and other aquatic plants; it overwinters this way. There is only a single generation per year, and adults begin to emerge in late June and peak around the first week of July. They are very aggressive biters, even indoors, and can disperse up to five miles from their larval habitat. Peak biting activity is at dusk and dawn. Eggs are laid in rafts on the surface of the water. Adult surveillance is best achieved with CO_2 traps and sweep net samples.

□ermanent □ ater Species

Other mosquito species not previously mentioned develop in permanent and semi-permanent sites. These mosquitoes comprise the remaining *Anopheles*, *Culex*, and *Culiseta* species. These mosquitoes are multi-brooded and lay their eggs in rafts on the surface of the water. The adults prefer to feed on birds or livestock but will bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. As previously mentioned, the District targets disease vectors (the *Culex*4 species and *Cs. melanura*) for surveillance and/or control.

□nvasive or □are Species

Aedes albopictus This invasive species is called the Asian tiger mosquito. It oviposits in tree holes and containers. This mosquito is a very efficient vector of several diseases, including

LAC. *Aedes albopictus* has been found in Minnesota, but it is not known to overwinter here. It was brought into the country in recycled tires from Asia and is established in areas as far north as Chicago. An individual female will lay her eggs a few at a time in several containers, which may contribute to rapid local spread. This mosquito has transmitted dengue fever in southern areas of the United States. Females feed predominantly on mammals but will also feed on birds.

Psorophora Larvae of this genus develop in floodwater areas, are human-biting, and not known to vector any disease. Four species occur in the District; although considered rare or uncommon, they have been detected more frequently since the mid-2000s. The adult *Psorophora ciliata* is the largest mosquito found in the District, and its larvae are predacious and even cannibalistic.

Blac ly Biology

L C Females lay eggs directly onto the water or on leaves of aquatic plants and objects in rivers, streams, and other running water. Once they hatch, the larvae attach themselves to stones, grass, branches, leaves, and other objects submerged under the water. In Minnesota, black flies develop in large rivers (e.g. Mississippi, Minnesota, Crow, and Rum) as well as small streams. Most larval black flies develop under water for 10 days to several weeks depending on water temperature. Larvae eat by filtering food from the running water with specially adapted mouthparts that resemble grass rakes. They grow to about 1/4 inch when fully developed; after about a week as pupae, they emerge as adults riding a bubble of air to the surface.

Female black flies generally ambush their victims from tree-top perches near the edge of an open area and are active during the day; peak activity is in the morning and early evening. Females live from one to three weeks, depending on species and weather conditions. They survive best in cool, wet weather. Studies done by MMCD show that the majority of black flies in the region lay only one egg batch.

T S (taken from Adler, P. et al, 2004)
Simulium venustum develops in smaller streams. It has one generation in the spring (April through early June), and is univoltine (one egg batch per year). Eggs overwinter and larvae begin hatching in April. Females can travel an average of 5.5-8 miles (maximum=22 miles) from their natal waterways. *Simulium venustum* is one of the most common black flies and probably one of the major biting pests of humans in North America.

Simulium johannseni develops primarily in the Crow and South Fork Crow rivers. It has one generation in the spring (April through May). Larvae develop in large, turbid, meandering streams and rivers with beds of sand and silt. Female adults feed on both birds and mammals.

Simulium meridionale develops in the Minnesota, Crow, and South Fork Crow rivers and is multivoltine with three to six generations (May- July). Adult females feed on both birds and mammals. Females will travel at least 18 miles from their natal sites and have been collected at heights up to 4,900 ft above ground (0.932 miles).

Simulium luggeri develops primarily in the Mississippi and Rum rivers and has five to six generations a year. Eggs overwinter with larvae and pupae present from May to October. Three to five overlapping generations are produced annually. Host-seeking females can travel at least

26 miles from their natal waters and perhaps more than 185 miles with the aid of favorable winds. Hosts include humans, dogs, horses, pigs, elk, cattle, sheep, and probably moose.

Adler, Peter H., Douglas C. Currie, and D. Monty Wood. 2004. *The Black Flies (Simuliidae) of North America*. Cornell University Press.

Species Code and Significance/Occurrence of the Mosquitoes and Black Flies in MMCD

Code	Genus	species	Significance/ Occurrence	Code	Genus	species	Significance/ Occurrence
Mosquitoes							
1.	*Aedes*	*abserratus*	common, spring	27.	*Anopheles*	*barberi*	rare, tree hole
2.		*atropalpus*	rare, summer	28.		*earlei*	common
3.		*aurifer*	rare, spring	29.		*punctipennis*	common
4.		*euedes*	rare, spring	30.		*quadrimaculatus*	common
5.		*campestris*	rare, spring	31.		*walkeri*	common
6.		*canadensis*	common, spring	311.	*An.* unidentifiable		
7.		*cinereus*	common, spring-summer				
8.		*communis*	rare, spring	32.	*Culex*	*erraticus*	rare
9.		*diantaeus*	rare, spring	33.		*pipiens*	common
10.		*dorsalis*	common, spring-summer	34.		*restuans*	common
11.		*excrucians*	common, spring	35.		*salinarius*	uncommon
12.		*fitchii*	common, spring	36.		*tarsalis*	common
13.		*flavescens*	uncommon, spring	37.		*territans*	common
14.		*implicatus*	uncommon, spring	371.	*Cx.* unidentifiable		
15.		*intrudens*	rare, spring	372.	*Cx.*	*pipiens/restuans*	common
16.		*nigromaculis*	uncommon, summer				
17.		*pionips*	rare, spring	38.	*Culiseta*	*inornata*	common
18.		*punctor*	common, spring	39.		*melanura*	uncommon, local
19.		*riparius*	common, spring	40.		*minnesotae*	common
20.		*spencerii*	uncommon, spring	41.		*morsitans*	uncommon
21.		*sticticus*	common, spring-summer	411.	*Cs.* unidentifiable		
22.		*stimulans*	common, spring	42.	*Coquillettidia*	*perturbans*	common
23.		*provocans*	common, early spring	43.	*Orthopodomyia*	*signifera*	rare
24.		*triseriatus*	common, summer, LAC vector	44.	*Psorophora*	*ciliata*	rare
25.		*trivittatus*	common, summer	45.		*columbiae*	rare
26.		*vexans*	common, #1 summer species	46.		*ferox*	uncommon
50.		*hendersoni*	uncommon, summer	47.		*horrida*	uncommon
51.		*albopictus*	rare, exotic, Asian tiger mosquito	471.	*Ps.* unidentifiable		
52.		*japonicus*	summer, Asian rock pool mosq.				
53.		*cataphylla**		48.	*Uranotaenia*	*sapphirina*	common, summer
118.		*abserratus/punctor*	inseparable when rubbed	49.	*Wyeomyia*	*smithii*	rare
261.	*Ae.* unidentifiable			491.	Males		
262.	Spring *Aedes*			501.	Unidentifiable		
264.	Summer *Aedes*						
Black Flies							
91.	*Simulium*	*luggeri*	treated, summer	96.	Other Simuliidae		
92.		*meridionale*	treated, summer	97.	Unidentifiable Simuliidae		
93.		*johansenni*	treated, spring				
94.		*vittatum*	non-treated, summer				
95.		*venustum*	treated, spring				

* Two *Aedes cataphylla* larvae were collected in April, 2008 in Minnetonka, MN

[illegible]

Aedes=Ae.	*Orthopodomyia=Or.*
Anopheles=An.	*Psorophora=Ps.*
Culex=Cx.	*Uranotaenia=Ur.*
Culiseta=Cs.	*Wyeomyia=Wy.*
Coquillettidia=Cq.	

A□□□□D□□ B Average □umber of Common Mosquitoes Collected per □ight in □our □□ □ight Traps and Average □early □ainfall□ 1□□5-2014

Year	Spring *Aedes*	*Aedes cinereus*	*Aedes sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Cq. perturbans*	All species	Avg. Rainfall
1965	0.10	0.22	0.06	0.01	107.54	8.76	1.28	135.69	27.97
1966	0.16	0.06	0.00	0.01	17.26	0.45	1.99	22.72	14.41
1967	0.31	0.27	0.25	0.03	85.44	0.96	4.93	95.5	15.60
1968	0.21	0.71	0.04	0.19	250.29	2.62	3.52	273.20	22.62
1969	0.15	0.23	0.01	0.03	20.39	0.57	3.57	30.12	9.75
1970	0.20	0.57	0.03	0.33	156.45	0.97	3.07	179.71	17.55
1971	0.87	0.42	0.12	0.11	90.45	0.50	2.25	104.65	17.82
1972	1.05	1.79	0.19	0.07	343.99	0.47	14.45	371.16	18.06
1973	0.97	0.68	0.03	0.04	150.19	0.57	22.69	189.19	17.95
1974	0.37	0.36	0.10	0.03	29.88	0.26	5.62	38.75	14.32
1975	0.28	0.63	0.44	0.17	40.10	6.94	4.93	60.64	21.47
1976	0.24	0.04	0.01	0.00	1.69	0.25	4.24	9.34	9.48
1977	0.14	0.07	0.00	0.02	21.75	5.98	7.42	34.07	20.90
1978	0.84	0.77	0.17	0.11	72.41	4.12	0.75	97.20	24.93
1979	0.29	0.21	0.03	0.48	27.60	0.29	2.12	35.44	19.98
1980	0.03	0.19	0.05	0.79	74.94	0.93	16.88	96.78	19.92
1981	0.05	0.14	0.13	0.69	76.93	1.50	4.45	87.60	19.08
1982	0.10	0.08	0.02	0.03	19.95	0.23	3.16	25.91	15.59
1983	0.15	0.08	0.02	0.04	45.01	0.67	3.44	53.39	20.31
1984	0.08	0.09	0.15	0.36	74.68	2.97	22.60	110.26	21.45
1985	0.07	0.00	0.02	0.01	21.02	0.33	4.96	28.72	20.73
1986	0.35	0.22	0.11	0.04	30.80	1.55	2.42	40.76	23.39
1987	0.00	0.09	0.01	0.17	29.91	1.18	1.52	37.43	19.48
1988	0.01	0.09	0.00	0.00	12.02	0.84	0.18	15.31	12.31
1989	0.05	0.35	0.01	0.26	13.13	1.60	0.17	21.99	16.64
1990	0.30	3.39	0.22	0.08	119.52	4.97	0.08	147.69	23.95
1991	0.11	0.56	0.15	0.26	82.99	1.17	0.45	101.33	26.88
1992	0.04	0.04	0.03	0.13	50.30	0.62	16.31	74.56	19.10
1993	0.03	0.24	0.10	1.15	50.09	0.96	10.90	72.19	27.84
1994	0.02	0.14	0.03	0.08	23.01	0.05	15.19	40.92	17.72
1995	0.04	0.28	0.02	0.29	63.16	0.42	6.79	77.71	21.00
1996	0.12	0.10	0.01	0.04	14.28	0.05	12.06	28.81	13.27
1997	0.09	0.64	0.14	0.63	39.06	0.14	2.03	45.35	21.33
1998	0.03	0.14	0.16	1.23	78.42	0.10	6.13	91.29	19.43
1999	0.01	0.28	0.09	0.11	28.24	0.06	1.74	33.03	22.41
2000	0.01	0.07	0.00	0.22	24.09	0.15	1.36	29.50	17.79
2001	0.05	0.41	0.32	0.10	20.97	0.27	1.01	26.26	17.73
2002	0.05	0.22	0.07	2.53	57.87	0.35	0.75	65.82	29.13
2003	0.04	0.15	0.43	2.00	33.80	0.13	1.59	40.51	16.79
2004	0.02	0.33	0.22	0.63	24.94	0.16	0.99	28.91	21.65
2005	0.05	0.11	0.17	0.42	22.27	0.17	0.57	25.82	22.82
2006	0.05	0.08	0.14	0.01	6.73	0.08	1.85	10.04	18.65

Continued on next page

Year	Spring *Aedes*	*Aedes cinereus*	*Aedes sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Cq. perturbans*	All species	Avg. Rainfall
2007	0.22	0.27	0.01	0.01	8.64	0.26	0.94	13.20	17.83
2008	0.38	0.32	0.17	0.01	8.17	0.10	2.01	12.93	14.15
2009	0.10	0.07	0.00	0.02	3.48	0.04	0.23	4.85	13.89
2010	0.07	0.08	0.06	0.17	16.18	0.23	0.36	26.13	24.66
2011	0.10	0.07	0.11	0.78	33.40	0.07	5.76	47.36	20.61
2012	0.04	0.03	0.15	0.21	21.10	0.04	4.01	30.39	17.53
2013	0.37	0.49	0.15	0.81	26.95	0.12	1.80	35.08	17.77
2014	0.12	0.32	0.19	0.44	32.42	0.20	2.18	41.72	23.60

A□□□□D□□ C Description of Control Materials □sed by MMCD in 2014

The following is an explanation of the control materials currently used by MMCD. The specific names of products used in 2014 are given. The generic products will not change in 2015, although the specific formulator may change.

□nsect Gro□th □egulators

Methoprene 150-day briquets — Central Life Sciences
Altosid® XR Extended Residual Briquet — EPA # 2724-421

Altosid briquets are typically applied to mosquito oviposition sites that are three acres or less. Briquets are applied to the lowest part of the site on a grid pattern of 14-16 ft apart at 220 briquets per acre. Sites that may flood and then dry up (Types 1 & 2) are treated completely. Sites that are somewhat permanent (Types 3, 4, 5) are treated with briquets to the perimeter of the site in the grassy areas. Pockety ground sites (i.e., sites without a dish type bottom) may not be treated with briquets due to spotty control achieved in the uneven drawdown of the site.

Coquillettidia perturbans sites are treated at 330 briquets per acre in rooted sites or 440 briquets per acre in floating cattail stands. Applications are made in the winter and early spring.

Methoprene pellets — Central Life Sciences
Altosid® Pellets — EPA# 2724-448

Altosid pellets consist of methoprene formulated in a pellet shape. Altosid pellets are designed to provide up to 30 days control but trials have indicated control up to 40 days. Applications will be made to ground sites (less than three acres in size) at a rate of 2.5 lb per acre for *Aedes* control and 4-5 lb per acre for *Cq. perturbans* control. Applications will also be done by helicopter in sites that are greater than three acres in size at the same rate as ground sites, primarily for *Cq. perturbans* control.

Methoprene sand — Central Life Sciences
Altosid® XR-G — EPA# 2724-451

Altosid XR-G sand consists of methoprene formulated in a sand-sized granule designed to provide up to 20 days control. Applications for control of *Cq. perturbans* are being evaluated at 10 lb per acre.

Methoprene granules — Valent Biosciences
MetaLarv® S-PT — EPA# 73049-475

MetaLarv S-PT consists of methoprene formulated in a sand-sized granule designed to provide up to 28 days control. Applications for control of *Cq. perturbans* and *Aedes* mosquitoes are being evaluated at 3 and 4 lb per acre.

Bacterial larvicides

***Bacillus thuringiensis israelensis* (*Bti*) corn cob** — Valent Biosciences
VectoBac® G — EPA#73049-10

VectoBac corn cob may be applied in all types of larval habitat. The material is most effective during the first three instars of the larval life cycle. Typical applications are by helicopter in sites that are greater than three acres in size at a rate of 5-10 lb per acre. In sites less than three acres, the material is applied to pockety sites with cyclone seeders or power backpacks.

***Bacillus thuringiensis israelensis* (*Bti*) liquid** — Valent Biosciences
VectoBac® 12AS — EPA# 73049-38

VectoBac liquid is applied directly to small streams and large rivers to control black fly larvae. Treatments are done when standard Mylar sampling devices collect threshold levels of black fly larvae. Maximum dosage rates are not to exceed 25 ppm of product as stipulated by the MnDNR. The material is applied at pre-determined sites, usually at bridge crossings applied from the bridge, or by boat.

Bacillus sphaericus (Bs) — Valent Biosciences
VectoLex® CG — EPA# 73049-20

VectoLex CG may be applied in all types of larval *Culex* habitat. The material is most effective during the first three instars of the larval life cycle. Typical applications are by helicopter in sites that are greater than three acres in size at a rate of 8 lb per acre. In sites less than three acres, VectoLex is applied to pockety sites with cyclone seeders or power back packs at rates of 8 lb per acre. This material may also be applied to cattail sites to control *Cq. perturbans*. A rate of 15 lb per acre is applied both aerially and by ground to cattail sites in early to mid-September to control emergence the following June-July.

Natular® spinosad — Clarke
Natular® G30 — EPA# 8329-83

Natular is a new formulation of spinosad, a biological toxin extracted from the soil bacterium *Saccharopolyspora spinosad,* that was developed for larval mosquito control. Spinosad has been used by organic growers for over 10 years. Natular is formulated as long release granules (G30) and can be applied to dry or wet sites.

Natular® spinosad — Clarke
Natular® G — EPA# 8329-80

Natular is a new formulation of spinosad, a biological toxin extracted from the soil bacterium *Saccharopolyspora spinosad,* that was developed for larval mosquito control. Spinosad has been used by organic growers for over 10 years. Natular is formulated on corn cob as a short release granule designed for application (3.5 – 9 lb/acre) to wet sites.

□yrethroid Adulticides

□ermethrin Clarke
Permethrin 57% OS EPA# 8329-44

Permethrin 57% OS is used by the District to treat adult mosquitoes in known daytime resting or harborage areas. Harborage areas are defined as wooded areas with good ground cover to provide a shaded, moist area for mosquitoes to rest during the daylight hours.

Adult control is initiated when MMCD surveillance (sweep net and CO_2 trap collections) indicates nuisance populations of mosquitoes, when employee conducted landing rate collections document high numbers of mosquitoes, or when a large number of citizens complain of mosquito annoyance from a given area. In the case of citizen complaints, MMCD staff conducts mosquito surveillance to determine if treatment is warranted. MMCD also treats functions open to the public and public owned park and recreation areas upon request and at no charge if the event is not-for-profit.

The material is diluted with soybean and food grade mineral oil (1:10) and is applied to wooded areas with a power backpack mister at a rate of 25 oz of mixed material per acre (0.0977 lb AI per acre).

□atural □yrethrin MGK, McLaughlin Gormley King
Pyrocide® Mosquito Adulticiding Concentrate 7369 EPA#1021-1569

Pyrocide is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrocide is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enable applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrocide is applied at a rate of 1.5 oz of mixed material per acre (0.00217 lb AI per acre). Pyrocide is a non-restricted use compound.

□sfenvalerate and □rallethrin MGK, McLaughlin Gormley King
Onslaught® FastCap Microencapsulated Insecticide EPA# 1021-1815

Onslaught (esfenvalerate, prallethrin, and the synergist PBO) is used by the District to treat adult mosquitoes in known daytime resting or harborage areas. Onslaught, a non-restricted use compound, is diluted with water (1:50) and applied to wooded areas with a power backpack mister at a rate of 25 oz of mixed material per acre (0.0026 lb AI per acre [0.0021 esfenvalerate and 0.0005 prallethrin]).

□esmethrin Bayer
Scourge® 4+12 EPA# 432-716

Scourge (resmethrin and the synergist PBO) is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Scourge is applied from truck or all-terrain-vehicle

mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enable the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. The material is applied at a rate of 1.5 oz of mixed material per acre (0.0035 lb AI per acre). Scourge is a restricted used compound and is applied only by Minnesota Department of Agriculture licensed applicators.

