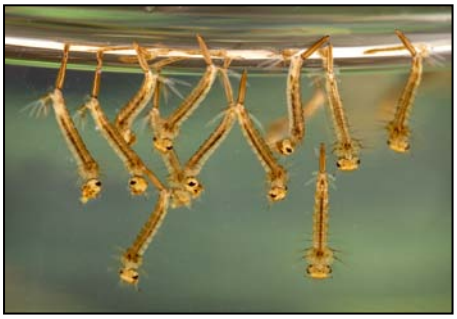
2009 Operational Review & Plans for 2010

Annual Report to the Technical Advisory Board



Metropolitan Mosquito Control District

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. A director is responsible for the operation of the program and reports to the MMCC.

Metropolitan Mosquito Control Commission 2010

Dick Lang	Anoka County
Rhonda Sivarajah	Anoka County
Robyn West	Anoka County
James Ische	Carver County
Tom Workman	Carver County
Thomas Egan	Dakota County
Liz Workman	Dakota County
Nancy Schouweiler	Dakota County
Jan Callison	Hennepin County
Jeff Johnson	Hennepin County
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Tony Bennett	Ramsey County
Jim McDonough	Ramsey County
Janice Rettman	Ramsey County
Jerry Hennen	Scott County
Barbara Marschall	Scott County
Myra Peterson	Washington Co.
Lisa Weik	Washington Co.

Technical Advisory Board

The TAB was formed in 1981 by the MMCC 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 2009-2010

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Jim Stark	Executive Director
Stephen Manweiler	Director of Operations/Tech. Serv.
Sandy Brogren	Entomologist
Diann Crane	Asst. 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

METROPOLITAN MOSQUITO CONTROL DISTRICT

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Dear Reader:

The following report is the Metropolitan Mosquito Control District's (MMCD) 2009 Operational Review and Plans for 2010. It outlines program operations based on the policies set forth by the Metropolitan Mosquito Control Commission (MMCC), MMCD's governing board of elected county commissioners.

The report has been reviewed by the Commission's Technical Advisory Board (TAB). TAB's charge is to comment on and make recommendations for improvements in the District's operations, on an annual basis. The minutes and recommendations from the TAB meeting in February 2010 are included in this report.

TAB's recommendations and report were accepted by the Commission at their April 2010 meeting. The Commission approved the MMCD 2009 Operational Review and Plans for 2010 and thanked the TAB for their work.

Please contact us if you would like additional information about the District.

Sincerely,

James R. Stark

James R. Stark
Executive Director

Minnesota Department of Transportation

Transportation Building
395 John Ireland Boulevard
Saint Paul, Minnesota 55155-1899

April 28, 2010

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

Dear Commissioner Peterson,

The Technical Advisory Board (TAB) met on February 17, 2010 to review and discuss MMCD operations in 2009 and plans for 2010. As you know, the TAB was originally formed to provide annual independent review of field control programs and to enhance interagency cooperation.

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

1. Whereas prevalence of Lyme disease and other tick-borne disease is increasing in the metro area, and whereas microbiologists are recognizing the presence of new pathogens, and whereas the range of *Ixodes scapularis* seems to be expanding in metro, therefore we encourage MMCD to find ways to improve tick surveillance and timeliness of reporting results, and explore additional new approaches for surveillance.

2. The TAB expresses support for MMCD's research efforts to reduce the cost and increase effectiveness of mosquito control by testing long-lasting, cost-effective and environmentally sensitive products that would allow pre-flood treatments to acres that repeatedly produce mosquitoes.

Sincerely,

Sarma Straumanis

Sarma Straumanis
Wetland Program Coordinator, MnDOT
Chair, Technical Advisory Board

Table of Contents

Executive Summary

The Metropolitan Mosquito Control District (MMCD) continues to provide cost-effective service in an environmentally sound manner. This report presents our efforts to accomplish that goal during 2009 through surveillance, disease monitoring, mosquito and black fly control, new product testing, data management, and public information.

The 2009 season was characterized by heavy early-season precipitation followed by dry, cool weather throughout the summer. Rainfall levels rose again as the season came to a close. These regional climate conditions helped suppress West Nile virus and La Crosse encephalitis activity throughout Minnesota and the Upper Midwest.

Staff monitored the rapid spread of the exotic species *Aedes japonicus* in 2009. Public interaction with District staff intensified as monitoring and surveillance increased. This enhanced public awareness and media scrutiny of our prevention and control measures led to a significant increase in tire pick-up and recycling and a greater general focus on cleaning up container-filled sites. Generally lower than average mosquito levels throughout much of the summer, however, resulted in lower than average numbers of phone calls and emails to the District reporting annoyance and requesting service.

Since 2005, MMCD has worked to expand the area within the District to which we provide larvicide services through strategies designed to stretch each dollar of funding. These strategies include evaluations of less expensive larvicides, reducing the labor (time) required to treat sites that breed frequently by using longer lasting larvicides, and identifying and treating sites with preventive larvicides so staff can reach additional breeding sites during a brood. These cost-effective strategies will help MMCD minimize the impact of budget limitations on service delivery.

Surveillance

The year's weather was characterized by an early wet spring followed by cool and dry weather. This led to a prolonged spring mosquito hatch. There were only four major mosquito broods with the major adult mosquito peak occurring in August. Staff identified 20,430 larval samples throughout the season. In 2009, we also saw a rapid expansion of the exotic species *Ae. japonicus*. *Aedes japonicus* have now been found in all seven metro counties. Plans for 2010 include re-evaluation of CO_2 and gravid trap placement, improved relay of surveillance results from field to lab, and development of best surveillance practices for monitoring the continued spread of *Ae. japonicus*.

Tick surveillance remains the backbone of MMCD's efforts to educate the public and prevent Lyme disease. Results from the 2008 study released during 2009, showed that for the second consecutive year we collected *I. scapularis* from at least one site in all seven metro counties. *Amblyomma americanum* (lone star tick) is an aggressive human biter and can transmit human monocytic ehrlichiosis (HME) and other pathogens. This tick is more common to the southern US, but *A. americanum*'s range is known to be moving northward. Over the years, these ticks have been submitted sporadically to MMCD. In June 2009, the MDH notified us of an *A. americanum* submission that had been most likely collected in Theodore Wirth Park in Minneapolis.

The goal of MMCD's black fly program is to reduce pest populations of adult black flies within the District to tolerable levels. Black flies develop in rivers and streams in clean flowing water. Larval populations are monitored at about 165 small stream and 28 large river sites using standardized sampling techniques during the spring and summer.

Disease

Mosquito-borne disease activity was considerably lower in 2009 compared to previous years. There were no La Crosse encephalitis cases in the District in 2009. While there were four human cases of West Nile virus in Minnesota, there were none within the District. Extensive sampling revealed WNV in only four mosquito samples collected by MMCD staff. Disease prevention efforts resulted in 219,045 catch basin treatments and 37,982 waste tires collected and recycled. In 2008, human case totals for Lyme disease (1,050) and human granulocytic anaplasmosis (278) were close to the all-time record setting totals tabulated for 2007. Tick borne disease statistics for 2009 will be available through the Minnesota Department of Health early in 2010.

Control

In 2009, District larvicide acreage increased by 30,419 acres over 2008 levels, but still remained below the 5-year average. Adulticide treatment acreage decreased by 84,989 over 2008 levels. In 2010, 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. For black fly control, liquid *Bti* is applied to sites when the target species reaches the treatment threshold. In 2009, larval mortality following *Bti* treatment on the large rivers averaged 96 percent. There were 67 *Bti* treatments to control large river-breeding black fly larvae in 2009. The amount of *Bti* used in 2008 and 2009 was below the yearly average of approximately 3,000 gal.

Product and Equipment Testing

Quality assurance processes focused on equipment, product evaluations, 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 four larvicides and one new adulticide. All four larvicides have been tested in different control situations in the past. Three larvicides were tested to control *Culex* breeding in catch basins, two to control *Culex* developing in wetlands, and one to control the cattail mosquito. The adulticide was tested for use in croplands. These additional materials will provide MMCD with more tools to use in its operations.

Data Management and Public Information

Calls, e-mails and other contacts from citizens are an important source of information for MMCD to identify areas that may need service, support disease control through tire disposal and dead bird reporting, and for recording citizen complaints and requests for limited or no treatment. In 2009 staff continued refinements on its web-based system for tracking and mapping customer calls, continued and refined GPS data support for aerial treatments, updated wetland and stormwater structure maps, and continued an array of education efforts including school presentations and efforts to increase awareness of the interaction between storm water management and mosquitoes.

Chapter 1 *Mosquito Surveillance*

2009 Highlights

- Below normal temperatures prolonged the spring hatch
- Drought conditions existed for most of the season
- Rainstorms produced only four major mosquito broods
- The major mosquito peak occurred in August
- Staff identified 20,430 larval samples
- Search for a second occurrence of *Aedes cataphylla* in MN was negative

2010 Plans

- Continue *Aedes* surveillance strategies as in 2009
- Re-evaluate placements of both CO_2 traps and gravid traps
- Continue search for presence of *Ae. cataphylla*
- Monitor spread of *Ae. japonicus*
- Develop best surveillance methods for detecting *Ae. japonicus*

2009 Mosquito Surveillance Results

Background

The MMCD 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 since 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.

Rainfall

Rainfall surveillance is an important tool used to estimate the amount of larval production and to determine the areas to dispatch work crews following a rain event. Generally, an inch or more of rain can produce a hatch of floodwater mosquitoes. The District operates a network of 80 rain gauges from May to September. The Minnesota Department of Natural Resources (MnDNR) State Climatology Office also uses this information to augment their rain gauge network. Weather data is available at their website: www.climate.umn.edu.

Average rainfall in the District from May 1 through September 30, 2009 was 13.89 inches (Table 1.1). This is slightly less than last year and 5.44 inches below the 51-year District average (19.33 inches). Anoka, Carver, and Dakota counties received the most rain, while Hennepin, Ramsey, and Washington counties were between 5.5 and 7 inches below their season averages. For most of the season, areas of the District were in moderate, severe, or extreme drought conditions.

Biologically, mosquito development is tied to environmental conditions. Eggs laid by spring *Aedes* in the summer need to be cold-conditioned and flooded by spring snowmelt and

rainfall to hatch. Eggs of summer floodwater species need to be inundated by floodwater from rain events to hatch. Permanent water species such as *Coquillettidia perturbans* overwinter as larvae and emerge from cattail marshes mid-summer. Water temperature can influence how quickly larvae develop in sites. Temperature and precipitation experienced from May – December 2009 was anything but "normal" as depicted by Figure 1.1, which displays the monthly departures from normal for both.

Table 1.1 Average rainfall received in each county from May through September, 2005-2009 and 51-year District average

Year	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
2005	22.20	22.75	21.53	22.75	23.00	24.25	23.87	23.60
2006	19.78	17.90	17.46	18.71	19.06	19.50	17.21	18.65
2007	16.01	17.26	20.89	17.92	16.93	16.58	19.02	17.83
2008	15.19	16.90	15.03	13.55	12.60	14.08	14.15	14.15
2009	14.84	17.75	15.52	13.12	12.35	13.65	13.08	13.89
51-Year Avg	18.85	*20.14	19.65	19.47	19.64	19.21	19.93	19.33

*27-year average (Carver joined the District in 1982)

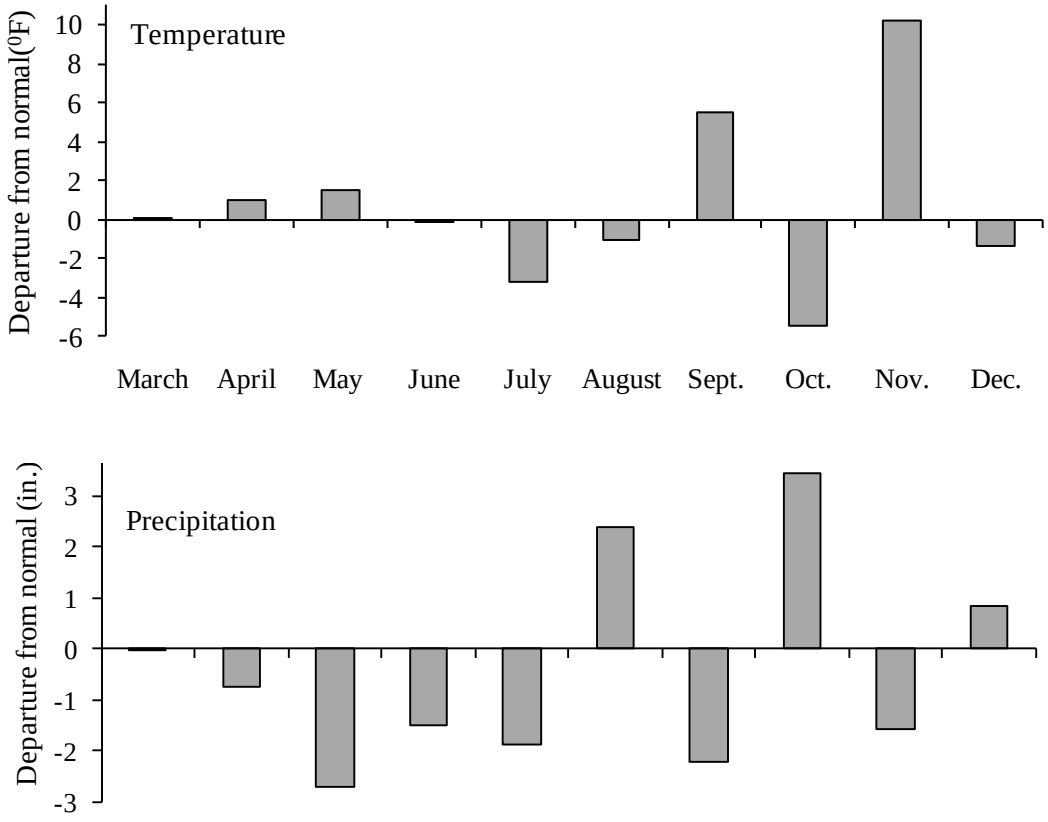

Figure 1.1 Monthly departure from normal for temperature and precipitation March-December, 2009

We experienced four summer rain events in 2009 (Figure 1.2) that produced two medium and two large broods of floodwater mosquitoes. Brood size describes the amount of area in the District affected by the rainfall, the amount of rainfall, and the amount of breeding that resulted. One rain event of 1-2 inches on June 8 (weekending June 12) produced a medium brood of mosquitoes in Hennepin and Scott counties.

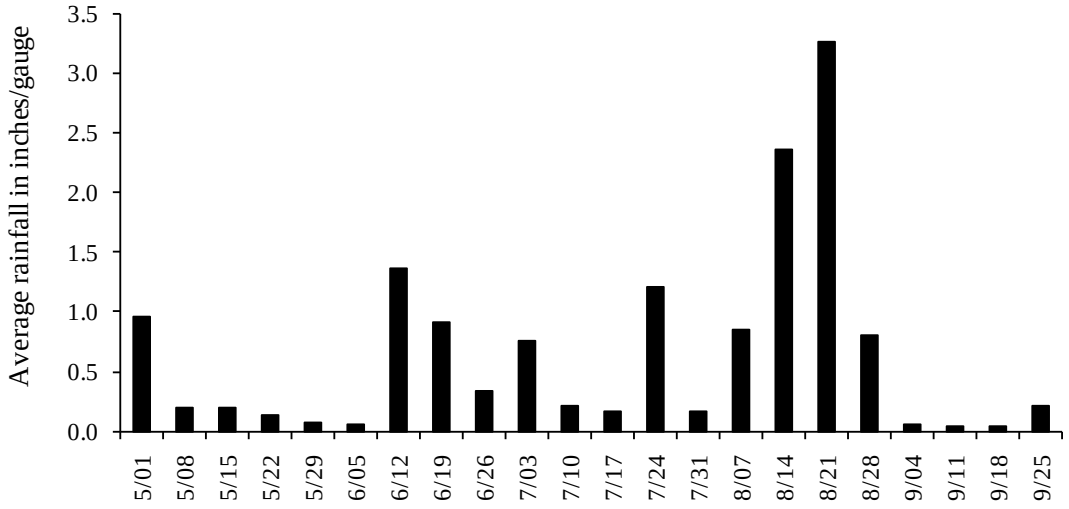

Figure 1.2 Average rainfall amounts per gauge per week, 2009.

The spring mosquito season was dry and cool again this year. Snowmelt caused spring larval species to begin hatching in late March and continued until the beginning of May. However, May was the third driest month on record and many of the larval development sites dried down before the spring species could emerge.

We received our first summer brood of floodwater mosquitoes from a 1½-inch rain event on June 12, which also caused some spring *Aedes* larvae to hatch. The second half of June was 13 degrees warmer than the first half of the month, with a few scattered, small broods. July was cool and dry with one medium mosquito brood. For only the eighth time since 1891, the thermometer did not reach 90° F in July. August was cooler but wetter than normal, which broke the streak of four consecutive drier than normal months. Some record-setting rain amounts (e.g., 10.15 total inches in Chaska for August) produced two large broods of mosquitoes in August. September was the 14th driest and among the top five warmest in Minnesota history with by far the longest stretch of above normal warmth for the year 2009. In contrast, October was the fifth wettest and fourth coldest in history and December snow was above normal. Weather information was obtained from Minnesota State Climatology, www.climate.umn.edu/weathertalk. Figure 1.3 depicts the geographic distribution of weekly rainfall received in District gauges from May through September 2009.

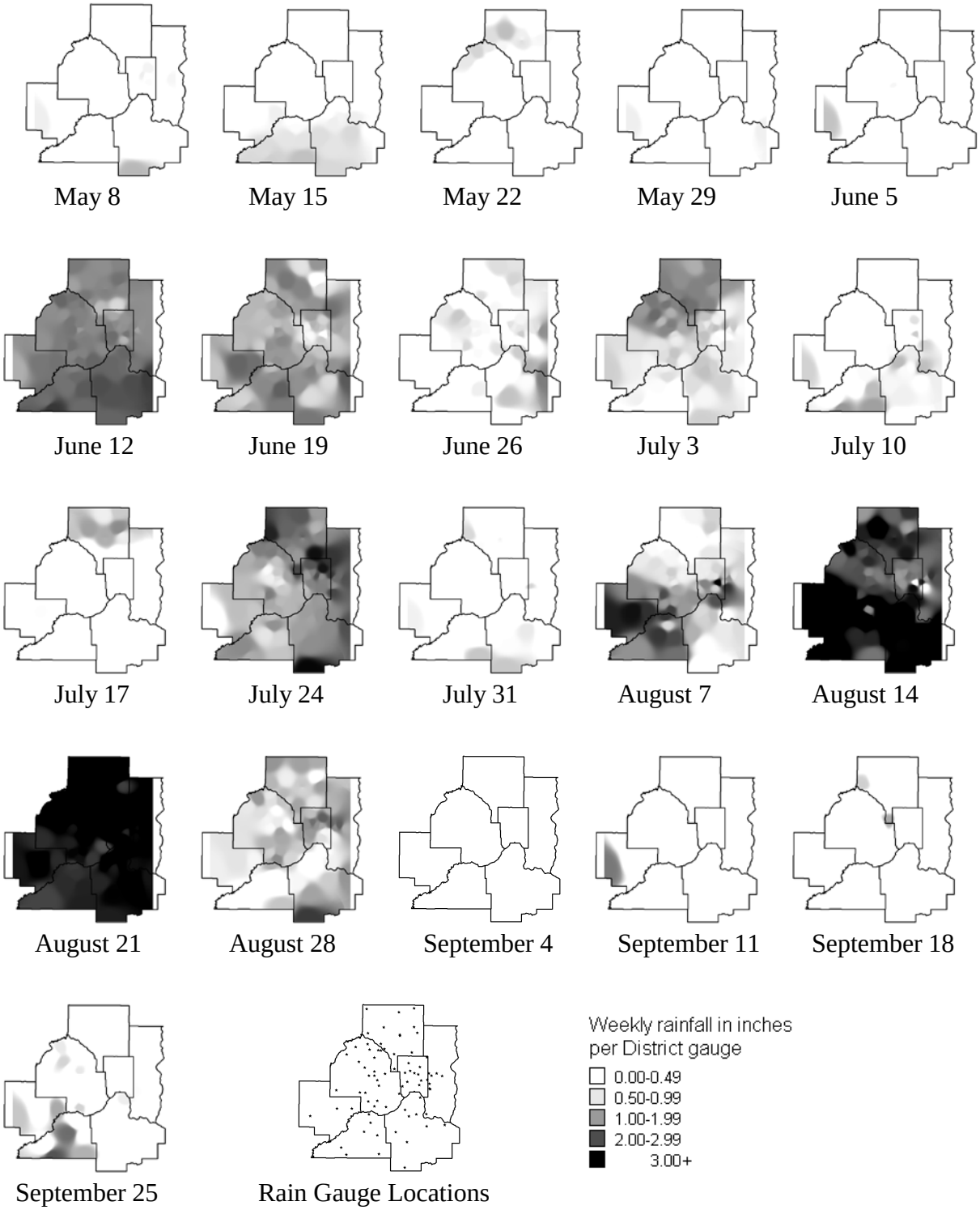

Figure 1.3 Weekly rainfall in inches per District gauge, 2009. The number of gauges varied from 71-75. A map of the rain gauge locations is included. Inverse distance weighting was the algorithm used for shading of maps.

Larval Collections

Larval mosquito collections are taken to determine if targeted species are present at threshold levels or to obtain species history in a breeding site. In 2009, staff identified 20,430 larval collections which is 19% higher than average for the last 12 years. 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. Lower priority samples are processed as time permits and are identified to species. Table 1.2 shows the results of the 11,407 samples identified to species, calculated as the percent of samples in which the species was present. A significant amount of sampling is done in catch basins and other man-made structures. These stormwater structures sample results are displayed separately from the natural breeding area results in Table 1.2.

The most abundant species in standard dipper larval collections from natural breeding areas was the spring species, *Aedes stimulans*, occurring in 29.9% of the samples (Table 1.2). This is the first time that a spring species outnumbered the floodwater species, *Aedes vexans*, which came in second at 26.2%. This most likely is the result of eggs laid by the record high number of spring *Aedes* adults in 2008 and increased spring larval sampling this season. Two other common spring species, *Ae. excrucians* and *Ae. fitchii*, were in third and sixth place. *Culex territans*, which prefers cold-blooded hosts, ranked fourth and *Cx. restuans*, which prefers to bite birds, was fifth. The WNV vector, *Cx. tarsalis*, occurred in 3.5% of the samples, ranked 10th. A few mosquitoes can be identified to species in the first instar stage, but most cannot. The high amount of "*Aedes* species" and "*Culex* species" is normal and represents first instar larvae that are not identifiable to species.

Culex mosquitoes are the dominant species breeding in catch basins and other stormwater structures. *Culex restuans* was found in 77.8% of the structure samples and *Cx. pipiens* in 25.2% (Table 1.2). A detailed discussion of the larval *Culex* surveillance in structures can be found in *Chapter 2: Vector-borne Disease*.

Exciting events in the Technical Services Lab this season included identifying specimens of *Ae. japonicus* and the rare spring species *Ae. euedes*. Even though the occurrence of *Ae. japonicus* greatly increased this season, it is still a cause for excitement to lab staff. More discussion of *Ae. japonicus* surveillance follows in the exotic species section of this chapter. *Aedes euedes* (formerly named *Ae. barri*) is a northern Minnesota spring species rarely found in the District. The last time *Ae. euedes* was detected in our collections was in 1982.

A species not known to occur in Minnesota, *Aedes cataphylla*, was identified in a larval sample from Minnetonka in 2008. *Aedes cataphylla* is a very early spring species whose range is the western US and Canada, no further east than Colorado. Extensive larval sampling began this spring in the area of the 2008 detection. While the sites contained water early in the season, the sites dried quickly due to lack of rainfall. *Aedes implicatus* was collected in a small pocket of water, but no *Ae. cataphylla* was found. A CO_2 trap operated near the location of the detection was also negative for adult specimens. Whether this species is established in Minnesota or this detection is just an anomaly is still a mystery we will continue to investigate.

Table 1.2 Percent of samples where larval species occurred in standard dipper collections by facility and District total, and the District total for stormwater structure samples, 2009; the total number of samples processed to species is in parentheses

	Percent of samples where species occurred by facility							Stormwater
Species	North (1,349)	East (2,412)	South Rosemount (1,258)	South Jordan (664)	West Plymouth (1,752)	West Maple Grove (904)	District Total (8,339)	Structure District Total (3,068)
Aedes abserratus	0.8	0.7	0.3	1.1	0.8	0.4	0.7	
aurifer		0.1					<	
canadensis	0.2	0.5	1.5	1.7	0.9	0.3	0.8	0.1
*cataphylla**								
cinereus	9.9	8.6	2.9	3.2	6.6	8.4	7.1	0.5
communis				0.2			<	
dorsalis	0.2	0.5	0.6	0.2	0.3	1.0	0.5	<
euedes			<				<	
excrucians	17.9	26.6	17.1	19.7	21.1	17.7	21.1	0.1
fitchii	7.2	16.2	9.3	5.1	4.7	6.9	9.4	0.1
flavescens				0.2			<	
implicatus	0.6	2.1	1.7	1.4	2.3	2.2	1.8	
intrudens		<					<	
japonicus								0.2
nigromaculis	0.8	0.2	0.6		0.1	0.2	0.3	<
punctor	0.3	0.7	0.2	0.5	0.7	0.7	0.5	
riparius	0.7	0.7	0.6	1.5	2.8	2.5	1.4	
spencerii	<						<	
sticticus	<	<	0.6		0.2		0.2	
stimulans	16.5	31.2	27.7	36.4	40.0	25.2	29.9	0.2
provocans	0.4	1.7	0.4	0.3	0.6	0.9	0.9	
triseriatus	<	0.1	0.2	0.2	0.2	0.2	0.2	0.4
trivittatus	1.9	2.1	3.6	1.1	0.9	1.0	1.8	0.3
vexans	39.1	25.4	31.1	11.1	20.5	24.5	26.2	13.5
Ae. species	30.8	33.8	41.3	36.1	41.1	33.0	36.1	3.2
Anopheles earlei	0.1	<			<		<	<
punctipennis	2.3	1.1	0.6	0.5		0.2	0.8	0.8
quadrimaculatus	<	0.1	0.2	0.2			<	<
walkeri	<						<	
An. species	4.0	1.0	1.1	1.4	0.3	0.4	1.3	1.8
Culex pipiens	6.2	6.8	2.1	1.7	1.3	7.0	4.4	25.2
restuans	15.3	13.9	11.9	9.9	10.1	12.7	12.6	77.8
salinarius	<	0.2			<	0.1	0.1	0.1
tarsalis	3.9	4.0	4.2	3.5	1.6	4.6	3.5	3.6
territans	18.0	13.6	9.0	21.2	7.1	13.7	12.9	8.6
Cx. species	5.2	4.0	3.3	4.2	2.9	6.6	4.2	39.8
Culiseta inornata	2.5	6.2	5.1	6.3	4.3	7.1	5.1	8.5
melanura								
minnesotae	0.5	0.5	0.6	0.2	0.6	0.7	0.5	0.1
morsitans	<	0.2		0.3		0.1	0.1	<
Cs. species	1.0	1.5	0.3	0.5	1.6	1.8	1.2	0.1
Psorophora ferox	<	<					<	
horrida								<
Ps. species					0.1		<	
Ur.sapphirina	1.0	0.9	0.2	1.2	0.2	0.8	0.7	0.2

< = percent of total is less than 0.1%

* 1st known occurrence in 2008

Adult Collections

There are 51 species of mosquitoes known to occur in Minnesota and different species exhibit a variety of host preferences. About 45 of these species, 20 of which are human biting, occur in the District. Other species prefer to feed on birds, large mammals, reptiles, or amphibians. Additionally, species of 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 are used in order to capture targeted species.

Most of the mosquitoes collected are identified to species, but in some cases, species are grouped together to expedite sample processing. *Aedes* mosquitoes can be grouped by their seasonal occurrence (spring, summer). Some vector species are grouped because species-level separation is very difficult (*Cx. pipiens/restuans*).

There are three major groups of human-biting mosquito species: spring *Aedes*, summer *Aedes* and *Cq. perturbans*. Spring *Aedes* (14 species) larvae hatch in March and April as a result of snow melt and adults emerge in late April to early May. They have one generation each season and adults can live for three months. The summer *Aedes* (*Ae. vexans, Ae. sticticus, Ae. trivittatus*) begin hatching in early May as a result of rainfall. They can have several generations throughout the summer. *Coquillettidia perturbans*, the cattail mosquito, develops in cattail marshes and has one generation per year, peaking in early July. Another important species we monitor is the West Nile virus and western equine encephalitis vector, *Culex tarsalis*. Because of the seasonal variation in their occurrence, data is summarized separately for the three groups and *Cx. tarsalis* is included separately from other *Culex*. A more detailed description of the biologies of mosquitoes occurring in the District is in Appendix A.

The sweep net and CO_2 trap data reported in this chapter are weekly collections referred to as the Monday night network. Employees took 2-minute sweep net collections and/or set overnight CO_2 traps in their yards every Monday night during the season. To achieve a District-wide distribution of CO_2 traps, other locations such as parks or wood lots are chosen for surveillance.

Sweep Net

The District uses sweep net collections to monitor human annoyance during the peak mosquito activity period, which is 35-40 minutes after sunset for most mosquito species. The number of collectors varied from 114-197 per evening. Sweep net collection locations in 2009 are shown in Figure 1.4.

A total of 3,049 collections were taken containing a total of 1,667 mosquitoes. For the first time, spring *Aedes*, summer *Aedes*, and *Cq. perturbans* were collected at the same rate in the evening sweep net collections (Table 1.3). The number of spring *Aedes* was much lower than last year's record high (Figure 1.5) but still slightly higher than the average for the past nine years. Summer *Aedes* species tied with 2007 for the lowest level in the last four years, way below normal.

Coquillettidia perturbans remained at low levels. *Culex tarsalis* is not effectively collected in sweep net sampling and, along with 2008, was the lowest of the past four years.

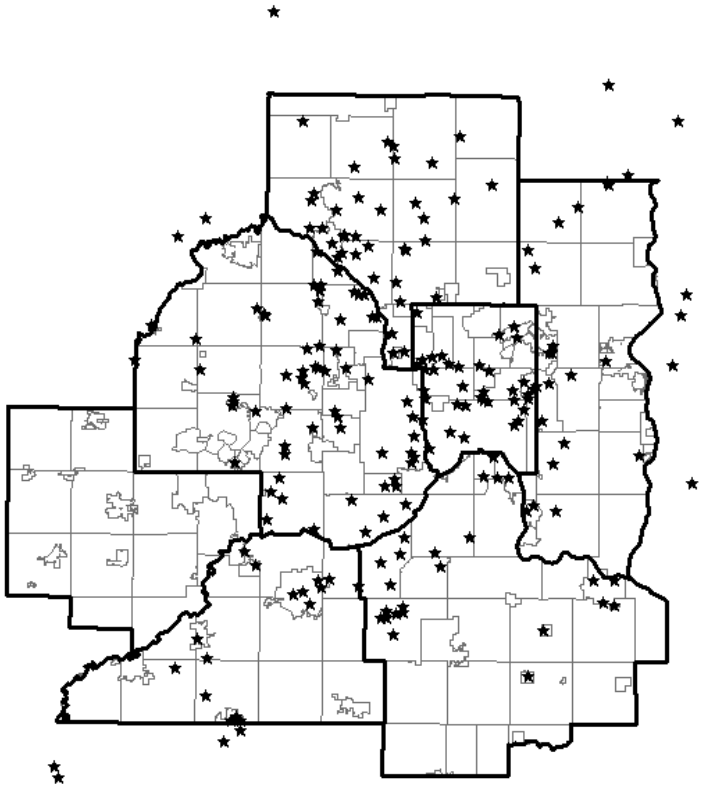

Figure 1.4 Locations of weekly evening sweep net collections, 2009.