Sumithrin Clarke
Anvil® 2+2 EPA# 1021-1687-8329

Anvil (sumithrin and the synergist PBO) is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Anvil is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand held cold fog machines that enable applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. The material is applied at a rates 1.5 and 3.0 oz of mixed material per acre (0.00175 and 0.0035 lb AI per acre). Anvil is a non-restricted use compound.

A□□□□D□ D 2014 Control Materials□Active □ngredient □A□□dentity□□ercent A□ □er Acre Dosage□A□Applied □er Acre and □ield □ife

Material	AI	Percent AI	Per acre dosage	AI per acre (lbs)	Field life (days)
Altosid® briquets [a]	Methoprene	2.10	220	0.4481	150
			330	0.6722	150
			440	0.8963	150
			1□	0.0020□	150
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063	30
			4 lb	0.1700	30
			0.0077 lb□ (3.5 g)	0.0003□	30
Altosid® XR-G	Methoprene	1.50	10 lb	0.1500	20
MetaLarv™ S-PT	Methoprene	4.25	2.5 lb	0.1063	30
			3 lb	0.1275	30
			4 lb	0.1700	30
Natular™ G30	Spinosad	2.50	5 lb	0.1250	30
Natular™ G	Spinosad	0.50	5 lb	0.0250	7
VectoBac® G	*Bti*	0.20	5 lb	0.0100	1
			8 lb	0.0160	1
VectoLex® CG	*Bs*	7.50	8 lb	0.6000	7-28
			0.0077 lb* (3.5 g)	0.0006□	7-28
Permethrin 57%OS [c]	Permethrin	5.70	25 fl oz	0.0977	5
Onslaught FastCap® [d]	Esfenvalerate Prallethrin	6.40 1.60	25 fl oz	0.0021 0.0005	5
Scourge® [e]	Resmethrin	4.14	1.5 fl oz	0.0035	<1
Anvil® [f]	Sumithrin	2.00	3.0 fl oz	0.0035	<1
Pyrocide® [g]	Pyrethrins	2.50	1.5 fl oz	0.00217	<1

[a] 44 g per briquet total weight (220 briquets=21.34 lb total weight)
[b] 1.72 lb AI per 128 fl oz (1 gal); 0.45 lb AI per 1000 ml (1 liter)
[c] 0.50 lb AI per 128 fl oz (1 gal) (product diluted 1:10 before application, undiluted product contains 5.0 lb AI per 128 fl oz)
[d] 0.0135 lb AI per 128 fl oz (1 gal) (product diluted 1:50 before application, undiluted product contains 0.675 lb AI per 128 fl oz)
[e] 0.30 lb AI per 128 fl oz (1 gal)
[f] 0.15 lb AI per 128 fl oz (1 gal)
[g] 0.185 lb AI per 128 fl oz (1 gal) (product diluted 1:1 before application, undiluted product contains 0.37 lb AI per 128 fl oz)
□Catch basin treatments—dosage is the amount of product per catch basin.

A□□□□D□□ □ Acres Treated □ith Control Materials □sed by MMCD for Mosquito and Blac□ □ly Control□200□-2014□The actual geographic area treated is smaller because some sites are treated more than once

Control Material	2006	2007	2008	2009	2010	2011	2012	2013	2014
L□□□□□□□□□									
Altosid® XR Briquet 150-day	352	290	294	225	174	205	165	189	193
Altosid® XRG	0	1,776	6,579	8,320	9,924	13,336	23,436	6,948	52
Altosid® Pellets 30-day	31,827	36,818	35,780	35,161	36,516	30,749	13,172	15,813	26,179
Altosid® Pellets catch basins (count)	167,797	161,876	195,973	219,045	227,611	234,033	226,934	246,300	239,829
MetaLarv™ S-PT	0	0	0	0	0	0	2,750	14,063	18,073
Natular™ G30	0	0	0	0	0	0	9,524	15,000	14,950
Altosid® XR Briquet catch basins (count)	5,210	6,438	40	0	0	0	458	375	437
VectoLex® CG granules	540	27	6	0	0	0	0	2,330	3,064
VectoMax® CG granules	0	0	182	5	0	0	0	0	0
VectoBac G *Bti* corn cob granules	160,780	118,128	122,251	151,801	250,478	201,957	207,827	150,280	255,916
VectoBac 12 AS *Bti* liquid (gal used) Black fly control	1,035	1395	2,063	2,181	2630	3,817	3,097	3,878	4,349
A□□□□□□□□□									
Permethrin 57% OS Permethrin	5,114	3,897	8,272	4,754	8,826	7,544	8,578	9,020	8,887
Scourge 4+12 Resmethrin/PBO	29,876	24,102	64,142	12,179	27,794	24,605	8,078	37,204	44,890
Anvil 2 + 2 Sumithrin/PBO	5,350	5,608	35,734	7,796	26,429	29,208	27,486	36,000	31,381
Pyrenone® Adulticide	0	0	2,214	943	2,560	0	0	0	0
Pyrocide® Adulticide	0	0	299	0	0	0	0	0	5,338

A□□□□D□□ □ Graphs of □arvicide□Adulticide□and □□□ □og Treatment Acres□1□□4-2014

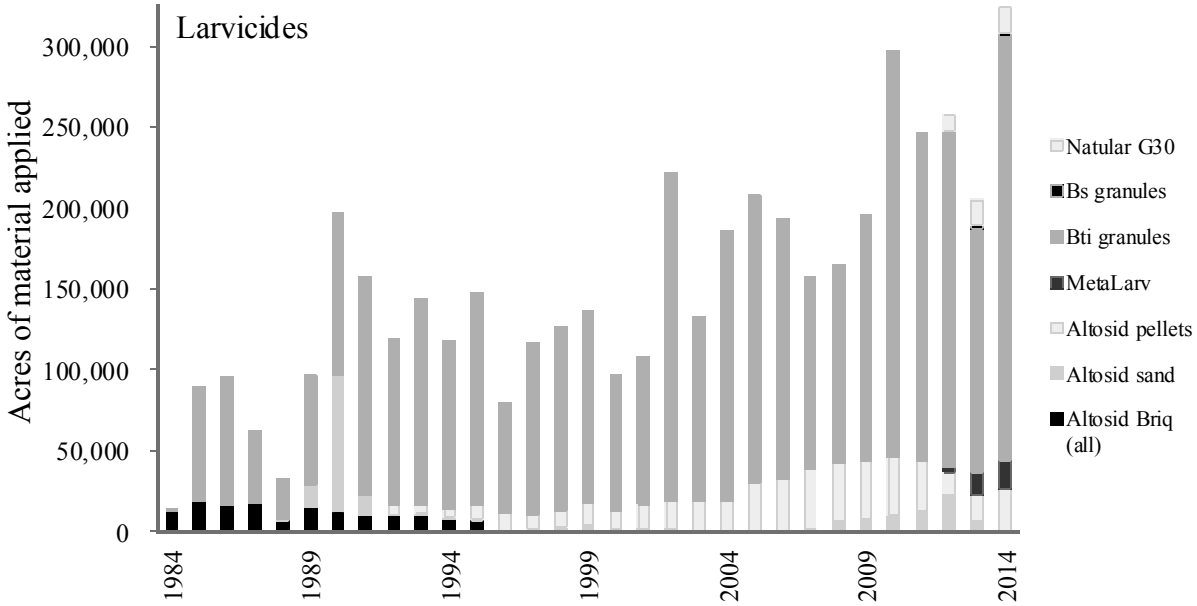

Figure F.1 Summary of total acres of larvicide treatments applied per year since 1984. For materials that are applied to the same site more than once per year, actual geographic acreage treated is less than that shown.

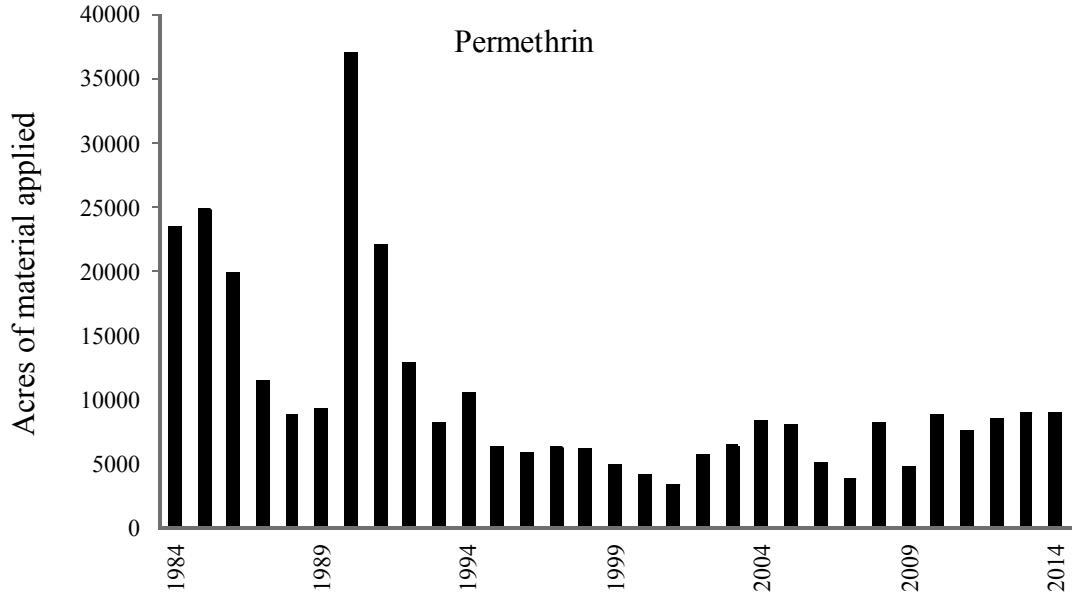

Figure F.2 Summary of total acres of permethrin treatments applied per year since 1984. This material may be applied to the same site more than once per year, so actual geographic acreage treated is less than that shown.

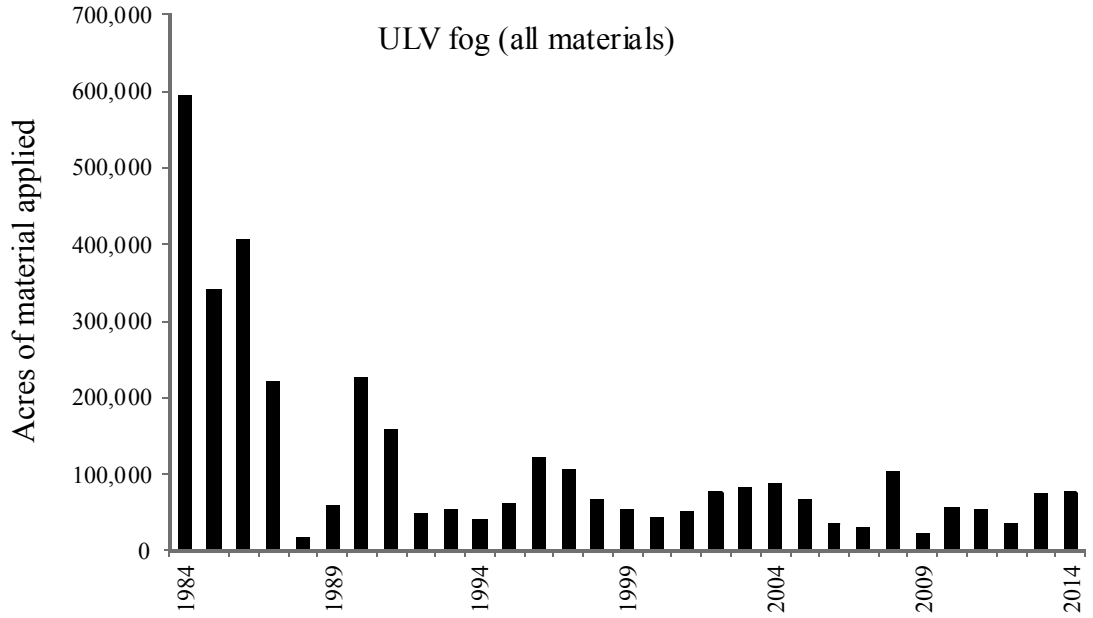

Figure F.3 Summary of total acres of ULV fog treatments applied per year since 1984. These materials may be applied to the same site more than once per year, so actual geographic acreage treated is less than that shown.

A□□□□D□ G Control Material □abels

Altosid® XR Extended Residual Briquets (EPA# 2724-421)

Altosid® Pellets (EPA# 2724-448)

Altosid® XR-G Sand (EPA# 2724-451)

MetaLarv® S-PT (EPA# 73049-475)

VectoBac® 12AS (EPA# 73049-38)

VectoBac® G (EPA# 73049-10)

VectoLex® CG (EPA# 73049-20)

Natular™ G (EPA# 8329-80)

Natular™ G30 (EPA# 8329-83)

Permethrin 57% OS (EPA# 8329-44)

Pyrocide® Mosquito Adulticiding Concentrate 7369 (EPA#1021-1569)

Onslaught® FastCap (EPA# 1021-1815)

Scourge® 4+12 (EPA# 432-716)

Anvil® 2+2 ULV (EPA# 1021-167-8329)

Zenivex® E20 (EPA# 2724-791)

A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE
(INCLUDING THOSE WHICH MAY TRANSMIT WEST NILE VIRUS)

SPECIMEN LABEL

ACTIVE INGREDIENT:

(S)-Methoprene [CAS #65733-16-6]* (Dry Weight Basis):	2.1%
OTHER INGREDIENTS:	97.9%
Total	100.0%

EPA Reg. No. 2724-421
EPA Est. No. 2724-TX-1

KEEP OUT OF REACH OF CHILDREN
CAUTION
SEE ADDITIONAL PRECAUTIONARY STATEMENTS

INTRODUCTION

ALTOSID® XR BRIQUETS are designed to release effective levels of (S)-Methoprene insect growth regulator over a period up to 150 days in mosquito breeding sites. Release of (S) Methoprene insect growth regulator occurs by dissolution of the briquet. Soft mud and loose sediment can cover the briquets and inhibit normal dispersion of the active ingredient. The product may not be effective in these situations where the briquet can be removed from the site by flushing action.

ALTOSID® XR BRIQUETS prevent the emergence of adult mosquitoes including: *Anopheles, Culex, Culiseta, Coquillettidia,* and *Mansonia* spp., as well as those of the floodwater mosquito complex *(Aedes, Ochlerotatus,* and *Psorophora* spp.) from treated water. Treated larvae continue to develop normally to the pupal stage where they die.

NOTE: (S) Methoprene insect growth regulator has no effect on mosquitoes which have entered the pupal or adult stage prior to treatment.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS - CAUTION

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

FIRST AID

Call a poison control center or doctor for treatment advice.

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of unused product.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

APPLICATION TIME

Place **ALTOSID® XR BRIQUETS** at or before the beginning of the mosquito season. Apply **ALTOSID® XR BRIQUETS** prior to flooding when sites are dry, or on snow and ice in breeding sites prior to spring thaw. Under normal conditions, one application will last the entire mosquito season, or up to 150 days, whichever is shorter. Alternate wetting and drying will not reduce their effectiveness.

APPLICATION RATES

Aedes, Ochlerotatus, and Psorophora spp.: For control in non (or low) flow shallow depressions (< 2 feet in depth), treat on the basis of surface area, placing one **ALTOSID® XR BRIQUET** per 200 ft². Place briquets in the lowest areas of mosquito breeding sites to maintain continuous control as the site alternately floods and dries up.

Culex, Culiseta and Anopheles spp.: Place one **ALTOSID® XR BRIQUET** per 100 ft².

Coquillettidia and *Mansonia spp.:* For application to cattail marshes and water hyacinth beds. For control of these mosquitoes, place one **ALTOSID® XR BRIQUET** per 100 ft².

***Culex* sp. in storm water drainage areas, sewers, and catch basins:** For catch basins, place one **ALTOSID® XR BRIQUET** into each basin. In cases of large catch basins, follow the chart below to determine the number of briquets to use. For storm water drainage areas, place one briquet per 100 ft² of surface area up to two ft deep. In areas that are deeper than two feet, use one additional briquet per two feet of water depth.

Water flow pressure increases the potential dissolution of the briquet. Conduct regular inspections (visual or biological) in areas of water flow to determine if the briquet is still present. Adjust the retreatment interval based on the results of an inspection.

ALTOSID® XR BRIQUETS Application Chart

Number of Briquets	Catch Basin Size (Gallons)	Surface Area/ Water Depth (ft)
1	0 – 500	0 – 2
2	1500 – 3000	2 – 4
3	3000 – 4500	4 – 6
4	4500 – 6000	6 – 8

APPLICATION SITES

ALTOSID® XR BRIQUETS are designed to control mosquitoes in treated areas. Examples of application sites are: storm drains, catch basins, roadside ditches, fish ponds, ornamental ponds and fountains, other artificial water-holding containers, animal watering troughs, cesspools and septic tanks, waste treatment and settling ponds, flooded crypts, transformer vaults, abandoned swimming pools, tires, construction and other manmade depressions, cattail marshes, water hyacinth beds, vegetation-choked phosphate pits, pastures, meadows, rice fields, freshwater swamps and marshes, salt and tidal marshes, treeholes, woodland pools, floodplains, and dredging spoil sites. For application sites connected by a water system, i.e., storm drains or catch basins, treat select water holding sites in the system to maximize the efficiency of the treatment program.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store in a cool place. Do not reuse empty containers.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment. Then offer for recycling, if available, or dispose of empty container in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, expressed or implied, concerning the use and handling of this product other than indicated on the label. To the extent permitted by law, Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

For information, or in case of an emergency, call 1-800-248-7763.

www.altosid.com

Wellmark International
1501 East Woodfield Road 200W
Schaumburg, Illinois 60173

ZOËCON Professional Products

Made in USA.

Aug. 2010
Schaumburg, IL

A GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE *(INCLUDING THOSE WHICH MAY TRANSMIT WEST NILE VIRUS)*

SPECIMEN LABEL

ACTIVE INGREDIENT:	
(S)-Methoprene [CAS #65733-16-6]	4.25%
OTHER INGREDIENTS:	95.75%
Total	100.00%

EPA Reg No. 2724-448 EPA Est. No. 39578-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

FIRST AID

Call a poison control center or doctor for treatment advice.

If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

INTRODUCTION

ZOECON® ALTOSID® Pellets (ALTOSID® Pellets) release **ALTOSID®** Insect Growth Regulator as they erode. **ALTOSID® Pellets** prevent the emergence of adult standing water mosquitoes, including *Anopheles, Culex, Culiseta, Coquillettidia,* and *Mansonia* spp., as well as adults of the floodwater mosquitoes such as *Aedes, Ochlerotatus,* and *Psorophora* spp. from treated sites.

GENERAL DIRECTIONS

ALTOSID® Pellets release effective levels of **ALTOSID®** Insect Growth Regulator for up to 30 days under typical environmental conditions. Continue treatment throughout the season. Treated larvae continue to develop normally to the pupal stage where they die. **NOTE:** This insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

APPLICATION SITES AND RATES

Use lower application rates when water is shallow, vegetation and/or pollution are minimal, and insect populations are low. Use higher rates when water is deep (>2 ft), vegetation, pollution, and/or organic debris or water flow are high, and insect populations are high. In instances of high organic debris and water flow, residual activity may be diminished.

MOSQUITO HABITAT	RATE (LB/ACRE)
Floodwater sites	
Pastures, meadows, rice fields, freshwater swamps and marshes, salt and tidal marshes, cattail marshes, woodland pools, floodplains, tires, other artificial water-holding containers	2.5–5
Dredging spoil sites, waste treatment and settling ponds, ditches and other manmade depressions	5–10
Permanent water sites	
Ornamental ponds and fountains, fish ponds, cattail marshes, water hyacinth beds, flooded crypts, transformer vaults, abandoned swimming pools, construction and other manmade depressions, birdbaths, other artificial water-holding containers	2.5–5
Storm drains, catch basins, roadside gutters, cesspools, septic tanks, waste settling ponds, vegetation-choked phosphate pits	5–10

APPLICATION METHODS

Mosquitoes: Apply **ALTOSID® Pellets** up to 15 days prior to flooding, or at any stage of larval development after flooding or in permanent water sites. Fixed wing aircraft or helicopters equipped with granular spreaders capable of applying rates from 2.5 to 10 lb/acre may be used to apply **ALTOSID® Pellets.** The pellets may also be applied using ground equipment which will achieve good, even coverage at the above rates. Apply **ALTOSID® Pellets** to artificial containers such as tires and catch basins, etc.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal. Store closed containers of **ALTOSID® Pellets** in a cool, dry place.

PESTICIDE DISPOSAL

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER HANDLING

Nonrefillable container. Do not reuse or refill this container. Triple rinse (or equivalent). Then offer for recycling, if available, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, expressed or implied, concerning the use and handling of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

For information or in case of an emergency, call **1-800-248-7763.**

www.altosid.com

Wellmark International
1501 East Woodfield Road 200W
Schaumburg, Illinois 60173

ZOECON. Professional Products

3005019-B

Made in the U.S.A.

May, 2010
Schaumburg, IL

AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE
(INCLUDING THOSE MOSQUITOES WHICH MAY TRANSMIT WEST NILE VIRUS)

SPECIMEN LABEL

ACTIVE INGREDIENT:

(S)-Methoprene [CAS #65733-16-6]	1.5%
OTHER INGREDIENTS:	98.5%
Total	100.0%

EPA Reg. No. 2724-451
EPA Est. No. 2724-TX-1

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS - CAUTION

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with eyes or skin. Due to the size and abrasiveness of the granule, use protective eyewear and clothing to minimize exposure during loading and handling. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of rinsate or equipment washwaters.

FIRST AID

If in eyes • Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.

If on skin or clothing • Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes.

Call a poison control center or doctor for treatment advice. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

GENERAL DIRECTIONS

ALTOSID XR-G® releases effective levels of **ALTOSID®** insect growth regulator for up to 21 days after application. Applications should be continued throughout the entire season to maintain adequate control. Treated larvae continue to develop normally to the pupal stage where they die.

Rotary and fixed-wing aircraft equipped with granular spreaders capable of applying rates listed below may be used to apply **ALTOSID XR-G®**. Ground equipment which will achieve even coverage at these rates may also be used. Apply **ALTOSID XR-G®** uniformly and repeat application as necessary.

NOTE: ALTOSID® insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

APPLICATION TIME

Apply **ALTOSID XR-G®** at any stage of larval mosquito development. Granules may be applied prior to flooding (i.e., "pre-hatch" or "pre-flood") in areas which flood intermittently. In such areas, one application of **ALTOSID XR-G®** can prevent adult mosquito emergence from several subsequent floodings. The actual length of control depends on the duration and frequency of flooding events.

APPLICATION RATES

Aedes, Anopheles, and *Psorophora* spp.: Apply **ALTOSID XR-G®** at 5 - 10 lb/acre (5.6-11.2 kg/ha). *Culex, Culiseta, Coquillettidia,* and *Mansonia* spp.: Apply **ALTOSID XR-G®** at 10-20 lb/acre (11.2-22.4 kg/ha). Within these ranges, use lower rates when water is shallow [< 2 feet (60 cm)] and vegetation and/or pollution are minimal. Use higher rates when water is deep [> 2 feet (60 cm)] and vegetation and/or pollution are heavy.

APPLICATION SITES

Non-Crop Areas: ALTOSID XR-G® may be applied as directed above to temporary and permanent sites which support mosquito larval development. Examples of such sites include: snow pools, salt and tidal marshes, freshwater swamps and marshes (cattail, red cedar, white maple marshes), woodland pools and meadows, dredging spoil sites, drainage areas, ditches, wastewater treatment facilities, live oak runoff lagoons, retention ponds, harvested timber stumps, swales, storm water drainage areas, sewers, catch basins, tree holes, animal watering troughs, water-holding receptacles (e.g., tires, urns, flower pots, cans, and other containers), and other natural and manmade water-holding depressions.

Crop Areas: ALTOSID XR-G® may be applied as directed above to temporary and permanent sites which support mosquito larval development. Examples of such sites include: irrigated crop lands, pastures, rangelands, vineyards, rice fields (domestic and wild), date palm, citrus, fruit, nut orchards, berry fields and bogs.

NOTE: Application of **ALTOSID XR-G®** to sites subject to water flow or exchange will diminish the product's effectiveness and may require higher application rates and/or more frequent applications.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE
Store closed containers of **ALTOSID XR-G®** in a cool, dry place.

PESTICIDE DISPOSAL
Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL
Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, expressed or implied, concerning the use and handling of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

Always read the label before using this product.

For information call 1-**800-248-7763**

www.altosid.com

Wellmark International
1501 East Woodfield Road 200W
Schaumburg, Illinois 60173

ZOËCON International Products

2005062.44 Made in the U.S.A.

January 2013
Schaumburg, IL

MetaLarv™ S-PT

MOSQUITO GROWTH REGULATOR

PELLET

ACTIVE INGREDIENT:	
(S)-Methoprene (CAS # 65733-16-6)	4.25%
OTHER INGREDIENTS	95.75%
TOTAL	100.00%

EPA Reg. No. 73049-475
EPA Est. No. 067829-IA-001 List No. 05765

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION

1.0 FIRST AID

If in eyes
- Hold eye open and rinse slowly and gently with water for 15-20 minutes.
- Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call a poison control center for treatment advice.

If on skin or clothing
- Take off contaminated clothing.
- Rinse skin immediately with plenty of water for 15-20 minutes.
- Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact (PROSAR service) 1-877-315-9918 (24 hours) for emergency medical treatment and/or transport emergency information. For all other information, call Valent BioSciences 1-800-323-9867.

2.0 PRECAUTIONARY STATEMENTS

2.1 Hazards To Humans and Domestic Animals
CAUTION

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with eyes, skin, or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

2.2 Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters or rinsate.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Introduction

MetaLarv S-PT is formulated to release S-Methoprene insect growth regulator for up to 42 days. MetaLarv S-PT prevents the emergence of *Aedes*, *Ochlerotatus* and *Psorophora* spp., (adult floodwater mosquitoes) and *Anopheles*, *Culex*, *Culiseta*, *Coquillettidia* and *Mansonia* spp. (adult standing water mosquitoes).

NOTE: MetaLarv S-PT prevents development of mosquito larvae into adults. MetaLarv S-PT has no effect on mosquitoes that have reached the pupal or adult stage prior to treatment.

4.0 APPLICATION DIRECTIONS

Apply MetaLarv S-PT to mosquito breeding sites at any time during the mosquito season. One application will control adult emergence for up to 42 days. Continue treatment through the last brood of the season. Treated larvae continue to develop normally to the pupal stage where they die.

Apply MetaLarv S-PT to breeding sites that will be intentionally flooded and to areas that will naturally flood, up to 30 days prior to flooding. Periods of greater than 28 days between application and flooding will provide shorter residual control and will need reapplication based on local program threshold requirements.

Apply the pellets evenly over the entire habitat that is flooded and/or expected to be flooded to maintain continuous control as the site alternately floods and dries. Alternate wetting and drying will not reduce pellet effectiveness.

MetaLarv S-PT can be applied to areas that contain fish, other aquatic life, and plants. MetaLarv S-PT can be applied to areas used by or in contact with humans, pets, horses, livestock, birds, or wildlife.

4.1 Application Sites And Rates

Use lower application rates when water is shallow, vegetation and/or pollution are minimal, and mosquito populations are low. Use higher rates when water is deep (>12"), vegetation, pollution, and/or organic debris or water flow are high, and mosquito populations are high. Application of MetaLarv S-PT to sites subject to high organic pollution and water flow or exchange will diminish the product's effectiveness.

Use Sites	Rate Range (lbs/acre)
Floodwater sites	
Pastures, meadows, freshwater swamps and marshes, salt and tidal marshes, cattail marshes, woodland pools, flood plains, grassy swales, bogs, fires, and artificial water holding containers	2.5-5
Drainage spoil sites, waste treatment and settling ponds, ditches, natural and man-made hollows or sinkholes that retain water.	5-10
Permanent water sites	
Ornamental ponds and fountains, fish ponds, cattail marshes, water hyacinth beds, flooded crypts, transformer vaults, abandoned swimming pools, treeholes, man-made craters and pits, and artificial and natural water-holding containers	2.5-5
Storm drains, curb basins, roadside ditches, cesspools, septic tanks, waste settling ponds, vegetation-choked phosphate pits.	5-10

(CONTINUED)

[redacted]

Metarhizium 9-HT should be broadcast applied as a dry product. Applications can be made using fixed wing aircraft, helicopter, boat, tractor mounted spreader, handheld or backpack spreader. Fixed wing aircraft or helicopters equipped with granular spreaders capable of applying rates from 2.5-10 lb/acre may be used to apply Metarhizium 9-HT. Ground rigs may also be applied using ground equipment that will achieve good, even coverage at rates from 2.5-10 lb/acre.

5.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Do not contaminate water when disposing of equipment washwaters.

Pesticide Storage: Store any unused product in original container. Ensure that container is tightly closed then store in a cool, dry place.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Handling: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

6.0 WARRANTY STATEMENT

To the extent consistent with applicable law, seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. To the extent consistent with applicable law user assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Metarhizium is a trademark of Valent BioSciences Corporation.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, ILLINOIS USA
PH. 800-323-9627

VectoBac® 12AS

BIOLOGICAL LARVICIDE

AQUEOUS SUSPENSION

Active Ingredient
Bacillus thuringiensis subsp. *israelensis*, strain AM65-52, fermentation solids and solubles 11.61%
Other Ingredients 88.39%
Total 100.00%

Potency: 1200 International Toxic Units (ITU) per mg
(Equivalent to 5.61 billion ITU per gallon, 1.279 billion ITU per liter)

There is no direct relationship between intended Activity (potency) and the Percent Active Ingredient by Weight.

EPA Reg. No. 73049-38
EPA Est. No. 39762-A-001 List No. 05505

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

1.0 FIRST AID

If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-877-315-5918 (24 hours) for emergency medical treatment and/or personal emergency information. For all other information call 1-800-323-9297.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS)

CAUTION

Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash contaminated clothing before reuse.

Mixer/loaders and applicators not in enclosed cabs or aircraft must wear a dust/mist filtering respirator meeting NIOSH standards of at least N 95, R 95, or P 95. Repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.

2.2 Physical and Chemical Hazards

Diluted or undiluted VectoBac 12AS can cause corrosion if left in prolonged contact with aluminum spray system components. Rinse spray system with plenty of clean water after use. Care should be taken to prevent contact with aluminum aircraft surfaces, structural components and control systems. In case of contact, rinse thoroughly with plenty of water. Inspect aluminum aircraft components regularly for signs of corrosion.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Do not apply directly to lakes, drinking water reservoirs or drinking water receptacles when water is intended for human consumption.

Do not apply when weather conditions favor drift from treated areas. Do not apply to metal painted objects, such as automobiles, as spotting may occur. If spray is deposited on metal painted surfaces, wash immediately with soap and water to avoid spotting.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determine the potential for spray drift. The applicator and the treatment coordinator are responsible for considering all these factors when making decisions.

3.1 Chemigation

Do not apply this product through any type of irrigation system unless labeling on chemigation is followed.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store in a cool, (less than 80° F (30° C)), dry place.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Once cleaned, some agricultural plastic pesticide containers can be taken to a container collection area or picked up for recycling or puncture and dispose of in a sanitary landfill, or by incineration or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Do not reuse container.

CONTINUED

5.0 APPLICATION DIRECTIONS

Do not apply when wind speed favors drift beyond the area of treatment.

Mosquito Habitat	Suggested Rate Range*
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing pools, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, boat wells, salt marshes and rice fields.	0.25 - 2 pts/acre
In addition, standing water containing mosquito larvae in fields growing crops such as: Alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches and walnuts may be treated at the recommended rates.	
When applying this product to standing water containing mosquito larvae in fields growing crops, do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.	
Polluted water (such as sewage lagoons, animal waste lagoons).	1 - 2 pts/acre

*Use higher rate range in polluted water and when larvae 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

Blackflies Habitat	Suggested Rate Range
Streams	
Stream water (—ppm) for 1 minute exposure time	0.5 - 25 mg/liter
Stream water (—ppm) for 10 minutes exposure time	0.05 - 2.5 mg/liter

*Use higher rate range when stream contains high concentration of organic materials, algae, or dense aquatic vegetation.

*Discharge is a principal factor determining dose. Use higher rate or increase volume of water dilution in low discharge rivers or streams under low volume (drought) conditions.

6.0 NUISANCE FLIES

For control of nuisance flies (*Psychoda* spp., *Chironomus* spp.) in sewage treatment facilities utilizing trickling filter systems.

APPLICATION DIRECTIONS

Nuisance Fly Habitat	Suggested Rate Range*
Trickling filter system of wastewater treatment plants	10 - 20 mg/liter a (0.833-1.67 ml) per liter of wastewater feed to the filter per 30 minutes

*Use high rate for control of *Chironomus* spp. Apply undiluted with pre-calibrated pump or other device into the wastewater feeding into the filters for a period of 30 minutes. Repeat applications as needed after 2-4 weeks. Control of *Chironomus* spp. may take up to 2 weeks.

7.0 NUISANCE AQUATIC MIDGES

For control of *Chironomine* midges (*Chironomidae: Chironomini*) infesting shallow, manmade and natural lakes or ponds.

APPLICATION DIRECTIONS

Nuisance Midge Habitat	Suggested Rate Range*
Shallow Lakes and Ponds or sewage oxidation ponds (less than acre 8 feet deep)	1 gallon (3.785 l) per acre

*Apply diluted with water in total volume of 5 gallons/acre by pouring or spraying over the surface to be treated with pre-calibrated device. Repeat application as needed after 2-4 weeks. Control of *Chironomine* midges may take up to 2 weeks.

8.0 GROUND AND AERIAL APPLICATION

VectoBac 12AS may be applied in conventional ground or aerial application equipment with quantities of water sufficient to provide uniform coverage of the target area. The amount of water will depend on weather, spray equipment, and mosquito habitat characteristics. Do not mix more VectoBac 12AS than can be used in a 72-hour period.

For most ground spraying, apply in 5-100 gallons of water per acre using hand-pump, airblast, mist blower, etc. spray equipment.

For aerial application, VectoBac 12AS may be applied either undiluted or diluted with water. For undiluted applications, apply 0.25 to 2.0 pt/acre of VectoBac 12AS through fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or rotary atomizers.

For diluted application, fill the mix tank or plane hopper with the desired quantity of water. Start the mechanical or hydraulic agitation to provide moderate circulation before adding the VectoBac 12AS. VectoBac 12AS suspends readily in water and will stay suspended over normal application periods. Brief recirculation may be necessary if the spray mixture has sat for several hours or longer. AVOID CONTINUOUS AGITATION OF THE SPRAY MIXTURE DURING SPRAYING.

Rinse and flush spray equipment thoroughly following each use.

For blackfly aerial applications, VectoBac 12AS can be applied undiluted via fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or open pipes. Rate of application will be determined by the stream discharge and the required amount of VectoBac 12AS necessary to maintain a 0.5 - 25 ppm concentration in the stream water. VectoBac 12AS can also be applied diluted with similar spray equipment. Do not mix more VectoBac 12AS than can be used in a 72-hour period.

9.0 SMALL QUANTITY DILUTION RATES

Gallons Spray Solution/Acre
(Ounces Needed per Gallon of Spray)

VectoBac 12AS
Rate in Pints

Per Acre	10 Gal/A	25 Gal/A	50 Gal/A
0.25 (4 oz)	0.4	0.16	0.08
0.5 (8 oz)	0.8	0.32	0.16
1.0 (16 oz)	1.6	0.64	0.32
2.0 (32 oz)	3.2	1.28	0.64

CONTINUED

10.0 CHEMIGATION

Apply this product through flood (basin) irrigation systems. Do not apply this product through any other type of irrigation system.

Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from non-uniform distribution of treated water.

If you have any questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts.

A person knowledgeable of this chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise.

10.1 RICE-FLOOD (BASIN) CHEMIGATION

Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from backflow / water flow stops.

VectoBac 12AS is metered or dripped into rice floodwater at application stations positioned at the point of introduction (levee gap) of water into each rice field or pan. Two to three pints of VectoBac 12AS are diluted in water to a final volume of 5 gallons. The diluted solution is contained in a 5 gallon container and metered or dispersed into the irrigation water using a constant flow device at the rate of 80 ml per minute. Introduction of the solution should begin when 1/3 to 1/2 of the pan or field is covered with floodwater. Delivery of the solution should continue for a period of approximately 4-1/2 hours. Floodwater depth should not exceed 10-12 inches to prevent excessive dilution of VectoBac 12AS which could result in reduced larval kill.

Agitation is not required during the period in which the VectoBac 12AS solution is being dispersed.

Application of VectoBac 12AS into rice floodwater is not permitted using a pressurized water and pesticide injection system.

11.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product, other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

VectoBac® is a registered trademark of Valent BioSciences Corporation

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 USA
PH: 800 323-9607

VectoBac® G

BIOLOGICAL LARVICIDE

GRANULE

ACTIVE INGREDIENT:
Bacillus thuringiensis, subspecies *israelensis*, strain AM 65-52, fermentation solids, spores, and insecticidal toxins 2.60%
OTHER INGREDIENTS 97.20%
TOTAL 100.00%

Potency: 200 International Toxic Units (ITU) per mg
(Equivalent to 0.091 billion potency ITU per pound)

The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

EPA Reg. No. 73049-10
EPA Est. No. 33769-IA-001 Ist No. 05108

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION

1.0 FIRST AID

If in Eyes

- Hold eyes open and rinse slowly and gently with water for 15-20 minutes.
- Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

Have the product container or label with you. When calling a poison control center or doctor, or going for treatment. You may also contact 1-877-315-9015 (24 hours) for emergency medical treatment and/or transportation information. For all other information, call 1-800-388-8507.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS)

CAUTION

Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling.

Mixers/loaders and applicators not in enclosed cabs or aircraft must wear a dust/mist respirator meeting NIOSH standards of at least N-95, R-95 or P-95. Repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.

2.2 ENVIRONMENTAL HAZARDS

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

4.0 APPLICATION DIRECTIONS

VectoBac G is an insecticide for use against mosquito larvae.

Mosquitoes **Habitat** (Such as the following examples)	**Suggested Range Rate***
Irrigation ditches, roadside ditches, floodwater, standing pools, livestock watering ponds and troughs, wood and pools, snowmelt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and tidal ds	2.5 - 10 lbs./acre

In addition, standing water containing mosquito larvae in fields growing crops such as alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches, sugar cane and walnuts may be treated at the recommended rates.