Table 1.3 Average number of mosquitoes collected per evening sweep net collection within the District, 2005-2009 and average of last nine years, 2000-2008

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2005	1.1	0.3	0.04	0.010
2006	0.3	0.3	0.03	0.004
2007	0.2	0.1	0.10	0.010
2008	0.5	0.2	0.60	0.003
2009	0.2	0.2	0.20	0.003
9-yr Avg.	2.2	0.4	0.10	0.010

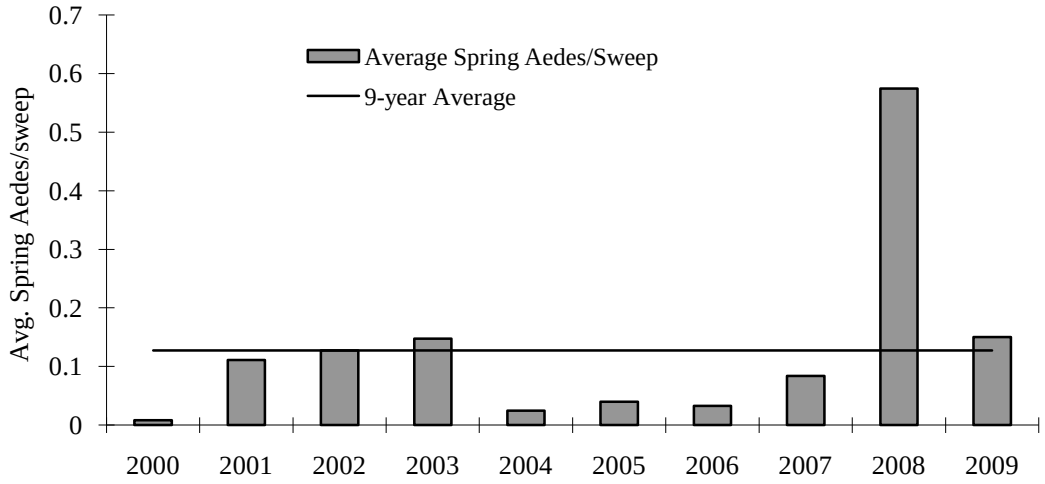

Figure 1.5 Average spring *Aedes* per sweep net 2000-2009 vs. 9-year average.

CO_2 Trap

CO_2 traps baited with dry ice are used to monitor mosquito population levels and the presence of disease vector species. In 2009, we operated 135 traps at 122 locations to allow maximum coverage of the District. At 13 of the locations, we operated a low (5 ft) and an elevated (25 ft) trap. Some traps were placed in locations more likely to collect the vector species *Cx. tarsalis* for WNV testing and *Culiseta melanura* for eastern equine encephalitis testing (Figure 1.6). The number of traps operated per night varied from 103-131. A total of 2,553 trap collections were processed, containing 178,945 mosquitoes.

Coquillettidia perturbans, the cattail marsh mosquito, was the predominant species captured in the traps this season (Table 1.4). Usually, the summer *Aedes* are the most numerous, but they came in second place with populations the lowest of the past four years. The spring *Aedes* were greatly reduced from last year, but higher than usual. *Culex tarsalis* numbers were the lowest of the past four years and are discussed later in this chapter. Typically, mosquitoes that develop in permanent water habitats (*Cq. perturbans* in cattail marshes) will be more predominant in low rainfall years since their habitats are less likely to dry up.

Lab staff were excited to find four specimens of *Ae. diantaeus* in CO_2 traps this season. *Aedes diantaeus* is a northern Minnesota spring species rarely found in the District. They have only been collected during three other years since 1958.

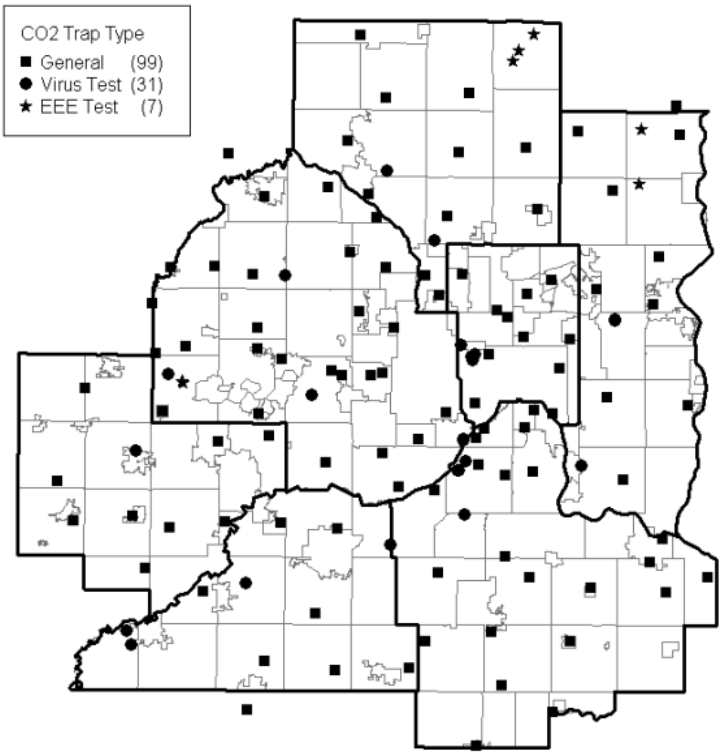

Figure 1.6 Locations of CO_2 traps to monitor general mosquito populations, WNV vectors and the eastern equine encephalitis vector, 2009.

Table 1.4 Average numbers of mosquitoes collected in CO_2 traps within the District, 2005-2009

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2005	201.5	42.0	6.9	1.6
2006	51.7	75.8	10.2	1.5
2007	43.7	31.9	10.2	5.2
2008	60.5	31.2	21.3	1.3
2009	28.4	30.4	7.2	0.8
9-yr Avg.	236.8	49.8	8.1	1.8

Geographic Distribution The weekly geographic distributions of the three major groups of mosquitoes collected in CO_2 traps are displayed in Figures 1.7, 1.8, and 1.9. The computer software extrapolates the data between collection points, so some dark areas are the result of one collection without another close by. The higher populations of spring *Aedes* were confined to the District borders. Except for a few weeks from late August to early September, mosquito levels of summer *Aedes* were tolerable throughout the season in priority zone 1 (see p. 43 for a description of priority zones). *Coquillettidia perturbans* populations occurred in their usual hot spots in the northern counties, near the District borders of Carver and Scott counties, and at Fort Snelling.

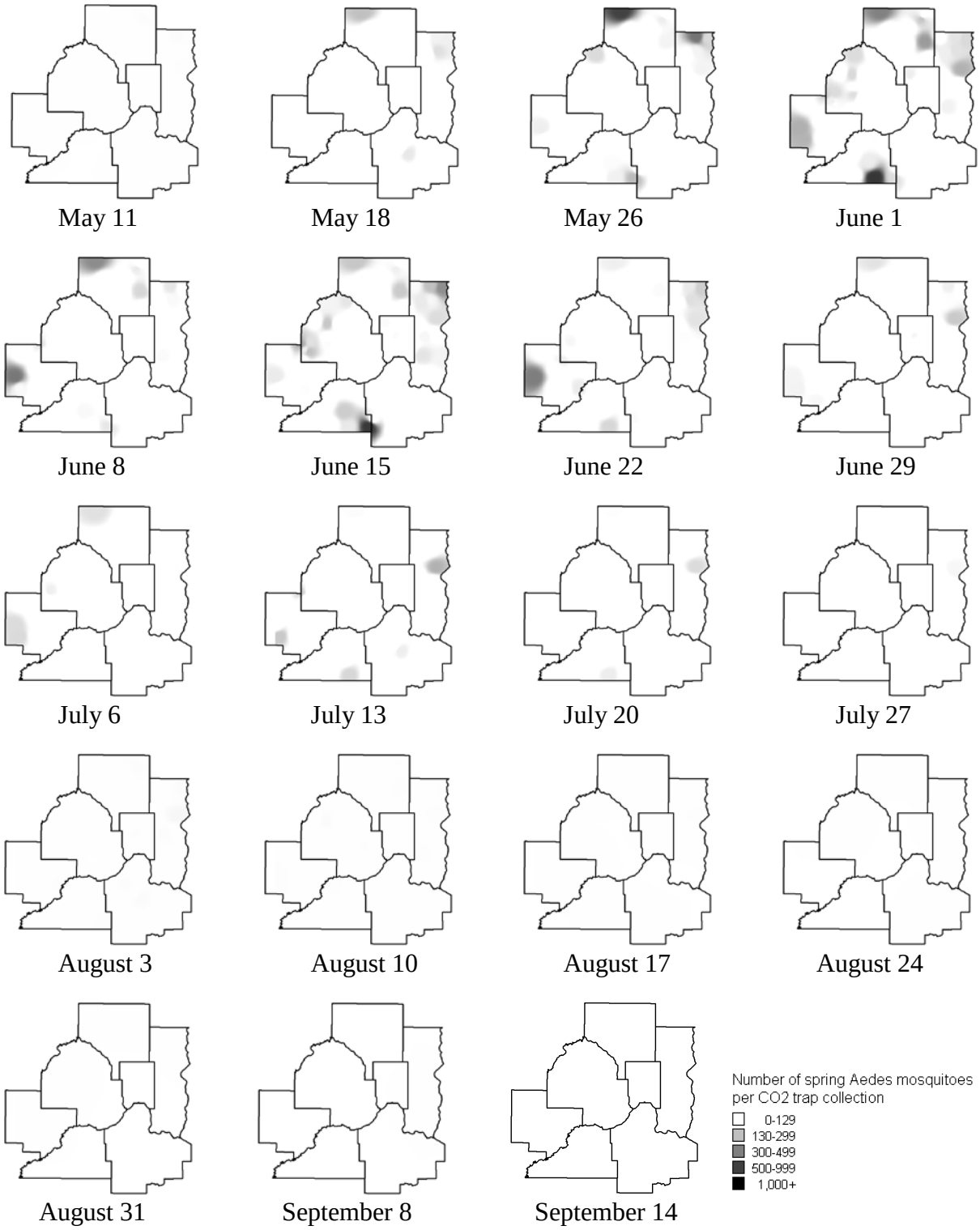

Figure 1.7 Number of spring *Aedes* in District CO_2 trap collections, 2009. The number of traps operated per night varied from 115-131. Inverse distance weighting was the algorithm used for shading of maps.

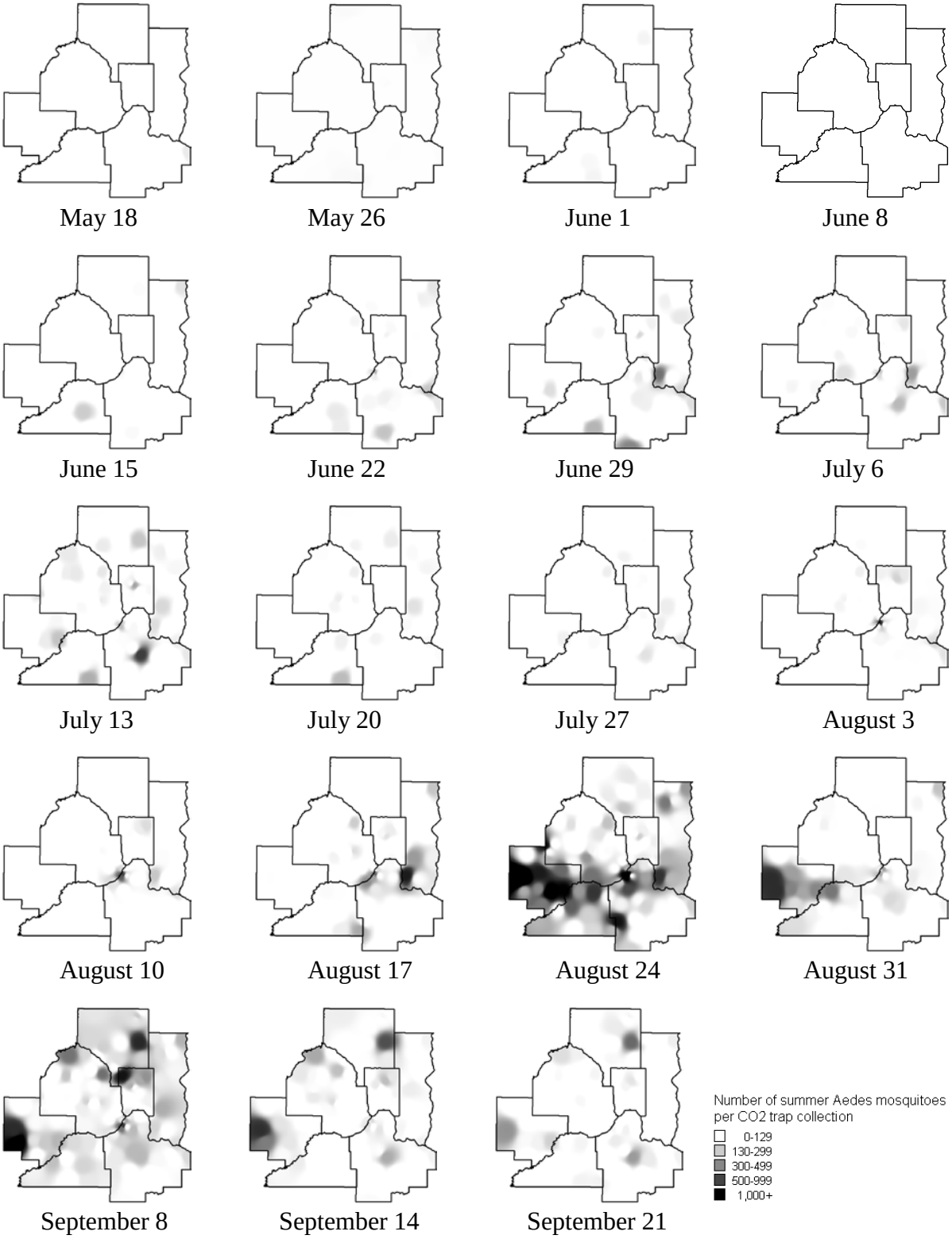

Figure 1.8 Number of summer *Aedes* in District CO_2 trap collections, 2009. The number of traps operated per night varied from 103-118. Inverse distance weighting was the algorithm used for shading of maps.

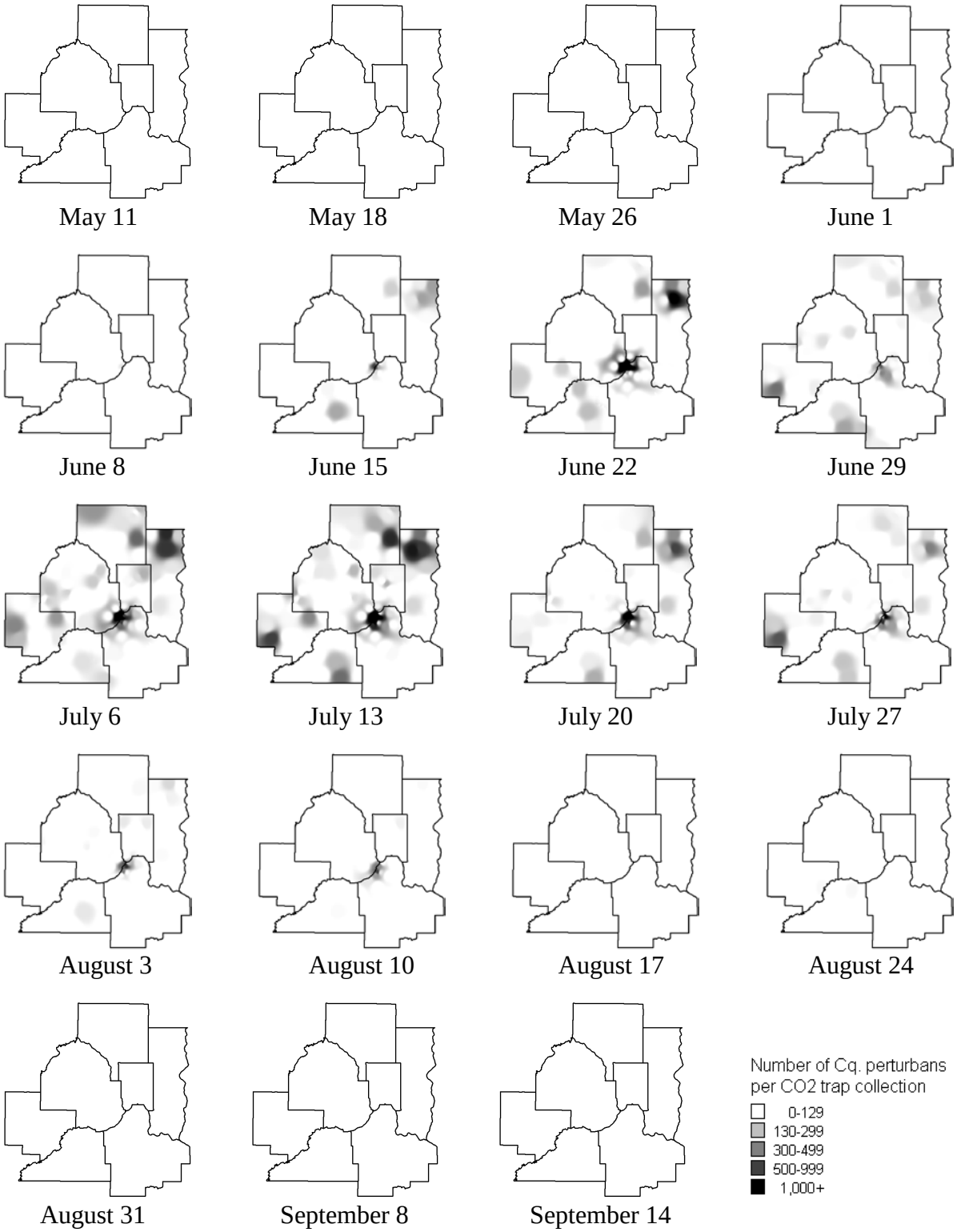

Figure 1.9 Number of *Cq. perturbans* in District CO_2 trap collections, 2009. The number of traps operated per night varied from 104-118. Inverse distance weighting was the algorithm used for shading of maps.

Seasonal Distribution As described earlier, the three major groups of mosquito species, spring *Aedes*, summer *Aedes* and *Cq. perturbans*, have different patterns of occurrence during the season based on their phenology and the surveillance method used. Sweep net and CO_2 trap collections were used to measure mosquito activity from May to September. Sweeps were taken for 18 weeks and CO_2 traps operated for 20 weeks, starting one week earlier than the sweeps and continuing one week later. Monday night sweeps and CO_2 trap collections can be used to determine if mosquitoes are present at threshold levels for treatment; thresholds are 2 mosquitoes in a sweep collection and 130 mosquitoes in a CO_2 trap.

Collections with sweep nets detected the spring *Aedes* emergence near the end of May and were experienced most of the summer (Figure 1.10). Summer *Aedes* populations were very low for most of the summer, but populations rose at the end of August after rain events sufficient to produce a hatch. *Coquillettidia perturbans* began emerging at the end of June and peak populations occurred July 6. The nights of June 8 and August 31 were cool (53° F and 61° F) (Figure 1.11), resulting in lower than normal mosquito activity.

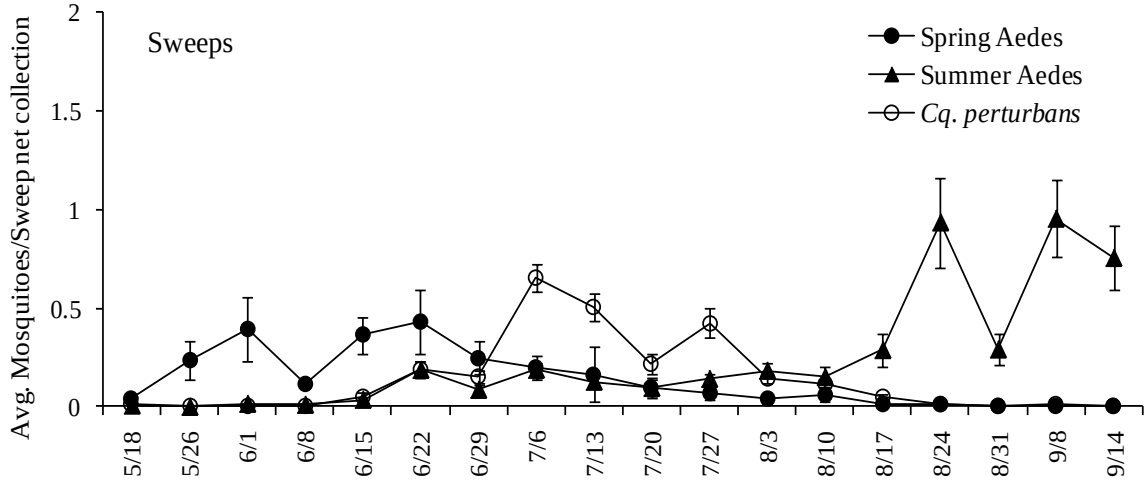

Figure 1.10 Average number of spring *Aedes*, summer *Aedes*, and *Cq. perturbans* per evening sweep net collection, 2009. Threshold is two mosquitoes in a sweep collection. Error bars equal ± 1 standard error of the mean.

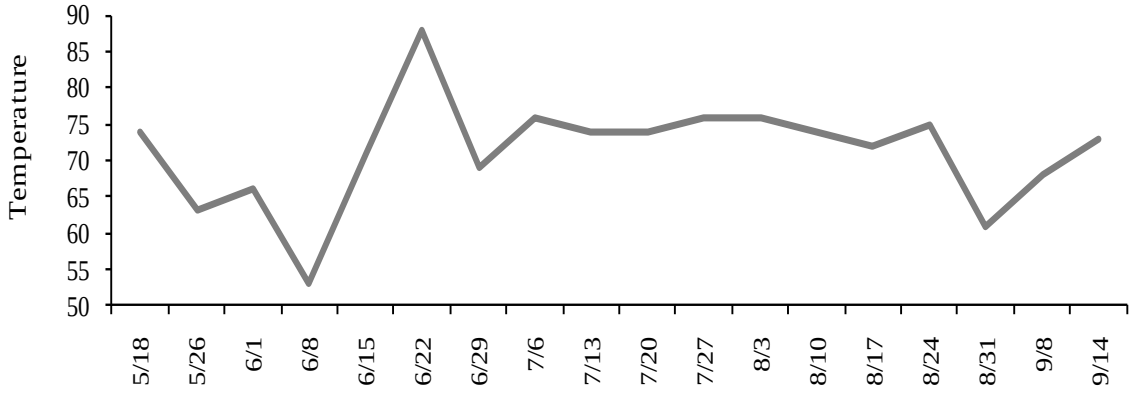

Figure 1.11 Temperature at 9:00 P.M. on Monday night surveillance dates.

CO_2 traps are placed at selected locations throughout the District to measure the abundance of mosquitoes. As with the sweeps, the traps detected higher spring *Aedes* activity than summer *Aedes* until the end of June (Figure 1.12). The peak activity for the season was August 24, caused by emergence from the largest brood of summer *Aedes*. The *Cq. perturbans* populations peaked on July 13, a week later than the sweeps and later than the usual peak of July 4. A trap at Fort Snelling collected an unusually high number of *Cq. perturbans* (10,624) on the night of June 22. This outlier was removed from the data set, but is indicated on the graph to show where it would have plotted if included.

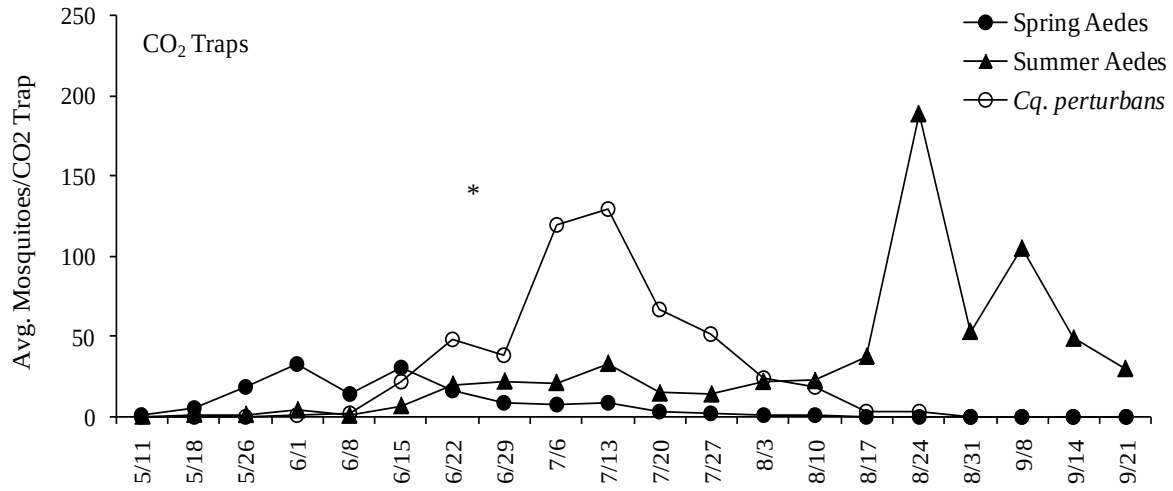

Figure 1.12 Average number of spring *Aedes*, summer *Aedes* and *Cq. perturbans* per CO_2 trap, 2009. Error bars equal ± 1 standard error of the mean. *Marker indicates actual data point if outlier of 10,624 *Cq. perturbans* from one trap was included in graph.

New Jersey Traps

For many years, mosquito control districts used the New Jersey (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 outbreak in 1983, the District reduced the number to seven to alleviate the regular workload due the shift to disease vector processing.

The number of traps and locations has fluctuated since then, and the District currently operates seven NJ light traps at the following locations. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap CA in the Carlos Avery Wildlife Refuge, trap AV at the Minnesota Zoo in Apple Valley, and a new trap location, MN in Minnetrista (Figure 1.13). Trapping runs nightly for 20 weeks from May to September and staff identify all adult female

mosquitoes to species. Traps 1, 9, 13, and 16 have operated each year since 1960. A comparison of the major species collected from 1965-2009 from those four traps is shown in Appendix B.

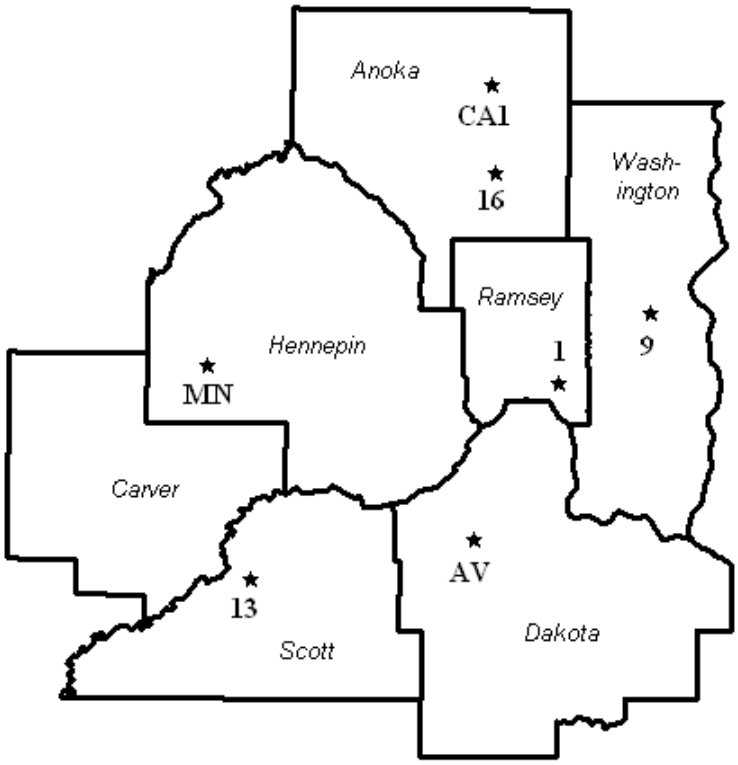

Figure 1.13 New Jersey light trap locations, 2009.

The most numerous species collected in NJ traps was *Ae. vexans*, with *Cq. perturbans* coming in second (Table 1.5). In third place was *Ae. cinereus*, occurring in both spring and summer. The spring species, *Aedes stimulans*, and the grouped category of "spring *Aedes*" came in fourth and fifth places. This is the first year that *Ae. japonicus* was collected in a NJ trap. Two females were captured at the Minnetrista trap location, one on September 11 and one on September 19. Another interesting occurrence was the capture of one specimen of *Aedes implicatus*, which is rare in NJ traps but found more frequently in larval collections. It is also odd that no specimens of *Ae. sticticus* were identified in NJ traps this season. This is a common summer floodwater species whose populations have been reduced the past few years due to the dry conditions. It is also unusual for *Ae. cinereus* to outnumber *Ae. vexans* in trap collections, as at the Carlos Avery location. *Aedes cinereus* can successfully use the variety of larval habitats types found there, including marshes, which can remain wet long enough for *Ae. cinereus* to emerge.

Table 1.5 Total number and frequency of occurrence for each species collected in New Jersey light traps, May 9-September 25, 2009

	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	139	137	138	136	130	136	132	948	Total	Night
1. Ae. abserratus	0	0	0	1	26	1	2	30	0.17%	0.03
3. aurifer	0	0	0	0	0	0	0	0	0.00%	0.00
6. canadensis	0	0	1	0	1	0	2	4	0.02%	0.00
7. cinereus	7	4	1	27	2,344	14	83	2,480	13.71%	2.62
10. dorsalis	0	0	0	0	1	0	0	1	0.01%	0.00
11. excrucians	0	8	0	1	72	0	185	266	1.47%	0.28
12. fitchii	2	5	0	1	5	1	7	21	0.12%	0.02
13. flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
14. implicatus	0	0	0	0	1	0	0	1	0.01%	0.00
52. japonicus	0	0	0	0	0	0	2	2	0.01%	0.00
16. nigromaculus	0	0	0	0	1	0	1	2	0.01%	0.00
18. punctor	0	2	0	1	35	1	0	39	0.22%	0.04
19. riparius	0	0	0	0	29	0	26	55	0.30%	0.06
20. spenceri	0	0	0	0	0	0	0	0	0.00%	0.00
21. sticticus	0	0	0	0	0	0	0	0	0.00%	0.00
22. stimulans	1	14	0	0	0	1	848	864	4.78%	0.91
23. provocans	0	0	0	0	2	0	0	2	0.01%	0.00
24. triseriatus	6	5	0	1	0	0	54	66	0.36%	0.07
25. trivittatus	6	3	0	0	0	3	2	14	0.08%	0.01
26. vexans	711	464	93	646	2,017	699	3,880	8,510	47.05%	8.98
118. abs/punct.	3	1	2	4	259	0	23	292	1.61%	0.31
261. Aedes species	17	0	0	0	0	4	32	53	0.29%	0.06
262. Spring *Aedes*	2	3	1	1	23	0	788	818	4.52%	0.86
264. Summer *Aedes*	1	1	0	0	0	1	0	3	0.02%	0.00
27. An. barberi	0	0	0	0	0	0	0	0	0.00%	0.00
28. earlei	0	1	3	0	6	0	4	14	0.08%	0.01
29. punctipennis	1	13	1	5	22	6	44	92	0.51%	0.10
30. quadrimac.	1	3	4	1	10	1	1	21	0.12%	0.02
31. walkeri	0	1	13	3	712	0	13	742	4.10%	0.78
311. An. species	1	0	1	0	28	0	4	34	0.19%	0.04
32. Cx. erraticus	0	0	0	0	0	0	0	0	0.00%	0.00
33. pipiens	0	0	0	0	0	0	0	0	0.00%	0.00
34. restuans	11	39	3	12	16	13	5	99	0.55%	0.10
35. salinarius	0	1	0	1	1	0	0	3	0.02%	0.00
36. tarsalis	9	4	0	9	1	6	6	35	0.19%	0.04
37. territans	1	6	4	1	2	3	6	23	0.13%	0.02
371. Cx. species	0	0	0	1	1	1	15	18	0.10%	0.02
372. Cx. pip/rest	72	69	3	33	43	80	80	380	2.10%	0.40
38. Cs. inornata	45	18	5	26	48	74	128	344	1.90%	0.36
39. melanura	0	0	0	0	0	0	0	0	0.00%	0.00
40. minnesotae	5	4	0	13	30	0	2	54	0.30%	0.06
41. morsitans	1	2	0	9	13	0	0	25	0.14%	0.03
411. Cs. species	0	0	1	1	11	0	12	25	0.14%	0.03
42. Cq. perturbans	34	8	36	50	1,722	88	583	2,521	13.94%	2.66
44. Ps. ciliata	0	0	0	0	0	0	0	0	0.00%	0.00
47. horrida	0	0	0	0	0	0	0	0	0.00%	0.00
471. Ps. species	0	0	0	0	0	0	0	0	0.00%	0.00
48. Ur. sapphirina	1	3	1	4	2	2	21	34	0.19%	0.04
501. Unident.	7	4	0	10	9	1	71	102	0.56%	0.11
Female Total	945	686	173	862	7,493	1,000	6,930	18,089	46.84%	19.08
Male Total	274	333	117	673	2,114	474	16,544	20,529	53.16%	21.66
Grand Total	1,219	1,019	290	1,535	9,607	1,474	23,474	38,618	100.00%	40.74

Anopheles quadrimaculatus and *Culex erraticus* are two species that are considered rare in the District. In recent years, they have been collected in traps more frequently. *Culex erraticus* were first found in 1988 and have occurred sporadically since then in low numbers (Figure 1.14). *Anopheles quadrimaculatus* occurred in the early years, were absent for a long span of years, then began appearing again in 1988. In 2007, there was an especially large peak in the number collected. We are investigating the reasons for this change in occurrence. It may be a result of changing weather patterns that have allowed this species to increase its productivity. Populations of *An. quadrimaculatus* continued to decline this season, down significantly from 2007. *Culex erraticus* was not detected in NJ traps this year.

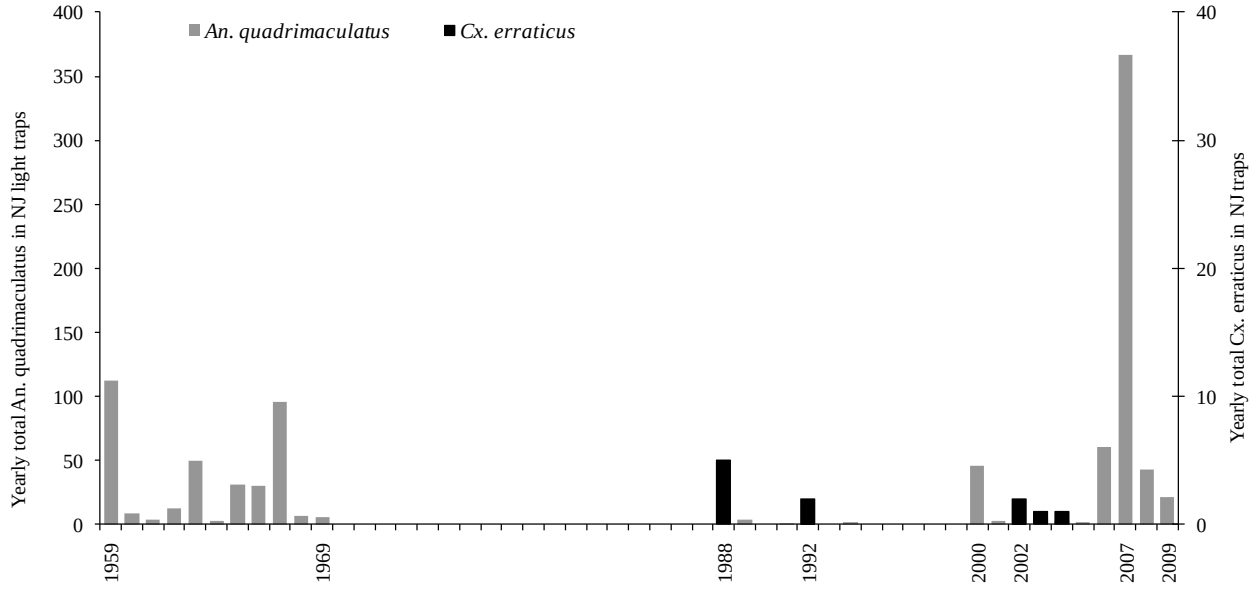

Figure 1.14 Yearly totals of *Anopheles quadrimaculatus* and *Culex erraticus* in New Jersey light traps, 1959-2009.

Vector Mosquito Surveillance

Aedes triseriatus Aspirator surveillance for the La Crosse encephalitis vector, *Ae. triseriatus,* began during the week of May 17. The peak rate of capture of 2.1/sample occurred during the week of June 28 (Figure 1.15). Dry conditions severely impeded *Ae. triseriatus* population growth, especially during the months of June and August. Surveillance results indicate that there were three periods of increased adult emergence; one in late June, one in mid-July, and one in early September.

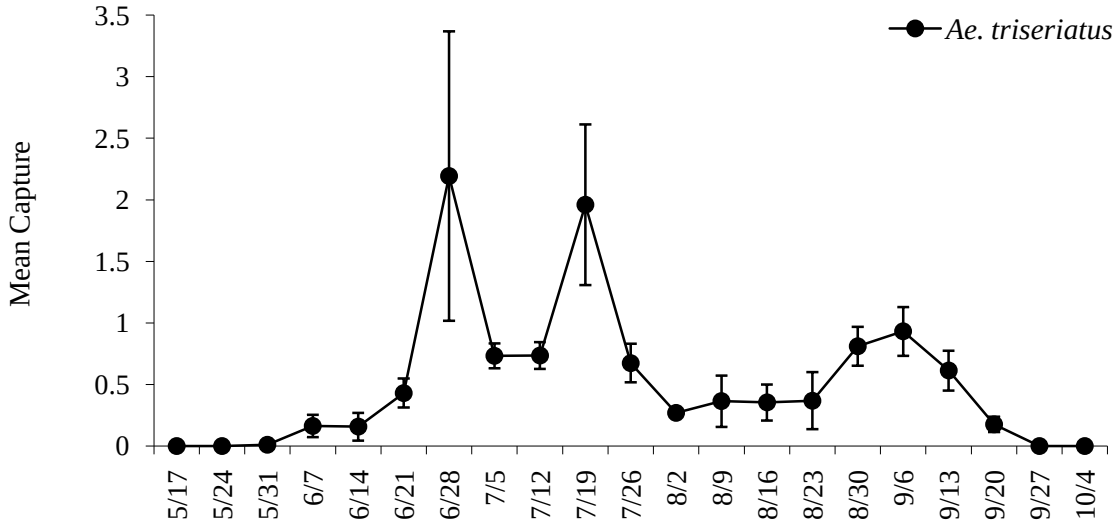

Figure 1.15 Mean number of *Ae. triseriatus* adults in aspirator samples, plotted by week. Dates listed are the first sampling day of each week. Sites sampled varied by week, although several locations were monitored repeatedly during the season. Error bars equal ± 1 standard error of the mean.

Culiseta melanura District staff monitored six locations for *Culiseta melanura* using seven CO_2 traps. Three of the sites are located in Anoka County, two in Washington County and one site in Hennepin County. The Hennepin County location had a ground level trap and a canopy level trap. *Culiseta melanura* have been collected from each of the locations in the past. In addition, 28 aspirator samples were collected from wooded habitats surrounding potential *Cs. melanura* larval habitat (i.e., tamarack bogs).

Only one *Cs. melanura* adult was collected by CO_2 traps at the selected locations. It was captured on July 14 in Scandia, Washington County. One additional specimen was collected in the Palmer Lake CO_2 trap in Hennepin County on July 28. This was the first time the species was collected at that location. There were no *Cs. melanura* collected by aspirator in 2009.

***Culex* Surveillance** *Culex* species are important for the amplification and transmission of West Nile virus (WNV) and western equine encephalitis virus (WEE) in our area. In addition to CO_2 traps, gravid traps are used to monitor *Culex* adults. The gravid trap is designed to attract female mosquitoes that are seeking oviposition sites while the CO_2 trap is used for collecting female mosquitoes in their host-seeking phase. The District operated 135 CO_2 traps and 36 gravid traps in 2009.

Culex tarsalis is the most likely vector of WNV to humans in our area. As is typical, very few *Cx. tarsalis* were collected by gravid trap in 2009. Capture rates in CO_2 were low for the entire season. The season peak of 2.7 *Cx. tarsalis* per CO_2 trap occurred on July 27 (Figure 1.16).

Culex restuans is another important vector of WNV in Minnesota. The species is largely responsible for the early season amplification of the virus and likely for season-long maintenance

of the WNV cycle. *Culex restuans* were detected in low numbers in CO_2 traps from May – July. By the end of July, it was on the decline (Figure 1.17). Gravid trap collections of *Cx. restuans* showed a typical pattern for the species characterized by early season population growth, then fluctuating capture rates until a steady decline was observed during the latter half of the season.

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 peak late in the summer when temperatures are typically warmer. Collections of *Cx. pipiens* were low in both CO_2 traps and gravid traps in 2009 (Figure 1.18). The peak gravid trap capture of 0.97 occurred during the final week of surveillance.

When *Culex* specimens are combined, they are grouped as either *Cx. pipiens/restuans* (Figure 1.19) or as *Culex* species (Figure 1.20). Both groups usually consisted largely of *Cx. restuans* during the early and middle portions of the season with *Cx. pipiens* contributing to the collections during the middle and later portions of the season. In 2009 the numbers of *Cx. pipiens/restuans* and *Culex* species were highest in gravid traps during most of June and July then again in September. Captures of *Cx. pipiens/restuans* in CO_2 traps were greatest during August.

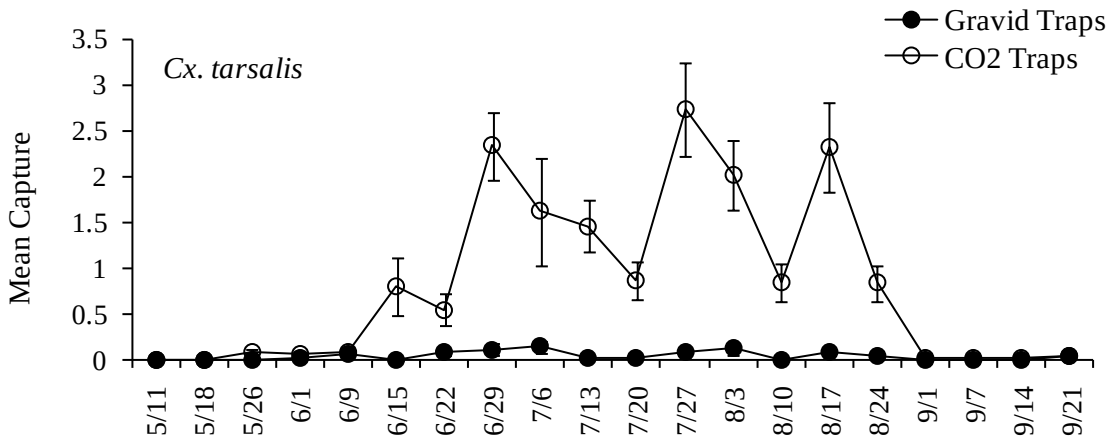

Figure 1.16 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2009. Error bars equal ± 1 standard error of the mean.

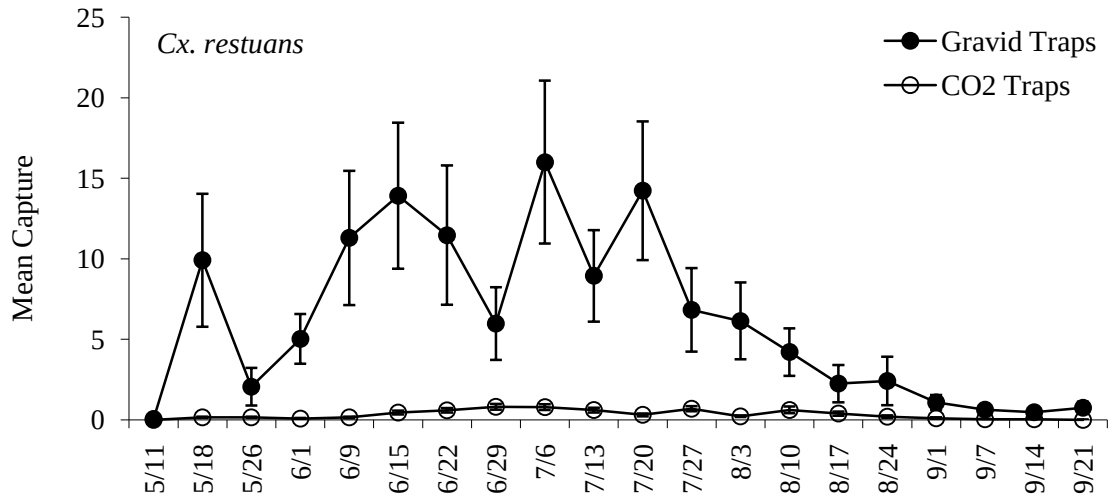

Figure 1.17 Average number of *Cx.restuans* in CO_2 traps and gravid traps, 2009. Error bars equal ± 1 standard error of the mean.

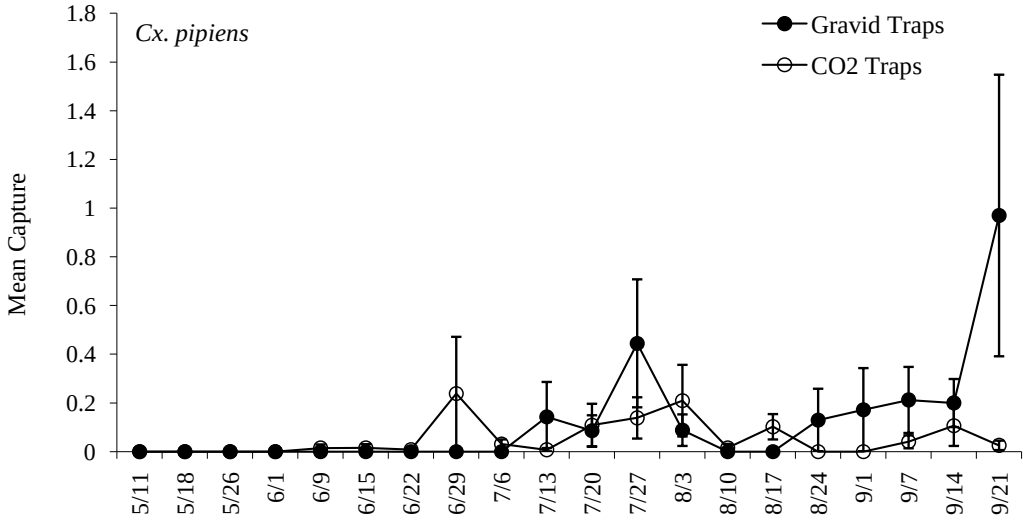

Figure 1.18 Average number of *Cx. pipiens* in CO_2 traps and gravid traps, 2009. Error bars equal ± 1 standard error of the mean.

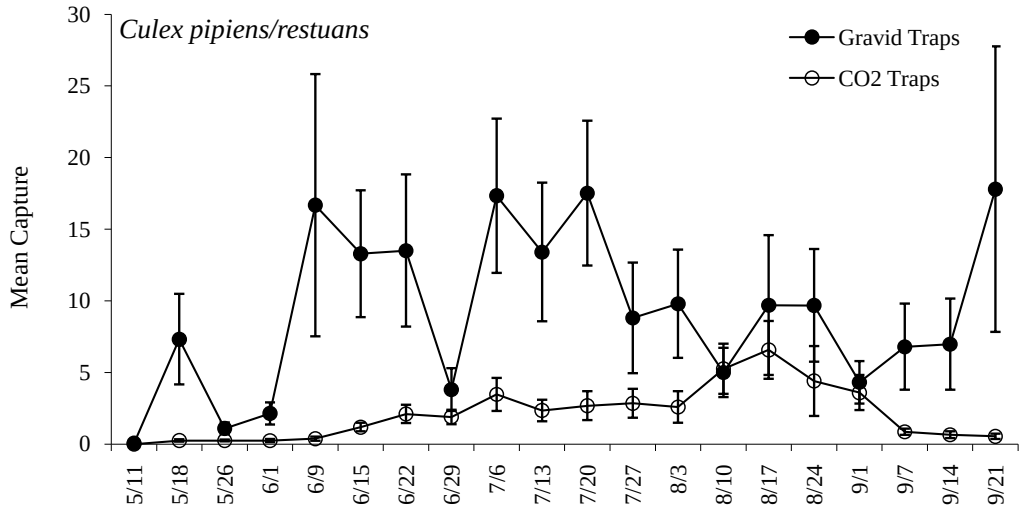

Figure 1.19 Average number of *Cx. pipiens/restuans* in CO_2 traps and gravid traps, 2009. Error bars equal ± 1 standard error of the mean.

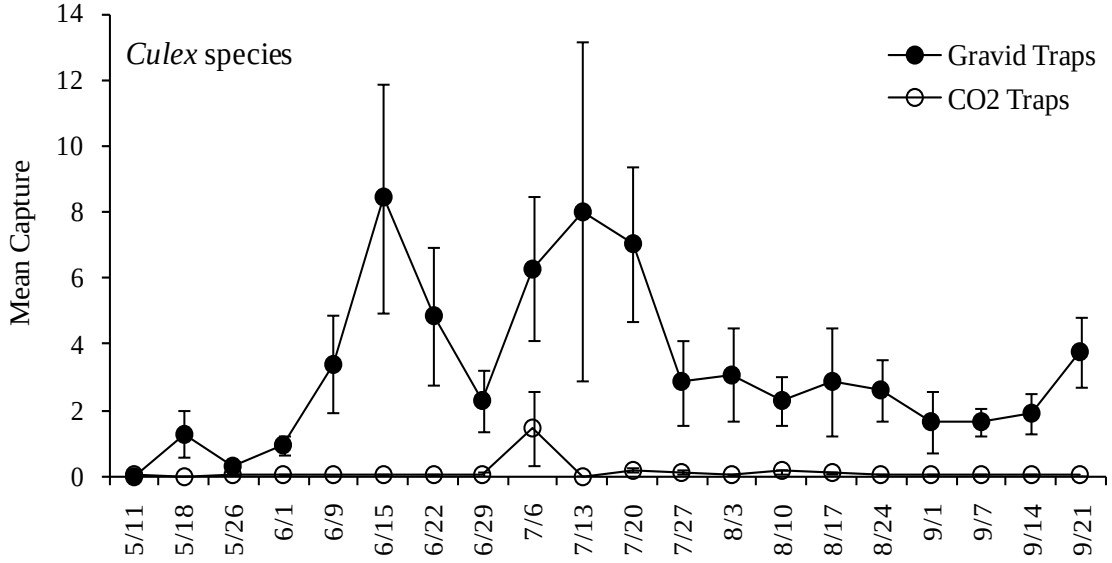

Figure 1.20 Average number of *Culex* species in CO_2 traps and gravid traps 2009. Error bars equal ± 1 standard error of the mean.

Exotic Species Each season, MMCD staff watches for exotic or introduced 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 thousands of samples processed each year. The exotic species most likely to be found in the District are *Ae. albopictus* and *Ae. japonicus*. Both are native to Asia and both have adapted to use tires and other artificial containers as oviposition sites and larval habitat. This allows them to be transported over great distances.

Multiple collections of both *Ae. albopictus* and *Ae. japonicus* occurred in the District in 2009. Several samples represented first county records: staff collected *Aedes albopictus* for the first time in Dakota County and *Ae. japonicus* were detected for the first time in Anoka, Carver, Hennepin, Ramsey and Washington counties in 2009.

Aedes albopictus were collected from three locations in 2009. One larval sample was collected in Credit River Township of Scott County on September 15 near a vacant home. Two larval samples (August 28 & September 15) and six ovitrap samples (two on August 17, two on August 27, September 15, & September 25) were obtained at or adjacent to a tire recycling facility in Savage in Scott County. This is the seventh year the species was collected in Scott County. They were found in 1991, 1996, 1999, 2005, 2006, and 2007. They were also previously collected in Wright County in 1997.

The first record of *Ae. albopictus* in Dakota County came by way of a larval sample from tires in Hastings on September 3. The owner of the property where the specimen was collected informed MMCD staff that the tires were not recently transported from another area; they had been on the property since before the previous winter. Mosquito larvae were found in 12 of 32 habitats inspected upon follow-up visits to the area. No other *Ae. albopictus* were collected.

Early in the spring of 2010, MMCD staff will inspect properties in the three areas where *Ae. albopictus* were discovered. The primary goal will be to eliminate larval habitats that might be used by *Ae. albopictus* in the event that they survived the winter. No previously detected *Ae. albopictus* population has been known to survive a winter within the District, however.

Following numerous collections of *Ae. japonicus* in Dakota County in 2008, District staff prepared a detailed, District-wide surveillance plan for 2009. The focus of the plan was on surveillance for mosquito larvae in tire, container, and tree-hole habitats. The plan also recognized the importance of surveillance of other aquatic habitats and for adult mosquitoes. The larval surveillance plan called for routine surveillance of containers and tires whenever they were encountered in the field, but also included a backup plan to insure some surveillance would occur regardless of other demands on staff time. In that part of the plan, each of the 31 crews selected four sections from which to collect mosquito larvae during a designated period once each month from April through October. Staff was prepared to respond to new findings of *Ae. japonicus* and to conduct early spring surveillance in areas of Dakota County with previous findings in attempts to confirm the ability of the species to survive a local winter.

On March 24, a survey was conducted in the Ravenna area where *Ae. japonicus* were collected in 2008. On that day, several container habitats were inspected for mosquito larvae. No larvae were

encountered; however, three tires and one plastic container were transported to the MMCD lab. The four habitats were flooded indoors and mosquito larvae were identified as they hatched. *Aedes triseriatus* were the only mosquitoes to hatch from the three tires, but the plastic container yielded *Ae. japonicus* along with *Ae. triseriatus* and *Ae. hendersoni*. This finding confirmed what was already suspected; *Ae. japonicus* can survive from one year to the next in the MMCD area.

Spring conditions were cool and quite dry in 2009 and few mosquito larvae were found in container and tire habitats in April. Only 5.8% of containers and tires inspected during the month had mosquito larvae present. There were no *Ae. japonicus* in the samples collected in April. The first *Ae. japonicus* larval specimen of the season was collected on May 8 in Lake Elmo. This represented the first record of the species in Washington County. By the end of May, five more larval samples were collected in Dakota County: four from Ravenna and one from Eureka Township.

Only one *Ae. japonicus* sample was collected in June, a larval sample from Eureka township found approximately ¼ mile from the location of the sample collected in May. With warmer temperatures and late June rainfall, conditions improved for *Ae. japonicus* in July. Fifty-four larval samples containing *Ae. japonicus* were collected in July along with the first adult samples containing the species, five aspirator samples in total. One of the aspirator samples was from Fridley and it represented the first record of the species in Anoka County. Another of the aspirator samples was from New Market in Scott County. This was the first *Ae. japonicus* specimen from Scott County since an ovitrap collection in 2007 from Savage.

A pattern of progression was beginning to emerge in July (Figure 1.21). Of the 59 *Ae. japonicus* samples collected during the month, 44 were from scattered locations in Dakota County, seven were from the southern half of Washington County, seven were from the eastern quarter of Scott County, and one was from southern Anoka County. It appeared that the species was spreading from the southeastern portion of the District where they were detected in 2008 toward the north and west.

In August, 31 larval samples and one adult sample contained *Ae. japonicus*. Dry weather and intensive habitat elimination efforts in areas known to be infested with *Ae. japonicus* each likely contributed to the reduction in specimens from the July total. One larval sample from Arden Hills in Ramsey County and one larval sample from Corcoran in Hennepin County each represented the first records of the species from those counties. Of the remaining August samples, 23 were from Dakota County, six were from Washington County, and one was from Scott County. The six Washington County samples were all from the northern half of the county. Those, along with the Corcoran and Arden Hills findings, suggested continued spread of the species to the north and west.

August rainfall provided an opportunity for *Ae. japonicus* population growth in September. Even though field staff levels were reduced to below 50% during September, 54 larval samples and eleven adult samples collected during the month contained *Ae. japonicus*. An aspirator sample from Chanhassen represented the first record of *Ae. japonicus* from Carver County. Of the 65 *Ae. japonicus* samples collected in September, 38 were from Dakota County, seven were from Scott County, seven were from Hennepin County, six were from Washington County, four were from

Carver County, two were from Anoka County, and one was from Ramsey County. Collections came from as far north as the northern border of Anoka County in Linwood Township and as far west as southwest Hennepin County in Minnetrista.

Cold weather in October ended the season for *Ae. japonicus*. Four larval specimens were collected, three from Dakota County and one from Ramsey County. One ovitrap sample was collected from Scott County. The latest collection of the season occurred on October 16.

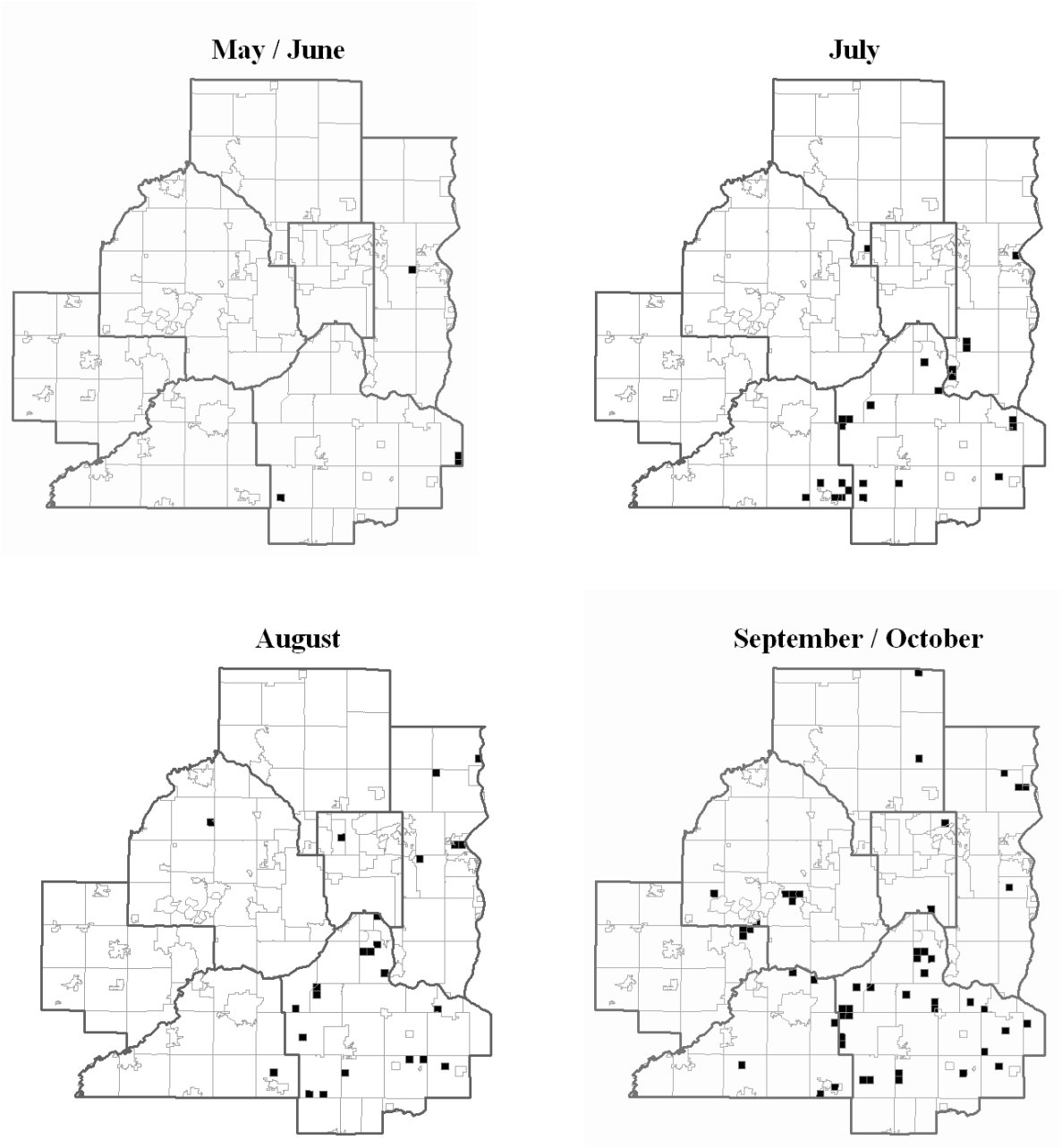

Figure 1.21 Locations of *Ae. japonicus* collections for the time periods May through June, July, August, and September through October. Findings are plotted by section.

Aedes japonicus were collected from 86 District sections overall (Figure 1.22), and from 14 of 124 sections that were selected for monthly surveillance. One ovitrap sample, 17 adult samples, and 151 larval samples contained *Ae. japonicus*. Of the adult samples, 13 were aspirator, two were gravid trap, and twp were NJ light trap collections. One aspirator sample contained three *Ae. japonicus* adults; all other adult samples contained a single specimen each.

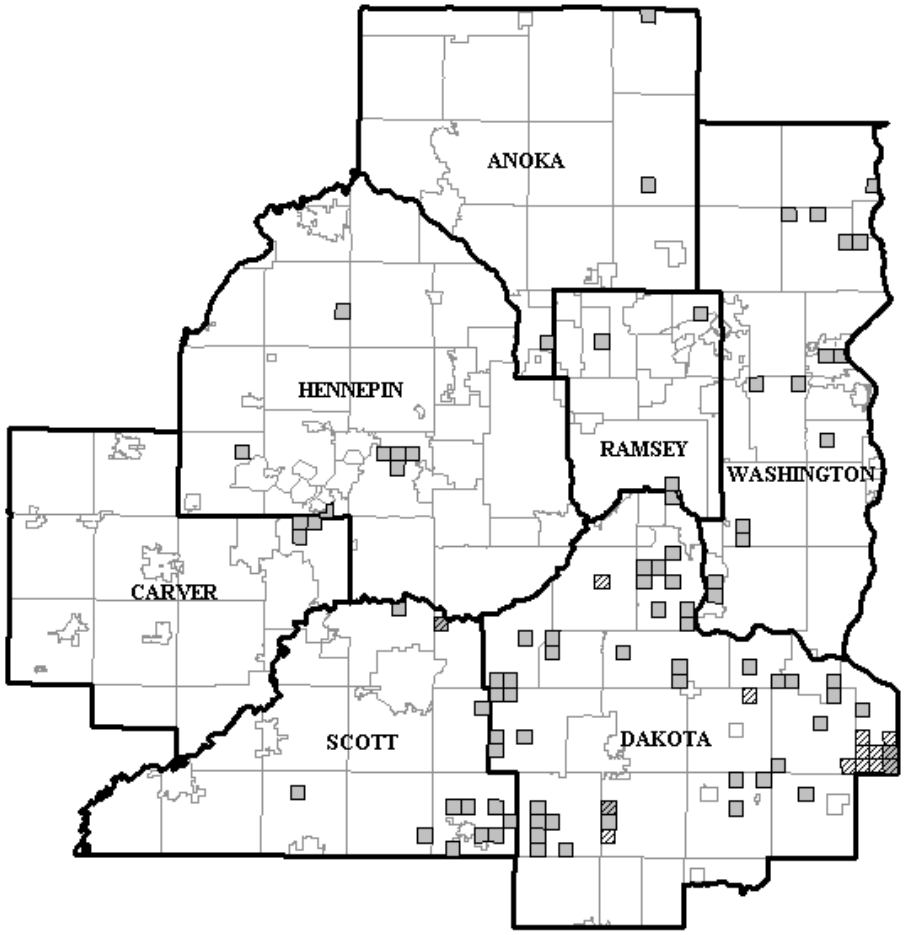

Figure 1.22 *Aedes japonicus* distribution in MMCD. Areas shaded in gray represent locations where *Ae. japonicus* were collected in 2009. Hashed areas represent locations where *Ae. japonicus* were collected prior to 2009.