* Use 10-20 lbs./acre when 4th and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted (sewage lagoons, animal waste lagoons), and/or algae are abundant.

Apply uniformly by aerial or ground conventional equipment.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the treatment coordinator are responsible for considering all of these factors when making decisions.

A 7 to 14 day interval between applications should be employed.

5.0 STORAGE AND DISPOSAL

Do not contaminate potable water, food or feed by storage or disposal.

Storage: Store in a cool [59-86°F (15-30°C)], dry place.

Pesticide Disposal: Completely empty bag into application equipment. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Non-refillable container. Do not reuse or refill this container. Once cleaned, some agricultural plastic pesticide containers can be taken to a container collection site or picked up for recycling. To find the nearest site contact your chemical dealer or manufacturer, or contact Ag Container Recycling Council at 202-061-3144 or www.acrecycle.org. If recycling is not available dispose of in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

VectoBac is a registered trademark of Valent BioSciences Corporation.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 USA
PH: 800-323-9627

Biological Larvicide

VectoLex® CG

Granules

ACTIVE INGREDIENT:
Bacillus sphaericus Serotype H5a5b, strain 2362 Technical Powder
(670 BsITU/mg) 7.5%
OTHER INGREDIENTS 92.5%
TOTAL 100.0%

Potency: This product contains 50 BsITU/mg or 0.022 Billion BsITU/Lb.

The personal active ingredient does not indicate product performance and potency measurements are not federally standardized.

EPA Reg. No. 73049-20
EPA Est. No. 70726-A-001 Lot No. 05722

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION

1.0

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-877-816-3818 (24 hours) for emergency medical treatment and/or transportation information. For all other information, call 1-800-228-3537.	

2.0 PRECAUTIONARY STATEMENTS

2.1 Hazards To Humans and Domestic Animals

CAUTION

Harmful if absorbed through the skin. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling.

Mixers, loaders and applicators not in enclosed cabs or aircraft, must wear a dust/mist filtering respirator meeting NIOSH standards of at least N-95, R-95, or P-95. Repeated exposure to high concentrations of microbial proteins can cause allergic sensitizations.

2.2 Environmental Hazards

Do not contaminate water when disposing of equipment washwaters or rinsate. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Clean contaminated equipment before disposal of equipment washwaters.

Pesticide Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke.

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

VectoLex CG is a selective microbial insecticide for use against mosquito larvae in a variety of habitats. VectoLex CG can be applied to areas that contain fish, other aquatic life, and pets. VectoLex CG can be applied to areas used by or in contact with humans, pets, horses, livestock, birds, or wildlife.

1. **For control of mosquito larvae species* in the following non-crop sites:**

Habitat	Rate Range
Wastewater: Sewage effluent, sewage lagoons, oxidation ponds, septic ditches, animal waste lagoons, impounded wastewater associated with fruit and vegetable processing.	5-20 lbs/acre**
Storm Waters/Drainage Systems: Storm sewers, catch basins, drainage ditches, retention, detention and seepage ponds.	5-20 lbs/acre**
Marine/Coastal Areas: salt marshes, mangroves, estuaries.	5-20 lbs/acre**
Water Bodies: Natural and manmade aquatic sites such as lakes, ponds, rivers, canals, streams and livestock watering ponds and troughs.	5-20 lbs/acre**
Dormant Rice Fields: Impounded water in dormant rice fields. (For application only during the interval between harvest and preparation of the field for the next cropping cycle.)	5-20 lbs/acre**
Waste Tires: Tires stockpiled in dumps, landfills, recycling plants, and other similar sites.	20-80 lbs/acre**

* Refer to 5.2 for list of species.
** 5.0 lbs/1000 sq. ft.

CONTINUED

II. For the control of mosquito larvae species* in agricultural crop sites where mosquito breeding occurs:

Habitats:	Rate Range
Rice, pasture/hay fields, orchards, citrus groves, irrigated crops.	5-20 bs/acre**

Apply uniformly by aerial or conventional ground equipment. Reapply as needed after 7 to 14 weeks.

* Mosquito species effectively controlled by VectoLex CG:

Culex spp.
Aedes vexans
Coquillettidia perturbans
Psorophora columbiae
Psorophora ferox
Anopheles quadrimaculatus
Ochlerotatus japonicus

Culiseta inornata	
Culiseta melanura	(*Aedes melanimon*)
Culiseta morsitans	(*Aedes atropalpus*)
Culiseta particeps	(*Aedes increpitus*)
Culiseta solicitans	(*Aedes solicitans*)

** Use higher rates (10 to 20 lbs/acre) in areas where extended residual control is necessary or in habitats having deep water or dense surface cover.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the treatment recipient are responsible for considering all these factors when making decisions.

5.0 NOTICE TO USER

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VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, ILLINOIS 60048 USA
PH: 800-323-9627

clarke

NATULAR™ G

Mosquito Larvicide Granule

To be used in governmental mosquito control programs, by professional pest control operators, or in other mosquito or midge control operations.

Active Ingredient	
Spinosad (a mixture of Spinosyn A and Spinosyn D)	0.5%
Other Ingredients	99.5%
Total	100.0%

U.S. Patent No. 5,362,634 and 5,496,801

This product contains 0.2 lb of active ingredient spinosad per 40 lb bag

Group	5	INSECTICIDE

KEEP OUT OF REACH OF CHILDREN

CAUTION

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes moderate eye irritation. Avoid contact with eyes or clothing. Wear protective eyewear. Remove and wash contaminated clothing before reuse. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco.

FIRST AID	
If in eyes:	Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1 800 214 7753 for emergency medical treatment information.

Environmental Hazards

This product is toxic to aquatic invertebrates. Non-target aquatic invertebrates may be killed in water where this pesticide is used. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not apply when weather conditions favor drift from treated areas. Drift from treated areas may be hazardous to aquatic organisms in neighboring areas. Apply this product only as specified on the label.

Directions For Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

General Information

Natular™ G is a product for killing mosquito and midge larvae. This product's active ingredient, spinosad, is biologically derived from the fermentation of *Saccharopolyspora spinosa*, a naturally occurring soil organism. Natular™ G may be applied with suitable ground or aerial application equipment.

General Use Precautions

Integrated Pest Management (IPM) Programs

Natular™ G is intended to kill mosquito and midge larvae. Mosquitoes are best controlled when an IPM program is followed. Larval control efforts should be managed through habitat mapping, active adult and larval surveillance, and integrated with other control strategies such as source reduction, public education programs, harborage or barrier adult mosquito control applications, and targeted adulticide applications.

Insecticide Resistance Management (IRM)

Natular™ G contains a Group 5 insecticide. Insect biotypes with acquired resistance to Group 5 insecticides may eventually dominate the insect population if appropriate resistance management strategies are not followed. Currently, only some strains of spinosad active ingredients are classified as Group 5 insecticides. Resistance to other insecticide groups is not likely to impact the effectiveness of this product. Spinosad may be used in rotation with all other labeled products in a comprehensive IRM program.

To minimize the potential for resistance development, the following practices are recommended:

- Base insecticide use on comprehensive IPM and IRM programs.
- Routinely evaluate applications for loss of effectiveness.
- Rotate with other labeled effective mosquito larvicides that have a different mode of action.
- In dormant rice fields, standing water with a high biological oxygen demand, and permanent marine and freshwater sites, do not make more than 20 applications per year.
- Use insecticides with a different mode of action (different insecticide group) on adult mosquitoes so that both larvae and adults are not exposed to products with the same mode of action.
- Contact your local extension specialist, technical advisor, and/or Clarke representative for insecticide resistance management and/or IPM recommendations for the specific site and resistant pest problems.
- For further information or to report suspected resistance, you may contact your local Clarke representative by calling 800-323-5727.

Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather-related factors determines the potential for spray drift. The applicator is responsible for considering all these factors when making decisions. Where states have more stringent regulations, they should be observed.

Application

Proper application techniques help ensure adequate coverage and correct dosage necessary to obtain optimum kill of mosquito and midge larvae. The following recommendations are provided for ground and aerial application of Natular™ G.

Ground Application

Use conventional ground application equipment and apply Natular™ G at the designated rate for the targeted site.

Spot Treatment

Apply Natular™ G as a spot treatment to areas where mosquitoes are breeding at rates appropriate for the treatment site habitat and conditions.

Aerial Application

Equipment used in the application of Natular™ G should be carefully calibrated before use and checked frequently during application to be sure it is working properly and delivering a uniform distribution pattern. Avoid overlaps that will increase Natular™ G dosage above recommended limits.

AL0309

Application Sites and Rates

The rates listed are typical for effectively killing mosquito and midge larvae in the listed habitat sites. Within this range, use lower rates when water is shallow, vegetation and/or pollution are minimal, and mosquito populations are low. Do not use less than labeled minimum rate. Natular™ G may be applied at rates up to 90 lb per acre in waters high in organic content (such as polluted water, sewage lagoons, animal waste lagoons, and waters with high concentrations of leaf litter or other organic debris), deep water mosquito habitats or those with dense surface cover, and where monitoring indicates a lack of kill at typical rates. Do not re-apply within 7 days of the initial application unless monitoring indicates that larval populations have reestablished or weather conditions have rendered initial treatments ineffective. Do not apply to water intended for irrigation.

For killing mosquito larvae species in the following non-crop sites:

Non-Crop Site	Natular™ G lb/acre (lb ai/acre)
Temporary Standing Water: Woodland pools, snow pools, roadside ditches, retention ponds, freshwater dredge spoils, tire tracks and other natural or manmade depressions, rock holes, pot holes and similar areas subject to holding water	3.5 - 6.5 (0.08 - 0.035)
Other Freshwater Sites: Natural and man-made aquatic sites, edges of lakes, ponds, canals, stream eddies, brook edges, detention ponds	
Freshwater Swamps and Marshes: Mixed hardwood swamps, cattail marsh, common reed wetland, water hyacinth ponds, and similar freshwater areas with emergent vegetation	9 (0.045)
Marine/Coastal Areas: Intertidal areas above the mean high water mark, mangroves, brackish water swamps and marshes, coastal impoundments and similar areas	
Stormwater/Drainage Systems: Storm sewers, catch basins, drainage ditches, and similar areas	6.5 - 9 (0.033 - 0.045)
Wastewater: Sewage effluent, sewers, sewage lagoons, cesspools, oxidation ponds, septic ditches and tanks, animal waste lagoons and settling ponds, livestock runoff lagoons, waste water impoundments associated with fruit and vegetable processing, and similar areas	
Dormant Rice Fields: Impounded water in dormant rice fields (for application only during the interval between harvest and preparation of the field for the next cropping cycle)	3.5 - 6.5 (0.08 - 0.035)
Natural and Artificial Containers: Tree holes, bromeliads, leaf axils, and other similar natural water holding containers, cemetery urns, bird baths, flower pots, rain barrels, buckets, single tires, tires stockpiled in dumps, landfills, recycling plants and other similar areas, abandoned swimming pools, ornamental ponds, flooded rooftops and similar water holding sites. Landfill containers, salvage yards, abandoned vehicles	3.5 - 9 (0.08 - 0.045)

Agricultural/Crop Sites Where Mosquito Breeding Occurs:

Apply Natular™ G at a rate of 3.5 to 9 lb per acre in standing water within agricultural/crop sites where mosquito breeding occurs (pastures/hay fields, rangelands, orchards, vineyards, and citrus groves). Do not apply to waters intended for irrigation.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

Pesticide Storage: Store in original container only. In case of leak or spill, contain material with absorbent material and dispose as waste.

Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site according to label use directions or at an approved waste disposal facility.

Container Handling for Non-Refillable Bag: Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment. Offer for recycling, if available, or puncture and dispose of in a sanitary landfill or by incineration, or by other procedures allowed by state and local authorities.

Container Handling for Rigid Refillable Tote: Refillable container. Refill this container with granular clay-based pesticide formulation only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment. Use a sprayer with water to quickly and completely rinse the interior of the container. Ensure the top, bottom, and all sides are rinsed. A high pressure sprayer with a rinsing nozzle could provide a thorough rinse of the interior. Drain and collect rinsate from the container into a collection system for later disposal. Drain the container dry so no water remains. Return to point of sale, Transfer for recycling if available or reconditioning, if appropriate or puncture and dispose of in a sanitary landfill or by incineration, or by other procedures allowed by State and local authorities.

Warranty: To the extent consistent with applicable law CLARKE MOSQUITO CONTROL PRODUCTS, INC. makes no warranty, express or implied, concerning the use of this product other than as indicated on the label. Buyer assumes all risk of use/handling of this material when use and/or handling is contrary to label instructions.

Natular® is a Trademark of Clarke Mosquito Control Products, Inc.

Manufactured For:
CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 North Garden Avenue
Roselle, IL 60172
U.S.A.

EPA Reg. No.: 5905-82 NET WEIGHT _____

EPA Est. No.: 8328-IL-20 LOT:

A_0305

Natular™ G30

To be used in governmental mosquito control programs, by professional pest control operators, or in other mosquito or midge control operations.

Active ingredient (dry weight basis):	
spinosad (a mixture of spinosyn A and spinosyn D)	2.5%
Other ingredients	97.5%
Total	100.00%

U.S. Patent No. 5,362,634 and 5,496,931
*A Naturalyte® Insect Control product

Natular G30 is a 2.5% extended release granule.

Group	5	INSECTICIDE

Keep Out of Reach of Children

CAUTION

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful if swallowed. Causes moderate eye irritation. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Avoid contact with eyes or clothing. Wear protective eyewear (such as goggles, face shield, or safety glasses).

First Aid

If swallowed:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything to an unconscious person.
If in eyes:	• Hold eye open and rinse slowly and gently with warm water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. • Call a poison control center or doctor for treatment advice.

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-214-7758 for emergency medical treatment information.

Environmental Hazards

This product is toxic to aquatic organisms. Non-target aquatic invertebrates may be killed in waters where this pesticide is used. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

General Information

Natular G30 is a Naturalyte® product for killing mosquito and midge larvae. The product's active ingredient, spinosad, is biologically derived from the fermentation of *Saccharopolyspora spinosa*, a naturally occurring soil organism. Natular G30 releases effective levels of spinosad for up to 30 days under typical environmental conditions. Natular G30 may be applied with ground or aerial equipment.

General Use Precautions

Integrated Pest Management (IPM) Programs

Natular G30 is intended to kill mosquito and midge larvae. Mosquitoes are best controlled when an IPM program is followed. Larval control efforts should be managed through habitat mapping, active adult and larval surveillance, and integrated with other control strategies such as source reduction, public education programs, barrier or residual mosquito control applications, and targeted adulticide applications.

Insecticide Resistance Management (IRM)

Natular G30 contains a Group 5 insecticide. Insect biotypes with acquired resistance to Group 5 insecticides may eventually dominate the insect population if appropriate resistance management strategies are not followed. Currently, only spinetoram and spinosad active ingredients are classified as Group 5 insecticides. Resistance to other insecticides is not likely to impact the effectiveness of this product. Spinosad may be used in rotation with other labeled products in a comprehensive IRM program.

To minimize the potential for resistance development, the following practices are recommended:

- Base insecticide use on comprehensive IPM and IRM programs.
- Routinely evaluate applications for loss of effectiveness.
- Rotate with other labeled effective mosquito larvicides that have a different mode of action.
- In dormant tree holes, standing water within agricultural/commercial sites, and permanent marine and freshwater sites, do not make more than 4 applications per year.
- Use insecticides with a different mode of action (different insecticide group) on adult mosquitoes so that both larvae and adults are not exposed to products with the same mode of action.
- Contact your local extension specialist, technical advisor, and/or Clarke representative for insecticide resistance management and/or IPM recommendations for the specific site and resistant pest problems.
- For further information or to report suspected resistance, you may contact your local Clarke representative by calling 800-323-5727.

Application

Proper application techniques help ensure adequate coverage and correct dosage necessary to obtain optimum kill of mosquito and midge larvae. Apply Natular G30 prior to hatching as a preventative application to areas that breed mosquitoes or at any stage of larval development after flooding in listed sites. Do not allow this product to drift onto neighboring crops or non-crop areas of use in a manner or at a time other than in accordance with label directions.

Ground Application

Use conventional ground application equipment that provides even coverage at labeled rates.

Aerial Application

Fixed wing aircraft or helicopters equipped with granular spreaders capable of applying rates from 5 to 30 lb per acre may be used to apply Natular G30. Aerial application equipment should be carefully calibrated before use to be sure it is working properly and delivering a uniform distribution pattern. Avoid overlaps that will increase the coverage of Natular G30 above labeled limits.

AL3152

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the treatment coordinator are responsible for considering all these factors when making application decisions.

Application Sites and Rates

Apply Natular G30 at 5 to 20 lb per acre. Rates are equivalent to 5 to 20 g per 1,000 sq ft of water surface for effective kill of mosquito and midge larvae in the listed habitat sites. Within this range, use lower rates when water is shallow, vegetation and/or pollution are minimal, and mosquito populations are low. Do not use less than the labeled minimum rate. Use higher rates when water is deep, vegetation and/or pollution are high, and mosquito populations are high. Natular G30 may be applied at rates up to 20 lb per acre in waters high in organic content, deep-water mosquito habitats or those with dense surface cover, and where monitoring indicates a lack of kill at typical rates. Reapply after 30 days. More frequent applications may be made if monitoring indicates that larval populations have reestablished or weather conditions have rendered this treatment ineffective.

Non-Crop Sites

Apply Natular G30 in the following non-crop sites to kill mosquito larvae species:

Temporary Standing Water: Woodland pools, snowmelt pools, roadside ditches, retention ponds, freshwater dredge spoils, tire ruts and other natural or manmade depressions, rock holes, tidal marshes and similar areas subject to holding water.

Other Freshwater Sites: Natural and manmade aquatic sites, edges of lakes, ponds, canals, stream eddies, creek edges, and detention ponds.

Freshwater Swamps and Marshes: Mixed hardwood swamps, cattail marsh, common reed wetland, water hyacinth ponds, and similar freshwater areas with emergent vegetation.

Marine/Coastal Areas: Intertidal areas above the mean high water mark, mangroves, brackish water swamps and marshes, coastal impoundments and similar areas.

Stormwater/Drainage Systems: Storm sewers, catch basins, drainage ditches, and similar areas.

Wastewater: Sewage effluent, sewers, sewage lagoons, cesspools, oxidation ponds, septic ditches and tanks, animal waste lagoons and settling ponds, livestock runoff lagoons, wastewater impoundments associated with fruit and vegetable processing, and similar areas.

Dormant Rice Fields: Impounded water in dormant rice fields (for application only during the interval between harvest and preparation of the field for the next cropping cycle).

Natural and Artificial Containers: Tree holes, bromeliads, leaf axils, and other similar natural water holding containers, nursery urns, bird baths, flower pots, rain barrels, buckets, single tires, tires stockpiled in dumps, landfills, recycling plants and other similar areas, abandoned swimming pools, ornamental ponds, flooded roof tops and similar water holding sites; landfill containers, salvage yards, abandoned vehicles.

Agricultural/Crop Sites Where Mosquito Breeding Occurs

Apply Natular G30 at the rate of 5 to 20 lb per acre in standing water within agricultural/crop sites where mosquito breeding occurs to kill mosquito larvae species: pasture/hay fields, rangeland, orchards, vineyards, and citrus groves. Do not apply to water intended for irrigation.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

Pesticide Storage: Store in a cool dry place in original container only.

Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Container Handling: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Warranty

To the extent consistent with applicable law, CLARKE MOSQUITO CONTROL PRODUCTS, INC. makes no warranty, express or implied, concerning the use of this product other than as indicated on the label. Buyer assumes all risk of use/handling of this material when use and/or handling is contrary to label instructions.

Natular® is a Trademark of Dow AgroSciences LLC.

Natular® is a Trademark of Clarke Mosquito Control Products, Inc.

Manufactured for
Clarke Mosquito Control Products, Inc.
159 North Garden Avenue
Roselle, IL 60172 U.S.A.

Made in the U.S.A. EPA Reg. No. 8329-83
EPA Est.8329-IL-03

Net Contents: 40 lbs / 18.14 kg
Lot/Batch No:

AL3152

RESTRICTED USE PESTICIDE

DUE TO TOXICITY TO FISH AND AQUATIC ORGANISMS

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

clarke

PERMETHRIN 57% OS

A Synthetic Pyrethroid for Effective Control and Residual Activity of Adult Nuisance and Vector Mosquitoes, Gnats, Biting and Non-Biting Midges, Stableflies, Deer Flies and Other Biting Flies in Outdoor Residential and Recreational Areas.

Active Ingredient:

Permethrin (3-Phenoxyphenyl) methyl (+/-) cis, trans-3-(2,2 dichlorobenzyl)-2,2-dimethylcyclopropane carboxylate	57.00%
Other Ingredients*	43.00%
TOTAL	100.00%

Contains 5 lb/gal Permethrin

*Contains petroleum distillates

Cis/trans isomer ratio: min. 35% (+) cis and max. 55% (+) trans.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

Have product container or label with you when calling a poison control center or doctor, or going for treatment. For medical emergency information, call the International Poison Control Center at 1-800-214-7768.

IF SWALLOWED	Immediately call a poison control center or doctor. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Note to physicians: Contains petroleum distillate. Vomiting may cause aspiration pneumonia.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION. Harmful if swallowed. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet.

Personal Protective Equipment (PPE): Mixers, loaders, applicators and other handlers must wear: long-sleeved shirt and long pants, shoes plus socks, and chemical-resistant gloves made of any waterproof material. Wet applicators, persons cleaning equipment, and persons exposed to the concentrate must wear a chemical-resistant apron.

User Safety Requirements: Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them.

User Safety Recommendations

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This product is extremely toxic to fish and aquatic organisms, including fish and invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment wash waters. Under some conditions it may also have the potential for transport into surface water in runoff (primarily absorbed to suspended soil particles), for several months or more after application. These include poorly draining clay soils with readily visible slopes toward adjacent surface waters frequently flooded areas, and areas overlying extremely shallow groundwater as well as in fields or soil cracks that drain to surface water, areas not separated from adjacent surface waters by vegetated filter strips, and areas overlying tile drainage systems that drain to surface waters.

This pesticide is highly toxic to bees exposed to direct treatment or blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively foraging the treatment area.

Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Precautions and Restrictions

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Not for use in outdoor residential misting systems. Not for use in metered release systems.

Use in handheld thermal foggers is prohibited. Not for application by stationary fogger.

Do not make applications during rain. Apply when wind speed is greater than 1 mph.

Except when applying to building foundations, all outdoor applications to impervious surfaces such as sidewalks, driveways, patios, and other structural surfaces (such as wire fences, decks, and fences) are limited to spot and crack-and-crevice application only. When applying sprays to building foundations, apply above a maximum height of 3 feet.

Do not allow spray treatment to drift onto cropland, poultry ranges or potable water supplies. Do not use on crops used for food or forage.

Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes, reservoirs, rivers, streams, marshes, natural ponds, estuaries, and commercial fish ponds).

Spray Drift Requirements

Only apply this product if the wind direction favors on-target deposition. Do not apply when the wind velocity exceeds 15 mph. Wind speed must be measured and recorded at the application site on the upwind side, immediately prior to application.

Do not make applications into temperature inversions. Inversions are characterized by stable air and increasing temperatures with height above the ground. Mist or fog may indicate the presence of an inversion in humid areas. The applicator may detect the presence of an inversion by producing smoke and observing a smoke layer near the ground surface.

Use only Medium or coarser spray nozzles according to ASAE (3572) definition for standard nozzles, and that produce a droplet spectrum of 150-300 microns VMD. In conditions of low humidity and high temperatures, applicators should use a coarser droplet size.

General Information

PERMETHRIN 57% OS is also registered for control of odor nuisance and vector mosquitoes and other listed insects on plant and other surfaces where these pests may rest (harbor) for up to 14 days in shaded areas. Secondary activity (barrier - type application) is through residency.

PERMETHRIN 57% OS is approved for use as a residual barrier/fog/mist/space spray in vegetation and around structures in residential and recreational areas and other areas where pests occur. Typical harborage sites include brush, building foundations, bushes, climbing ivy, grasses, lawns, logs, turf, vegetative groundcover, windbreak vegetation and other such vegetative cover within or surrounding municipal and residential areas such as, but not limited to: athletic fields, campgrounds, collapsed structures (including burrow forms), fences, junk yards, single family garages, mosquito breeding areas, parks, playgrounds, outdoor residential areas, animal yards, picnic areas, patios (including associated vehicles), wooded park trails, roadbeds, woodlots, and campsites.

Application Directions

Apply product by ground application with a mist blower, power backpack, pressure sprayer, or ultra-low volume (ULV) cold aerosol generator. If a ULV sprayer is used, adjust pressure to deliver particles of 150-300 microns VMD.

PERMETHRIN 57% OS must be mixed with a non-phytotoxic oil mixture prior to application. The mixture is obtained by combining 1 part soybean oil to 7 parts mineral oil. Other oils or oil mixtures must be tested to avoid plant damage within treated areas.

To kill mosquitoes, midges, deer flies and biting flies, in a well-enough ventilated area, apply 0.1 ounces of Permethrin per acre. The following calculations are based on assuming a 2 MPH walking speed and a fifty (50) foot applicator swath. For different application rates or walking speeds used, adjust rate according so as to achieve 0.1 ounces of Permethrin per acre.

Mixture			Finished Spray (Permethrin)		Application rate at 2 MPH walking speed		
PERMETHRIN 57% OS	Soybean Oil	Mineral Oil	Volume	Ounces per gallon	Gallons per Acre	Acres per Gallon	Ounces per Acre
1 Part	3 Parts	6 Parts	57.3%	0.5	95	5.0	0.1

For optimum results thoroughly spray vegetation. Do not spray to the point of runoff. For large recreational areas such as football fields, stadiums, racetracks, and public parks, spray the insecticide only in and to all vegetative areas and groundcover and to surrounding harborage areas.

STORAGE & DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

PESTICIDE STORAGE & SPILL PROCEDURES: Do not store at temperatures below 40 °F (4.5 °C). If this material has been exposed to temperatures below 40 °F, there may be precipitation. Check for crystallization if evident, warm to 80 °F (26.5 °C) and thoroughly mix before using. DO NOT USE OPEN FLAME. Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of at an approved waste disposal facility.

CONTAINER HANDLING: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into rinsate collection system. Repeat the rinsing procedure two more times. Then offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

FOR MORE INFORMATION CALL: 1-800-323-6727

NOTICE: Read the label carefully with application. Seller makes no warranty, expressed or implied, concerning the use of this product other than as indicated on the label. Buyer assumes all risk of use and/or handling of this material when use and/or handling is contrary to label instructions.

MANUFACTURED BY:
CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 NORTH GARDNER AVE.
ROSELLE, IL 60172
U.S.A.

EPA REG. NO. 8329-47
EPA EST. NO. 8329-IL-01

AVAILABLE CONTAINERS: (NET CONTENTS): 30 GAL
LOT NO. marked on container

AL027

7396_1021-1569_0311

MGK® McLAUGHLIN GORMLEY KING COMPANY

PYROCIDE® Mosquito Adulticiding Concentrate for ULV Fogging 7396

8810 Tenth Avenue N. / Minneapolis, Minnesota 55427-4319 U.S.A. - Telephone (763) 544-0341

FOR USE ONLY BY FEDERAL, STATE, TRIBAL OR LOCAL GOVERNMENT OFFICIALS RESPONSIBLE FOR PUBLIC HEALTH OR VECTOR CONTROL OR BY PERSONS CERTIFIED IN THE APPROPRIATE CATEGORY OR OTHERWISE AUTHORIZED BY THE STATE OR TRIBAL LEAD PESTICIDE REGULATORY AGENCY TO PERFORM ADULT MOSQUITO CONTROL APPLICATIONS, OR BY PERSONS UNDER THEIR DIRECT SUPERVISION.

ACTIVE INGREDIENTS:

Pyrethrins	5.0%
* Piperonyl Butoxide Technical	25.0%
** OTHER INGREDIENTS	70.0%
	100.0%

* Equivalent to 23.30% (butylcarityl)(6-propylpiperonyl) ether and 5.03% related compounds

** Contains petroleum distillate

PYROCIDE® - Registered trademark of McLaughlin Gormley King Company

This product contains 0.479 lb/gal (56.80 g/L) Pyrethrins and 2.375 lb/gal (284 g/L) Piperonyl Butoxide.

SPECIMEN LABEL

KEEP OUT OF REACH OF CHILDREN

CAUTION

(First Aid)

IF SWALLOWED:	▪ Immediately call a poison control center or doctor. ▪ Do not give any liquids to the person. ▪ Do not induce vomiting unless told to do so by a poison control center or a doctor. ▪ Do not give anything by mouth to an unconscious person.
IF IN EYES:	▪ Hold eye open and rinse slowly and gently with water for 15-20 minutes. ▪ Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. ▪ Call a poison control center or doctor for treatment advice.
IF ON SKIN OR CLOTHING:	▪ Take off contaminated clothing. ▪ Rinse skin immediately with plenty of water for 15-20 minutes. ▪ Call a poison control center or doctor for treatment advice.
IF INHALED:	▪ Move person to fresh air. ▪ If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth to mouth if possible. ▪ Call a poison control center or doctor for further treatment advice.
NOTE TO PHYSICIAN:	This product contains petroleum distillate and may pose an aspiration pneumonia hazard.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information regarding medical emergencies or pesticide incidents, call 1-866-740-8712.	

Net Contents _____

Manufactured by:
McLAUGHLIN GORMLEY KING COMPANY
8810 Tenth Avenue North
Minneapolis, MN 55427

EPA Reg. No. 1021-1569 EPA Est. No. 1021-MN-2

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if swallowed, inhaled, or absorbed through skin. Causes eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing vapors or spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic organisms, including fish and aquatic invertebrates. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Before making the first application in a season, it is advisable to consult with the state or tribal agency with primary responsibility for pesticide regulation to determine if other regulatory requirements exist. Do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries) except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize the contact deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or wash waters.

BEE WARNING: This product is highly toxic to bees exposed to direct treatment or blooming crops or weeds. Do not apply this product to or allow it to drift onto blooming crops or weeds when bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribe or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

This concentrate is formulated to be diluted with a suitable oil diluent, such as (but not restricted to) light mineral oil, deodorized kerosene or petroleum distillate, for use in cold fog aerosol generators.

This concentrate may be diluted or used as supplied for mosquito control programs involving residential, industrial, recreational and agricultural areas, swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur.

Use in agricultural areas should be in such a manner as to avoid residues in excess of established tolerances for pyrethrins and piperonyl butoxide on crops or commodities.

Best results are expected from application when the meteorological conditions favor an inversion of air temperatures in the area treated and when the wind is not excessive. Repeated applications may be made as necessary to obtain the desired reduction in adult mosquitos.

Back pack application may require a greater rate of dilution than the dilution used for vehicle or aircraft mounted sprayers, in order to achieve the desired rate of application of active ingredients per acre.

EQUIPMENT CALIBRATION PARAMETERS

SPRAY PARTICLE SIZE AND DROPLET SPECTRA

Directions from the equipment manufacturer or vendor, pesticide registrant or a test facility using laser-based measurement instrument must be used to adjust equipment to product acceptable droplet size spectra. Application equipment must be tested annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

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If necessary, contact the distributor or manufacturer of this product for undiluted spread factors or the manufacturer of diluting oils for a spread factor to use to determine droplet size with this product if applied undiluted or diluted.

Ground Equipment:

Specifically, Cold Aerosol, ULV Non-Thermal Spray, Mechanical Cold Aerosol, Turbine Spray, and Thermal Aerosol Fogging Equipment.

Spray equipment must be adjusted so that the volume median diameter (VMD) is less than 30 microns (Dv 0.5 < 30um) and that 90% of the spray is contained in droplets smaller than 50 microns (Dv 0.9 <50 um).

Aerial Equipment:

Spray equipment must be adjusted so that the volume median diameter produced is less than 60 microns (Dv 0.5 < 60um) and that 90% of the spray is contained in droplets smaller than 80 microns (Dv 0.9 < 80).

The effects of flight speed and, for non-rotary nozzles, nozzle angle on the droplet size spectrum must be considered.

PROHIBITION ON AERIAL USE: Not for aerial application in Florida unless specifically authorized by the Bureau of Entomology, Florida Department of Agriculture and Consumer Services.

Do not apply more than 0.2 lbs of pyrethrin per acre/year (224.76 g/Ha/year) and 2.0 lbs of piperonyl butoxide per acre/year (2,247.5 g/Ha/year) in any treated area. Do not exceed 26 applications at 0.008 pounds of pyrethrins per acre in any given season.

Apply PYROCIDE® Mosquito Adulticiding Concentrate for ULV Fogging 7396 diluted or undiluted at rates between 0.0018 pounds pyrethrins and no more than 0.008 pounds pyrethrins per acre in any given 24 hour period unless otherwise noted.

More frequent treatments may be made to answer for conditions subject to public and/or animal health determined by state, tribal, or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animals or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

PESTICIDE STORAGE: Store in a cool, dry place. Keep container closed. Post as a pesticide storage area. Always store pesticides in the original container. Store away from food, pet food, feed, seed, fertilizers, and veterinary supplies. Place liquid formulations on lower shelves and dry formulations above.

PESTICIDE DISPOSAL: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local governments or by industry).

CONTAINER HANDLING [For Containers of 5 Gallons or Less]: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

CONTAINER HANDLING [For Containers Greater Than 5 Gallons]: Nonrefillable container. Do not reuse or refill this container. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times.

Storage and Disposal for Refillable Rigid Containers with a capacity greater than 5 gallons

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store in a cool, dry place. Keep container closed.

PESTICIDE DISPOSAL: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local governments or by industry).

CONTAINER REUSE: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller.

CONTAINER DISPOSAL: To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Offer for recycling, if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Ortho
FASTCAP
Spider & Scorpion Insecticide

Specimen Label

- Fast-acting microencapsulated formula
- Combines fast kill and residual control
- Kills Ants, Spiders, Scorpions, Fleas, and other listed insects

ACTIVE INGREDIENTS:

[illegible]	[illegible]%
[illegible]	[illegible]%
[illegible]	[illegible]%
OTHER INGREDIENTS*	[illegible]%
	100.00%

*Contains petroleum distillates

KEEP OUT OF REACH OF CHILDREN

CAUTION

See inside for first aid and precautionary statements.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

[illegible]

[illegible]

INSECTS CONTROLLED:
Ants
Aphids
Armored Scales
Asseclids
Beetles
Boxelder Bugs
Boxelder Bugs
Brown Marmorated Stink Bug
Carpenter Ants
Centipedes
Chinch Bugs
Clover Mites
Crickets
Earwigs
Elm Leaf Beetles
Fleas
Flies
Gnats
Grasshoppers
Ground Beetles
Hornets
Japanese Beetles
Lace Bugs
Leafhoppers
Leaf Miners
Lygus Bugs
Millipedes
Mites
Mosquitoes
Moths
Pillbugs
Psyllids
Rove Beetles
Scale Insects
Silverfish
Slugs
Snails
Spiders
Springtails
Stink Bugs
Tarantulas
Thrips
Ticks
Treehoppers
Weevils
Whiteflies
Wireworms

FLYING INSECTS INCLUDING:
Bees
Flies
Gnats
Hornets
Mosquitoes
Wasps
Yellow Jackets

WOOD DESTROYING PESTS INCLUDING:
Carpenter Ants
Carpenter Bees
Powderpost Beetles
Termites
Old House Borers
Pine Sawyers
Roundheaded Borers
Western Pine Beetles

BITING AND STINGING PESTS:
Bed Bugs
Fleas
Mosquitoes
Spiders
Ticks
Wasps
Yellow Jackets

PLANT PESTS INCLUDING:
Aphids
Armyworms
Asiatic Garden Beetle
Billbugs
Black Turfgrass Ataenius
Cankerworms
Caterpillars
Chinch Bugs
Cutworms
Diamondback Moth
Eastern Tent Caterpillar
Elm Leaf Beetle
Fall Armyworm
Flea Beetles
Grape Colaspis
Grasshoppers
Japanese Beetles
Leafhoppers
Leaf Miners
Lygus Bugs
Mealybugs
Mites
Orange Tortrix
Pear Psylla
Pear Slugs
Plant Bugs
Psyllids
Rose Chafer
Sawflies
Scale Insects
Sod Webworms
Spittlebugs
Stink Bugs
Tarnished Plant Bug
Thrips
Tobacco Budworm
Tussock Moths
Webworms
Western Tent Caterpillar
Whiteflies

[illegible]

GENERAL INFORMATION:

[illegible]

One gallon of this product is diluted with [illegible] gallons of water to provide a total of [illegible] gallons of spray solution. Use enough spray solution to provide adequate coverage of the treated surface. Do not apply more than [illegible] gallons per [illegible].

One gallon of this product is diluted with [illegible] gallons of water to provide a total of [illegible] gallons of spray solution. Use enough spray solution to provide adequate coverage of the treated surface. Do not apply more than [illegible] gallons per [illegible].