Of the 151 *Ae. japonicus* larval samples collected, 103 were from containers, 42 were from tires and six were found in man-made structures. Five of the structures were functional stormwater management structures and one was an ornamental pond or water garden.

In their aquatic habitats, *Ae. japonicus* were associated with several other mosquito species. Fifty-seven percent of container or tire samples that contained *Ae. japonicus* also contained *Cx. restuans*. Forty-seven percent contained *Ae. triseriatus*, 4% contained *Cx. pipiens*, 3% contained *Ae. hendersoni*, and 0.7% contained *Ae. albopictus*. Twenty-five percent of the

Ae. japonicus samples also contained *Cx. restuans* and *Ae. triseriatus*; 1.4% contained *Cx. restuans*, *Ae. triseriatus*, and *Cx. pipiens*.

Aedes japonicus appeared to be more plentiful in Dakota County than elsewhere in the District. In Dakota County, 8.4% of the samples from tires or containers contained *Ae. japonicus*. Elsewhere in the District, 1.3% of the samples from tires or containers contained the species. Aspirator samples from Dakota County contained *Ae. japonicus* 1.4% of the time while 0.3% of the remaining aspirator samples captured the species. This illustrates that the concentration of *Ae. japonicus* in an area will increase with each passing season until a static level dictated by habitat availability and other limiting factors is reached.

By eliminating 48,551 potential larval mosquito habitats in 2009, MMCD staff greatly impeded *Ae. japonicus* population growth and the rate of their spread. Still, the species was collected in multiple locations in each of the seven District counties. We fully anticipate the species to continue to expand its range within and beyond the District's borders. Until they are fully established throughout the District our efforts will be focused on containing and eliminating small, isolated populations of the species by limiting larval habitat availability. Once they are well established in areas of or throughout the District, our goal will be to maintain an effective population control program to minimize the risk of disease transmission.

2010 Plans for Mosquito Surveillance

Surveillance strategies for *Aedes* mosquitoes will continue as in 2009. We will continue to evaluate the placement of CO_2 and gravid traps. Our goal is to operate a CO_2 trap in each township in the District to monitor mosquito population levels. Locations include: areas where adult treatments are performed on a regular basis and threshold determination is needed, near cattail sites to monitor *Cq. perturbans* populations, areas of potential disease vector mosquito activity, and employee's homes.

The fall and winter precipitation has increased the subsoil moisture and sets the stage for mosquito breeding in the spring. We plan to continue the search for *Ae. cataphylla* to determine whether or not it is established in the District. Additionally, we will monitor the spread of *Ae. japonicus* across the District and investigate which surveillance methods can best detect its presence. We will continue to monitor likely points of introduction for *Ae. albopictus*.

Chapter 2 Vector-borne Disease

2009 Highlights

- There were no La Crosse encephalitis cases in the District
- WNV illness confirmed in four Minnesotans, there were no cases in the District
- WNV detected in four District mosquito samples
- Conducted product efficacy tests against *Culex* vectors in catch basins and stormwater structures
- Made 219,045 catch basin treatments
- Collected and recycled 39,934 waste tires
- In 2008, *I. scapularis* was collected from at least one site in all seven metropolitan counties as was the case in 2007
- The average *I. scapularis* per mammal was 0.644 in 2008, down from the elevated averages documented for most years since 2000 (all≥.806)
- 2008 human case totals for Lyme disease (1,050) and human granulocytic anaplasmosis (278) were close to the records set in 2007 (source MDH)
- 2009 distribution study report will be on the web by June 2010
- Surveyed for *I. scapularis* and *A. americanum* in Minneapolis and St. Paul
- Responded to a metro-area acquired Rocky Mountain spotted fever case

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, 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) or a history of LAC cases. These areas are targeted for intensive control efforts including public education, mosquito breeding site removal, and limited adult mosquito treatments. Additionally, routine surveillance and control activities are conducted at past LAC case sites. Surveillance for the exotic species *Aedes albopictus* (Asian tiger mosquito) and *Aedes japonicus* Asian rock pool mosquito) routinely occurs to detect infestations of these potential disease vectors.

The District monitors adult mosquitoes of the species *Culex tarsalis* for presence of WEE, which can cause severe illness in Minnesota horses and humans.

Eastern equine encephalitis was detected for the first time in Minnesota in 2001. Since then, MMCD has conducted surveillance for the enzootic vector, *Culiseta melanura.*

Since the arrival of WNV in Minnesota in 2002, MMCD has investigated a variety of mosquito control procedures to be used to enhance our comprehensive integrated mosquito management strategy for the prevention of West Nile illness.

2010 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Evaluate control materials in stormwater structures providing *Culex* larval habitat
- Continue catch basin larvicide treatments to manage WNV vectors
- Communicate treatment strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Monitor and exotic species and integrate control of *Ae. japonicus* into program
- Surveillance at 100 sampling locations for *I. scapularis* will continue
- Continue with tick-borne disease education, tick identifications, and homeowner consultations
- Target education activities to specific metro townships based on higher human case totals and/or numbers of *I. scapularis* collected
- If requested, collect *D. variabilis* for MDH for monitor for *Rickettisia ricketsii* (RMSF bacterial agent)
- Follow-up on *I. scapularis* detection in Waconia (Carver County)

Birds and mosquitoes are tested for WNV and the District uses that information, along with other mosquito sampling data, to make mosquito control decisions.

In 1989, the District was mandated by the state legislature "*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.

The District 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 Metropolitan Mosquito Control District employs 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 useful as we can target control where needed; for tick vectors control is currently restricted to public education. However, knowing where the vectors are is only one piece of the vector-borne disease cycle; knowing if a vector-borne disease may

be circulating is also important. To date MMCD has lacked the capacity to test vectors or reservoir hosts for pathogens.

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 plan to continue this process in 2010. We would ultimately like to increase our ability to better serve metro citizens given that in recent years we have more frequently been receiving reports of previously undetected (EEE, WNV, Powassan virus) or rarely documented (metro-acquired Rocky Mountain spotted fever) diseases. Additionally, we are detecting unusual or new vector species (*Ae. albopictus*, *Ae. japonicus*, *Amblyomma americanum*) more often and our own surveillance continues to show increases in population levels and geographic distribution of disease vectors (*Ae. japonicus, I. scapularis*).

2009 Mosquito-borne Disease Services

Breeding Source Reduction

Water-holding containers such as tires, buckets, tarps, and even plastic toys provide developmental habitat for many vector species including *Ae. triseriatus, Ae. albopictus, Ae. japonicus*, *Culex restuans*, and *Culex pipiens*.

Container habitat elimination is an effective strategy for preventing mosquito-borne illnesses. District staff recycled 39,934 tires that were collected from the field in 2009. Since 1988, the District has recycled 511,027 tires. In addition, MMCD eliminated 8,088 containers and filled 529 tree holes in 2009. This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities, including the 12,445 property inspections by MMCD staff in 2009.

La Crosse Encephalitis

***Aedes triseriatus* Surveillance and Control** *Aedes triseriatus* is a container inhabiting floodwater species and the vector of LAC in our area. Staff sample wooded mosquito habitats by vacuum aspirator to monitor adult *Ae. triseriatus* populations and to direct adult and larval control efforts. *Aedes triseriatus* populations were limited naturally by a fourth consecutive year of mid-summer drought conditions.

In 2009, MMCD staff collected 3,125 aspirator samples to monitor *Ae. triseriatus* populations. The District's treatment threshold of ≥ 2 adult *Ae. triseriatus* per aspirator collection was met in 288 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when samples reached threshold. Additionally, 124 adulticide applications to wooded areas were prompted by collections of *Ae. triseriatus* in aspirator samples.

Adult *Ae. triseriatus* were captured in 534 of 2,219 individual wooded areas sampled. This ratio was similar to the three previous dry seasons. The mean number of *Ae. triseriatus* captured per sample was low, but comparable to previous seasons which lacked ideal weather conditions for the species (Table 2.1).

Table 2.1 Individual wooded areas sampled by aspirator and the number of those where *Ae. triseriatus* were captured, 2000 – 2009

Year	Total areas surveyed	No. with *Ae. triseriatus*	% with *Ae. triseriatus*	Mean no. per aspirator sample
2000	1,037	575	55.4	1.94
2001	1,222	567	46.4	1.32
2002	1,343	573	42.7	1.70
2003	1,558	470	30.2	1.20
2004	1,850	786	42.5	1.34
2005	1,993	700	35.1	0.84
2006	1,849	518	28.0	0.78
2007	1,767	402	22.8	0.42
2008	1,685	495	29.4	0.64
2009	2,219	534	24.1	0.56

La Crosse Encephalitis in Minnesota There were no La Crosse encephalitis cases reported in Minnesota in 2009. This is the first time since La Crosse was made reportable that there were no illnesses confirmed by the Minnesota Department of Health. The nearest case occurred in Grant County, Wisconsin.

Eastern Equine Encephalitis

In 2009, 18 states detected eastern equine encephalitis (EEE) virus, primarily on the East Coast and along the Gulf of Mexico. There were four human illnesses diagnosed, one each in Louisiana, New Hampshire, New York, and North Carolina. There were 307 veterinary reports of EEE illnesses in domestic animals, primarily horses, from 17 states. There were no veterinary cases in the Midwest.

Eastern equine encephalitis virus 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 only record of EEE in Minnesota was in 2001 when three horses were infected with the virus including one from Anoka County.

***Culiseta melanura* Surveillance** *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* are occasionally collected in other areas of the District. Surveillance results are found in Chapter 1.

Western Equine Encephalitis

Western equine encephalitis (WEE) circulates among mosquitoes and birds in Minnesota. In most years, the virus is not detected in the state. 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.

In 2009, *Cx. tarsalis* adults collected in the District during weekly CO_2 trap and gravid trap sampling were submitted to MDH for West Nile and WEE virus analysis. One hundred forty-four *Cx. tarsalis* pools were tested for WEE, none of which were positive. The last record of WEE in the District was from a sentinel chicken sample collected in September 2001.

West Nile Virus

WNV in the United States West Nile virus (WNV) transmission was documented in 47 states in 2009. There were no WNV findings in Alaska, Hawaii, or New Hampshire. The U.S. Centers for Disease Control and Prevention received reports of 722 West Nile illnesses from 34 states. Fatalities occurred in 33 of the cases. Texas, California, and Colorado reported the greatest number of WNV illnesses with 115, 112, and 103 respectively. Screening of the American blood supply detected WNV in 104 donors from 19 states. Additionally, West Nile illness was diagnosed in 260 domestic animals, mainly horses, from 33 states.

WNV in Minnesota MDH reported four WNV illnesses in residents of four Minnesota counties. There were no WNV related fatalities. The earliest onset of a WNV illness in the state was June 24. There were no detections of WNV from Minnesota blood donors in 2009. The only Minnesota veterinary report of a WNV infection was in a dog from Ramsey County.

West Nile Infections in the District For the first time since its arrival in 2002, there were no human WNV infections reported in the District.

Surveillance for WNV For much of the season, West Nile virus circulates at low levels, below the limits of detection of MMCD's surveillance system. Only four mosquito samples and one bird sample returned positive results for the virus. The virus appeared to be most active during a three-week period from late June to mid-July when the WNV positive bird and three of the WNV positive mosquitoes were collected. The canine illness described above also occurred during this time.

The District monitors for WNV by testing mosquitoes and wild birds. Several mosquito species from 33 CO_2 traps (13 elevated into the tree canopy) and 36 gravid traps were processed for viral analysis each week. In addition, *Cx. tarsalis* collected in Monday night CO_2 traps were processed for viral analysis. We tested over 600 mosquito pools using Response Biomedical Corporation's RAMP® method. Of the 161 mosquito pools submitted to MDH for viral analysis by PCR, four pools were WNV positive. Table 2.2 is a complete list of mosquitoes MMCD processed for viral analysis.

Table 2.2 Number of MMCD mosquito samples processed for viral analysis and minimum infection rate (MIR) by species; data from both RAMP® test and PCR are included

Species	Number of mosquitoes	Number of pools	WNV+ pools	MIR per 1,000
Aedes japonicus	19	17	0	0.00
Culex pipiens	62	5	0	0.00
Culex restuans	2,687	84	1	0.37
Culex tarsalis	1,561	156	0	0.00
Culex species	3,959	163	0	0.00
Culex pipiens/restuans	8,731	337	3	0.34
Total	17,019	762	4	0.24

Bird mortality, especially among corvids, can be a sensitive indicator of WNV activity. The District conducted surveillance for WNV in wild birds with help from the public. Citizens reported dead birds to MMCD and some of those birds were selected for WNV analysis. Reports of dead birds received by telephone, internet, or from employees in the field totaled 111. RAMP® tests were done on seven birds. One bird, collected on June 25, was positive for WNV.

The first pool of mosquitoes to return a WNV positive result was collected on June 24. West Nile virus was detected in two mosquito pools in July, one in each of the first two weeks of the month. The fourth and final WNV positive sample of the season was collected on August 19. Infection rates in mosquitoes (Figure 2.1) remained low throughout the season.

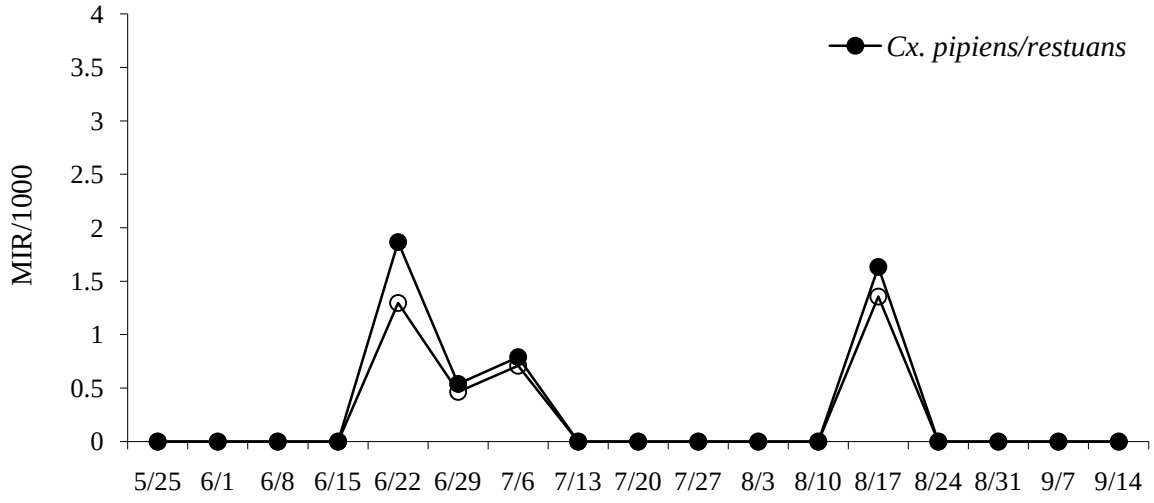

Figure 2.1 Weekly minimum WNV infection rates for all mosquito samples collected and the *Cx. pipiens/restuans* group, which includes pools of *Cx. pipiens*, *Cx. restuans*, and combined pools with both species.

Larval *Culex* Surveillance

Culex tarsalis, Cx. restuans, Cx. pipiens, and *Cx. salinarius* lay rafts of eggs on the surface of standing water. *Culex* larvae can be difficult to find because they are typically much less abundant than other types of mosquitoes in our area. Furthermore, they can disperse over a wide area in large wetlands or they may clump together in small portions of large wetlands. They are generally easier to locate in small habitats where greater concentrations of larvae tend to be more evenly dispersed.

Stormwater Management Structures and Other Man Made Habitats Since 2006, MMCD field staff have been working to locate undocumented stormwater structures, evaluate habitat, and provide larval control. Staff devised a classification system to categorize potential habitats. Types of structures included culverts, washouts, rip/rap, risers (pond level regulators), underground structures, swimming pools, ornamental ponds, and intermittent streams. In 2009, crews concentrated on surveying and applying larvicides to confirmed *Culex* habitats, identifying previously undocumented habitats, and testing larval control products.

Staff made 22,966 inspections of 12,813 structures in 2009. Of the 10,144 wet structures inspected, 3,028 contained by mosquitoes on the day visited. Inspectors collected 2,477 larval samples from stormwater structures and other man-made habitats. West Nile virus vector *Culex* species were found in 84.8 percent of the samples (Table 2.3). Other species commonly collected in 2009 were *Ae. triseriatus, Ae. vexans, An. punctipennis, Cx. territans,* and *Cs. inornata.*

Table 2.3 *Culex* vector species collected from stormwater management structures and other man made habitats

Samples collected (N=2,477)	% occurrence
With *Cx. pipiens*	20.3
With *Cx. restuans*	75.9
With *Cx. salinarius*	0.1
With *Cx. tarsalis*	4.2
With ≥ 1 *Culex* species	84.8

For 2009, field studies were conducted to test Natular™ XRG in stormwater structures. Culverts were selected as habitats suitable to test Natular™ XRG, as *Culex* species often inhabit those that remain wet for a week or longer. Results of these material tests are described in Chapter 5.

Mosquito Control in Underground Stormwater Structures 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). Staff have worked with city crews to survey underground BMPs since 2005.

In 2009, we continued the cooperative mosquito control plan for underground habitats. Nineteen municipalities volunteered their staff to assist with material applications (Table 2.4). Altosid® XR briquets were used at the label rate of one briquet per 1,500 gal of water retained. Briquets were placed in 950 underground habitats.

Table 2.4 Cities that assisted in treating underground stormwater habitats; 950 structures were treated and a total of 1,240 briquets were applied

City	Structures treated	Briquets used	City	Structures treated	Briquets used
Arden Hills	6	6	Minneapolis	164	164
Blaine	6	19	New Brighton	5	8
Bloomington	59	75	New Hope	6	12
Brooklyn Park	4	15	Plymouth	150	335
Crystal	4	12	Prior Lake	286	306
Eagan	20	20	Roseville	11	14
Eden Prairie	12	20	Savage	6	15
Hastings	2	2	Spring Lake Park	2	2
Maplewood	120	120	White Bear Lake	60	60
Mendota Heights	27	35			

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.

Larval *Culex* Control in Catch Basins Four extended efficacy larvicides were evaluated for use in catch basins in 2009. The FourStar™ briquet which includes both *Bti* and *B. sphaericus* was evaluated. The Natular™ 150 day tablet with its active ingredient spinosad was tested. Additionally, two formulations of an insect growth regulator produced by McLaughlin Gormley King (MGK) were tested (10g, 50g). A review of this research is in Chapter 5.

The summer of 2009 could be characterized as being abnormally dry. This was the fourth consecutive mosquito season with drought conditions. Mosquitoes that inhabit catch basins are generally aided by extended periods of dry weather, as larvae are not swept away by flushing rainfall. We observed high rates of larval presence in catch basins from mid-June to early September. Larvae were found during 505 of 689 catch basin inspections (73.3%) in 2009. Fifty sites were inspected most weeks from the last week of May through the second week of September during material efficacy trials. Field staff inspected additional catch basins for other purposes such as for training or for locating sources of mosquitoes in adult traps. Rates of larval presence in catch basins by week are displayed in Figure 2.3.

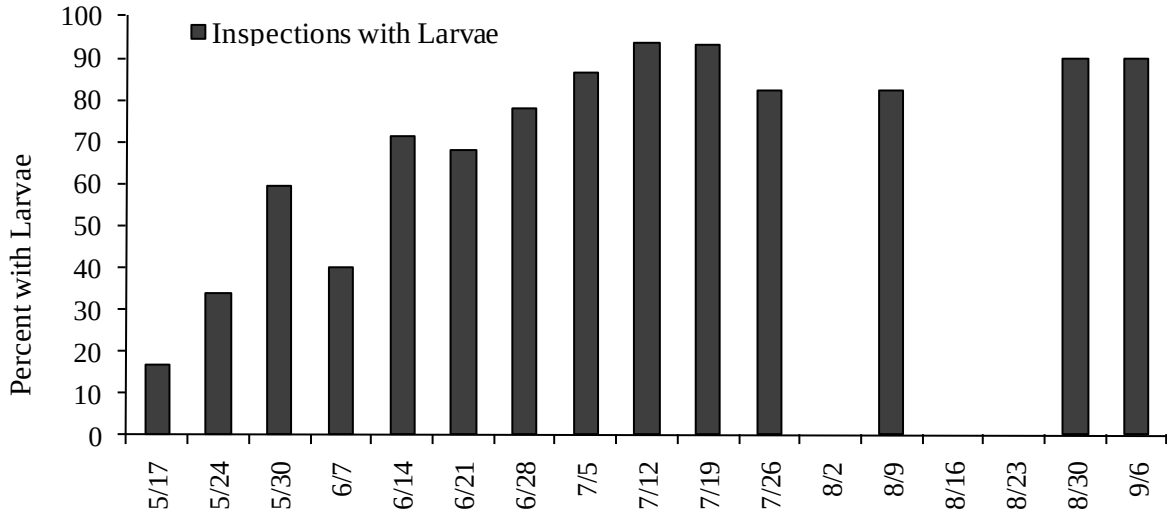

Figure 2.3 Weekly ratios of catch basins inhabited by mosquitoes (n=10 to 102). No samples were collected the weeks of August 2, August 16, and August 23.

Mosquito larvae occurred in 497 catch basin samples (Figure 2.4). The predominant species was *Cx. restuans,* as is usually the case in our area. *Culex restuans* were found in 84.5% of catch basin larval samples. *Culex pipiens* were identified from a large number of catch basin samples, 51.3%, which exceeds all previous observations.

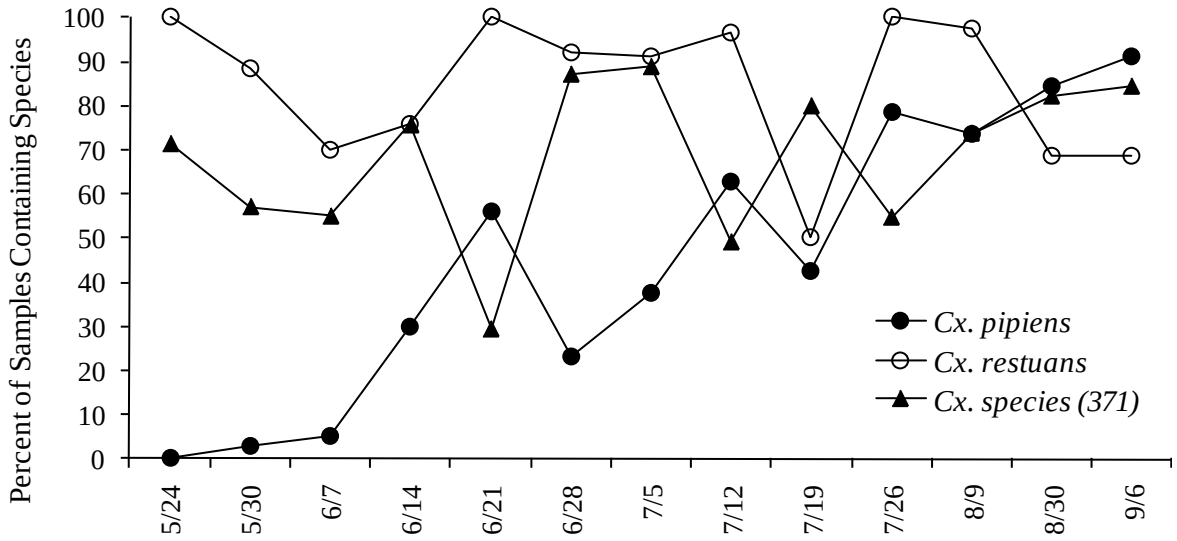

Figure 2.4 Composition of *Culex* mosquito species in catch basin larval samples by week (n= 44 to 59). No samples were collected the weeks of August 2, August 16, and August 23.

Plans for 2010 – Mosquito-borne Disease

District staff will continue to provide mosquito surveillance and control services for the prevention of La Crosse encephalitis. Preventive measures include adult sampling, adult control, and tree hole and container habitat reduction along with property inspections. The District will continue to survey aquatic habitats for *Culex* larvae for use in design and improvement of larval control strategies. *Culex tarsalis* will remain a species of particular interest. Staff will expand evaluations of larvicides to control *Culex* species in habitats that result from stormwater management practices. District staff will continue to refine catch basin larviciding operations. The scale of new product evaluations will increase. Cooperative work with municipalities within the District to treat underground stormwater structures that produce mosquitoes will continue.

We will continue to conduct surveillance for WNV and other mosquito-borne viruses in coordination with MDH and others involved in surveillance for WNV in Minnesota.
Staff will also continue to monitor *Cs. melanura* in the District with attention focused on areas in Anoka and Washington counties where the species has been encountered in the past. Finally, MMCD staff will continue to monitor the spread of *Ae. japonicus* and will remain watchful for the introduction of other exotic mosquito vectors, especially *Ae. albopictus*. The District will focus on habitat elimination as the primary control effort against these exotic species.

2009 Tick-borne Disease Services

Ixodes scapularis Distribution

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 from them. Collections from the northeastern metropolitan area—primarily in Anoka and Washington counties—have consistently detected *I. scapularis*, and in 1998 *I. scapularis* was detected in Hennepin and Scott counties for the first time. Since then we have continued to detect *I. scapularis* with greater frequency at sites located south of the Mississippi River. Following are the latest data compilations available (2008 results) as well as some updates from the 2009 season. The 2009 report will be available on our website (www.mmcd.org) in June.

When comparing our data geographically (Figure 2.5) and via changes in other *I. scapularis* collection results over time (Table 2.5), we believe we had first detected an elevated *I. scapularis* population in 2000 (Table 2.6). Our 2008 distribution study results seem to provide continued evidence of an elevated metro *I. scapularis* population. For only the second time, we collected *I. scapularis* from all seven counties that comprise our service area (the first occurrence was 2007), our positive site total was in the 50s again (this first occurred in 2000), and we continued to tabulate higher than typical numbers of positive sites from counties south of the Mississippi River (Table 2.7). The total of 19 positive sites in 2008 is another new record, surpassing the previous high of 16 set in 2007. Although our overall average of .644 ticks per mammal was lower than our elevated averages (all $\geq$ .806) of 2000 – 2002, 2004, 2005, and 2007, it is still higher than from any other year (Table 2.6). While larval *I. scapularis* collections were low, we

collected 112 nymphs; the first occurrence of a nymph count in the 100s was in 2000. Historically it has been typical for *Dermacentor variabilis* (common wood tick) to comprise the majority of our tick collections (Table 2.6), but in 2002, 2004, 2005, and 2006 *I. scapularis* comprised the majority (≥50%) of our tick collections. However, in 2008, for the second consecutive year, we again collected a higher percentage of *D. variabilis* than *I. scapularis*.

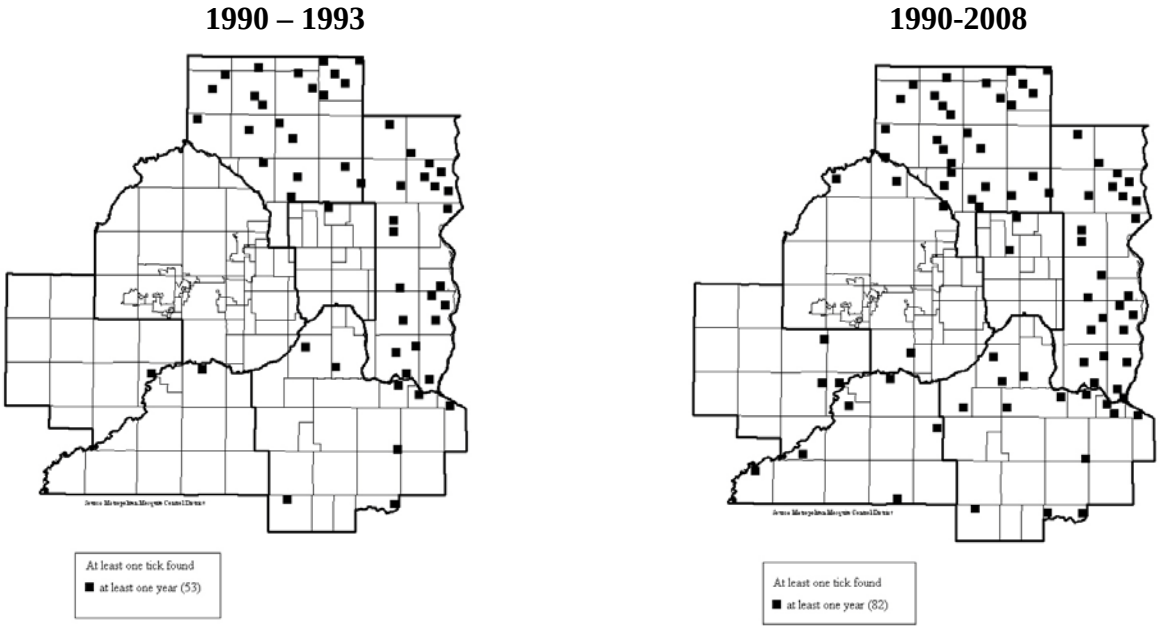

Figure 2.5 Presence/absence status of *I. scapularis* collected for the periods 1990-1993 and 1990-2008. Black squares indicate at least one *I. scapulars* has been collected during the period.

Table 2.5 Comparison of *I. scapularis* presence/absence status at 100 repeat sampling sites

	Sampling year								
	1992	1994	1996	1998	2000	2002	2004	2006	2008
No. sites changing status	26	38	47	58	61	69	75	78	81
Ticks found:									
All years (100%)	21	17	11	5	5	4	1	1	1
Most years (50%-99%)	5	15	19	27	31	35	38	41	42
Least years (1%-49%)	21	23	28	31	30	34	37	37	39
Not found	53	45	42	37	34	27	24	21	18

Table 2.6 Numbers and percentages of tick species collected by stage and year

				Dermacentor variabilis				*Ixodes scapularis*					
		Total	Total									Other	
	No.	mammals	ticks	larvae		nymphs		Larvae		nymphs		species[b]	
Year	sites	collected	collected	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)
1990 [a]	250	3651	9957	83	(8289)	10	(994)	6	(573)	1	(74)	0	(27)
1991	270	5566	8452	81	(6807)	13	(1094)	5	(441)	1	(73)	0	(37)
1992	200	2544	4130	79	(3259)	17	(703)	3	(114)	1	(34)	0	(20)
1993	100	1543	1785	64	(1136)	12	(221)	22	(388)	1	(21)	1	(19)
1994	100	1672	1514	53	(797)	11	(163)	31	(476)	4	(67)	1	(11)
1995	100	1406	1196	54	(650)	19	(232)	22	(258)	4	(48)	1	(8)
1996	100	791	724	64	(466)	20	(146)	11	(82)	3	(20)	1	(10)
1997	100	728	693	73	(506)	10	(66)	14	(96)	3	(22)	0	(3)
1998	100	1246	1389	56	(779)	7	100)	32	(439)	5	(67)	0	(4)
1999	100	1627	1594	51	(820)	8	128)	36	(570)	4	(64)	1	(12)
2000	100	1173	2207	47	(1030)	10	(228)	31	(688)	12	(257)	0	(4)
2001	100	897	1957	54	(1054)	8	(159)	36	(697)	2	(44)	0	(3)
2002	100	1236	2185	36	(797)	13	(280)	42	(922)	8	(177)	0	(9)
2003	100	1226	1293	52	(676)	11	(139)	26	(337)	11	(140)	0	(1)
2004	100	1152	1773	37	(653)	8	(136)	51	(901)	4	(75)	0	(8)
2005	100	965	1974	36	(708)	6	(120)	53	(1054)	4	(85)	0	(7)
2006	100	1241	1353	30	(411)	10	(140)	54	(733)	4	(58)	1	(11)
2007	100	849	1700	47	(807)	8	(136)	33	(566)	10	(178)	1	(13)
2008	100	702	1005	48	(485)	6	(61)	34	(340)	11	(112)	1	(7)
2009	100	941	1897	48	(916)	9	(170)	39	(747)	3	(61)	0	(3)

[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

Table 2.7 Number of sites south of the Mississippi River positive for *I. scapularis*

	Years sampled								
	1992	1994	1996	1998	2000	2002	2004	2006	2008
Total sites south of river:	*1	2	4	4	7	12	9	12	19
By county:									
Dakota	1	2	4	2	6	8	8	9	12
Hennepin	0	0	0	1	1	3	0	2	3
Scott	0	0	0	1	0	1	1	1	2
Carver	0	0	0	0	0	0	0	0	2

*This count includes only our current site network; intensive surveillance outside of the network yielded one additional positive site, also from Dakota County.

Tick-borne Disease

Similarly, MDH has been tabulating record-setting human tick-borne disease case totals since 2000. Pre-2000, the highest Lyme disease case total was 302. The Lyme case totals since 2000 have ranged from 463 to 1,239 cases, while the total HGA case numbers ranged from 78 to 186 from 2000 – 2006 compared with an average of roughly 15 cases per year through 1999. The all-

time high, statewide Lyme disease and HGA case records occurred in 2007 (Lyme 1,239; HGA 322), surpassing the previous Lyme (1,023 in 2004) and HGA (186 in 2005) records by a large margin. The 2008 human case totals for Lyme disease (1,050) and HGA (278) were again high. Human disease case data for 2009 is not yet available but MMCD was informed of a 2009 metro-acquired Rocky Mountain spotted fever case in July 2009. To date RMSF is very rarely documented in Minnesota and even more rarely documented as having been acquired in our service area.

Additional Updates – New Strategies 2009

Vector ticks in Minneapolis and St Paul In fall 2008, MMCD received two independent credible reports of *I. scapularis* being found along the Mississippi River, one each in Minneapolis and Saint Paul. In each case, the tick was found on a dog. In May of 2009, we evaluated these areas for trap line set-ups but we determined that the combination of the lack of quality habitat and high activity (dogs and people) was not conducive for that type of an effort. Instead, MMCD intensely surveyed both areas via dragging cloth along vegetation. While the survey was underway, we made a point to communicate with citizens that we encountered both to inform and to convey our interest in receiving more ticks. Although these citizens consistently reported finding ticks on their dogs in these areas in recent years and during the timeframe of our surveys, we did not find any additional ticks by dragging.

Amblyomma americanum (lone star tick) 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 and this species was first collected by MMCD in 1991 via a road kill examination of a white-tailed deer (*Odocoileus virginianus*). On June 11, the MDH notified us of an *A. americanum* submission to MDH that had been most likely collected in Theodore Wirth Park (Minneapolis). Like the fall 2008 *I. scapularis* collections along the Mississippi River, this tick also had been collected from a dog. A survey of Theodore Wirth Park was completed by MMCD on June 15 and no additional ticks of any species were collected in the park. Staff did continue to receive citizen reports of ticks being collected in this park, too, however. In tandem, a survey in northern Dakota County confirmed our sampling method and timing was adequate as staff collected 20 *D. variabilis*.

On a stand-alone basis, each report was just an interesting submission. However, by the time of the Theodore Wirth Park tick notification there were three independent reports of tick vectors being collected well inside city limits that had all been found on dogs. Citizens in each of these survey areas continued to report that ticks were still being found at the time we were performing the surveys. For those reasons, MMCD put out a press release on June 25 requesting the public to submit ticks.

In mid-July, MMCD received a mailed tick for identification that we identified as a nymphal *A. americanum*. It was reported to us that this almost fully engorged tick was removed from a person on July 10 who had no travel history outside of Circle Pines (Anoka County). We did not

attempt any additional sampling in response to this particular tick record due to our previous unsuccessful efforts combined with our estimate that we were likely past peak for *Amblyomma*.

On July 21, a staff member turned in an *I. scapularis* that had been collected in Waconia (Carver County). This tick, too, had been removed from a dog. Because it was unusual to collect an *I. scapularis* from this area we decided to further investigate despite our view that we were likely past peak for *I. scapularis*. A trap line was set at the suspected tick collection location for the week of July 27 but no ticks of any species were collected. We may attempt to re-sample this area in 2010.

Summary – 2009 response to metro Rocky Mountain spotted fever case In July, MDH notified MMCD of a likely locally acquired RMSF case, and the MMCD Commission was soon updated. Staff was given basic RMSF information for their own use as well as to enable them to respond to general questions from the public. We made an aggressive tick collection effort from July 23-July 31 and provided these ticks to MDH. The District also provided archived ticks from areas of interest to the MDH. MDH plans to test these ticks in the future. Additional tick collections for the MDH may occur in 2010.

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services were maintained in 2009 using methods and tools described in previous operational reviews.

2010 Plans for Tick-borne Services

Metro Surveillance

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

Tick Identification Services/Outreach

We plan to maintain our tick-borne disease education activities and services including tick identifications and homeowner consultations. Since 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 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 offer an encompassing slide presentation.

Amblyomma americanum / New or Unusual Tick Species

The District and MDH continue to discuss possible strategies that would enable both agencies to detect possible establishment of *A. americanum* in Minnesota. Staff will continue to check for this tick in our surveillance and both MMCD and MDH plan to maintain or speed up our notification process to the other agency upon identifying an *A. americanum* or other new or unusual tick species.

Dermacentor variabilis Tick Collections

The District may collect additional ticks for MDH to test for *Rickettsia rickettsii*, the bacterial agent of RMSF.

Chapter 3 Mosquito Control

2009 Highlights

- 30,419 more acres worth of larvicides were applied to wetlands in 2009 than in 2008
- A cumulative total of 219,045 catch basin treatments were made in three rounds to control vectors of WNV
- Enhanced surveillance detected *Aedes japonicus* in all seven District counties
- 84,989 fewer acres worth of adulticides were applied in 2009 than in 2008

2010 Plans

- Concentrate on the stormwater management structure treatment program to maintain efficacy and reduce workload to enable staff to provide additional mosquito control services
- Review MMCD's integrated mosquito management program to maximize service we can provide to citizens with current resources
- 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 *Coquillettidia perturbans*, and several disease vectors including: *Aedes triseriatus* (eastern treehole mosquito) which can transmit La Crosse encephalitis (LAC); *Culex tarsalis,* the vector of western equine encephalitis (WEE) and West Nile virus (WNV); and *Cx. pipiens, Cx. restuans,* and *Cx. salinarius* which are also potential vectors of WNV. Another vector species, *Aedes japonicus*, which arrived on the scene in 2007, has also increased control needs. Larval control is the main focus of the program but is supplemented by adult mosquito control when necessary.

Aedes larvae hatch in response to snowmelt or rain with adults emerging at various times during the spring and summer. Cattail mosquito larvae develop in cattail marshes over 12 months and emerge as adult mosquitoes in June and July. *Culex* populations increase during periods of greater precipitation but inhabit waters that are more permanent and therefore are not as dependent upon rainfall. Stormwater catch basins can also provide habitat for *Cx. pipiens* and *Cx. restuans.* This type of mosquito habitat can be the primary source of WNV vectors in heavily urbanized areas. *Aedes triseriatus* and *Ae. japonicus* both use many kinds of natural and artificial containers for larval habitat.

The District uses priority zones to focus service in areas where it will benefit the highest number of citizens (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 resources allow.

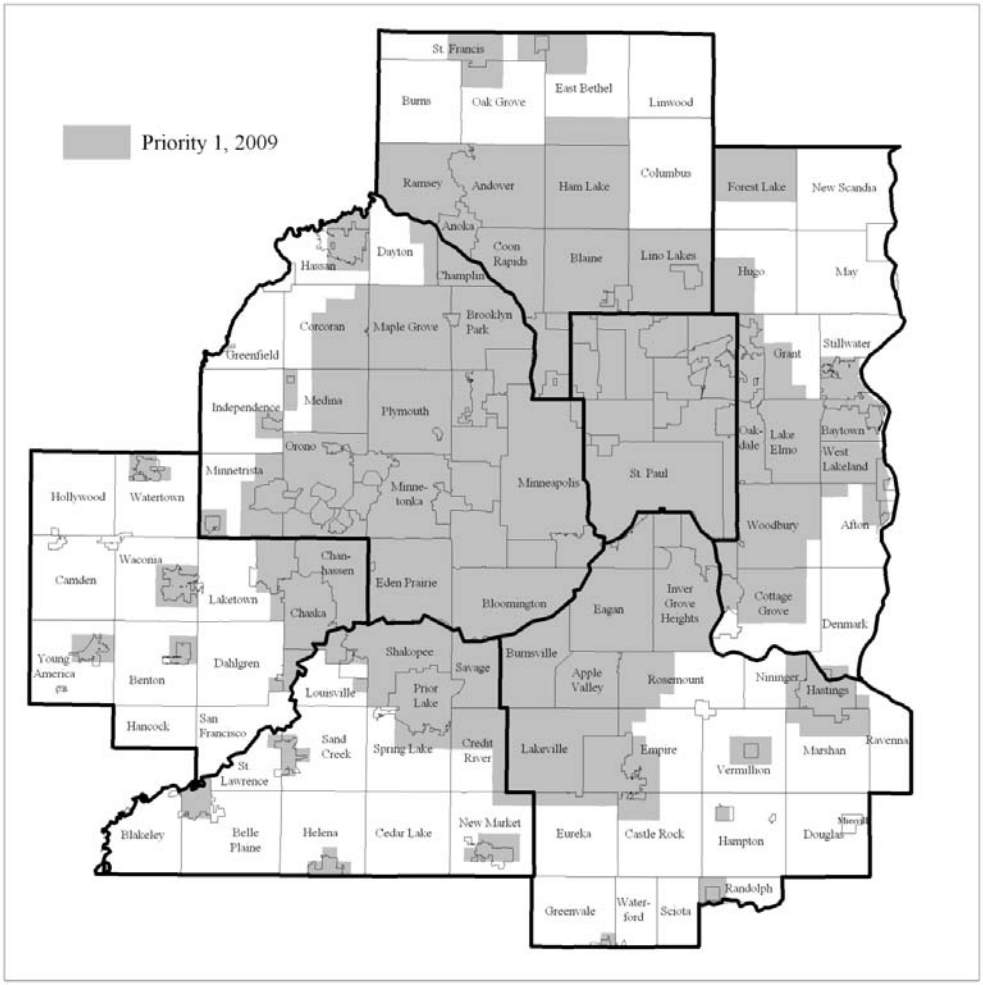

Figure 3.1 Priority zones 1 (shaded) and 2 (white), with District county and city/township boundaries.

Adult mosquito control supplements the larval control program. Adulticide applications are done after sampling detects mosquito populations at threshold levels (especially disease vectors), primarily in high use park and recreation areas, for public events, or in response to citizen mosquito annoyance reports. Three synthetic pyrethroids are used: resmethrin, permethrin, and sumithrin. Two formulations of natural pyrethrins, Pyrenone® and Pyrocide®, are also used, mainly 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 summary of the number of acres treated with each control material from 2001-2009. Appendix F shows the amount of larvicide and permethrin acres treated from1984-2009. Pesticide labels are located in Appendix G.

2009 Mosquito Control

Larval Mosquito Control

The District primarily used VectoBac® G, *Bacillus thuringiensis israelensis* (*Bti*), to control populations of spring *Aedes* and summer floodwater *Aedes*. Because resources are limited (time and materials), P1 and P2 have different thresholds, allowing us the ability to target sites that produce high numbers of mosquitoes that are in or near the human population centers. Spring *Aedes*, which tend to be long-lived, aggressive biters, have relatively low thresholds (.1/dip and .5/ dip in P1 and P2, respectively). After mid-May, thresholds are increased to control floodwater summer species (2/dip and 5/dip in P1 and P2, respectively). The threshold for *Culex*4 (*Cx. restuans, Cx. pipiens, Cx. salinarius, Cx. tarsalis*) larvae is 1/dip in all priority zones at any time of the season. Occasionally, *Aedes* and *Culex* are present together in a site and neither meets their respective threshold; they can be treated if, when combined, they meet the 2/dip or 5/dip threshold in P1 and P2, respectively.

Treatments began in April to control spring *Aedes* mosquitoes hatching in snowmelt water (Figure 3.1). Spring *Aedes* hatch at different times, depending on the timing, amount, and rate of snowmelt and the species. Typically, the spring brood is treated with one round of aerial applications, timed to occur at the peak abundance of hatched larvae. As in 2008, weather conditions prolonged the spring hatching, making it difficult to determine the optimal time to make aerial applications. In 2009, two rounds of *Bti* applications were made to maximize the control of the spring brood, totaling 46,777 treatment acres (32% of total aerial treatment acres done in 2009).

Precipitation was significantly below average from April through July and only scattered treatments of nine small-medium broods of summer *Aedes* occurred. Heavy rains in August resulted in 62,750 acres (42%) of aerial *Bti* treatments to control two large broods.

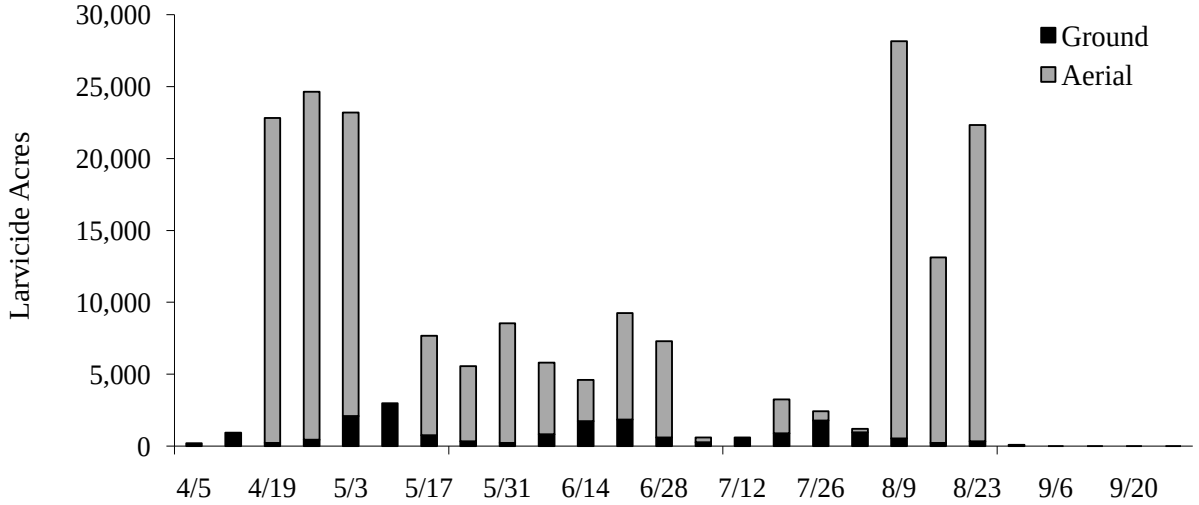

Figure 3.1 Acres of ground and aerial larvicide treatments each week, April-September 2009.

In 2009, we further expanded large-scale treatments of Altosid® (methoprene) XR-G sand to control the cattail mosquito (1,741 more acres than in 2008, Table 3.1). Because of the lower cost per acre of XR-G sand vs. Altosid® pellets currently used for most cattail treatments, shifting budget dollars to XR-G sand allows us to treat about 25% more acres, and we plan to continue this shift in 2010. However, there is usually a limited time period in late May when XR-G sand can be applied and provide effective control, so we also tested an alternative material that could be applied in late summer. A September 2008 treatment of 70 acres of cattail sites with VectoLex® (*B. sphaericus*) effectively suppressed cattail mosquito emergence in cages in June-August 2009 (see Chapter 5). We postponed additional testing in 2009 due to lack of study sites with sufficient larval populations.

Stormwater catch basin treatments began in early June and ended in early September. Most catch basins were treated three times with Altosid® pellets (3.5 g per catch basin) to control *Culex* mosquitoes from June through mid-September (Table 3.1). The primary goal of control material tests in 2009 was to find a longer lasting material and decrease the number of times per season catch basins required treatment to control WNV vectors (see Chapter 5).

Table 3.1 Comparison of larval control material usage in wetlands and stormwater catch basins for 2008 and 2009

	2008		2009	
Material	Amount used	Area treated	Amount used	Area treated
Wetlands				
Altosid® briquets	478.54 cases	294 acres	375.36 cases	225 acres
Altosid® pellets	119,538.12 lb	35,780 acres	117,869.02 lb	35,161 acres
Altosid® XR-G	65,787.20 lb	6,579 acres	83,200.00 lb	8,320 acres
VectoLex® CG	45.30 lb	6 acres	0.00 lb	0 acres
VectoMax® CG	1,459.02 lb	182 acres	39.77 lb	5 acres
VectoBac® G	978,056.76 lb	122,251 acres	1,214,478.44 lb	151,801 acres
Larvicide subtotals		165,092 acres		195,511 acres
Catch basins				
Altosid® briquets	0.18 cases	40 CB[1]	0.00 cases	0 CB[1]
Altosid® pellets	1,563.85 lb	195,793 CB	1,776.46 lb	219,045 CB
CB subtotals		195,833 CB		219,045 CB

[1]CB=catch basin treatments

We continued to study how to reduce the amount of time and personnel required for effective season-long control of WNV vectors breeding in other stormwater management structures. In 2009, we expanded our program to control vectors breeding in stormwater management structures by testing larvicides designed to be effective in culverts that repeatedly dry out and re-flood. We tested a granular formulation that should be easier to apply to small stormwater management structures (see Chapter 5).

Adult Mosquito Control

Adult mosquito control operations are considered when mosquito levels rise above established thresholds. For non-vector mosquitoes, the treatment threshold is two mosquitoes per 2-minute sweep or 2-minute slap count or 130 mosquitoes in an overnight CO_2 trap. For *Culex*4 species, the treatment thresholds are one of any of these *Culex* per 2-minute sweep, 5 per CO_2 trap, or 5 per 2-day gravid trap. Adulticide treatments were also considered when two or more *Ae. triseriatus* or at least one *Cx. tarsalis* were captured in a vacuum aspirator sample. One *Ae. japonicus* captured using any adult surveillance method was the threshold in 2009. We may modify this threshold as we learn more about how *Ae. japonicus* spreads in the District.

In 2009, MMCD applied adulticides to 25,627 acres. This was much less than 2008 (Table 3.2) and the lowest amount of ULV fog used since the major drought year of 1988 (Figure 3.2). In most of 2009, high adult mosquito levels were rare except for localized areas or late in the season (Figure 1.8). In contrast, 2008 had higher, more widespread adult levels present from late June through early July (2008 Operational Review, Figure 1.9) and weather conditions favored treatment that year.

Table 3.2 Comparison of adult control material usage in 2008 and 2009

	2008		2009	
Material	Gallons used	Acres treated	Gallons used	Acres treated
Permethrin	1,615.69	8,272	874.23	4,754
Resmethrin	758.66	64,142	149.50	12,179
Sumithrin	513.27	35,734	161.04	7,796
Pyrocide*	3.50	299	0.00	0
Pyrenone*	25.95	2,214	11.05	943
Total		110,661		25,672

* Products containing natural pyrethrins for adulticide treatments in agricultural areas

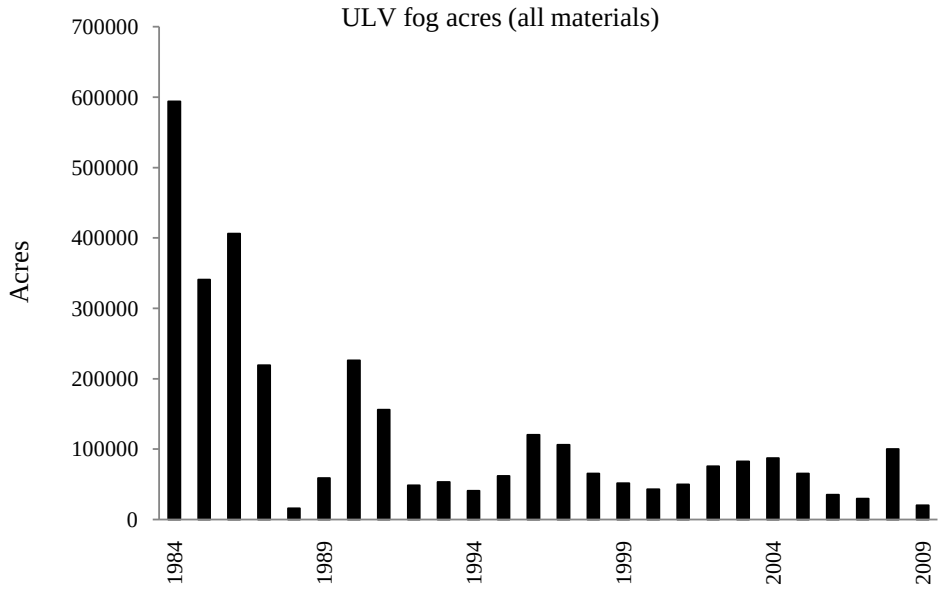

Figure 3.2 ULV fog (adulticide) acres treated, 1984-2009: includes resmethrin, sumithrin, Pyrocide, and pyrenone.

In 2009, the proportion of CO_2 trap locations with threshold-level detections remained low throughout the season, with small peaks in late June and early July and again in late August (Figure 3.3, see Chapter 1 for map of locations). Annoyance species included mainly spring *Aedes* and *Ae. vexans* in June, plus the permanent water species *Cq. perturbans* in early July (Figure 1.12). Vector threshold detections (mainly *Cx. restuans* and *Cx. pipiens*) also were low, with a small peak in late June and then again in late July through mid-August. Adulticide treatments began in early June, peaked in late June, and continued at lower levels until mid-September. The *Culex* levels in July and August did not trigger more adulticiding because of the very low amounts of *Cx. tarsalis* and the lack of indication of West Nile virus activity (virus tests, dead birds, human or horse cases). Levels of both traps over threshold and adulticiding were markedly lower in 2009 than in 2008 (Figure 3.4)

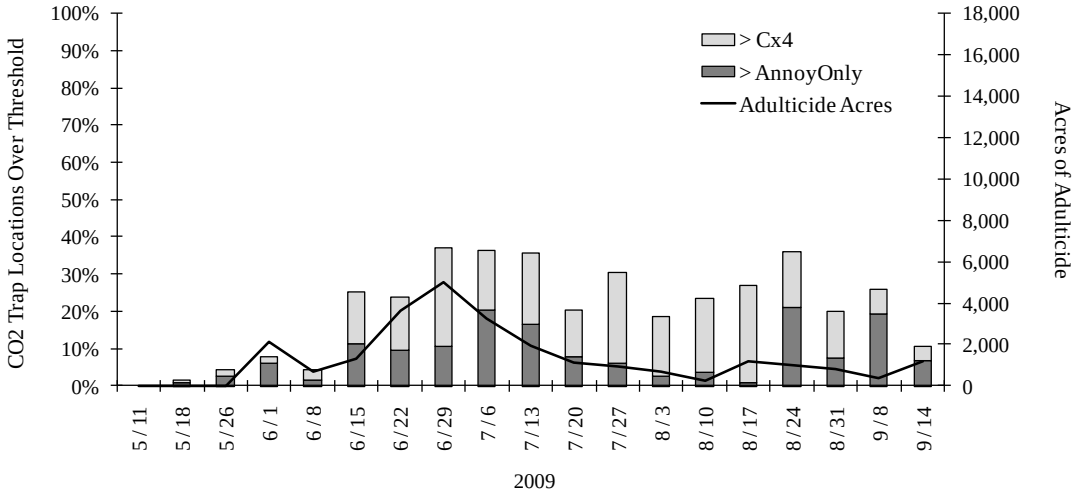

Figure 3.3 Percent of CO_2 trap locations with counts over threshold, showing subtotals by annoyance or *Culex* vector thresholds, with acres of adulticides applied, 2009.

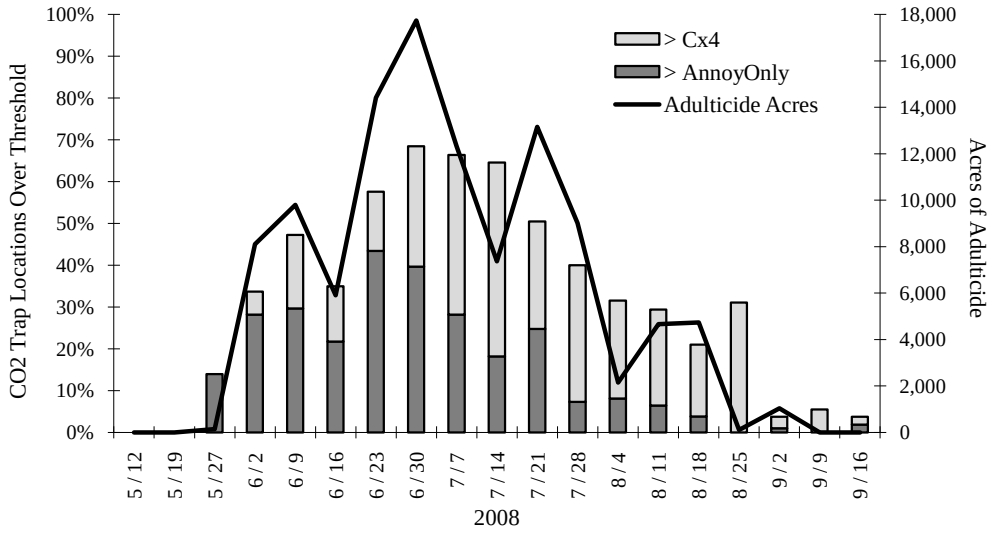

Figure 3.4 Percent of CO_2 trap locations with counts over threshold, showing subtotals by annoyance or *Culex* vector thresholds, with acres of adulticides applied, 2008.

The recorded relationship between adulticide treatments and surveillance or call data for 2009 is shown in Table 3.3. In 2009, efforts to improve surveillance data linkage (Chapter 6) apparently made a difference, with the percent of treatments with links to surveillance records increasing from 33% to 65% for ULV treatments and 38% to 69% for permethrin. We plan to continue system improvements and training in 2010. The proportion of permethrin treatments recorded as a response to vector numbers remained about the same as 2008. The proportion of ULV treatments recorded as vector response decreased somewhat from 33% in 2008, probably related to the overall low vector populations in 2009. The proportions of treatments recorded as response to events, parks, or calls remained similar to previous years.

Table 3.3 Recorded links to adulticide treatments in 2009

	No. of treatments	Source designation			% of treatments with species ID	Of those with ID >vector threshold*
		Events	Parks	Other calls		
ULV fog	659	3%	13%	14%	431 (65%)	19%
Permethrin	1724	4%	13%	17%	1182 (69%)	34%

* Exceeded threshold for *Culex* vector spp., *Ae. triseriatus*, or *Ae. japonicus*

2010 Plans for Mosquito Control Services

Integrated Mosquito Management Program

In 2010, 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.

Larval Control

Cattail Mosquitoes In 2010, control of *Cq. perturbans* will use a strategy similar to that employed in 2009. The District 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). Beginning in late May, staff will treat with Altosid® pellets applied by helicopter at a rate of 4 lb/acre and Altosid® XR-G sand at 10 lb/acre. Additionally, staff will continue evaluating the success of late summer VectoLex® applications.

Floodwater Mosquitoes The primary control material will again be *Bti* corncob granules. Budgeted *Bti* (VectoBac® G) and Altosid® pellet needs in 2010 are similar to 2009 requirements. 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 (<3 acres) with methoprene products (Altosid® pellets, Altosid® briquets) or *Bti* corncob granules. During a wide-scale mosquito brood, breeding sites in P1 will receive treatments first. The District will then expand treatments into P2 where treatment thresholds are higher. Larval treatment thresholds will be the same as in 2009.

We intend to continually review breeding histories of ground sites to identify those that breed most often to better prioritize which sites to inspect before treatment, which sites to treat before breeding with Altosid® products, and which sites to not visit. The ultimate aim is to provide larval control services to a larger part of the District by focusing on the most prolific breeding sites.

Vector Mosquitoes 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).

Since the arrival of WNV in 2002, MMCD has expanded control to include four *Culex* species. Ground and aerial larvicide treatments of wetlands have been increased to control *Culex*. Catch basin treatments control *Cx. restuans* and *Cx. pipiens* breeding in urban areas. Catch basins will be treated with Altosid® pellets. A few may be treated with Natular™ (spinosad) or FourStar™ (*Bti/B. sphaericus*) briquets. 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 have tentatively planned to complete a first round of pellet treatments by June 25 with subsequent Altosid® pellet treatments every 30 days. Catch basins treated with Natular™ or FourStar™ briquets will be treated by June 25 and retreated if larval surveillance indicates a cessation of control. We will continue tests of longer lasting larvicides with the goal of decreasing the number of treatments required per season to control WNV vectors.

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 as we determine which larvicides effectively control vector larvae in these structures (see Chapter 5).

Adult Mosquito Control

Staff will continue to review MMCD's adulticide program to ensure that resources are used most effectively to provide services and minimize possible non-target effects. Budgeted adulticide needs in 2010 are similar to 2009 requirements. 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. We will also continue to improve our ability to record links between surveillance, calls, and treatments.

We plan to use Anvil® (sumithrin) as needed to control WNV vectors in agricultural areas because the updated label now allows applications in these areas. We will also be evaluating possible adulticide use in response to *Ae. japonicus* spread.

Chapter 4 *Black Fly Control*

2009 Highlights

- Larval mortality following *Bti* treatment on the large rivers averaged 96%
- Collected non-target monitoring samples on the Mississippi River
- Completed non-target monitoring report for samples collected in 2007
- Monitored adult populations weekly using overhead net sweeps and CO_2 traps

2010 Plans

- Threshold for treatment will be the same as previous years
- Monitor adult populations by the overhead net sweep and CO_2 trap methods
- Process the non-target monitoring samples collected in 2009
- Complete work on a 5-year operational framework for the black fly program

Background

The goal of the black fly program is to reduce pest populations of adult black flies within the MMCD to tolerable levels. Black flies develop in rivers and streams in clean flowing water. Larval populations are monitored at about 165 small stream and 28 large river sites using standardized sampling techniques during the spring and summer. Liquid *Bti* is applied to sites when the target species reaches the treatment threshold.

The small stream 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.

2009 Program

Small Stream Program - *Simulium venustum* Control

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

In April, 164 potential *S. venustum* breeding sites were sampled 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 74 sites on 16 streams met the threshold and were treated once with VectoBac® 12AS formulation of *Bti*. A total of 27.1 gal of *Bti* was used (Table 4.1). The average discharge for small streams treated in 2009 was less than the average discharge for 2008 resulting in less *Bti* usage in 2009.