[illegible]

APPLICATION IN FOOD PROCESSING/HANDLING ESTABLISHMENTS:

[illegible]

[illegible]

Spot or crack & crevice applications:

[illegible]

[illegible]

MIXING INSTRUCTIONS:

[illegible]

[illegible]

[illegible]

Dilution Rate in Water	0.5 fl. oz. per Gallon	1.0 fl. oz. per Gallon
	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Tank Mixing:

[illegible]

INDOOR USE:

Application Rates for Indoor Structural Pests:

Pests	Dilution Rate in Water	Application Rate of Mixed Solution	Application Method(s)
Spiders and Other Listed Crawling Insects			Residual surface treatment • Perimeter/Edge Spray • Spot Surface Treatment • Void Treatment • Space Treatment
Light Infestation	[illegible]	[illegible]	
Heavy Infestation	[illegible]		
Flying Insects	[illegible]	[illegible]	
Scorpions and Other Listed Stinging Insects	[illegible]	[illegible]	
Ticks	[illegible]	[illegible]	
Fleas, Ticks and Bed Bugs	[illegible]	[illegible]	Spray around base of walls and other infested areas

Spiders, scorpions and other listed crawling insect pests indoors:

[illegible]

For ant control indoors:

[illegible]

Flying insect pests indoors:

[illegible]

Stinging insect pests indoors:

[illegible]

For control of Brown Dog Ticks:

[illegible]

For control of Fleas:

[illegible]

To control Bed Bugs:

[illegible]

For control of stored product pests:

[illegible]

To treat voids in equipment and structures:

[illegible]

To kill the accessible stages of listed granary insects:

USE IN AND AROUND LIVESTOCK HOUSING:

Pests	Dilution Rate in Water	Application Method(s)
Crawling Insects Including Litter Beetles	or	• Spray Barriers Around Structures • Shielded, Directed Sprays • Spot Treatment
Flying Insects	or	• Spot Treatment • Space Treatment

Crawling insect pests in livestock and poultry premises:

Litter Beetle control in livestock and poultry premises:

Flying insect pests in livestock and poultry premises:

OUTDOOR USE:

Outdoor applications for spiders, scorpions and other listed pests:

	Dilution Rate in Water	Application Method(s)
Treating Exterior Walls, Foundations and Structures	or	Apply as a coarse, wet spray • Shielded, Directed Sprays Treatment • Spot Treatment
Treating Nests and Harborage Areas of Stinging Insects	or	
To Control Swarming Termites and Wood Destroying Pests	or	
Treating Ornamental Trees and Landscapes	or	Apply as a coarse, wet spray • Shielded, Directed Sprays Treatment • Spot Treatment
Mosquito Breeding Sites	or	
Treating Lawns and Turf	or or	Apply as a coarse, wet spray • Shielded, Directed Sprays Treatment

Treating exterior walls, foundations and structures:

Stinging insect control outdoors:

Fleas and Ticks outdoors:

Insect control in ornamental trees and landscapes:

Insect control on lawns, turf grass, and turf:

Rate range:

To kill Swarming Termites: OUTDOORS ONLY

To kill wood destroying pests: OUTDOORS ONLY

Mosquito breeding sites:

FIRST AID

IF SWALLOWED:

- Call a poison control center or doctor immediately for treatment advice.
- Do not give anything by mouth to an unconscious person.
- Do not induce vomiting unless told to do so by a poison control center or doctor.
- Drink a glass of water if able to swallow.

IF IN EYES:

- Hold eye open and rinse slowly and gently with water for 15-20 minutes.
- Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call a poison control center or doctor for treatment advice.

IF ON SKIN OR CLOTHING:

- Take off contaminated clothing.
- Rinse skin immediately with plenty of water for 15-20 minutes.
- Call a poison control center or doctor for treatment advice.

NOTE TO PHYSICIAN: Contains petroleum distillate and synergist. Vomiting should be avoided due to aspiration hazard.

For medical emergency information call 1-800-248-7763.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

ENVIRONMENTAL HAZARDS

PHYSICAL OR CHEMICAL HAZARDS

STORAGE AND DISPOSAL:

PESTICIDE STORAGE:

PESTICIDE DISPOSAL:

CONTAINER HANDLING

Triple rinse as follows:

FASTCAP
Spiders & Scorpion Insecticide

EPA Reg. No. 1021-2574
EPA Est. No. 021-MN-2
0113-0413

MGK

RESTRICTED USE CLASSIFICATION
Due to Acute Fish Toxicity
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators Certification.

Scourge®

Insecticide
with RESMETHRIN/PIPERONYL BUTOXIDE
4% + 12% MF FORMULA II

FOR USE ONLY BY FEDERAL, STATE, TRIBAL OR LOCAL GOVERNMENT OFFICIALS RESPONSIBLE FOR PUBLIC HEALTH AND VECTOR CONTROL, OR BY PERSONS CERTIFIED BY THE STATE OR TRIBAL LEAD PESTICIDE REGULATORY AGENCY TO PERFORM ADULT MOSQUITO CONTROL APPLICATION, OR BY PERSONS UNDER THEIR DIRECT SUPERVISION

- A READY TO USE SYNTHETIC PYRETHROID FOR EFFECTIVE ADULT MOSQUITO (INCLUDING ORGANOPHOSPHATE RESISTANT SPECIES), MIDGE (BITING AND NON-BITING), AND BLACK FLY CONTROL
- FOR CONTROL OF BITING AND NON-BITING FLIES
- CONTAINS 0.9 lb/gal (90 g/L) OF RESMETHRIN AND 2.8 lb/gal (106 g/L) OF PIPERONYL BUTOXIDE
- FOR AERIAL AND GROUND APPLICATION

ACTIVE INGREDIENTS

*Resmethrin	4.14%
**Piperonyl Butoxide Technical	12.42%
OTHER INGREDIENTS:†	83.44%
	100.00%

* Cis/trans isomers ratio: max. 30% (a) cis and min. 70% (a) trans.
** Equivalent to min. 9.84% [butylcarbityl (6-propylpiperonyl) ether and 2.18% related compounds.
†Contains Petroleum Distillates

EPA REG. NO. 432-716 EPA EST. NO. 432-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

Refer to attached labels for complete First Aid, Precautionary Statements, Directions for Use and Storage and Disposal Instructions.

Net Contents

- 275 gal: 4254685
- 55 gal: 4192825
- 5 gal: 4192787

4494267D 100707AV2a

BACKED by BAYER.

PRECAUCION AL CONSUMIDOR: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente. (TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

FIRST AID	
IF SWALLOWED	• Call a poison control center or doctor immediately for treatment advice. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give any liquid to the person. • Do not give anything by mouth to an unconscious person.
IF ON SKIN OR CLOTHING	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 to 20 minutes. • Call a poison control center or doctor for treatment advice.
[Synthetic Pyrethroid]	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-334-7577 for more poison medical treatment information.	
Note To Physician: Contains petroleum distillates - vomiting may cause aspiration pneumonia.	

In case of medical emergency, health and safety incidents or in case of fire, leaking or damaged containers, information may be obtained by calling 1-800-334-7577.

PRECAUTIONARY STATEMENTS

Hazards To Humans & Domestic Animals

CAUTION

Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

Environmental Hazards

This pesticide is extremely toxic to fish, aquatic invertebrates and shrimp. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposit into the water body. Do not contaminate water when disposing of equipment wash waters.

This pesticide is highly toxic to bees exposed to direct treatment or blooming crops or weeds. Do not apply this product or allow drift when bees are actively visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes, or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
READ ENTIRE LABEL FOR DIRECTIONS

NOTICE: This concentrate cannot be diluted in water. Mix well before using. Avoid storing excess formulation in spray equipment tank beyond the period needed for application.

In treatment of corrals, feed lots, cattle lots, and zoos, cover any exposed drinking water, drinking water fountains and animal feed before application.

Before making the first application in a season, it is advisable to consult with the state or tribal agency with primary responsibility for pesticide regulation to determine if permits or other regulatory requirements exist.

Do not exceed 25 applications at 0.004 pounds of resmethrin per acre (not to exceed a total of 0.10 pounds of resmethrin per acre) in any given season.

More frequent treatments may be made to prevent or control a threat to public and/or animal health determined by the state, tribal or local health or vector control agency on the basis of documented evidence of disease-causing agents in adult mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

GENERAL

Scourge is designed for application as an Ultra Low Volume (ULV) aerosol to control adult mosquitoes and flies in residential, industrial, urban, recreational areas, and other areas where the labeled pests are a problem. Scourge provides effective control of adult mosquitoes, black flies, gnats, biting and non-biting midges, stable flies, horse flies, deer flies, sheep flies, horn flies, yellow flies and nuisance flying insects such as house flies in areas such as but not limited to: industrial areas, urban areas, parks, campsites, woodlands, athletic fields, golf courses, playgrounds, recreational and overgrown waste areas, roadsides, etc. other public areas where adult mosquitoes and flies occur. Apply when ground wind speed is equal or greater than 1 mph.

Scourge **can be applied as undiluted or diluted with** refined soybean oil, light mineral oil or 5% natural vegetable oil or other suitable solvent or diluent.

Spray Droplet Size Determination

Ground Equipment:

Spray equipment must be adjusted so that the volume median diameter is less than 30 microns (Dv 0.5 < 30 µm) and that 90% of the spray is contained in droplets smaller than 50 microns (Dv 0.9 < 50µm). Directions from the equipment manufacturer or vendor, pesticide registrant or a test facility using a laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

Aerial Equipment:

Spray equipment must be adjusted so that the volume median diameter produced is less than 60 microns (Dv 0.5 < 60 µm) and that 90% of the spray is contained in droplets smaller than 100 microns (Dv 0.9 < 100 µm). The effects of flight speed and for non-rotary nozzles, nozzle angle on the droplet size spectrum must be considered. Directions from the equipment manufacturer or vendor, pesticide registrant or a test facility using a wind tunnel and laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

ULTRA LOW VOLUME APPLICATIONS

All types of applications should be conducted at temperatures of 60°F or higher. Apply when ground wind speeds are equal to or greater than 1 mph.

GROUND APPLICATION

Vehicle Mounted ULV Cold Aerosol Generators or Vehicle Mounted Non Thermal Aerosol (Cold Fog) Apply through non-thermal ULV application equipment and use acreage calculations on the equipment manufacturer's recommended swath width. Apply at a rate not to exceed 0.007 pounds of resmethrin per acre in any given 24 hour period. An optimum swath is created when Scourge is applied from a truck that is being driven perpendicular to the wind direction. Direct the spray head of equipment to ensure even distribution of the spray cloud throughout the area. For best results, apply when insects are most active and in meteorological conditions are conducive to keeping the spray cloud in the air column close to the ground. An inversion of air temperatures and a light breeze is preferable. Application during the cooler hours of the night or early morning is recommended. Scourge may be applied through ULV Cold Aerosol Generators, or other equipment designed for non-thermal ULV aerosol applications. The desired application rate may be obtained under different conditions by altering the dilution rate of Scourge, the flow rate of the insecticide from the application equipment and the vehicle speed. Examples are given in the following table.

Treatment lb ai/A of Scourge Wanted Resmethrin/PBO	fl oz/A of undiluted Spray to be Applied	Application Rate-fl oz/Min	
		5 MPH	10 MPH
0.007/0.021	3.0	9.0	18.0
0.0035/0.0105	1.5	4.5	9.0
0.0017/0.0052	0.75	2.25	4.5
0.0011/0.0035	0.50	1.50	3.0

Where dense vegetation is present, the use of the higher rates and/or slower speed is recommended.

AERIAL APPLICATION

Scourge may be applied either diluted or undiluted at rates of 0.0035 to 0.007 pounds resmethrin per acre by fixed wing or rotary aircraft that are capable of making a ULV application. Aerial application of Scourge should be made at a minimum altitude of 75 ft for rotary and 100 ft for fixed wing aircraft. Applications shall only be made when recommended by public health officials and trained personnel of mosquito abatement districts and other mosquito control programs.

For best results, treat when insects are most active and meteorological conditions are conducive to keeping the spray cloud close to the ground. In order to compensate for windy conditions and ensure drift onto the target area, aerial application with aircraft equipped with Global Positioning Systems (GPS) is recommended.

lb ai/A Wanted Resmethrin/PBO	fl oz/A of Undiluted Spray to be Applied
0.007/0.021	3.0
0.0035/0.0105	1.5
0.0017/0.0052	0.75
0.0011/0.0035	0.50

BACKPACK ULTRA LOW VOLUME APPLICATIONS

For use in backpack ULV pulse fog/mist equipment, mix 20 fl oz of this product with 1 gal of refined soybean oil, light mineral oil of 54 second viscosity or other suitable solvent or diluent. Adjust equipment to deliver 1µ particles of 18-30 microns mass median diameter. Apply at the rate of 4.25-8.50 fl oz of finished formulation per acre as a 50 ft swath while walking at a speed of 2 mph. This is equivalent to 0.0035-0.0070 pounds resmethrin per acre. Where dense vegetation is present, the use of higher label rates is recommended.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE AND SPILL PROCEDURES: Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal:

Rigid, Non-refillable containers (all enough to shake lid) with capacities equal to or less than 5 gallons:

Non-refillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with mineral oil and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill or incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.

Rigid Non-refillable containers that are too large to shake (i.e. with capacities greater than 5 gallons or 50 lbs):

Non-refillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with mineral oil. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill or incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.

Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10 percent full with mineral oil. Agitate vigorously or recirculate mineral oil with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Bayer CropScience LP. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BAYER CROPSCIENCE LP MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer CropScience LP is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BAYER CROPSCIENCE LP DISCLAIMS ANY LIABILITY WHATSOEVER FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

LIMITATIONS OF LIABILITY: TO THE EXTENT OF THE LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID OR AT BAYER CROPSCIENCE'S OPTION, THE REPLACEMENT OF PRODUCT.

Bayer (reg'd), the Bayer Cross (reg'd), Scourge® and Backdoc by Bayer™ are trade marks of Bayer.

Produced by
Bayer Environmental Science
A business of Bayer CropScience LP
2 T.W. Alexander Drive
Research Triangle Park, NC 27709

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ANVIL® 2+2 ULV

Contains an Oil Soluble Synergized Synthetic Pyrethroid for Control of Adult Mosquitoes (Including Organophosphate-Resistant Species), Midges and Black Flies in Outdoor Residential and Recreational Areas

For use only by federal, state, tribal or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribe's pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision.

ACTIVE INGREDIENTS	
(5-Phenoxyphenyl)(1RS,3RS,1RS,3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate	2.00%
Piperonyl Butoxide*	2.00%
OTHER INGREDIENTS**	96.00%
	100.00%

Contains 0.74 lbs of Technical Sumithrin® Cyclopropanecarboxylic Acid, 3-(2-methyl-1-propenyl)-2,2-dimethyl-, (5-phenyl-3-furanyl)methyl ester per Gallon

*(butyl carbityl) (6-propylpiperonyl) ether and related compounds
** Contains a petroleum distillate

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta haya sido explicado ampliamente

FIRST AID

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information regarding medical emergencies or pesticide incidents, call 1-800-740-0712

IF ON SKIN OR CLOTHING	Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
IF SWALLOWED	Immediately call a poison control center or doctor. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not administer any liquids to the person. Do not give anything by mouth to an unconscious person.

Note to Physician: Contains petroleum distillate - vomiting may cause aspiration pneumonia.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION. Harmful if absorbed through the skin. Avoid contact with skin, eyes and clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

Personal Protective Equipment (PPE): Mixers, loaders, applicators and other handlers must wear the following: long-sleeve shirt, long pants, shoes and socks, chemical resistant gloves made of barrier laminate or viton. See engineering controls for additional requirements.

User Safety Requirements: Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with the product's concentrate. Do not reuse them.

USER SAFETY RECOMMENDATIONS: Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. User should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

Engineering Controls: Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(6)].

ENVIRONMENTAL HAZARDS

This pesticide is toxic to aquatic organisms including fish and aquatic invertebrates. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Before making the first application in a season, it is advisable to consult with the state or tribal agency with primary responsibility for pesticide regulation to determine if other regulatory requirements exist. Do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material beyond the body of water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or wash waters.

This product is highly toxic to bees exposed to direct treatment or blooming crops or weeds. Do not apply to or allow drift onto blooming crops or weeds when bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal, local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state during a natural disaster recovery effort.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

IN CALIFORNIA: This product is to be applied by County Health Department, State Department of Health Services, Mosquito and Vector Control or Mosquito Abatement District personnel only.

IN FLORIDA: Do not apply by aerial unless approved by the Florida Department of Agriculture and Consumer Services.

Do not treat a site with more than 0.0075 pounds of Sumithrin and piperonyl butoxide per acre in a 24-hour period. Do not exceed 0.1 pounds of Sumithrin or piperonyl butoxide per acre in any site in one year. More frequent applications may be made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state to be during a natural disaster recovery effort.

NOTE: When rotating products with other insecticides containing PBO, do not exceed 2 lbs PBO per acre per year.

Not for use in outdoor residential misting systems.

USE INFORMATION

USE AREAS: For use in mosquito adulticiding programs involving outdoor residential and recreational areas where adult mosquitoes are present in spraying numbers in vegetation surrounding parks, woodlands, swamps, marshes, overgrown areas and golf courses. ANVIL 2+2 ULV may be applied over agricultural areas for the control of adult mosquitoes within or adjacent to these areas.

For best results, apply when mosquitoes are most active and weather conditions are conducive to keeping the spray cloud close to the ground. Application in calm air conditions is to be avoided. Apply only when ground wind speed is greater than 1 mph. Air temperature should be greater than 50 °F when conducting all types of applications.

AL2250

NOTE: ANVIL 2+2 ULV cannot be diluted in water. Dilute this product with light mineral oil if dilution is preferred.

SPRAY DROPLET SIZE DETERMINATION

Ground Equipment: Spray equipment must be adjusted so that the Volume Median Diameter (VMD) is less than 30 microns (Dv 0.5 < 30 um) and that 90% of the spray is contained in droplets smaller than 50 microns (Dv 0.9 < 50 um). Literature from the equipment manufacturer or vendor pesticide registrant, or a test facility using a laser diffraction measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that the size of the nozzle and nozzle flow rate(s) are properly calibrated.

Aerial Equipment: Spray equipment must be adjusted so that the volume median diameter produced is less than 50 microns (Dv 0.5 < 50 um) and that 90% of the spray is contained in droplets smaller than 80 microns (Dv 0.9 < 80 um). The choice of flight speed, number of rotary nozzles, nozzle angle on the dropleg and spectrum must be considered. Literature from the equipment manufacturer or vendor pesticide registrant or a test facility using a wind tunnel and laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that the size of the nozzle and nozzle flow rate(s) are properly calibrated.

GROUND DILUTION RATES

Apply ANVIL 2+2 ULV through a standard ULV cold aerosol or non-thermal aerosol (cold fog) generator. Consult the following table for examples of various dosage rates using a swath width of 300 feet for acreage calculations. Vary flow rate according to vegetation density and mosquito population. Use higher flow rate in heavy vegetation or when pest populations are high.

Dosage Rate (Lbs. S-methrin/ Acre)	ANVIL 2+2 Fl.oz/ Acre	Flow Rates in Fl.oz/Minute at truck speeds of			
		5 MPH	10 MPH	15 MPH	20 MPH
0.0036	3.245	9.8	19.7	29.5	39.3
0.0024	2.163	6.6	13.1	19.7	26.2
0.0012	1.081	3.3	6.6	9.9	13.1

ANVIL 2+2 ULV may also be applied undiluted with non-thermal equipment, calibrated to deliver ULV particles of less than 100 microns VMD. Use 1.081 to 3.245 fl. oz. of the undiluted spray per acre (equal to 0.0012 to 0.0036 lb active ingredient per acre). Do not exceed 3 fl oz/min (19.2 mph with hand held equipment, use 100 second viscosity mineral oil for use with hand carried foggers. Use same rates of active ingredient per acre. Do not exceed dosage since oil base formulations may be phytotoxic. Use a clean, well maintained and properly calibrated fogger, eg diamond. Do not use hand held equipment for this type of application in enclosed spaces.

AERIAL APPLICATION

ANVIL 2+2 ULV may be applied at rates of 1.081 to 3.245 fluid ounces ANVIL 2+2 ULV per acre by fixed wing or rotary aircraft equipped with suitable ULV application equipment.

DIRECTIONS FOR USE

Fixed wing: Apply using a nozzle height of no less than 100 feet above the ground or canopy.

Rotary wing: Apply using a nozzle height of no less than 15 feet above the ground or canopy.

STORAGE & DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

PESTICIDE STORAGE: Store in a cool, dry place. Keep container closed.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL:

(For 2.5-gallon Jugs): Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with mineral oil and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

(For refillable drums & totes): Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into rinsate collection system. Repeat this rinsing procedure two more times. Offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

FOR MORE INFORMATION CALL 1-800-323-6727

NOTICE: Read this entire label. Use only according to label directions. Before buying or using this product, carefully consider the risks associated with the pest problem you have and the various management options available to you, including not buying or using this product. If terms on this label are unacceptable, return unopened container for full refund of purchase price.