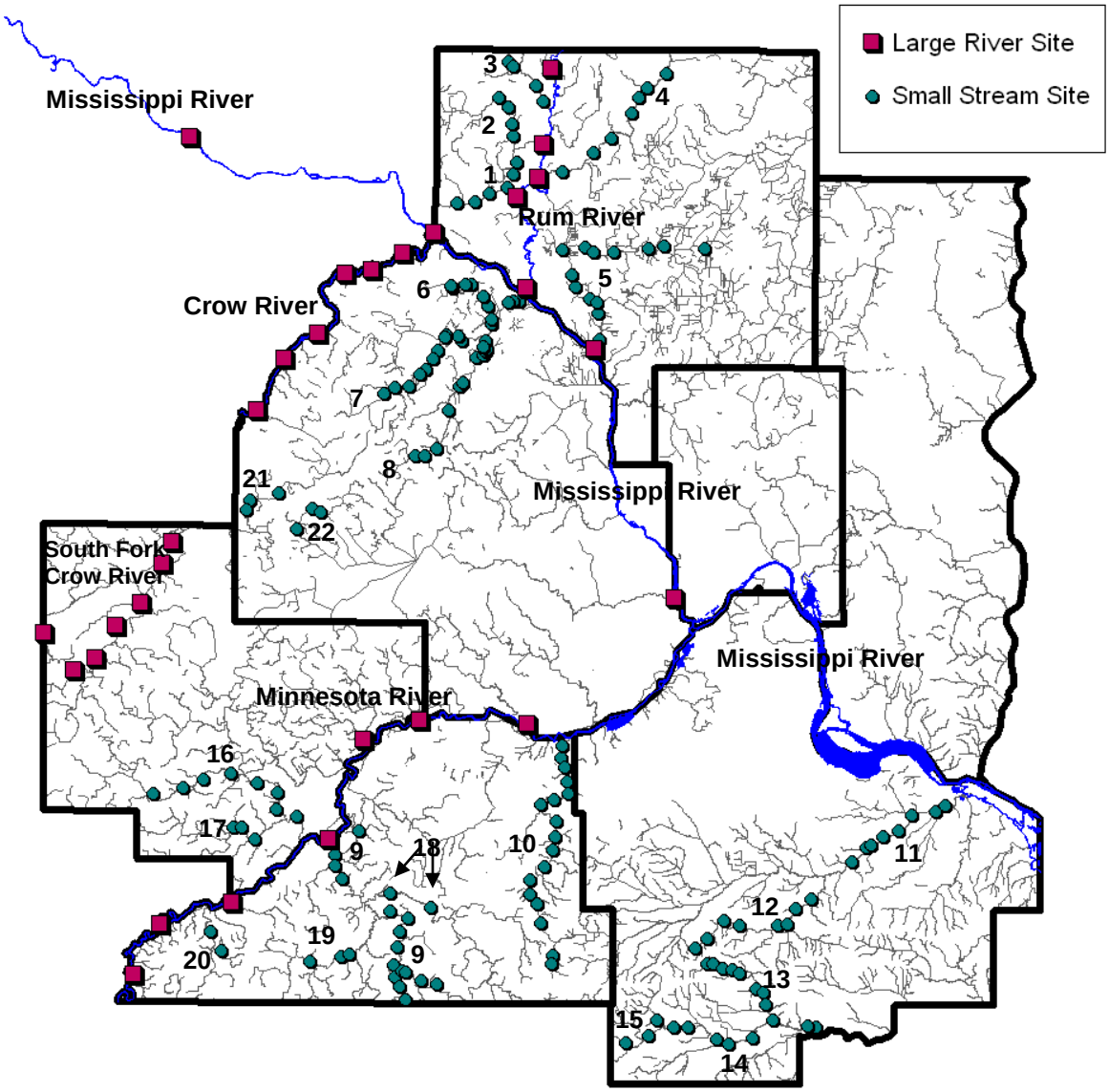

Figure 4.1 Large river and small stream black fly larval monitoring/treatment locations, 2009. Note: the large river site located outside the District on the Mississippi River is for monitoring only. The numbers on the map refer to the small stream names listed below:

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	
4=Cedar	9=Sand	14=Chub	19=Raven W. Branch	
5=Coon	10=Credit	15=Dutch	20=Robert	

Large River Program

There are three large river black fly species that the MMCD targets for control. *Simulium luggeri* develops mainly in the Rum and Mississippi rivers, although it also occurs in smaller numbers in the Minnesota and Crow rivers.

Depending on stream flow, *S. luggeri* is abundant from mid-May through September. *Simulium meridionale* and *Simulium johannseni* occur primarily in the Crow, South Fork Crow, and Minnesota rivers. These species are most abundant in May and June, although *S. meridionale* populations will remain high throughout the summer if stream flow is also high.

The black fly larval population was monitored weekly between May and early September using artificial substrates at the 28 sites permitted by the Minnesota Department of Natural Resources (MnDNR) on the Rum, Mississippi, Crow, South Fork Crow and Minnesota rivers. A total of 480 samples were collected to determine if the treatment threshold was met. The treatment thresholds were the same as those used since 1990. Sixty-seven *Bti* treatments were made using 2,153.7 gal of VectoBac® 12AS to control large river-breeding black fly larvae in 2009 (Table 4.1). River discharge for 2009 was above average on the Rum, Mississippi, Minnesota, and Crow rivers in April but was mostly below average between May and September. The amount of *Bti* used in 2008 and 2009 was below the yearly average of approximately 3,000 gal.

Bti treatment effectiveness was excellent in 2009. The average post-*Bti* treatment larval mortality (measured at least 250 m downstream of the point of the *Bti* application) was 99% on the Mississippi River, 93% on the Minnesota River, 93% on the Rum River, 99% on the Crow River, and 98% on the South Fork Crow River. Overall, the average post-treatment mortality recorded on the large rivers in 2009 was 96%.

Table 4.1 Summary of *Bti* treatments for black fly control by the MMCD in 2008 and 2009

	2008			2009		
Water body	No. treatment sites	No. treatments	Gallons of *Bti* used	No. treatment sites	No. treatments	Gallons of *Bti* used
Small Stream Total	71	71	62.1	74	74	27.1
Large River						
Mississippi	2	17	1,166.7	2	17	1,129.0
Crow	2	3	55.0	2	4	27.5
South Fork Crow	6	10	89.5	5	12	32.5
Minnesota	3	5	625.0	7	16	887.0
Rum	4	22	65.5	4	18	77.7
Large River Total	17	57	2,001.7	20	67	2,153.7
Grand Total	88	128	2,063.8	94	141	2,180.8

Adult Population Sampling

Daytime Sweep Net Collections The adult black fly population was monitored at 53 standard stations throughout the MMCD 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 2009 was 1.80 (Table 4.2). The average number of adult black flies captured per net sweep sample from 1984 to 1986 when no large river *Bti* treatments were done was 14.8. Between 1987 and 1995, when experimental *Bti* treatments were conducted on the large rivers, the average number of adult black flies captured per sample was 3.6. The average number of adult black flies captured per sample since the start of the District's full-scale large river larval black fly control program in 1996 is 1.45 (1996-2009).

The most abundant black fly collected in the overhead net-sweep samples in 2009 was *S. luggeri*, comprising 89% of the total black flies captured. The overall average number of *S. luggeri* captured per net-sweep sample in 2009 was 1.60 (Table 4.2). *Simulium luggeri* was most abundant in Anoka County in 2009, as it has been since the program began. The average number of *S. luggeri* captured in Anoka County was 10.45 in 2009. The higher number of *S. luggeri* captured in Anoka County compared to other counties within the MMCD is most likely due to the close proximity of prime *S. luggeri* larval habitat in the nearby Rum and Mississippi rivers.

The second most abundant black adult species captured in 2009 was *S. meridionale*, averaging 0.07 per sample (Table 4.2) and comprising 3.7% of the total black flies collected. *Simulium meridionale* was most abundant in Carver County in 2009 where an average of 0.21 were captured.

Black Fly Specific CO_2 Trap Collections Adult black fly populations were also monitored in 2009 between mid-May and mid-June with CO_2 traps at four sites in Scott County, four sites in Anoka County, and five sites in Carver County. The stations in Anoka and Scott counties have been monitored with CO_2 traps since 1998; monitoring in the Carver County expansion area began in 2004. Samples are immediately stored in ethyl alcohol to facilitate species-level identification.

Results of CO_2 trap collections from Anoka, Scott, and Carver counties are shown in Table 4.3. The most abundant black fly species captured in the CO_2 traps were *S. venustum, S. johannseni,* and *S. meridionale*. The average number of *S. venustum* captured per trap in 2009 was 18.3 in Anoka County, 238.2 in Scott County, and 425.0 in Carver County. The average number of *S. venustum* captured per trap between 1998 and 2008 was 11.7 in Anoka County, 26.8 in Scott County, and 49.6 in Carver County. The reason for the higher numbers of *S. venustum* captured in the CO_2 traps in 2007 - 2009, particularly in Scott and Carver counties, is unknown. Low water temperature during spring *Bti* treatments, less than optimal treatment timing, or unknown sources of larvae production are some possible reasons for high *S. venustum* adult numbers.

The average number of *S. johannseni* captured per trap in 2009 was 0.34 in Anoka County, 22.8 in Scott County, and 35.9 in Carver County. The average number of *S. johannseni* captured per trap between 1998 and 2008 was 1.0 in Anoka County, 11.0 in Scott County, and 87.8 in Carver County.

The average number of *S. meridionale* captured per CO_2 trap in 2009 was 0.7 in Anoka County, 98.8 in Scott County, and 820.3 in Carver County. The average number of *S. meridionale* captured per trap between 1998 and 2008 was 2.0 in Anoka County, 100.5 in Scott County, and 274.1 in Carver County.

Table 4.2 Annual 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

Year[1]	All species[3]	*Simulium luggeri*	*Simulium johannseni*	*Simulium meridionale*
1984	17.95	16.12	0.01	1.43
1985	14.56	13.88	0.02	0.63
1986	11.88	9.35	0.69	1.69
1987	6.53	6.33	0.02	0.13
1988[2]	1.60	1.54	0.05	0.00
1989	6.16	5.52	0.29	0.18
1990	6.02	5.70	0.01	0.24
1991	2.59	1.85	0.09	0.60
1992	2.63	2.19	0.12	0.21
1993	3.00	1.63	0.04	1.24
1994	2.41	2.31	0.00	0.03
1995	1.77	1.34	0.32	0.01
1996	0.64	0.51	0.01	0.07
1997	2.91	2.49	0.00	0.25
1998	2.85	2.64	0.04	0.04
1999	1.63	1.34	0.04	0.06
2000	2.38	2.11	0.01	0.02
2001	1.30	0.98	0.04	0.18
2002	0.61	0.43	0.01	0.14
2003	1.96	1.65	0.01	0.20
2004	0.97	0.35	0.02	0.39
2005	0.74	0.58	0.01	0.08
2006	0.55	0.45	0.00	0.04
2007	0.82	0.60	0.00	0.12
2008	1.07	0.88	0.01	0.08
2009	1.80	1.60	0.01	0.07

[1]The first operational treatments of the Mississippi River began in 1990 at the Coon Rapids Dam.

[2]1988 was a severe drought year and limited black fly production occurred.

[3]All species includes *S. luggeri, S. meridionale, S. johannseni,* and all other species collected.

Table 4.3 Mean number of adult *S. venustum*, *S. johannseni*, and *S. meridionale* captured in CO_2 traps set twice weekly between May and mid-June

County	Year	*Simulium venustum*	*Simulium johannseni*	*Simulium meridionale*
Anoka	1998	15.34	2.42	0.08
	1999	1.53	0.26	0.30
	2000	4.83	0.08	0.35
	2001	6.22	0.37	0.29
	2002	4.77	0.26	1.09
	2003	18.29	1.35	2.61
	2004	0.89	5.11	14.09
	2005	2.31	0.03	1.23
	2006	22.80	0.75	0.75
	2007	37.62	0.20	0.51
	2008	13.84	0.13	0.68
	2009	18.32	0.34	0.70
Scott	1998	3.16	1.08	2.56
	1999	6.58	5.50	35.35
	2000	0.51	1.71	11.17
	2001	8.30	4.70	611.27
	2002	0.62	0.41	53.82
	2003	1.76	12.93	109.57
	2004	2.25	0.17	0.65
	2005	3.40	3.50	23.25
	2006	3.38	38.07	10.50
	2007	35.59	32.50	172.48
	2008	228.93	20.18	75.03
	2009	238.16	22.80	98.77
Carver	2004	0.25	32.93	327.29
	2005	0.84	99.04	188.02
	2006	1.82	98.75	107.53
	2007	75.67	112.77	388.64
	2008	169.63	95.63	359.02
	2009	425.00	35.92	820.25

Monday Night CO_2 Trap Home Collections 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 2009. Because these traps are operated for mosquito surveillance, samples are not placed in ethyl alcohol making black fly species-level identification difficult. Results are displayed as total number of black flies per CO_2 trap (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 May and early June in Scott and Carver 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. In 2008, a second, localized

increase was observed in eastern Dakota County beginning in late June and ending in early July. Elevated numbers of black fly adults were not observed in eastern Dakota County in 2009 (Figure 4.2).

Non-target Monitoring

The District conducts biennial monitoring of the non-target invertebrate population in the Mississippi River as part of the permit requirements set by the MnDNR. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. The report for the monitoring samples collected in 2007 was submitted to the MnDNR in July 2009. Results from monitoring data collected in 2007 were consistent with those from previous monitoring years (1995, 1997, 1999, 2001, 2003, and 2005) and indicate that there have been no large-scale changes in macroinvertebrate community in the *Bti*-treated reaches of the Mississippi River. Monitoring sampling was repeated as scheduled on the Mississippi River in 2009. Sample processing and enumeration is underway with completion scheduled for early winter 2010. A report is scheduled for completion in spring 2011.

2010 Plans

2010 marks the 26th year of black fly control in the District. Our goal in 2010 is 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 2010 black fly control permit application request has been submitted to the MnDNR. Non-target monitoring samples collected in 2009 will be processed, identified, and enumerated. The goal is to complete sample processing and enumeration by the end of 2010. A report will be submitted to the MnDNR in the spring of 2011.

Increased larval surveillance will continue in those areas of Carver and Scott counties that had elevated adult black fly populations in 2009 based on CO_2 trap data. Efforts will also be directed towards finalizing a 5-year plan for the black fly program. Emphasis will be placed developing a framework for improving future program effectiveness, surveillance, and efficiency.

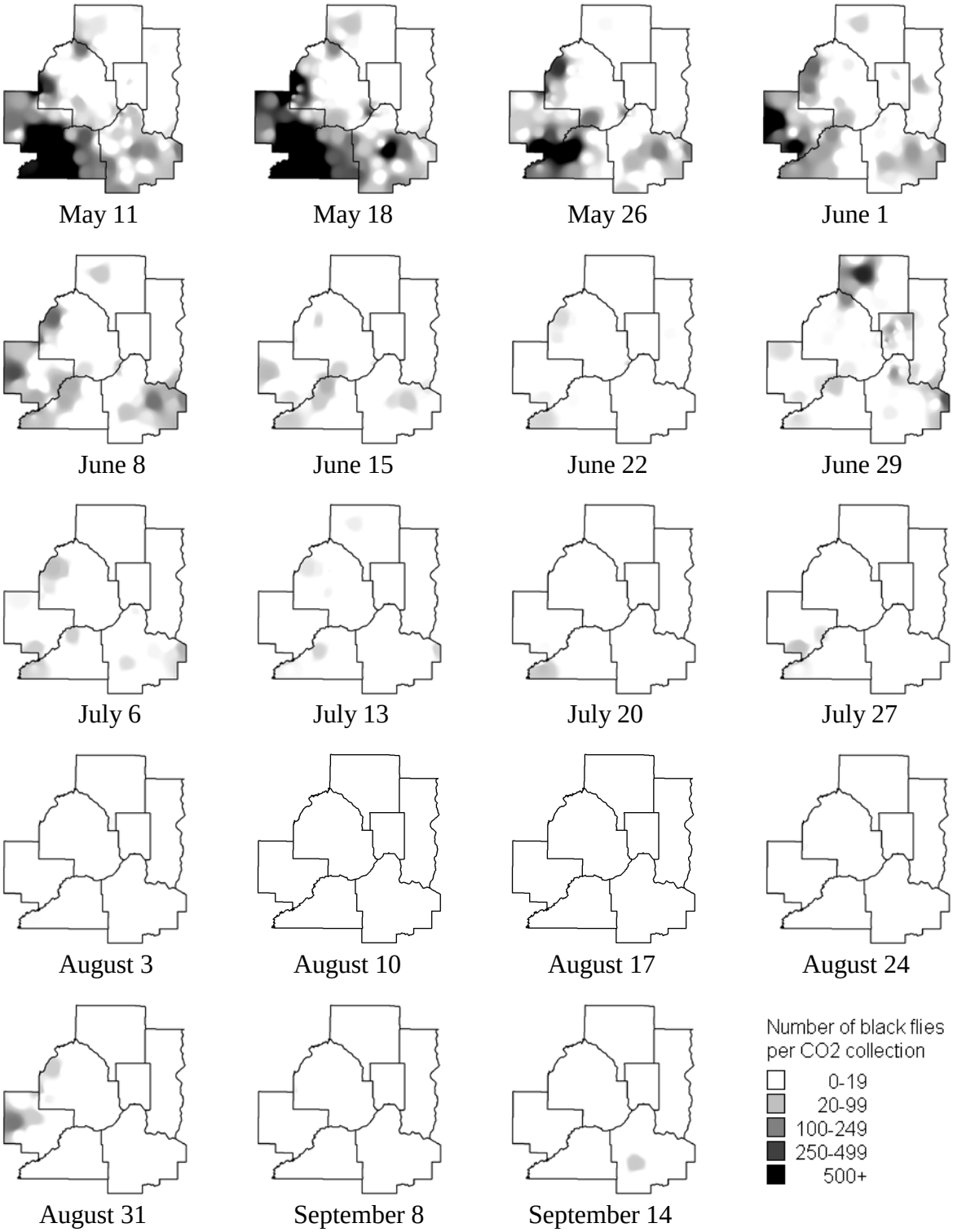

Figure 4.2 Number of black flies collected in mosquito surveillance District low (5 ft) and elevated (25 ft) CO_2 traps, 2009. The number of traps operated per night varied from 115-131. Inverse distance weighting was the algorithm used for shading of maps.

Chapter 5 *Product & Equipment Tests*

2009 Highlights

- VectoBac® G *Bti* achieved the same high level of control of *Ae. vexans* in air sites as in previous years
- Natular™ XRT controlled WNV vector larvae in catch basins at least through July
- Natular™ XRG controlled floodwater mosquitoes in ground sites
- Natular™ XRG controlled WNV vector larvae in culverts for four weeks
- Late summer treatments of VectoLex® CG *Bs* effectively controlled *Cq. perturbans* the next spring
- Basing some helicopter and warehouse operations in the North facility allowed more efficient operations

2010 Plans

- Continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy
- Test Natular™ XRG in April in natural ground sites to better determine the length and degree of control of mosquito larvae during cold conditions
- Continue late summer cattail treatments of VectoLex® CG *Bs* to verify effectiveness and optimize treatment dosage
- Continue tests of adulticides in different situations emphasizing control of *Culex* and effectiveness of barrier treatments

Background

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

2009 Projects

Quality assurance processes focused on equipment, product evaluations, 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 four larvicides and one new adulticide. All four larvicides have been tested in different control situations in the past. Three larvicides were tested to control *Culex* breeding in catch basins, two to control *Culex* developing in wetlands, and one to control the cattail mosquito. The adulticide was tested for use in croplands. These additional materials will provide MMCD with more tools to use in its operations.

Acceptance Testing of Altosid® (methoprene) Briquets and Pellets

Warehouse staff collected random Altosid® product samples from shipments received from Wellmark International for methoprene content analysis. Legend Technical Services, an independent testing laboratory, conducts the active ingredient (AI) analysis. Zoecon Corporation, Dallas, Texas, provided the testing methodologies. The laboratory protocols used were CAP No. 311, "Procedures for the Analysis of S-Methoprene in Briquets and Premix" and CAP No. 313, "Procedure for the Analysis of S-Methoprene in Sand Formulations". All 2009 samples were within acceptable values of the label claim of percent methoprene (Table 5.1).

Table 5.1 Methoprene content of Altosid® (methoprene) briquets, pellets, and sand

Methoprene Product	No. Samples Analyzed	Methoprene Content: Label Claim	Methoprene Content: Analysis Average	SE
XR-Briquet	12	2.10%	2.03%	0.0131
Pellets	18	4.25%	4.08%	0.0290
XR-G Sand	5	1.50%	1.22%	0.0200

Evaluation of Active Ingredient Levels in Adult Mosquito Control Products

The District has requested the certificates of AI analysis from the manufacturers to verify product AI levels at the time of manufacture. The District 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. Technical Services staff is building a database on warehoused adult control materials to assist in inventory management and purchasing decisions; voucher samples of the 2009 adulticides were collected and analyzed. Results of this analysis (Table 5.2) showed that all products were within acceptable values of the label claim of active ingredients.

Table 5.2 Active ingredient content of 2009 adulticides

Product	No. Samples Analyzed	% AI Content: Label Claim	% AI Content: Analysis Average	SE
Permethrin 57% Concentrate	2	57.00	57.15	0.1500
Permethrin 5.7% Mix	4	5.70	6.65	0.0141
Resmethrin 4%	3	4.00	3.98	0.0441
PBO 12%	3	12.00	12.33	0.1453
Sumithrin 2%	2	2.00	2.06	0.0100
PBO 2%	2	2.00	2.06	0.0900
Sumithrin 10%	2	10.00	9.93	0.0050
PBO 10%	2	10.00	10.02	0.0800
Sumithrin Mix 5%	2	5.71	4.97	0.0800
PBO Mix 5%	2	5.71	5.14	0.3550
MGK Pyrocide Concentrate 5%	1	5.00	4.99	n/a
MGK Pyrocide Mix 2.5%	1	2.50	2.48	n/a

Improvement of Warehouse Inventory Management

Warehouse operations were expanded in 2009 with the addition of the Andover Warehouse as part of the North Facility expansion. This warehouse facility significantly increased our control material storage capacity (75 pallets) and supports the operations of three District facilities. This extra storage capacity has reduced the pressure on warehouse personnel to re-supply this high use facility (North) and allows West facilities (Maple Grove and Plymouth) to significantly reduce their mileage to access additional control materials.

Transfer of Helicopter Hanger Location to Anoka County Airport

Staff worked with our helicopter contractor to station two of seven helicopters in the northern part of the District. Previously, all of MMCD's contracted helicopters were stored at hangers in Eden Prairie or LeSueur, Minnesota. District aerial operations have been delayed due to weather conditions surrounding the main helicopter hanger in Eden Prairie. By storing aircraft in multiple locations, we increase the opportunities to get helicopters airborne and significantly reduce the ferrying time to the northern metro locations. This relocation worked well in 2009 and we plan to continue this arrangement. In addition, we have reduced our exposure to a catastrophic event at the main hanger from severely inhibiting our District aerial operations.

Addition of Helicopter Landing Pad at North Facility

As part of the North Facility expansion, a helicopter landing pad was added to the facility. This landing pad has the capacity to improve our operations in multiple ways. First, it allows our staff to utilize the helicopter in a more controlled, safer environment. Most landing sites are in public locations (sporting fields, parking lots, etc.) in which citizens can readily approach our loading operations and staff has to manage these varying situations as they occur. Secondly, staff has ready access to control materials/fuel without dealing with the logistics of transporting these materials to an off-site landing area. This proximity can be a time-saving benefit to immediately start aerial operations and avoid dealing with traffic, road construction, and other transportation issues.

A permanent landing site affords the possibility of other operational improvements. A bulk helicopter loading system and/or bulk fuel system could be adapted for use. These types of systems have the potential to reduce the number of employees required for loading operations, would lower the amount of packaging material in our waste stream, and lower the overall costs of our control materials.

Recycling of Pesticide Containers

We 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 the related pesticide contamination of ground and water. MDA used Consolidated Container Company, Minneapolis, MN, for disposal services of their plastic pesticide container recycling program in 2009.

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 directly to the recycling facility in quantities of $\geq$ 400 jugs. This system allowed each facility to free up storage space in a timely manner.

Staff collected 6,366 jugs for this recycling program. The control materials that use plastic 2.5 gal containers are sumithrin (62 jugs), *Bti* liquid (873 jugs), and Altosid® pellets (5,431 jugs). The District also purchases adulticides in 55-gal drums and refills 5-gal steel cans of the same

labeled material thus reducing the need for new packaging which lowers 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-gal drums are brought to a local company to be refurbished and reused.

Recycling of Pesticide Pallets

Each season, MMCD operations produce 800-1,000 empty pallets used in the transportation of VectoBac® G brand *Bti* granules. Technical Services worked with the vendor, Valent BioSciences, to re-use these heavy-duty pallets in our operations. After new product deliveries, MMCD periodically returns truckloads of empty pallets to Valent. In doing so, MMCD reduces the need for new pallets, reduces the overall cost of production, and maintains lower control material cost for the District.

Efficacy of Control Materials

VectoBac® G VectoBac® G brand *Bti* (5/8 inch mesh size corncob granules) from Valent BioSciences was the primary *Bti* product applied by helicopter in 2009. Efficacy calculated using pre- and post-treatment larval counts from randomly selected sites was similar in 2008 and 2009 (Table 5.3). Effective control by methoprene (Altosid®) was most recently demonstrated in large floodwater sites (2005, 2006), pond level regulators (2007), and cattail sites (2006, 2007). Future tests will most likely compare Altosid® and other larvicides.

Table 5.3 Efficacy of aerial VectoBac® G applications in 2008 and 2009 (SE=standard error)

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2008	247	87.5	100.0	1.9%	0.0	100.0
2009	272	92.3	100.0	1.4%	0.0	100.0

New Control Material Evaluations

The District, as part of its Continuous Quality Improvement philosophy, desires to continually improve its control methods. Much testing has focused upon controlling potential vectors of WNV since its arrival to Minnesota in 2002. Testing in 2009 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.

Control of WNV Vectors (*Culex*) in Catch Basins The primary goal of control material tests in 2009 was to find a longer lasting material and decrease the number of times per season catch basins required treatment to control WNV vectors. In 2009, we selected 50 catch basins in St. Paul that we dipped weekly (three dips per catch basin per inspection) beginning May 29 and ending September 11. We identified and tallied the developmental stages of immature mosquitoes (larvae and pupae) in all samples. Immediately after the first inspection in June, ten catch basins were treated with FourStar™ 15-g briquets, ten were treated with Natular® XRT, 20

were treated with an experimental IGR larvicide (MGK 2936) (10 catch basins at each of two dosages); ten were not treated and served as untreated controls. Data from the untreated catch basins were compared to catch basins treated with Natular™, FourStar™, and MGK larvicides.

Clarke Natular™ XRT in catch basins Natular™ contains a biological active called spinosad that is isolated from the soil bacterium *Saccharopolyspora spinosa*. Spinosad has been used by organic growers for over ten years (WHO 2008). Only recently have spinosad formulations been developed as mosquito larvicides.

Ten catch basins were treated with one Natular™ XRT tablet each on June 5, the date when larvae began to appear. The per catch basin mean cumulative number of mosquito larvae and pupae collected from untreated catch basins increased each sampling date after June 19 until the end of the season (September 11) (Figure 5.1). Significantly fewer larvae and pupae had been collected from Natular™ XRT-treated catch basins than the untreated control through July 31, the last weekly dipping date before significant daily rainfall (>1 inch) (Table 5.4). The per catch basin mean cumulative number of mosquito larvae collected from Natular™ XRT-treated catch basins through September 11 remained significantly lower than the untreated control (Table 5.4). Greater variability (relative to the mean) in the per catch basin mean cumulative number of mosquito pupae collected from Natular™ XRT-treated catch basins through September 11 obscured detection of a statistically significant difference (Table 5.5). Natular™ XRT-treated catch basins contained consistently low numbers of pupae; untreated catch basins were more variable with some containing few and others containing many pupae.

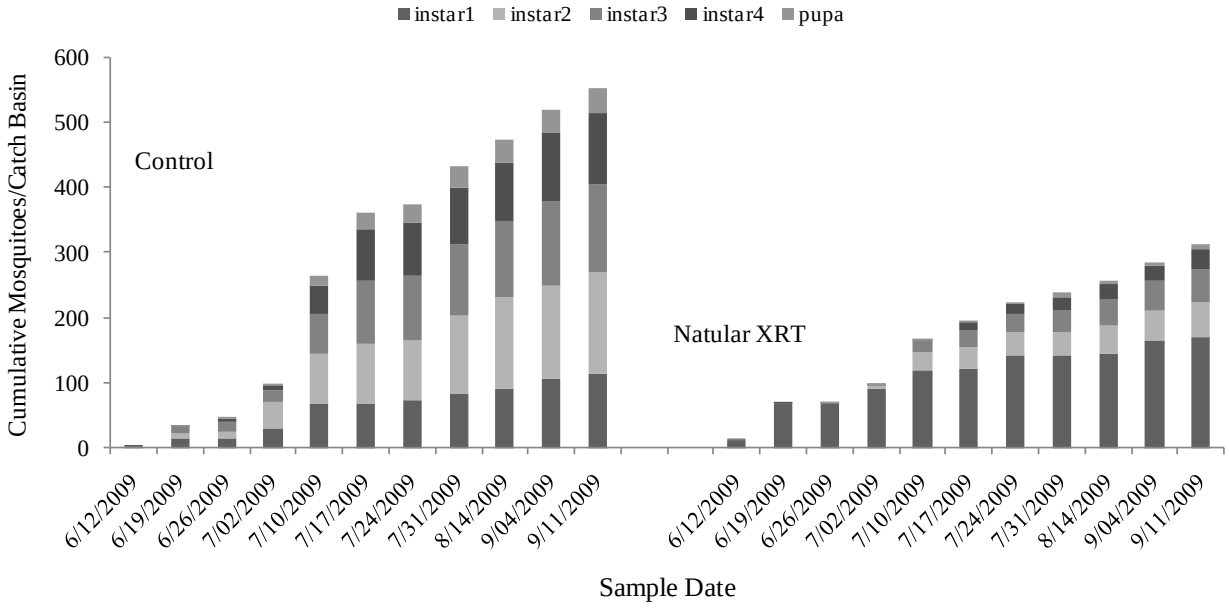

Figure 5.1 Cumulative immature mosquitoes per dip differentiated by instar from catch basins treated with Natular® XRT in 2009 compared to untreated catch basins (Control).

Table 5.4. Comparisons of cumulative mean larvae per catch basin (±SE) and mean pupae per catch basin (±SE) collected from catch basins treated with Natular™ XRT and from untreated catch basins (Kruskal-Wallis ANOVA)

		Kruskal-Wallis	Treatment Group	
Life Stage	Period	p-value	Control	Natular® XRT
Larvae	6/12 - 7/31	0.0191	399.55 ± 77.64	227.17 ± 88.96
	6/12 - 9/11	0.0413	511.38 ± 113.27	299.05 ± 95.32
	8/14 - 9/11	0.9397	111.83 ± 46.39	71.88 ± 15.48
Pupae	6/12 - 7/31	0.0092	32.21 ± 17.03	5.88 ± 3.90
	6/12 - 9/11	0.1736	36.82 ± 19.89	8.88 ± 3.71
	8/14 - 9/11	0.8193	4.61 ± 3.67	3.00 ± 1.36

Comparisons of cumulative values including only larvae and pupae collected during and mostly after the significant August daily rainfall (cumulative values including only August 14, September 4 and 11 inspections) detected no significant differences between untreated and Natular™ XRT-treated catch basins, suggesting that the rainfall may have hindered Natular™ XRT efficacy (Table 5.4).

Natular™ XRT effectively controlled mosquitoes at least through July 3, assuming that pupal abundance as measured by dipping is a more accurate proxy for adult emergence than larval abundance. The large increase of pupae collected from untreated catch basins between July 2 and July 17 was not observed in Natular™ XRT-treated catch basins (Figure 5.2).

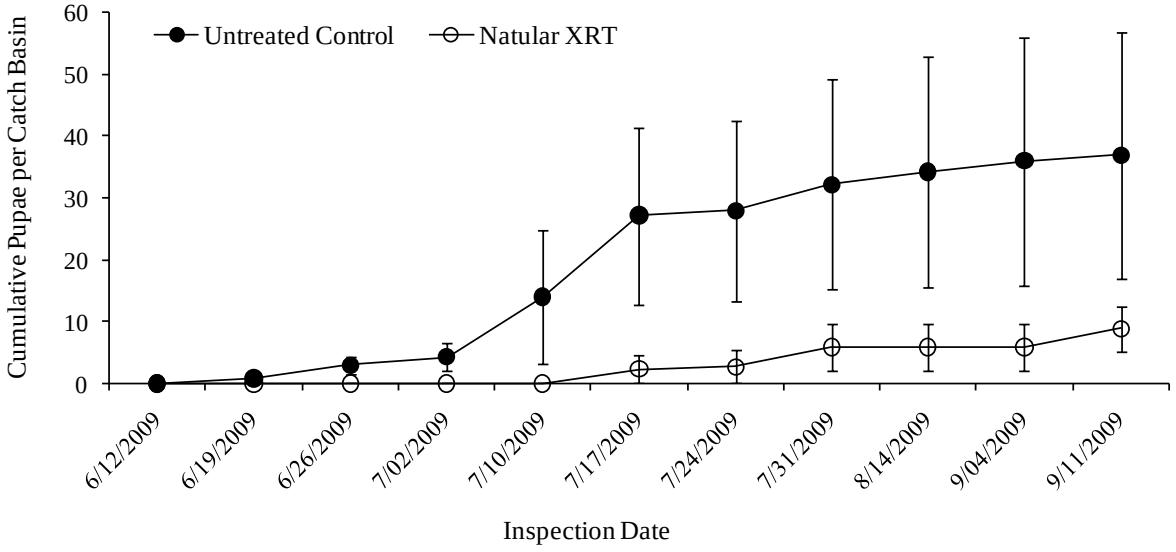

Figure 5.2 Cumulative pupae per dip from catch basins treated with Natular™ XRT in 2009 compared to untreated catch basins (mean±SE).

A mean percent control value can be calculated by comparing cumulative pupae per catch basin in the untreated control and the Natular™ XRT treatment. In 2009, Natular™ XRT achieved >99% control for 35 days after treatment, >90% control for 49 days, >80% control for 91 days, and about 76% control season long (98 days) (Table 5.5). While lower than the >99% control achieved season long in a similar test in 2008, Natular™ XRT efficacy both in 2008 and 2009 has been consistently longer and better than any other larvicide tested to date. Rainfall in August 2009 made this test more rigorous by including at least four days when potentially flushing rain events occurred. Natular™ XRT still performed very well. No potentially flushing rain events (daily rainfall > 1 inch) occurred during the 2008 test (Table 5.5).

Table 5.5 Percent control (mean pupae in control and Natular™ XRT-treated catch basins compared) and number of days with daily rainfall > 0.5, 1, and 2 inches in 2008 and 2009

	Cumulative Days with Rainfall			Sample	Days after	%
Test Year	>0.5 inch	>1 inch	>2 inch	Date	Treatment	Control
2008	3	0	0	6/26	35	100.0%
	3	0	0	7/3	42	99.4%
	4	0	0	7/11	50	99.4%
	4	0	0	7/17	56	99.6%
	5	0	0	7/24	63	99.4%
	5	0	0	7/30	69	99.4%
	5	0	0	8/8	78	99.5%
	6	0	0	8/15	85	99.5%
	6	0	0	8/21	91	99.5%
	7	0	0	9/5	106	99.5%
	7	0	0	9/12	113	99.3%
2009	2	0	0	6/19	14	100.0%
	3	0	0	6/26	21	98.9%
	3	0	0	7/2	27	99.2%
	4	0	0	7/10	35	99.8%
	4	0	0	7/17	42	91.5%
	5	0	0	7/24	49	90.2%
	5	0	0	7/31	56	81.7%
	7	1	0	8/14	70	82.8%
	10	4	1	9/4	91	83.7%
	10	4	1	9/11	98	75.9%

FourStar™ Bti/B. sphaericus briquets in catch basins Ten catch basins were treated with two, 15 g FourStar™ briquets on June 5, the date when larvae began to appear. Each FourStar™-treated and untreated control catch basin was dipped approximately weekly beginning on May 29 and ending on September 11.

The per catch basin mean cumulative number of mosquito larvae and pupae collected from untreated catch basins increased each sampling date after June 12 until the end of the season (September 11) (Figure 5.3). Significantly fewer larvae had been collected from FourStar™-treated catch basins than the untreated control through July 31, the last weekly dipping date before significant daily rainfall (>1 inch) (Table 5.6). By September 11, the per catch basin mean cumulative number of mosquito larvae collected from FourStar™-treated catch basins no longer was significantly different than the untreated control (Table 5.6). Cumulative pupal abundance in FourStar™-treated and control catch basins did not differ significantly on July 31 or September 11 (Table 5.6, Figure 5.4).

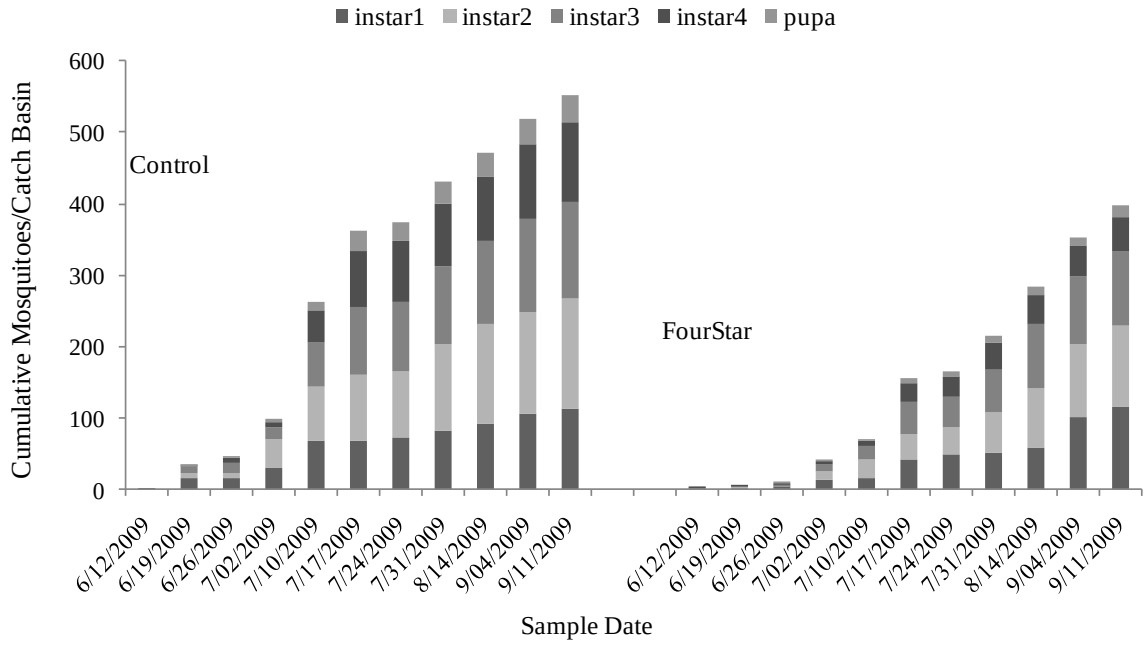

Figure 5.3 Cumulative immature mosquitoes per dip differentiated by instar from catch basins treated with FourStar™ 15-gram briquets in 2009 compared to untreated catch basins (Control).

Comparisons of cumulative values including only larvae and pupae collected during and mostly after the significant August daily rainfall (cumulative values including only August 14, September 4, and 11 inspections) detected no significant differences between untreated and FourStar™-treated catch basins, suggesting that the rainfall may have hindered FourStar™ efficacy (Table 5.6).

Table 5.6 Comparisons of cumulative mean larvae per catch basin (±SE) and cumulative mean pupae per catch basin (±SE) collected from catch basins treated with FourStar™ and from untreated catch basins (Kruskal-Wallis ANOVA)

		Kruskal-Wallis	Treatment Group	
Life Stage	Period	p-value	Control	FourStar™
Larvae	6/12 - 7/31	0.0233	399.55 ± 77.64	204.64 ± 31.93
	6/12 - 9/11	0.2568	511.38 ± 113.27	383.40 ± 77.70
	8/14 - 9/11	0.2568	111.83 ± 46.39	178.76 ± 66.10
Pupae	6/12 - 7/31	0.3642	32.21 ± 17.03	10.39 ± 4.22
	6/12 - 9/11	0.7623	36.82 ± 19.89	17.88 ± 5.88
	8/14 - 9/11	1.0000	4.61 ± 3.67	7.49 ± 2.89

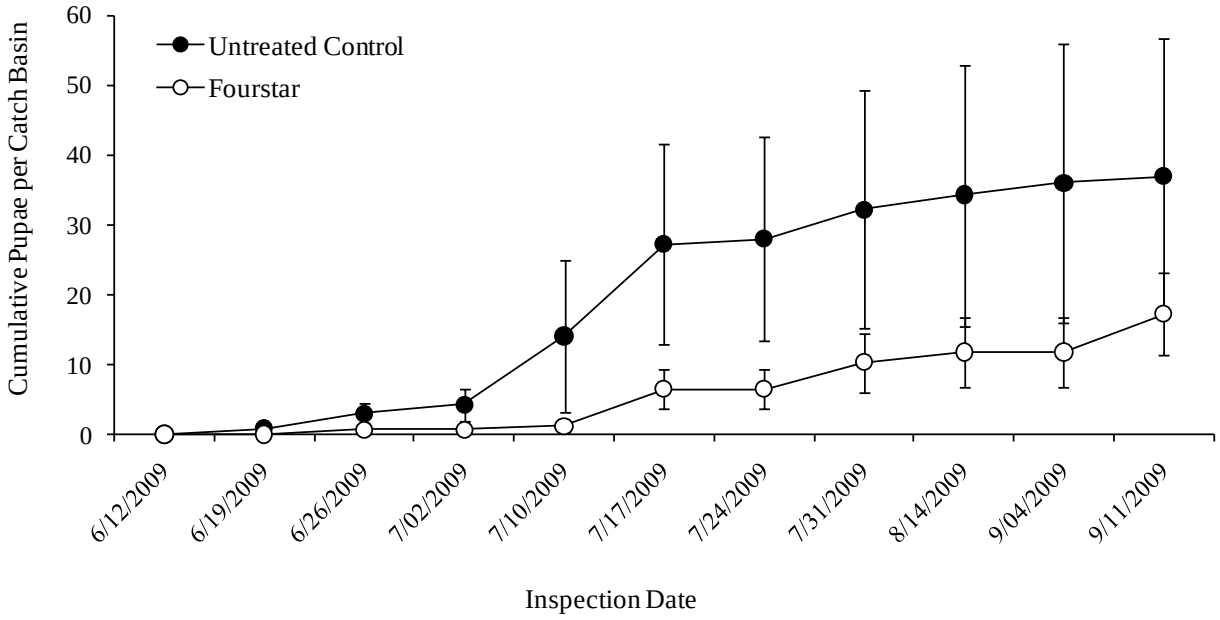

Figure 5.4 Cumulative pupae per dip from catch basins treated with FourStar™ briquets in 2009 compared to untreated catch basins (mean±SE).

In contrast to 2008, when two, 14 g FourStar™ briquets per catch basin suppressed pupal development throughout the season, efficacy in 2009 was much more limited. Larval abundance in FourStar™-treated catch basins was significantly lower through July 31, which suggests limited control (Table 5.6). Pupal abundance in 2009 did not differ from the untreated control, which suggests no detectable efficacy (Table 5.6, Figure 5.4).

MGK (2936) IGR granules in catch basins We tested two dosages (10 g and 50 g) of an experimental granular IGR formulation (0.5% pyriproxifen; MGK 2936). Each treated and untreated control catch basin was dipped approximately weekly beginning May 29 and ending September 11. We identified and tallied the developmental stages of immature mosquitoes

(larvae and pupae) in all samples. After samples of immature mosquitoes were collected, pupae were collected if present. Pools of 20-100 pupae from one or more catch basins were held in the lab to evaluate degree of successful adult emergence. Ten catch basins were treated with 10 g (MGK10) of MGK 2936 and ten with 50 g (MGK50) of MGK 2936 immediately after they were inspected on June 4.

Pupal bioassay results expressed as emergence inhibition (EI) that was corrected with an Abbott's type adjustment for mortality (proportion of pupae that failed to emerge) in the untreated control were used as the primary evaluation of efficacy. Bioassay results from untreated catch basins were assessed for normality using a Kolmolgorov-Smirnov test (Marascuilo & Serlin 1988) and change over time (slope) using linear regression (Steel et al. 1997). Ninety-five percent confidence limits around the average untreated bioassay results were calculated using the t-distribution (Steel et al. 1997). All EI values for MGK10 and MGK50 catch basins that fell outside the 95% confidence limits were considered to be significantly different from the untreated control.

Bioassay results from untreated catch basins were distributed normally (Kolmolgorov-Smirnov test; $d = 0.0779748$; $p > 0.05$) and did not change over time (Linear Regression: slope=0; $F = 2.06984$; $p = 0.1739$). Ninety-five percent confidence limits for untreated bioassay results (EI) ranged between 0% and 33% (mean=13.42%; SE=2.31%; n=16). EI values for bioassays from MGK10- and MGK50-treated catch basins were consistently greater than the upper 95% confidence limit (33%) until 57 days after treatment when one of two MGK10 bioassays was lower (Figure 5.5). Sufficient pupae for bioassay analysis were not found and collected again until 99 days after treatment, presumably because daily rainfall events >1 inch between 65 and 82 days after treatment flushed immature mosquitoes out of all catch basins.

We conclude that both treatments effectively controlled mosquitoes at least 57 days. The lower dosage (MGK10) was beginning to lose efficacy around 57 days post-treatment. Neither dosage was effective 99 days post-treatment although loss of efficacy could have been caused in part by flushing of catch basin contents by rainfall.

The high dose (MGK50) of the experimental IGR decreased the number of immature mosquitoes in catch basins, possibly due to larvicidal effects. The almost complete lack of differences between treated and untreated catch basins following flushing rain effects decreases the odds that differences seen in earlier collections are due solely to differences in the catch basins (Table 5.7). The high dose also reduced pupae enough so that no bioassay evaluations could be completed the first 28 days after treatment (Figure 5.5). During that time period, sufficient pupae were collected to complete three bioassays from untreated catch basins and nine from catch basins treated with MGK10. These effects together contributed to much lower numbers of immature mosquitoes being collected from MGK50-treated catch basins season-long (Table 5.7).

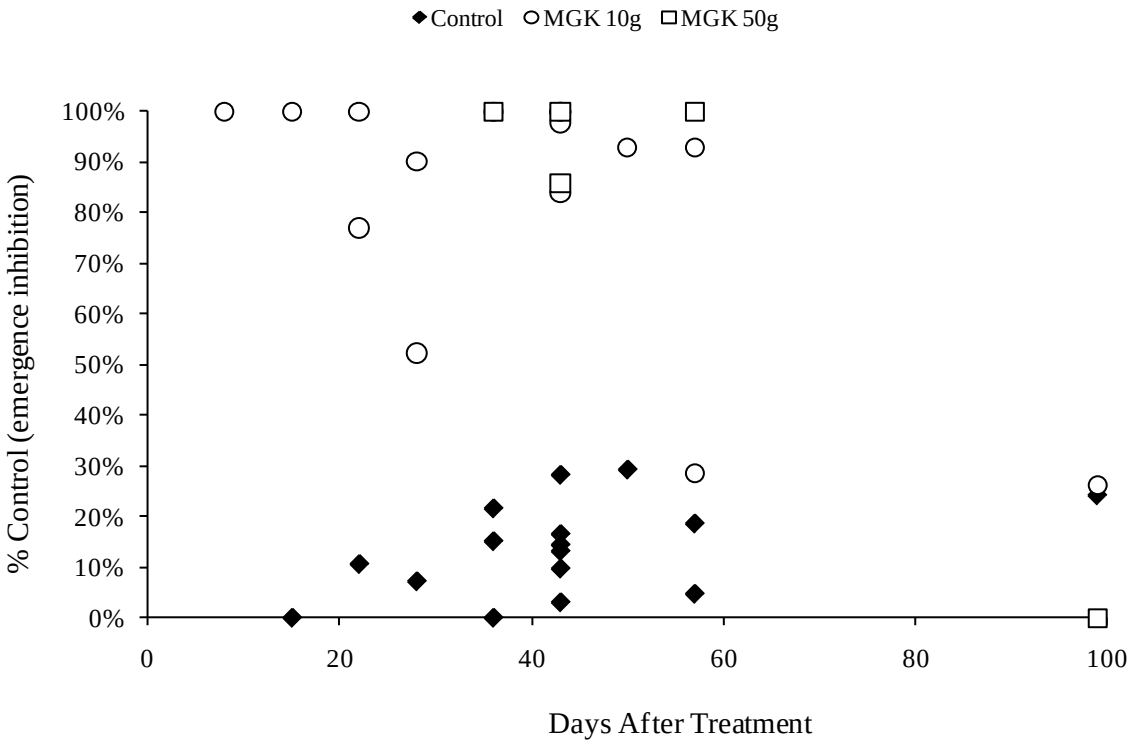

Figure 5.5 Emergence inhibition of pupae collected from MGK10- and MGK50-treated catch basins (corrected for untreated control mortality). Untreated control EI values are raw mortality (percent of pupae that did not emerge). Each symbol represents one pool of 20-100 pupae collected from one (usually) or more catch basins.

Table 5.7 Statistical comparisons of cumulative immature mosquitoes per catch basin (mean±SE) 6/12 through 9/11, 6/12 through 7/31 (before daily rain >1 inch), and 8/14 through 9/11 (after daily rain >1)

Period	Kruskal-Wallis p-value	Treatment Group		
		Control*	MGK10*	MGK50*
6/12 - 9/11	0.0007	548.20 ± 132.39[a]	890.27 ± 138.14[a]	223.56 ± 55.39[b]
6/12 - 7/31	0.0005	431.76 ± 93.88[a]	762.96 ± 130.73[a]	161.22 ± 39.08[b]
8/14 - 9/11	0.1449	116.44 ± 49.63[a]	127.31 ± 20.61[a]	62.34 ± 23.24[a]

* Values in the same row followed by the same lower case letter are not significantly different (three pairwise comparisons using normalized rank distribution, overall p not greater than 0.05) (Gibbons 1971, Marascuilo & Serlin 1988, Steel et al 1997)

Clarke Natular™ XRG in culverts Culverts are one of the most common stormwater management structures in the District. Sampling conducted in 2006 detected significant levels of *Culex* vectors developing in culverts and washouts. The primary goal of control material tests in

2009 was to determine the duration and consistency of control achieved by Natular™ XRG in culverts. In these tests, we selected culverts that tended to remain wet longer because previous attempts to test materials in these kinds of sites were limited when the sites dried up soon after treatment. Both untreated and treated culverts and washouts were dipped (five dips per culvert or washout per inspection date) weekly before and after treatment beginning June 17 and ending September 9. On June 17, staff treated six culverts with Natular™ XRG (10 lb/acre) immediately after sampling. The same six culverts were retreated on July 29 immediately after sampling. Six additional culverts remained untreated.

Larval abundance in both groups of six culverts was similar before the first treatment and significantly lower in Natular™ XRG-treated than untreated culverts one through four weeks after treatment. Larval abundance became statistically similar in both groups of six culverts five and six weeks after the first treatment (Table 5.8). This suggests that Natular™ XRG was effective four weeks after treatment. Lower larval abundance in untreated culverts more than one week after the second treatment on July 29 made detecting significant effects harder. Cumulative larval abundance (weeks one through four pooled) in Natular™ XRG-treated culverts was significantly lower than that in untreated culverts after both treatments (Table 5.9).

Table 5.8 Comparisons of mean larvae per dip (±SE) collected each week from culverts treated with Natular® XRG and from untreated culverts (Kruskal-Wallis ANOVA)

Treatment Date	Sample Date	Weeks after Treatment	Kruskal-Wallis p-value	Treatment Group	
				Control	Natular® XRG
6/17	6/17	0	0.1215	1.82 ± 0.91	7.77 ± 3.55
	6/24	1	0.0021	5.90 ± 1.42	0.00 ± 0.00
	7/1	2	0.0201	13.05 ± 4.47	0.20 ± 0.14
	7/8	3	0.0275	16.65 ± 5.95	1.38 ± 0.83
	7/15	4	0.0450	29.95 ± 22.10	2.25 ± 1.84
	7/22	5	0.2215	6.07 ± 3.43	1.97 ± 1.46
	7/29	6	0.5058	2.82 ± 1.66	0.80 ± 0.45
7/29	8/5	1	0.0021	2.42 ± 0.79	0.00 ± 0.00
	8/12	2	0.4005	0.03 ± 0.03	0.37 ± 0.23
	8/19	3	0.7969	0.40 ± 0.25	0.25 ± 0.13
	8/27	4	0.1397	0.20 ± 0.16	0.00 ± 0.00
	9/2	5	0.4732	0.33 ± 0.20	0.13 ± 0.10
	9/9	6	0.8055	2.35 ± 1.15	0.42 ± 0.24

Table 5.9 Comparisons of mean cumulative larvae per dip (±SE) collected from culverts treated with Natular™ XRG and from untreated culverts (Kruskal-Wallis ANOVA)

Sample Period	Weeks after Treatment	Kruskal-Wallis p-value	Treatment Group	
			Control	Natular® XRG
6/24 - 7/15	1 - 4	0.0104	65.55 ± 28.83	3.83 ± 2.53
8/5 - 8/27	1 - 4	0.0245	3.05 ± 0.94	0.62 ± 0.22

Experimental Products (various manufacturers) District staff are working individually with multiple manufacturers to develop and evaluate new products and/or formulations. Due to various agreements, MMCD will not disclose these product's name or active ingredients but Technical Services staff conducted various trials and swath characterizations in 2009. Technical Services interacted with each respective party to evaluate, develop, and provide operational insight to improve these formulations.

Clarke Natular™ XRG in ground sites Eleven small ground sites (<0.1 acre) were dipped on June 10, a couple days after precipitation significant enough to completely flood the sites and induce a mosquito hatch. Immediately after being dipped, three sites were treated with Natular™ XRG (10 lb/acre). All 11 sites were dipped again on June 12 to evaluate efficacy of Natular™ XRG. Natular™ XRG achieved 100% control (Table 5.10). Thereafter, all sites remained dry until well into August which precluded any additional efficacy evaluations.

Table 5.10 Efficacy of Natular® XRG in ground sites (SE=standard error; n= number of sites)

Sample Date	Days after Treatment	Treatment Group	
		Control	Natular™ XRG
6/10	0	19.70 ± 8.51	25.40 ± 8.34
6/12	2	32.70 ± 12.99	0.00 ± 0.00

VectoLex® CG *B. sphaericus* (30-day granules) for *Cq. perturbans* Control We received 1,600 lb of VectoLex® granules for evaluation in *Cq. perturbans* sites. This abundant pest lays its eggs in mid- to late summer and overwinters as larvae attached to aquatic vegetation, primarily cattail roots. Our current operations treat for this single brood mosquito in late May, just prior to its emergence. Because cattail control applications often coincide with treatments of other floodwater species, a fall application period may lessen the demand of limited resources during this extremely active floodwater treatment period. To that end, we are evaluating whether a fall application of VectoLex® can provide good control for the subsequent season's cattail mosquitoes.

In September 2008, seven breeding sites in Anoka and Washington counties were treated with VectoLex® CG (20 lb/acre) while water temperatures were approximately 50 °F and the larvae potentially were still feeding actively. Pre-treatment samples from these sites contained high larval populations. Five emergence cages were placed in each of these seven treated sites and in five untreated sites at the beginning of June 2009. All 60 cages were inspected twice each week beginning on June 5 and ending on August 8, 2009. All adult mosquitoes were captured and identified. All male and female *Cq. perturbans* were tallied separately. Efficacy was evaluated by comparing the number of *Cq. perturbans* in cages in treated and untreated sites.

VectoLex® CG achieved 95.7% control of *Cq. perturbans* throughout the June-August emergence period (Figure 5.6). *Coquillettidia perturbans* emerged from significantly fewer cages in VectoLex® CG-treated sites (Table 5.11).

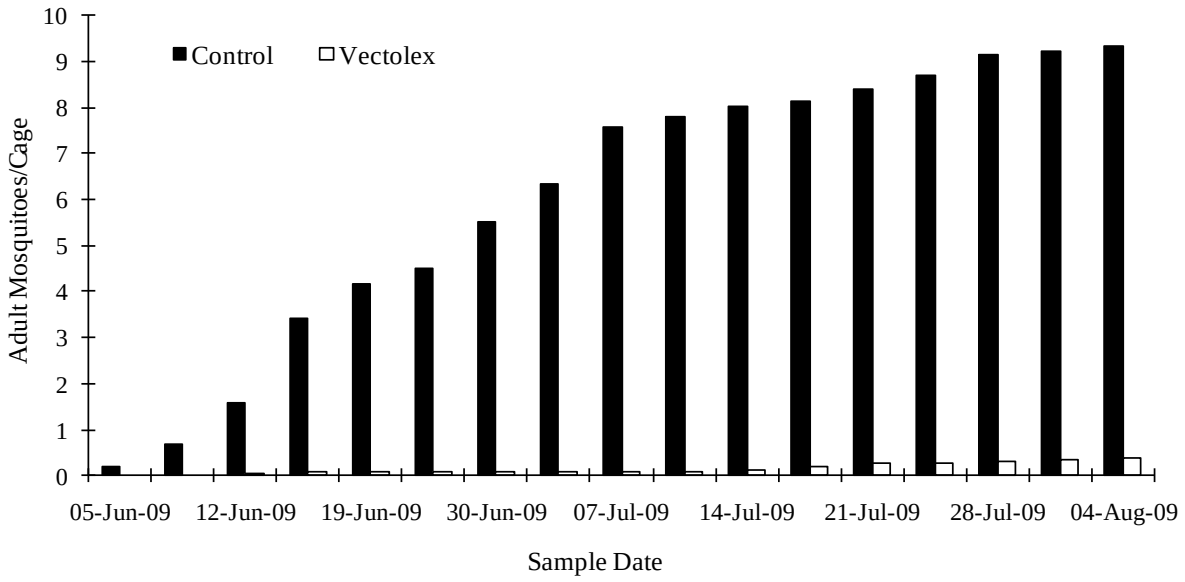

Figure 5.6 Cumulative emergence of *Cq. perturbans* in cages in VectoLex® CG-treated and untreated sites.

Table 5.11 Percent of cages in VectoLex® CG-treated and untreated sites from which *Cq. perturbans* emerged

Treatment	Total cages	Cages with *Cq. perturbans*	Cages with no *Cq. perturbans*	Percent with *Cq. perturbans*	Fisher Exact p-value
Control	25	19	6	76.0%	
VectoLex CG®	35	8	27	22.9%	0.000047

Cognis Agnique® MMF G (30-day granules) The District received 176 lb of the re-formulated pupacide granule for aerial application evaluations. This product has the potential to extend the number of days during a brood that MMCD could make large-scale aerial applications. This product is designed to control immature mosquitoes in the non-feeding life stage (i.e. late fourth larval instar and pupae) prior to emergence. The District does not currently have a control material that could be used in our aerial application program during this stage of mosquito development. This product could be beneficial when helicopter flight is limited for multiple days due to poor weather or unsafe flying conditions.

Technical Services staff evaluated this material at two recommended application rates (7 and 10 lb/acre). The helicopter swath characterizations demonstrated that this product could be applied effectively at both rates. The product did contain a significant amount of fines (i.e. oily dust) that may possibly be a maintenance issue with product buildup in equipment with large-scale use or possibly drift off-target during aerial applications. Staff is communicating with the manufacturer to address our concerns. Further efficacy evaluations are being considered in 2010.

Adulticide Tests Research in 2009 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. Permethrin may soak into treated foliage and remain toxic to some insects that eat the foliage up to a month after treatment. We were unable to complete any tests because adult mosquito abundance was too low.

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services and field staff conducted eight aerial calibration sessions for dry granular materials during the 2009 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so each helicopter's dispersal characteristics are optimized. Eight sessions were held at the municipal airport in LeSueur, MN. Staff completed calibrations for 11 different operational and experimental control materials. In total, eight helicopters were calibrated and each helicopter was configured to apply an average of three different control materials.

In addition, staff used blank materials (no active ingredients) during these calibration sessions to remove and/or reduce the amount of active ingredients released into the environment. We continue to strive to optimize equipment and improve methodologies to reduce the amount of products used in our operations.

Evaluation of Single Hopper Swath Patterns for Larvicides The District conducts aerial applications on a multitude of different breeding sites and each of these sites has its own unique shape and contours. Our helicopters are set up to apply dry control materials on a fixed swath (72-84 ft) based upon both hoppers running simultaneously. Some sites have treatment areas that are narrower than the fixed swath width and therefore, MMCD ends up applying control materials to dry ground next to these mosquito breeding sources to provide adequate coverage. Staff worked with the helicopter contractor to test single hopper applications to produce smaller width swaths. We conducted multiple trials with three different control materials and the swath characterizations demonstrated the helicopters were able to effectively apply an even 45-50 ft swath at the proper application rates with all three control materials. Staff will review where single hopper swaths might be applicable and evaluate this application method in 2010. This method holds the potential to reduce the amounts of pesticides applied to the environment, save budgetary funds, and extend treatments to other areas.

Droplet Analysis of Ground-based Spray Equipment During March 2009, Technical Services and the East Region staff used our 20 ft x 40 ft indoor spray booth to evaluate our adulticide application equipment. One benefit of this self-contained booth is that it collects the adulticide spray particles so they are not unduly released into the air following the calibration process. 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. We use this analyzer to fine-tune equipment to produce an ideal droplet spectrum of 8-

20 microns. Adjusting the ULV sprayers to produce a more uniform droplet range maximizes efficacy by creating droplets of the correct size needed to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and swath coverage throughout the District.

Curtis Dyna-Fog Twister XL3 Staff evaluated an updated model of the ULV backpack spray unit. Staff noted that the pack was improved with sturdier parts/protective guards and the manufacturer had addressed our previous issues we had with the unit. After a two-month evaluation, MMCD's equipment team approved this sprayer for District use and purchased the ULV unit.

Guardian Truck-mounted Cold Fog Unit ADAPCO provided a new truck-mounted Guardian 190ES fogger for evaluation. The District's policy is to accept bid proposals only from vendors whose equipment has demonstrated it can fulfill the requirements of our adulticide program. This evaluation will assess this equipment and qualify it for our certification program. Staff was only able to utilize this equipment once during 2009. The dry conditions did not provide adequate numbers of adult mosquitoes to fully test the unit under normal operational parameters. Staff will continue with this evaluation in 2010.

Plans for 2010

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 2010, we plan to test lower dosages of VectoLex® CG (late summer treatments) to control the cattail mosquito. We also plan to continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy. We will expand tests of Natular™ formulations in stormwater management and natural ground sites to better determine how long they control mosquito larvae. We plan to add tests in April in natural ground sites to better determine the length and degree of control of mosquito larvae during cold conditions. We also plan to repeat tests of adulticides, emphasizing control of *Culex* and effectiveness of barrier treatments.

References

Mulla's Formula:

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

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

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Chapter 6 Supporting Work

2009 Highlights

- Updated Customer Call Tracking system, added dead bird recording, and trained all staff.
- Updated public and internal web map sites and added functionality
- Added Landmark/Point-of-Interest lookup to metro geocoder (used in web maps and call system)
- Conducted follow-up on 47 constructed rain gardens to see if they support mosquito larval development
- Continued education efforts on stormwater and mosquitoes
- Presented "Mosquito Mania" curriculum to 3,689 students in 36 schools

2010 Plans

- Continue adding functionality to internal web map to improve access to data, including helicopter tracks.

2009 Projects

Call Tracking & Mapping System

Calls, e-mails and other contacts from citizens are an important source of information for MMCD to identify areas that may need service, support disease control through tire disposal and dead bird reporting, and for recording citizen complaints and requests for limited or no treatment.