ANVIL is a trademark of Clarke Mosquito Control Products, Inc.

Sumithrin® is a trademark of Sumitomo Company Ltd.

MANUFACTURED FOR:
CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 W. GARDEN AVENUE
ROSELLE, ILLINOIS 60172

ANVIL ONE PACKAGING: 2.5 GAL., 30 GAL., 55 GAL., 275 GAL., TOTE

LOT NO.: Marked on Container Label

EPA REG. NO. 1021-1687-8329

EPA EST. NO. 8329-IL-001

AL0200

Zenivex® E20

For use only by federal, state, tribal, or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision

- **FOR THE CONTROL OF ADULT MOSQUITOES, NON-BITING MIDGES, AND BLACK FLIES**
- **FOR USE AS A SPACE SPRAY BY AIR AND GROUND APPLICATION TO CONTROL ADULT MOSQUITOES**
- **CAN BE USED UNDILUTED OR DILUTED**
- **CONTROLS ADULT MOSQUITOES THAT MAY CARRY WEST NILE VIRUS, EASTERN EQUINE ENCEPHALITIS, ST. LOUIS ENCEPHALITIS**
- **CONTROLS NON-BITING MIDGES, NUISANCE AND BITING FLIES**
- **QUICK PERMANENT KNOCKDOWN OF ADULT MOSQUITOES**

SPECIMEN LABEL

ACTIVE INGREDIENT:	
Etofenprox (CAS #80844-07-1)	20%
OTHER INGREDIENTS*:	80%
Total:	100%

Contains 1.48 lbs Etofenprox per gallon
*Contains petroleum distillates

EPA Reg No. 9274-791 EPA Est. No. 9274-IA-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

See additional Precautionary Statements, First Aid Treatments, and Directions for Use

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION

Harmful if swallowed. Causes moderate eye irritation. Avoid contact with eyes, skin, or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove contaminated clothing and launder before reuse. Repeated exposure to etofenprox can cause skin irritation.

FIRST AID
Call a poison control center or doctor immediately for treatment advice.
If swallowed • Immediately call a poison control center or doctor. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give any liquid to the person. • Do not give anything by mouth to an unconscious person.
If in eyes • Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. • Call a poison control center or doctor for treatment advice.
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.
NOTE TO PHYSICIAN: May pose an aspiration pneumonia hazard. Contains petroleum distillate.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to aquatic organisms, including fish and aquatic invertebrates. Runoff from treated areas or deposition into bodies of water may be hazardous to fish and other aquatic organisms. Do

not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to large areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or washwaters.

This product is highly toxic to bees exposed to direct treatment or to blooming crops or weeds. Time applications to provide the maximum possible interval between treatment and the next period of bee activity. Do not apply to blooming crops or weeds when bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

PHYSICAL/CHEMICAL HAZARDS

Combustible. Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. **READ AND FOLLOW ALL LABEL DIRECTIONS.** Before making the first application of the season, it is advisable to consult with the state or tribal agency with primary responsibility for pesticide regulation to determine if other regulatory requirements exist.

GENERAL

Zenivex® is an effective insecticide used at low volumes to control adult mosquitoes, non-biting midges, biting and non-biting flies. Use Zenivex®, either undiluted as Ultra-Low Volume (ULV) or diluted with mineral oil or other suitable oil solvent, for the control of pest species in or near residential, industrial, commercial, urban, recreational areas, woodlands, golf courses, and other areas where these pests are a problem. Do not spray on or allow drift onto pasture land, cropland, or potable water supplies. In the treatment of canals, feedlots, swine lots, and zoos, cover any exposed drinking water, drinking water fountains, and animal feed before application. Apply Zenivex® aerially (both Fixed and rotary aircraft), for low volume applications or through mist-blowers, backpack, and hand-held sprayers for ground applications. Zenivex® will control flies and mosquitoes and can be used as part of a total integrated pest management program for controlling disease vectors. Apply Zenivex® at rates from 0.00175 to 0.0070 pounds of etofenprox per acre. Dilute this product with oil (10-30 cst) only; do not mix with water. Apply when wind is ≤ 10 mph. Do not apply when wind speeds exceed 10 mph. A temperature inversion is preferable to keep the fog close to the ground and applications should be made when labeled insects are most active.

Do not spray more than 0.18 lbs etofenprox per acre per site per year. Do not make more than 25 applications per site per year. More frequent treatments may be made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

GROUND APPLICATION

Use a vehicle mounted cold aerosol ULV sprayer to apply the product. Direct the spray equipment nozzle to provide even distribution of the product. For best results, apply perpendicular to the wind direction using a swath width of 300 ft. Spray equipment must be adjusted so that the volume median diameter (VMD) is between 10-30 microns ($10\mu < D_{v0.1} < 30\mu$) and that 90% of the spray is contained in droplets smaller than 50 microns ($D_{v0.9} \leq 50\mu$). Directions from the equipment manufacturer or vendor, pesticide registrant, or test facility using a laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

The appropriate application rate can be achieved by altering the dilution rate of Zenivex®. Refer to the following chart for examples.

Application rate pound A.I. per acre	Vehicle Speed MPH	Flow rates Undiluted Oz/minute	Diluted 1 to 1 Oz/minute	Diluted 1 to 2 Oz/minute	Diluted 1 to 4.5 Oz/minute
0.00175	10	0.9	1.8	2.72	4.57
	15	1.4	2.7	5.40	9.90
	20	1.8	3.6	7.20	13.20
0.00350	10	1.8	3.6	5.40	9.14
	15	2.7	5.4	10.80	19.80
	20	3.6	7.2	14.40	26.40
0.00700	10	3.6	7.2	10.78	19.80
	15	5.4	10.8	16.18	39.60
	20	7.2	14.4	21.50	52.00

Use the higher label rates when spraying areas where dense vegetation is present. Conduct applications when temperatures are between 50-95° F.

Backpack Sprayer ULV Application
Apply Zenivex® diluted or undiluted through non-thermal ULV backpack sprayer capable of applying the product in the 10 to 30 micron range. Apply product to the crop as evenly as possible. Apply at the rate of 0.00175 to 0.0070 pounds etofenprox per acre.

Urban ULV Mosquito Control Applications
For control of resting or flying adult mosquitoes, biting flies and non-biting midges in areas such as utility tunnels, sewers, storm drains and catch basins, pipe chases, underground basements, underground passages, parking decks, crawl spaces or uninhabited buildings, apply Zenivex® using mechanical foggers, hand-held or truck-mounted ULV equipment, thermal foggers or other spray equipment suitable for this application. Apply Zenivex® at rates not to be not exceeding 0.007 pounds of etofenprox per acre.

Thermal Fogging Application
Apply using a truck, daily-mounted, ranched, or other thermal fogging equipment. Following the equipment manufacturer's instructions, apply this product at a rate of 0.00175 to 0.0070 pounds etofenprox per acre. Direct fog to areas where mosquitoes and other pests are located. The volume median diameter (VMD) of droplets produced by thermal foggers is less than 60 microns ($D_{v,0.5}$ < 60μ) and 90% of the spray is contained in droplets smaller than 100 microns ($D_{v,0.9}$ < 100μ).

AERIAL APPLICATION
Apply Zenivex® aerially either diluted or undiluted, by fixed wing or rotary aircraft. Apply at the rate of 0.00175 to 0.0070 pounds of etofenprox per acre. Apply using ULV equipped and capable aircraft. Spray equipment must be adjusted so that the volume median diameter (VMD) produced is less than 60 microns ($D_{v,0.5}$ < 60μ) and that 90% of the spray is contained in droplets smaller than 100 microns ($D_{v,0.9}$ < 100μ). The effects of flight speed and, for non-rotary nozzles, nozzle angle on the droplet size spectrum must be considered. Directions from the equipment manufacturer or vendor, pesticide registrant, or test facility using a wind tunnel and laser based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated. Do not apply Zenivex® at altitudes below 100 feet. Apply at altitudes from 100-300 feet. Apply when wind speed on the ground is ≥ 1 mph. Apply when labeled insects are most active. For best results, use Global Positioning System (GPS) equipped aircraft. **In Florida:** Do not apply by aircraft except with the approval of the Florida Department of Agriculture and Consumer Services.

PESTICIDE STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE AND SPILL PROCEDURES: Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Refillable 30 Gallon Drums and 275 Gallon Tote: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. If not refilled, offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration. **To clean the container before final disposal**, triple rinse (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with mineral oil or other suitable oil diluent. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Non-refillable 2.5 gallon containers: Non-refillable container.** Do not reuse or refill this container. Triple rinse (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or mix tank and drain container for 10 seconds after the flow begins to drip. Fill the container ¼ full with mineral oil or other suitable oil diluent and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank. Drain container for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Once triple rinsed, recycle if available, or puncture and dispose of in a sanitary landfill, or by incineration.

To the extent consistent with applicable law, seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

For information or in case of emergency call **1-800-248-7763.**

Wellmark International
1501 East Woodfield Road 200W
Schaumburg, Illinois 60173

ZOECON Professional Products

February, 2010
Schaumburg, IL

Appendi□ □ MMCD Technical Advisory Board Meeting □otes

February 10, 2015

TAB Members □resent□
Sarma Straumanis, MN Department of Transportation, Chair
Mark Abrahamson, MN Dept. of Agriculture
Don Baumgartner, US EPA (remote link)
Steve Hennes, MN Pollution Control Agency
Gary Montz, MN Dept. of Natural Resources
Roger Moon, University of Minnesota
John Moriarty, Three Rivers Park District
David Neitzel, MN Department of Health
Robert Sherman, Independent Statistician

Absent□
Vicky Sherry, US Fish and Wildlife Service
Susan Palchick, Hennepin County Public Health
[Note: Karen Oberhauser, University of Minnesota, resigned as of Feb. 1, 2015]

MMCD Staff in Attendance□Stephen Manweiler, Nancy Read, Sandy Brogren, Diann Crane, Janet Jarnefeld, Kirk Johnson, Carey LaMere, Mike McLean, Mark Smith, John Walz, Scott Helling-Christy, Molly Nee, Jennifer Crites

Guests□Franny Dorr (MDH), Elizabeth Schiffman (MDH)

(Initials in the notes below designate discussion participants)

□ elcome and Call to □rder

Chair Sarma Straumanis called the meeting to order at 12:30 p.m. All present introduced themselves. Sarma then introduced MMCD Executive Director, Stephen Manweiler.

MMCD □vervie□ □□ersonnel Changes

Stephen discussed some of the major events of 2014. Starting a year ago, MMCD had some of the most significant employee changes in a long time, including a new Director and Business Administrator. We are dealing with succession planning like many other agencies.

2014 Season □ighlights

S□□□□B□□□□□ started the Season Overview with a description of the precipitation and temperature patterns for 2014. Rainfall was 4 inches above normal and was concentrated in April to mid-June. This was reflected in adult mosquito numbers. Spring *Aedes* hatched about a week later than usual. Summer *Aedes* also started late and had two major peaks early in the year from large rains. *Coquillettidia perturbans* were low this year. Looking at predictions for 2015, the weather outlook indicates a wet start.

S **M** discussed the treatment response to the weather patterns. By June 6, we had treated a record amount of acres with *Bti*. At that time, we switched to a lower dose rate to conserve resources. We also received a record number of citizen calls, mostly from the northern edge of our larvicide treatment area. Adulticide treatments increased slightly. The April-May treatments represented both rainfall and snowpack affecting habitats. The season was also long.

GM - why was May so high for treatment, compared with June, which had more rain?
SM - pattern of rainfall - April/May more frequent events; June was a few large events.

Stephen described the history of our larval control and how we've been able to increase acres, using graph of acres of treatment since 1994 (see appendix). Adulticide use has not increased consistently over the same period. In planning for 2015, we do not plan major changes, and will be decreasing use of Natular G30 somewhat because of cost.

DB - what products do you use for adulticiding? SM - permethrin, resmethrin, and sumithrin.

reported on disease concerns. West Nile virus had over 2,122 cases in the US, most occurring in August and September. Minnesota had 21 cases, 8 within the District. Overall, in Upper Midwest, WNV was less prevalent than in previous years. We only had 21 WNV positive pools. When temperatures cooled in August it slowed viral and mosquito development. For La Crosse encephalitis, we did have two cases in the District, and responded with control and prevention efforts. There were also four cases of Jamestown Canyon virus in MN, one in a district resident (but possibly exposed elsewhere). This virus can be transmitted relatively early in the season.

RM - other surveillance has specific places monitored, is that true of aspirators?
KJ - no, it's based on risk factors and we try to cover as much of the District as we can.
RM - then patterns from one year to next are suspect? KJ - could be, but there are high numbers of samples collected so we hope that covers it.

described tick results that are available. Record numbers of ticks per mammal were observed in 2014. She also presented a 24-year time series showing the increasing prevalence of *Ixodes scapularis* south of the Mississippi.

DN - are there wooded parts of the metro that don't have ticks yet? JJ - Dakota County is similar to Washington and Anoka counties now. Carver still has low numbers, also some parts of northern Hennepin County.
RM - do you only sample in wooded habitat? JJ - yes.

presented an overview of the black fly program. Overall, for small streams we used about an average amount of material, but that was because some streams were untreatable and that made up for the large amount needed for others. Large river treatments were also suspended for late June to mid-July. When we didn't treat, there was quite a spike in adult numbers. However, over the whole year the average sweep counts were comparable to recent years. Multiplate samples for non-target monitoring are in

progress and results will be submitted to the DNR as part of the permit process. John also showed a brief video on the impact of black flies on loons, and mentioned the North American Black Fly Association.

C L M presented an update on MMCD's Sustainability Initiative, including retrofit of light switches, fuel-efficient vehicles, more efficient surveillance routes, and reducing waste primarily through control materials handling. We are also learning about renewable energy options, and are promoting social responsibility activities.

Brea 1 20-1 5 p m

Subgroup eport – atular ontarget Data

N R described the background on Natular use and nontarget concerns, and **D C** described the study conducted this year. Amphipods (scuds) were collected in a site (not a study site) in April when we tested the sampling methods. Unfortunately, none of the study sites had scuds during the actual study period. The sites were in northern Washington County in May and New Scandia townships. Sampling was done with a D-net in random 6-foot transects. Diann described the sample preservation, concentration, and picking process. We tested using sugar floatation to separate invertebrates from debris, but the samples still had to be picked for clams, which do not float in sugar water, and it seemed to not make the work any easier, so it was not used.

RM - were the water column and bottom transects separate? DC - yes
SH - did you identify other organisms? DC - yes, other snails included. We also picked other organisms not included in the analysis.

[Don B. had to leave the meeting at this time]

Diann also presented several questions that staff members have about possible changes to the study if it is repeated next year.

RS - did you measure the amount of Natular actually in the water? Could do a bioassay.

R M presented the results (Appendix I). Only Roger, John, and Gary know the codes for un-blinding the double blind study, and these have not been revealed to MMCD staff. Roger presented results from both normal MMCD dips and the D-net study results. *Aedes stimulans* was the most abundant mosquito in the D-net samples. There was no evidence that there was any affect of Natular on fingernail clams. Numbers of these clams were significantly higher in bottom samples. Ram's horn snails, pond snails, and bladder snails showed no significant difference from treatment. Fairy shrimp also showed no significant difference of treatment, and declined in all sites over this time span. It was disappointing that we didn't collect any scuds.

GM - some of those sites probably are not as good habitat, more likely in deeper water, and you also tend to find them later in the year. If they were actually there, you would have seen them. DC - the shallower sites are more likely to have mosquitoes.

GM - scuds are also in cattail sites if water is fairly clear.
JM - are fairy shrimp more likely to be sensitive to chemicals than scuds? GM - depends on chemical, but often yes.
SH - should we be looking at community indices instead of particular species? Might be rarer species that would be affected? RM - you could analyze this data for that. GM - we chose these groups because the literature suggested they might be more susceptible.
RM - could be useful to look at. DC - we did pick all aquatic inverts except annelids, leeches, and copepods which were ubiquitous, but they are not identified or counted. RM - would you be satisfied if MMCD dried and weighed these? GM - for midges, better to do a count or subsample than weigh. DC - we did not have high numbers of midges or cladocerans. GM - count would be sufficient.

Roger then presented two questions:
1. Should we look at the sites a second year to see if there are longer- term effects, resample one or two times next spring—still blind? GM - would like to look later in year and get amphipods, would that be a problem with design? RM - design would be fine. RS - this stands on its own at the moment, if you look at the next year, could have odd things happen that you might need to explain. SH - would like to extend study somehow to sites where there are amphipods. JM - if you go to sites where there are amphipods, you probably will not get mosquitoes.
RM - do we know if dose is the same G30 and G? NR – yes (according to info we have)

2. Would like to know if material affects scuds:
JM - could we do aquarium studies to test that? GM - I think *Hyallela* is relatively easy to work with; one of EPA test organisms? SH - if we're sure that's an organism we're concerned about that would work. But I'd like to see if there are any community impacts.
JM - the wetlands seem like different types. SM - we chose to represent variability.
RM - consider tiered approach - do lab bioassay with *Hyallela*, and choose sites with amphipods for another test. SM - combine with cattail tests?
NR - look at what sites have both scuds and mosquitoes? GM - possible to process more simply to focus on scuds, tend to be in margins of cattails in the larger water bodies.
NR - is there a need to do more work on the organisms done this year? - Group - No.

RS - another question is what is the future of your use of Natular. SM - tends to be most expensive product, but we would like to use some of it. The G formulation we can't really use in pre-hatch.
GM - I'm interested in the non-annelid other inverts, could count those and send data to Roger. (general agreement).
SB - is there anything similar to scuds we've collected? GM - fairy shrimp are somewhat related, but not that close. SB - isopods? GM - not that closely related. Usually we get more amphipods.
Held more discussion for resolutions.

MMCD and □ollinator Concerns

M□□ M□L □□□ presented an overview of MMCD's work related to pollinator concerns. MMCD has been making an effort to communicate with beekeepers, especially to make sure we know locations of hives. We are also contacting cities about beekeeping permits and using that information if available to help update maps. As required by label, we avoid flowering plants when treating with adulticides at times of day when bees are active. Mike also described some recent legislative activity regarding pollinators and Class 1 city potential pesticide regulations.

JM – Karen Oberhauser left in part because of concerns about native pollinators, not just bees. Tree lines are often filled with monarchs, pollinators, and that's where you spray. If monarchs get listed as an endangered species, a lot of us will have to change what we do. I like the steps you're taking, but in general more use of larvicides is better, there's a reason we don't allow adulticides at Three Rivers. MM – there is also legislation introduced that would ban pesticides in environmental areas. We try to focus treatments on areas with least habitat, but we have a charge to manage environment for human benefit. RS - other pollinators are also of concern JM - honeybees ok at night, some native bees go to woodland edges at night. RM - would help when speaking about this to distinguish what groups we're referring to - honeybees, other bees, non-bee pollinators.

SH - if you know about a hive, what is your buffer zone? If a neighbor wants treatment, what do you do? MM - use 2x listed setback on label, resmethrin, sumithrin 300 ft. Sometimes beekeepers actually call us in to make treatments when mosquitoes are bad. RM - Mark, do you know of any bee kills attributed to MMCD? MA - No. MM - we want to keep it that way. We think the next big thing is going to be urban organic agriculture, we will need to be aware of locations and inform them of options.

General Discussion and □esolutions

Chair **S□□ □S□□□□ □□□** opened the floor for discussion and suggestions for resolutions to be brought before the MMCD Commission.

General discussion led to the following overall priorities raised by TAB members:

1) Separate and count other taxa in 2014 samples, analyze data for possible community effects
2) Do a lab study on acute toxicity of scuds to Natular G in 2015 – (for example, something like 5 doses, 10 barrels, can order *Hyallela* or hire a lab to do it)
3) Add scud sampling (water column) to 2015 cattail efficacy sampling for mosquito control, use double blind technique
4) Do a field survey of sites with scuds to look at potential sites that could be used in 2016 if lab study shows potential impacts and if #3 does not pick up scuds

MMCD staff will continue to meet with the TAB subgroup to work out research details, and Steve H. will join subgroup to replace Karen Oberhauser.

Motion – That the TAB commends MMCD for their efforts to do non-target impact studies, and that studies be continued in 2015 to answer remaining questions. These studies may be done by in-house staff, in consultation with the TAB subcommittee.
Motion JM, second RM. Passed unanimously.

Motion – That the TAB commends MMCD for its continued and expanding sustainability efforts.
Motion by RM, second BS. Passed unanimously.

Motion – That the TAB commends MMCD for their sensitivity towards honeybees and other pollinators and encourages continued efforts to conserve pollinator populations and minimize non-target impacts.
Motion by JM, second SH. Passed unanimously.

TAB Membership

Nancy Read gave some history on having representation of concerns such as those that have been expressed by Karen Oberhauser in the past on the TAB. She asked the group to suggest possible TAB members that could bring both concerns and non-target research expertise to the Board. Some suggested looking for a candidate with expertise in pollinators. TAB members were asked to forward suggestions to Nancy within four to six weeks.

Meeting adjourned 3:35 p.m.

Next chair will be the representative from MN Dept. of Natural Resources (Gary Montz).

Appendi□ □ □fficacy and □on-target □ffects of □atular Mosquito □arvicide in Spring □ etlands in the T□in Cities Metro Area□2014

Metropolitan Mosquito Control District (MMCD) staff and a subgroup of their Technical Advisory Board (TAB) designed a field study of Natular, a granular commercial formulation of spinosad. The goals were to evaluate efficacy of Natular against spring *Aedes* mosquitoes, and possible non-target effects on fairy shrimp, amphipods (scuds), clams (Sphaeriidae) and bladder snails (*Physa*) that were thought to inhabit the spring wetlands.

Materials and Methods

The experimental design was a double blind arrangement of active or blank granules applied to ten Type 2 and Type 3 wetlands in May and New Scandia Townships. Each wetland was sampled with D-nets and mosquito dippers on Friday, 2 May, 2014. Three days later, ten bags of granules, half with active spinosad and half without, were double-blind coded and applied at operational doses to the wetlands. Staff returned on 12 and 19 May to repeat the sampling at each wetland, 7 and 14 days after treatment.

On each occasion, D-net samples were taken along two randomly positioned 2-m transects, first at the water surface and second on the bottom. Intent was to capture all invertebrates, including mobile and immobile insects, Crustacea and molluscs that were in the water column or benthos. Wetlands were also sampled with a standard mosquito dipper (10 dips per site-date) to further characterize numbers of larvae of different mosquito species.

Diann Crane and Carey LaMere "picked" a total of 60 D-net collections and 30 dipper samples to identify and count all invertebrates. After results were compiled, Roger Moon and Karen Oberhauser decoded the double-blinded bag labels and planned data analyses. Roger then analyzed the counts of mosquito larvae and non-target invertebrates using a split-split plot design to test for effects of active granules, sampling method and days before and after treatment. Taxon definitions, raw data and R code used in the analyses will be presented in three appendices, to be attached below. Images used to illustrate the different taxa were copied from Wikipedia.

□esults

A total of 8,144 mosquito larvae and pupae were identified and counted in D-net samples from the 10 wetlands over the three sampling dates. Late instars of three species of spring *Aedes* were abundant enough to be analyzed separately, whereas counts of less abundant species and life stages, including ones that could not be identified to species, were combined and analyzed as "Other mosquitoes."

Counts of all four groups of mosquitoes in wetlands treated with blank granules decreased modestly or increased from before to after treatment (Fig. 1). In contrast, numbers of the same groups decreased substantially in the sites treated with active granules. Statistically, interactions between treatment and day of study were significant in all four cases (Table 1), which indicated spinosad reduced mosquito abundance. Compared to non-treated sites, percent reduction in treated sites ranged from 51 % with *Ae. excrucians* on day 7 to 90% or greater with *Ae. stimulans, Ae. fitchii,* and other mosquitoes on both post-treatment dates.

Patterns of abundance as judged by dip samples confirmed what was seen with D-net samples (Fig. 2, Table 2).

As an aside, numbers of mosquitoes in matching column and bottom D-net samples were not significantly different (Table 1).

A total of 18,002 non-target invertebrates were obtained from the same D-net samples. Numbers of fingernail clams and three kinds of snails remained steady from three days before treatments to 14 days after treatments, and were independent of Natular treatments (Table 3, Fig. 3). In contrast, numbers of fairy shrimp declined during the study, but rate of decline was independent of treatment. The clams and ram's horn snails were more abundant in the bottom samples, fairy shrimp and pond snails were equally abundant in bottom and column samples, and bladder snails were more abundant in the column samples Table 3, Fig. 3).

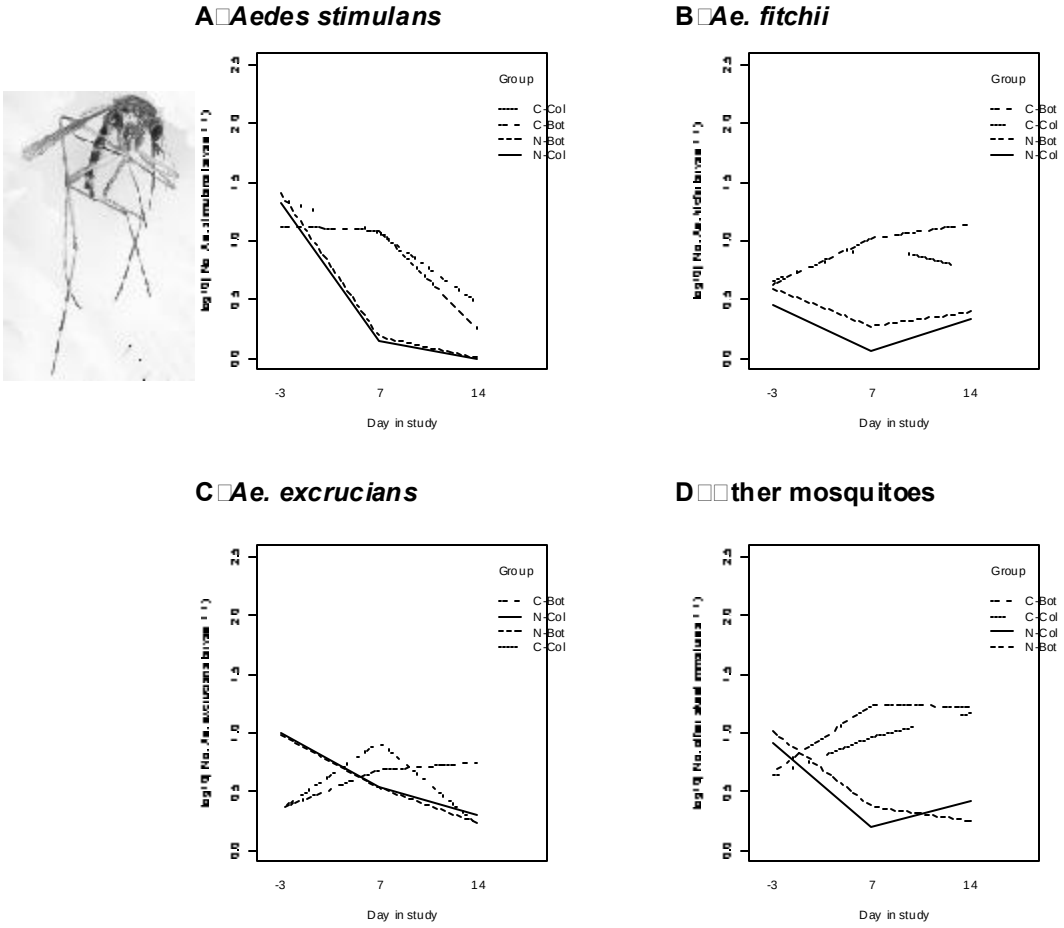
Thoughts

No amphipods (scuds) were detected in any of the wetlands, so non-target effects on that group of invertebrates remains to be evaluated.

We need to confirm that counts of shelled animals were of living specimens.

Also, we need to think about whether the time frame of the study was long enough for effects of treatment to become evident. Should we go back and resample the same wetlands this spring? If so, we will need to keep treatments blinded.

And would it be possible to find wetlands inhabited with amphipods, and do a second study focused on them?



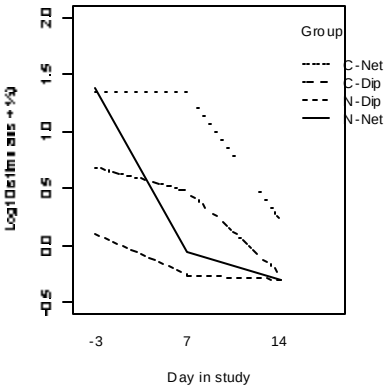
1 Average counts (in log 10 scale) of four groups of immature mosquitoes in D-net samples from wetlands treated with Natular (N) or with blank carrier (C) granules. Line vertices represent means in matched samples from the water column (-Col) or bottom (-Bot) taken 3 days before treatment and again 7 and 14 days after treatment (n = 5 wetlands each).

T 1 *P*-values from F-tests for significance of interactions and main effects of treatment, day of study, and height of sample in water column on numbers of four different mosquito taxa in 10 wetlands in May and New Scandia Townships, 2014. Degrees of freedom (df) for each effect are based on split-split-plot design.

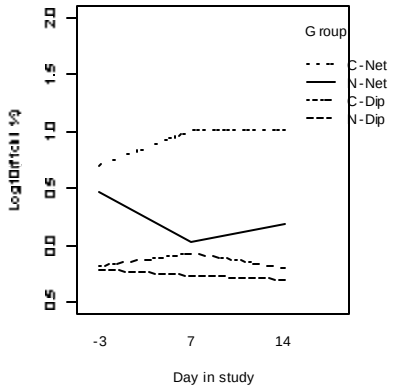
Taxon	Trt*Day (2, 32 df)	Trtmt (1, 8 df)	Day (2, 32 df)	Height*Day (2, 32 df)	Height (1, 8 df)
Ae. stimulans		*na*	*na*	0.93	0.66
Ae. fitchii	**1**	*na*	*na*	0.71	0.41
Ae. excrucians	**1**	*na*	*na*	0.29	0.66
Other mosquitoes	**1**	*na*	*na*	0.63	0.55

na = not applicable, because effect of treatment varied with day in study (See Fig. 1).

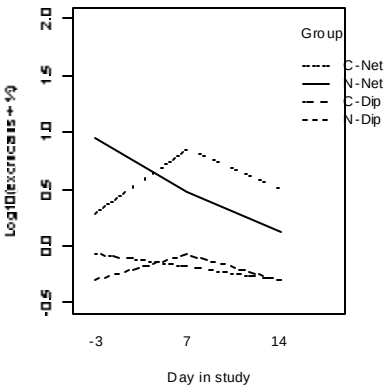
A *Aedes stimulans*



B *Ae. fitchii*



C *Ae. excrucians*



D Other mosquito taxa

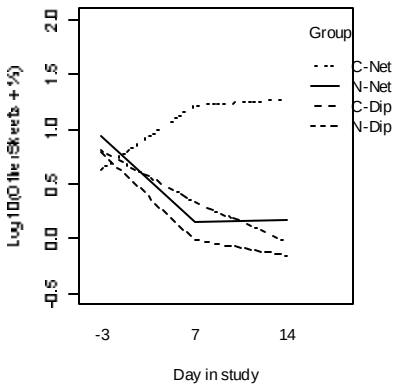


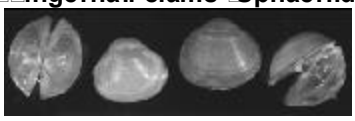
Figure 2. Average counts (in log 10 scale) of four groups of mosquito larvae in wetlands either treated with Natular (N) or with blank carrier (C) granules, and measured with D-nets, averaged from the two column heights, and mosquito dippers. Line vertices represent means of a given kind taken 3 days before treatment and again 7 and 14 days after treatment (n = 5 wetlands each).

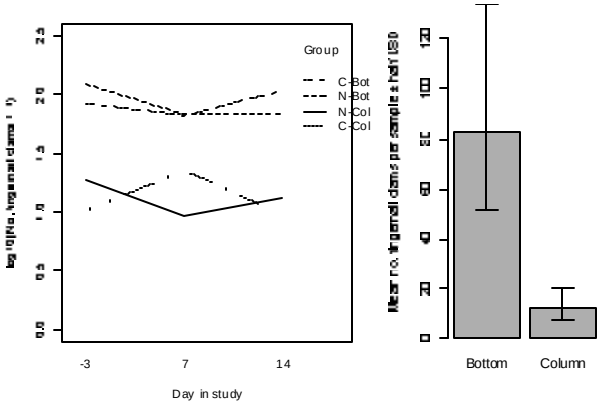
Table 2. *P*-values from F-tests for significance of interactions and main effects of treatment, day of study, and sampling method (D-net or dipper) on numbers of four different mosquito taxa in 10 wetlands in May and New Scandia Townships, 2014. Degrees of freedom (df) for each effect are based on split-split-plot design.

Taxon	Trt*Day (2, 32 df)	Trtmt (1, 8 df)	Day (2, 32 df)	Method*Day (2, 32 df)	Method (1, 8 df)
Ae. stimulans	0.04	*na*	*na*	0.09	< 0.01
Ae. fitchii	< 0.01	*na*	*na*	0.50	< 0.01
Ae. excrucians	0.05	*na*	*na*	0.45	< 0.01
Other culicids	< 0.01	*na*	*na*	0.02	*na*

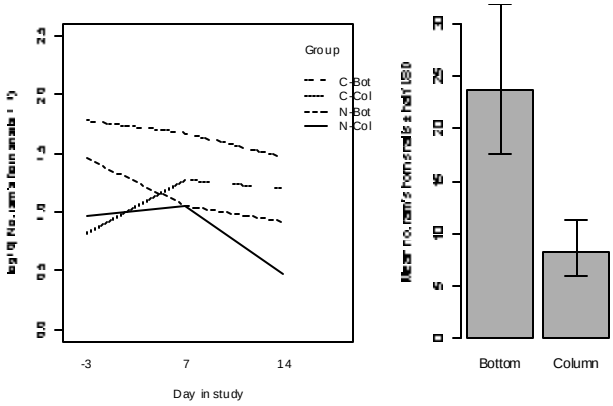
na = not applicable, because effect of treatment varied with day in study (See Fig. 1).

A□□ingernail clams □Sphaeriidae□

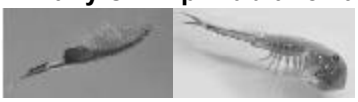


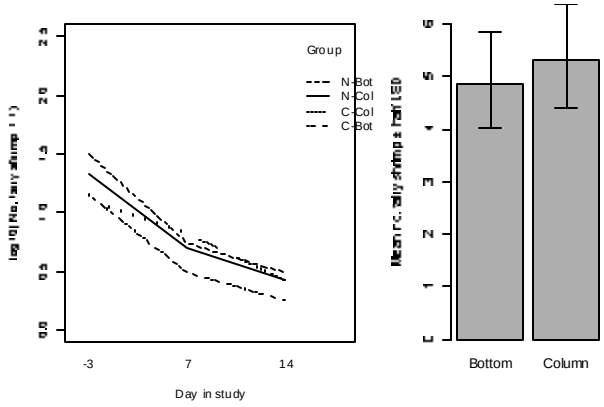


B□□am's horn snails □□lanorbidae□

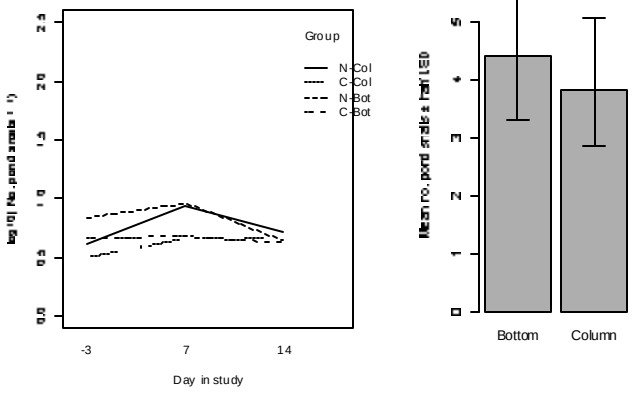


C□□airy shrimp □□ubranchia spp□

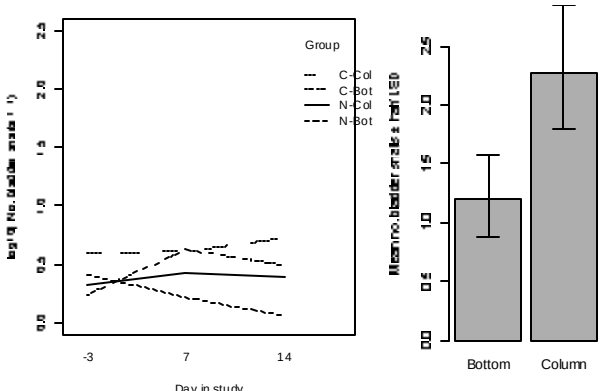




D□□ond snails □□ymnaeidae□



□□Bladder snails □□hysa□



□□□□□□**3** Average counts (in log-10 scale) of five groups of non-target invertebrates in D-net samples from ten wetlands either treated with Natular (N) or with blank carrier (C) granules. Line vertices represent means in matched samples from the water column (-Col) or bottom (-Bot) taken 3 days before treatment and 7 and 14 days after treatment ($n = 5$ wetlands each). Bar plots show back-transformed numbers per sample in the wetlands' bottoms or water surface.

T□□□3 *P*-values from F-tests for significance of interactions and main effects of treatment, day of study, and height of sample on numbers of the five most abundant non-target wetland invertebrates in 10 wetlands in May and New Scandia Townships, 2014. Degrees of freedom (df) for each effect are based on split-split-plot design.

Taxon	Trt*Day (2, 32 df)	Trtmt (1, 8 df)	Day (2, 32 df)	Height*Day (2, 32 df)	Height (1, 8 df)
Fingernail clams (Sphaeriidae)	0.47	1.00	0.85	0.77	□ □□□1
Ram's horn snails (Planorbidae)	0.12	0.08	0.11	0.13	□ □□□1
Fairy shrimp (*Eubranchia* spp)	0.67	0.65	□ □□□1	0.63	0.80
Pond snails (Lymnaeidae)	0.40	0.63	0.18	0.36	0.59
Bladder snails (*Physa* spp)	0.26	0.32	0.77	0.64	□□□2

na = not applicable, because effect of treatment varied with day in study (See Fig. 1).

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