In 2008, MMCD worked with Houston Engineering Inc. (HEI) to develop a web-based call tracking system that included valuable new functionalities:

1. addresses checked on entry to make sure they are complete, valid and interpretable, and geocoded to enable immediate map display
2. ready access by all staff members to call data and call location maps for the entire District

We demonstrated that geocoding calls reduced the amount of time spent looking for call locations by about 80%, which during peak call volumes was a significant savings in staff time. (See Figure 6.4 and Table 6.2 later in this chapter for more information on total calls.)

In 2009, we held training sessions in field facilities and at the Main Office to make sure all staff could take advantage of both the call system and the linked internal web map. Additional work was done on the system to improve tracking and retrieval of dead bird reports.

Field staff also used the system to examine patterns in calls received. For example, a cluster of calls from April 1 to May 20 in P2 of the West-Maple Grove area (Figure 6.1) focused attention on an area where sampling had shown larvae present but we were unable to complete treatments because of resource limitations.

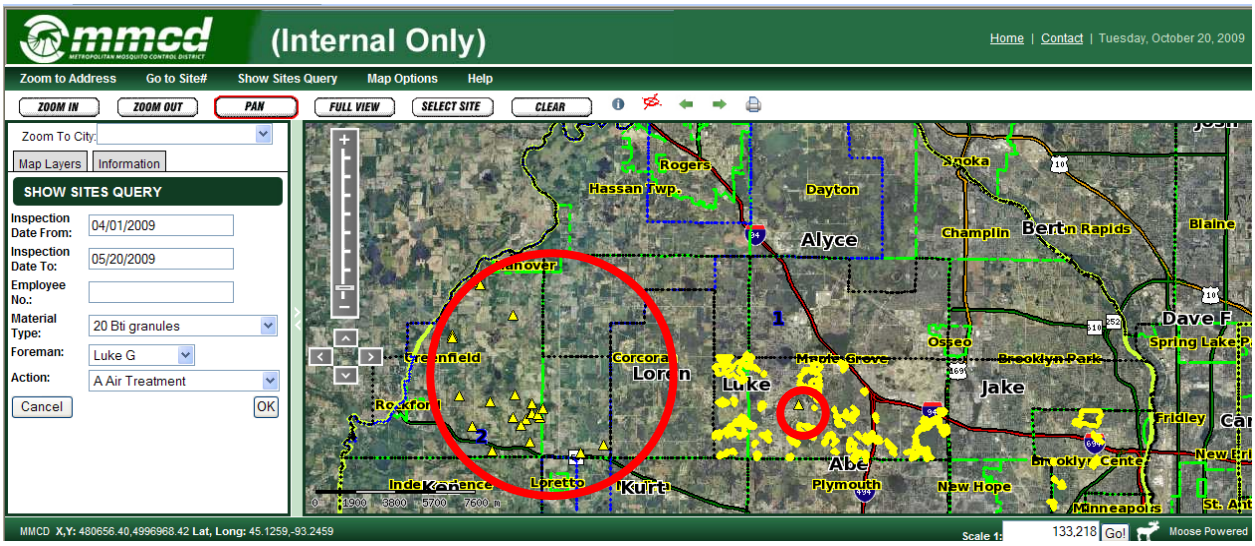


Figure 6.1 Example of screen shot comparing areas treated with *Bti* (light shaded areas) in April 2009 vs. the location of calls received (light colored triangles) April 1-May 20.

The internal-only version of MMCD's web-based mapping system was upgraded to a new version of GeoMoose (2.2), the open source mapping package (with MapServer) used to create and manage the site. HEI also added the ability to do custom queries to display sites inspected or treated within certain date ranges or material types (as in Figure 6.1).

Public and Internal Web Map Sites

The Distict's web-based mapping system continues to make wetland locations and larval treatment records for the entire District readily available to staff and the general public. Larval treatment records are updated daily from MMCD's DataGate (our electronic field and lab data entry system), and include site history dating back through 2006. The map and data interface developed by HEI uses open source GeoMoose 2.2 software and the MetroGIS Geocoder. Basemap information comes from MetroGIS (Metropolitan Council) and MnGeo (Minnesota Geographic Information Office).

The public version of the web map site, available from MMCD's home page, www.mmcd.org, has been running since April 2007. In 2009, the public web map received 2,996 visitors (1,809 unique IP addresses), of which 462 went on to look up detailed treatment histories.

A separate internal version with greater detail is available from MMCD computers. In 2009, we added a viewable wooded areas ("harborage") layer, and tools to query site data, allowing staff to explore patterns of wetland site inspections and larval treatments District-wide.

Geocoder

The ability to look up the location of a particular street address ("geocoding") is key to both MMCD's call system and public web map. Many government or business web sites and applications use similar functionality. In 2008, MMCD staff led a MetroGIS/Metropolitan

Council funded project to develop a free high-quality geocoding web service for the metro area. Any agency or web developer could use this service for address look-up in web applications, using both county parcel data and MetroGIS street data (from The Lawrence Group) as a base.

In 2009, we led additional work on this project to automate street and parcel data updates and add the ability to look up by name locations of landmarks/points-of-interest such as parks and schools. This work was also funded through MetroGIS, and continues to benefit multiple agencies and the public. For complete information on the MetroGIS Geocoder Project see www.metrogis.org/data/apps/geocoder/.

Aerial Treatment Tracking and Guidance

The AG-NAV® Guía system, an aircraft-mounted GPS system provided by our helicopter contractor, Scott's Helicopter Service, continued to be part of routine aerial treatment operations in 2009. Staff provides site boundary files to pilots and retrieves treatment tracks when flights are completed. Staff also provided marked paper maps. We are working with HEI to develop a web-based system to make these tracks easier to evaluate post-flight and also make it easier for pilots to review using our web map.

Field & Lab Data Entry and Reporting

DataGate, continues to be the center for mosquito and black fly larval and adult inspection, treatment, sample data, and much of the physical inventory entry and reporting. In conjunction with our map files, it provides rapid access for data to load into helicopters for treatment plans (see Ag-Nav, above), as well as providing data for the public web map site. Field data continues to be entered using Palm OS-based personal digital assistants (PDAs), and data records are uploaded into DataGate on the network when field staff return to their base. We are actively researching cost-effective alternatives to the PDAs and means to upgrade DataGate to take advantage of technology advances and move away from hardware/software that are becoming obsolete.

In 2009, two major changes were made to the entry forms and data structures:

- streamlined recording of container inspections (needed for *Ae. japonicus* response)
- improved linkage of adulticide treatment records with adult mosquito samples (see results in Chapter 3).

Wetland and Stormwater Mapping

Field staff update wet area boundaries annually during the winter months, using notes from summer treatments and fall inspections. Once again we benefited from statewide aerial photography flown by the Natural Resources Conservation Service (NRCS). The 2009 flight was made available in the latter part of 2009 by MnGeo as a web service, which eliminates the need for large storage on a local server and provides access speed as fast or faster than local storage. As a pilot project in the fall of 2009, field staff tested the feasibility of using laptops in the field to record inspection data for cattail mosquitoes (i.e., mapping areas where larvae are found). Results will be evaluated in the spring when treatments are made from these maps.

Maps of street catch basins are the basis of MMCD's *Culex* control program in urban areas. Over 50,000 catch basins have been mapped and designated for water-holding ability. Since 2007, field staff have been mapping locations of larger stormwater control structures such as pond regulators and culverts which can also provide habitat for *Culex* species. Over 12,000 such structures were recorded as of January 2010. Many of these sites now receive routine treatment (see Chapter 2).

District staff members continue to participate in a Minnesota Pollution Control Agency (MPCA)-led effort to standardize mapping of stormwater structures among cities, watershed districts, MnDOT, and other agencies. The group produced a draft standard which has been reviewed by the MnGeo Hydrography and Standards Committees and was presented at two professional meetings (see below). Discussions with cities, a major source of this data, continue and a pilot project is being developed.

We continue to provide digital wetland files upon request to other units of government, and we are setting up an automated delivery system through the MetroGIS DataFinder. District staff serves on the Technical Advisory Committee of the National Wetlands Inventory (NWI) update project, funded by Legislative-Citizen Commission on Minnesota Resources (LCCMR) and the MnGeo Hydrography Committee.

District staff continue to participate in MetroGIS, including serving on the Technical Leadership workgroup, working with local governments on plans for a metro-wide property address data set, and providing project management for the Geocoding project (above).

Stormwater Management, Wetland Design, and Mosquitoes

Rain Garden Study Rain gardens have become a part of many water quality projects in the Minneapolis-St. Paul metro area. Designed to hold water for less than five days, they would not be expected to provide sufficient habitat for larval mosquitoes to allow them to emerge as adults. However, if there are problems with construction, maintenance, or continuous rain events that cause these sites to hold water longer, they can produce mosquitoes.

In 2009, Eric Sell and Kyle Beadle from the Rosemount facility examined sets of rain gardens in Inver Grove Heights, Lakeville, Burnsville, and West St. Paul/Mendota (Figure 6.2). Most of these were constructed at least three years ago. They visited the sites after rainfall and evaluated whether larval mosquitoes were present and whether the sites were likely to support development through adult emergence. Data collection was somewhat hampered by lack of rainfall, but 46 sites were checked one or more times after rain from May through October. Of these, eight held some water (17%), and three had larvae at least once (6%). There were 202 inspections, with sites wet 25 times and larvae present six times (12% wet and 3% breeding).

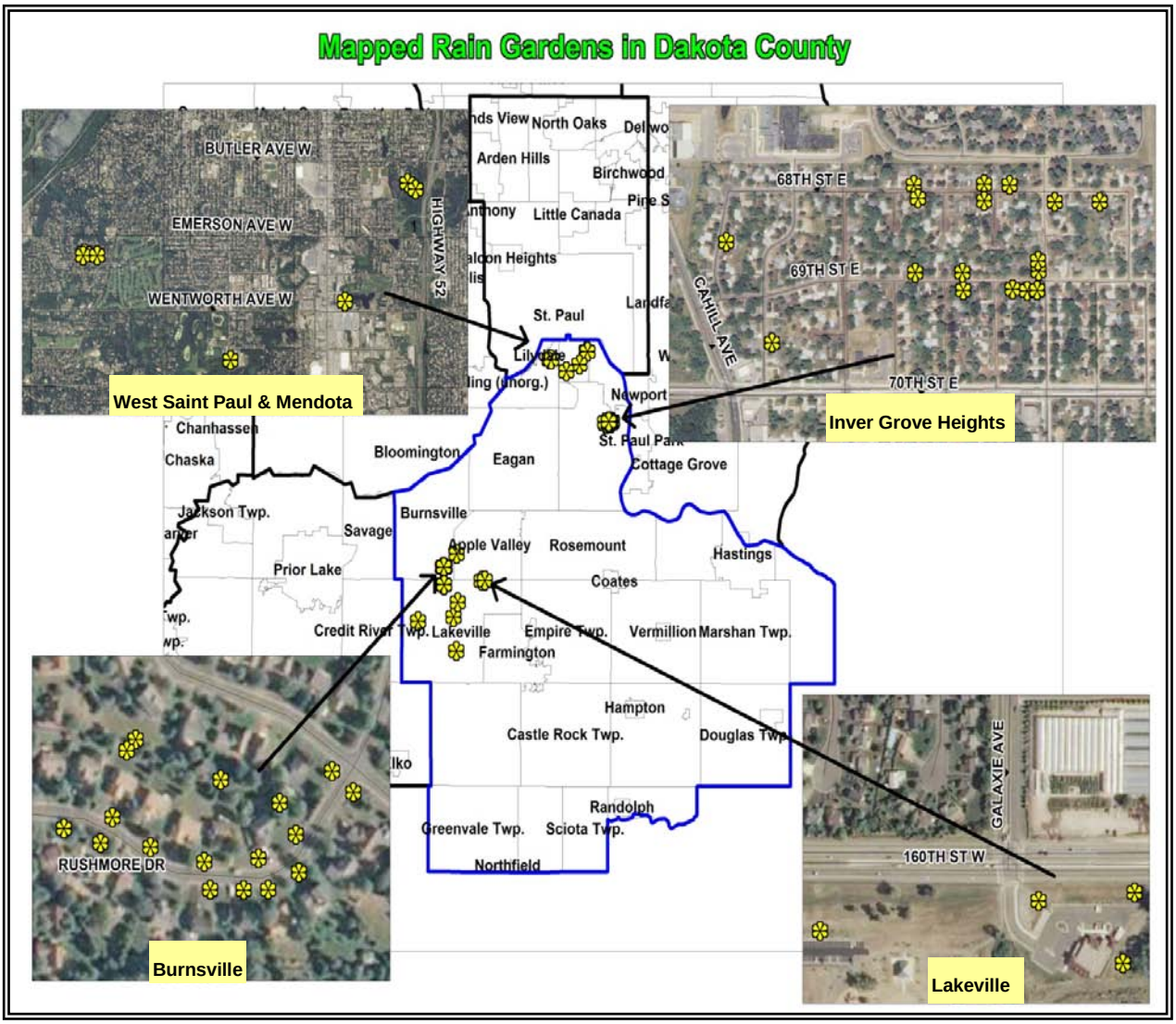


Figure 6.2 Location of rain garden study sites, 2009.

In the same time frame and the same general locale, staff conducted 2,260 regular wetland inspections and found 1,340 wet and 786 with larva present (59% wet and 35% breeding). Staff also conducted 1,879 stormwater structure inspections and found 1,409 wet, and 518 with larva present (75% wet and 28% breeding).

We concluded that rain gardens that were functioning correctly were very effective in managing stormwater runoff with minimal potential for mosquito larvae development. The rain gardens monitored were usually dry within 48 hr after a significant rain event, although a few had surface water present after three days (Figure 6.3). None of the rain gardens inspected allowed mosquito larvae to fully develop into pupa and adults (wet greater than five days). The number of rain gardens found with larvae present was significantly lower than the natural wetlands or other stormwater management structures in the same general area.

Figure 6.3 Lakeville Municipal Liquor Store, 160th St. and Galaxie Ave. Pictures were taken October 7 - 9, 2009, after receiving 3.79 inches of rain from October 1-6. This site did not always dry completely, was found to have floodwater mosquito larvae, and might be able to support mosquito larval development to adult emergence if rainfall was sufficient. Two other rain gardens constructed on the same property never held standing water at any time they were inspected in 2009.

Most of these rain gardens were well constructed and maintained, and were functioning effectively in 2009 conditions. However, we know that other rain garden developments exist in the metro area that have either had construction or maintenance problems and now hold water. We recommend that existing rain gardens be periodically monitored to ensure they function properly over time, and newly constructed rain gardens be monitored to ensure they are functioning properly from initial installation.

We chose the rain gardens used in this study based on previous reports, personal contacts, and our knowledge of the area. It would be helpful to have a registry of existing rain gardens, who constructed them, and who is responsible for maintenance, especially if we find ones that are supporting mosquito larval production.

Stormwater Design Outreach **S**taff works to maintain awareness of mosquito issues within the stormwater design and regulatory community.

- Staff participated in the MN Water Resources Conference (civil engineers, city & watershed dist. staff, U of M researchers) and presented a poster on Mosquitoes and Rain Gardens and discussed rain garden concerns with attendees.
- The "Stormwater and Mosquitoes" page on the MMCD web site received 993 visits in 2009.
  - The 2008 fact sheet on rain barrels recorded 662 downloads, up from 200 last year.
  - The Rain Gardens poster was made available through the web site (at the request of Water Resources Conference participants), and recorded 280 downloads since its posting in early November. (see Resources – Stormwater Management, http://www.mmcd.org/storm.html)

We also stay in contact with MPCA Stormwater Steering Committee regarding current activities and updates to the *Minnesota Stormwater Manual*, which includes a section on mosquitoes and

stormwater in Chapter 6. (http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html).

District staff contributed to efforts by the Society of Wetland Scientists (SWS) to develop an SWS White Paper on West Nile virus, mosquitoes, and wetlands. This paper reached a final consensus version and has been released by the SWS (see link, publications) and submitted for publication in the journal Wetlands. Staff member N. Read has worked to present the results of this effort to both SWS and mosquito control audiences (see presentations list).

Nontarget Studies

Previous Adulticide Nontarget Studies A paper was published by Dr. Karen Oberhauser summarizing studies on ULV resmethrin on monarch (*Danaus plexippus* (L.)) larvae in the *Journal of the American Mosquito Control Association* (see publication list, below) which reported on part of the 2004-05 adulticide nontarget studies organized by the TAB subgroup (Karen Oberhauser, Roger Moon, Nancy Read, and Stephen Manweiler).

Previous Larvicide Nontarget Studies 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) assembled by MMCD, are available on the MMCD web site, mostly as PDF files. Download totals for 2006-2009 are given in Table 6.1.

Table 6.1 Larvicide nontarget impact study report downloads from www.mmcd.org

Report content		2006	2007	2008	2009
SPRP Final Report, 1996		89	289	313	499
Long-term study brief overview		72	125	58	58
Results summary (1991-1998) with graphs		119	213	223	190
Balcer et al. 1999 Report	text	104	190	73	47
	figures	66	122	23	25
	tables	61	119	37	48
	appx. – cores	48	130	26	31
	appx. – substrates	41	107	27	26
Dose Report		62	131	92	116

The frog malformation study done by C. M. Johnson et al. (NRRI Technical Report # NRRI/TR-2001/01) showed 12 downloads in 2009.

A presentation summarizing the Wright Co. study and other recent information on nontarget effects of *Bti* and methoprene was presented by staff at the North Central Mosquito Control Association Annual Meeting in April, 2009.

Permits and Treatment Plans

National Pollutant Discharge Permit Issues District staff members have been monitoring the situation regarding the potential requirement of a National Pollutant Discharge Elimination System (NPDES) permit for application of pesticides to water. The following is a

summary of the background and current situation, excerpted from the January 2010 Michigan Mosquito Control Association newsletter:

> "The problem stems from a January 2009 ruling by the U.S. Sixth Circuit Court of Appeals, which struck down a 2006 Environmental Protection Agency (EPA) rule that interpreted the Clean Water Act did not regulate most pesticide applications into, over or near "waters of the United States," so long as the pesticide use complied with EPA's requirements (such as EPA-approved label restrictions). The practical effect of the Sixth Circuit decision is that almost all pesticide applications directly to water, over water, or "near" water will require a Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit. If the decision stands, farmers and others who use pesticides, such as mosquito abatement districts, will be required to obtain permits in order to apply pesticides on or near most water, including wetlands and some ditches.
>
> "The American Farm Bureau Federation (AFBF) has filed a petition with the U.S. Supreme Court, asking the high court to review the lower court ruling, In its petition, AFBF argues that the EPA pesticide rule simply formalized how EPA and Congress have always addressed environmental regulation of pesticide use. Responses to the AFBF petition, and friend-of-the court briefs in support of the petition, were due in early December. The Supreme Court is expected to decide whether to hear the case by the end of the year."

In June of 2009, the EPA was granted a 2-year stay to allow time to develop a permit program to handle the estimated 365,000 pesticide applicators that perform 5.6 million pesticide applications annually that could be affected by this court decision. The stay was also designed to allow time for EPA to work with states to develop permits and to provide outreach and education to the regulated community (see http://cfpub.epa.gov/npdes/home.cfm?program_id=41).
The American Mosquito Control Association (AMCA) has been working with EPA on ways to implement permitting, should the court decision stand, that would be manageable for both those seeking permits and those who have to review and issue them. The approach centers on following "Best Practices" for mosquito control, and AMCA has developed a draft Integrated Mosquito Management Plan (IMM) that could be used as a template. We will be reviewing the IMM, and continuing our contacts with local regulatory agencies as this situation continues to develop.

US Fish & Wildlife Service – Mosquitoes and Refuges The District and local US Fish &Wildlife Service (FWS) staff were near completion of a refuge plan for areas in the District when the FWS released a draft mosquito and mosquito-borne disease management policy in October 2007. Work on the local plan was set aside until the national policy is finalized. In 2009, refuge staff developed "Minnesota Valley National Wildlife Refuge 2009 Mosquito-Borne Disease Human Health Emergency Response Procedure" and prepared Pesticide Use Proposals for a larvicide, *Bacillus sphaericus* (VectoLex®), and an adulticide, Sumithrin (Anvil®), to ensure that approvals were in place to allow for treatment of disease vectors on the Refuge if "a mosquito-borne disease human health emergency exists in vicinity of the Refuge" and such treatment "is found to be appropriate." The plan states that "the Service, MMCD, and the MDH will work together as a panel to determine a human health emergency and associated response."

Public Communication

Notification of Control The District continues to post daily adulticide information on its web site (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. The District also publishes a 3-column by 9-inch ad in local daily and weekly newspapers, just prior to Memorial Day weekend, advising citizens how to find out where and when District adulticiding will take place throughout the season. This ad also describes the process for opting out of treatment. Aerial larvicide treatments schedules are also posted on the web site.

Calls Requesting Service Calls requesting treatment early in the season generally followed the seasonal pattern shown by sweep net counts for human-biting mosquitoes (Figure 6.4). People planning outdoor activities, such as picnics, outdoor weddings, and graduation open houses are responsible for many early season calls, as they anticipate an annual early-season increase in the number of mosquitoes with which they may have to contend.

As MMCD staff monitored the rapid spread of the exotic species *Aedes japonicus* in 2009, public interaction with District staff intensified as monitoring and surveillance increased. This enhanced public awareness and media scrutiny of our prevention and control measures led to a spike in late-season calls requesting service (Figure 6.4) and a significant increase in tire pick-up and recycling along with a greater general focus on cleaning up container-filled sites. Lower than average mosquito levels throughout much of the summer, however, resulted in generally lower than average numbers of phone calls and emails to the District reporting annoyance and requesting adult mosquito control service (Table 6.2).

Yearly comparisons of specific types of citizen calls (Table 6.2) shows significant declines in the number of calls requesting adult mosquito treatment from 2002 to 2007, continuing a downward trend from a high of 3,602 treatment request calls recorded during 2003 when mosquito numbers were high. Treatment requests increased in 2008 to 1,375, then decreased again in 2009 to 594 (April through September). Calls requesting treatment prior to events – both public and private – increased significantly in 2009 and account for much of the early season phone traffic. Requests to pick up dead birds for WNV testing (not included in this table) were also considerably lower due to low WNV activity.

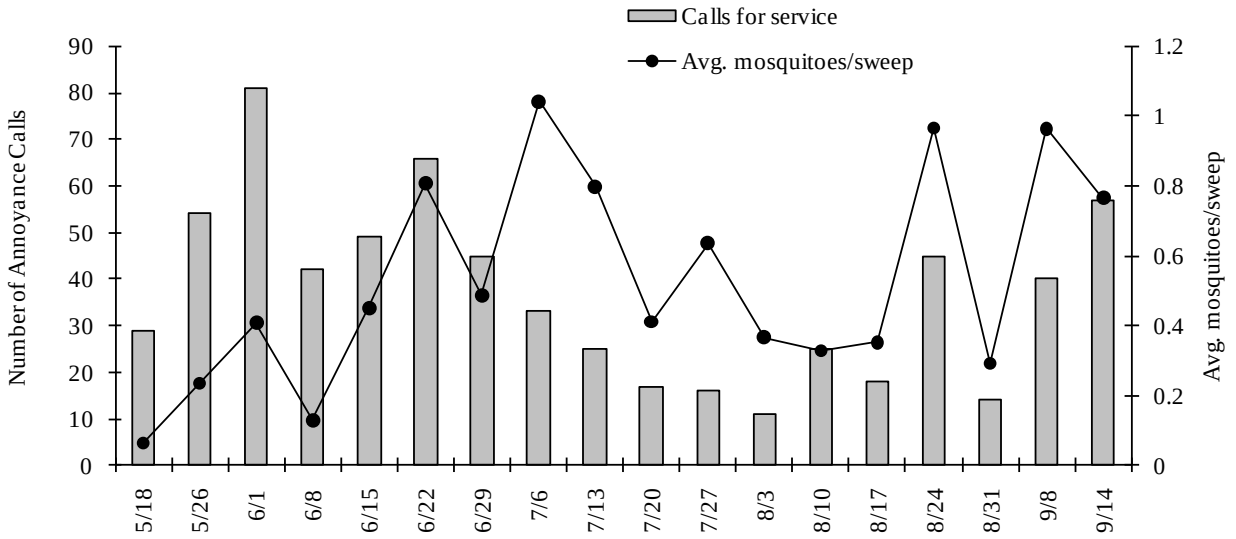


Figure 6.4 Calls requesting treatment and sweep net counts by week, 2009.

Table 6.2 Yearly comparisons of citizen calls tallied by service request from 2002 to 2009*

	No. Calls/Year							
Caller Concern	2002	2003	2004	2005	2006	2007	2008	2009
Check a breeding site	1,307	1,516	984	633	610	393	220	197
Request adult treatment	3,062	2,714	2,506	1,094	854	867	1375	594
Public event, request treatment	171	132	135	100	72	60	109	250
Request tire removal	321	236	255	242	170	208	257	253
Request or confirm limited or no treatment	**190	60	38	36	**171	49	66	61

* Includes email requests for service

** - years where confirmation postcards sent to confirm restricted access property status

Curriculum in Schools The District continues to deliver "Mosquito Mania," a 3-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 field facility staff made presentations to 3,689 students in 36 schools during 2009.

Professional Association Support

American Mosquito Control Association Staff members continue to provide support for the national association in a variety of ways.

- Jim Stark was elected Regional Director for the North Central AMCA region, and will be serving on the AMCA Board of Directors
- Mark Smith assisted in planning AMCA's Field Demonstration Day in New Orleans, LA on April 8, 2009. This off-site event, held in conjunction with the Annual Meeting, promotes the exchange of ideas and information in an informal, hands-on environment. Mark used his previous experience (2003 AMCA, Minneapolis, MN) to provide guidance to the local arrangements committee. The event was considered a success and continues to be a useful forum for mosquito control professionals.
- Diann Crane continues to provide editorial assistance with the AMCA Annual Meeting Program.

North American Black Fly Association John Walz served as President and Program Chair for this group in 2009.

North Central Mosquito Control Association On April 23-24, 2009 MMCD hosted the North Central Mosquito Control Association 4th Annual Meeting at our North facility in Andover, MN. This meeting brought together university researchers, regional mosquito control professionals, regulatory officials, and industry to promote education and networking of professionals of the surrounding 5-state area. Mark Smith chaired the host committee and organized the 2-day event with MMCD staff. We had 83 attendees with representation from over ten states. District staff conducted numerous presentations and educational training and the meeting was well received.

The District has supported the development of the North Central Mosquito Control Association. This regional association is focused on education, communication, and promoting interaction between the various regional organizations. This group supports individuals in Minnesota, North Dakota, South Dakota, Wisconsin, Iowa, and Canada's Central Provinces. This new association will provide a forum for those who work with similar habitats, mosquito species, and vector-borne diseases found in the upper Midwest. Mark Smith has been appointed to the Association's Board of Directors.

MN GIS/LIS Consortium Nancy Read was presented with the Consortium's Polaris Leadership Award at the October 2009 conference in Duluth. This award was established to recognize mid-career GIS professionals who demonstrate a beacon of energy and creativity that inspires and guides the rest of the organization.

Scientific Presentations, Posters, and Publications

District staff attends a variety of scientific meetings throughout the year. Following is a list of papers and posters presented during 2009 and talks that will be presented in 2010. Also included are publications that have MMCD staff as authors or co-authors.

2009 Presentations & Posters

Brogren S, Johnson K. 2009. Mosquitoes on the move: First occurrences of *Aedes japonicus* and *Aedes cataphylla* in Minnesota. Presentation at the American Mosquito Control Association Annual Meeting in New Orleans, LA.

Griemann L. 2009. Inventory process for abatement districts. Presentation at the American Mosquito Control Association Annual Meeting in New Orleans, LA.

Griemann L, Read N. 2009. Internal web map for field support. Poster presentation at Minnesota GIS/LIS Conference, Duluth, MN.

LaMere, C. 2009. Metropolitan Mosquito Control District mosquito and black fly surveillance methods, maps and more. Presentation at the Annual North American Black Fly Meeting in Lake Placid, FL.

Manweiler, S, Johnson K. 2009. Control of WNV vectors in catch basins in St. Paul, Minnesota by FourStar™ larvicide briquet formulations. Presentation at the American Mosquito Control Association Annual Meeting in New Orleans, LA.

Read, N. 2009. Citizen call system. Presentation at the Michigan Mosquito Control Association Annual Meeting in Ann Arbor, MI.

Read, N. 2009. Mosquito ecology in stormwater systems. Seminar presentation for Urban Ecology series, U. MN.

Read, N. 2009. Review of nontarget studies on *Bti* and methoprene (larvicides). Presentation at the North Central Mosquito Control Association Annual Meeting, Andover, MN.

Read, N. 2009. Wetlands and mosquitoes – Resources available. Presentation at Society of Wetland Scientists Annual Meeting, Madison, WI.

Read, N. 2009. Landmark / Point of Interest Geocoder Web Service for the Seven-County Metro Area. Presentation at MN GIS/LIS Conference, Duluth, MN.

Read, N. 2009. The value of collaboration. Presentation at MN GIS/LIS Conference, Duluth, MN.

Read, N. 2009. Stormwater structures and mosquitoes: Dealing with multiple goals. Symposium presentation at Northeast Mosquito Control Association Annual Meeting, Sturbridge, MA.

Read, N. 2009. Call tracking and web map. Poster presentation at Northeast Mosquito Control Association Annual Meeting, Sturbridge, MA.

Sell, E, Beadle K, Read N. 2009. Mosquitoes and established rain gardens: An update. Poster presentation at MN Water Resources Conference, St. Paul, MN.

Smith, M. 2009. Introduction to Metropolitan Mosquito Control District. Presentation at the North Central Mosquito Control Association Annual Meeting in Andover, MN.

Trojan, M, Read N, Studtmann J, Kloiber S. 2009. Stormwater mapping: Making connections with the new data exchange standard. Poster presentation at MN GIS/LIS Conference, Duluth, MN, and MN Water Resources Conference, St. Paul, MN.

Walz, J. 2009. History of mosquito and black fly control in Minnesota. Presentation at the Annual North American Black Fly Meeting in Lake Placid, FL.

2009 Publications

Neitzel DF, Johnson KA, Brogren S, Kemperman MM. 2009. First collection records of *Aedes japonicus* in Minnesota. *J. Am. Mosq. Control Assoc*. 25:367-369.

Oberhauser, K, Manweiler S, Lelich R, Blank M, Batalden RV and de Anda, A. 2009. Impacts of ULV resmethrin applications on nontarget insects. *J. Am. Mosq. Control Assoc.* 25:83-93.

Society of Wetland Scientists. 2009. Current practices in wetland management for mosquito control. *SWS White Paper* available at http://www.sws.org/wetland_concerns/docs/SWS-MosquitoWhitePaperFinal.pdf.

Berg, J, Felton M, Gecy L, Laderman A, Mayhew C, Mengler J, Meredith WH, Read N, Rey J, Roberts C, Sakolsky-Hoopes G, Walton WE, Wolfe R. (submitted). Mosquito control in wetlands. *Wetlands*.

2010 Presentations & Posters

Grant, S. 2010. *Aedes japonicus* in Minnesota: 2007-2009. Presentation at the Annual Meeting of the Michigan Mosquito Control Association Annual Meeting in Traverse City, MI.

Johnson, K. 2010. The expanding distribution of *Aedes japonicus* in the Metropolitan Mosquito Control District. Presentation at the American Mosquito Control Association Annual Meeting in Lexington, KY.

Johnson, K. 2010. Experimental use of Natular™ against WNV vectors in stormwater management structures. Presentation at the American Mosquito Control Association Annual Meeting in Lexington, KY.

Manweiler, S. 2010. Natular™ Larvicide tests in Minnesota: 2008-2009. Presentation at the Annual Meeting of the Michigan Mosquito Control Association, Traverse City, MI.

Manweiler, S. 2010. Natular™ Larvicide tests in Minnesota: 2008-2009. Annual Meeting of the New Jersey Mosquito Control Association, Atlantic City, NJ.

Read, N. 2010. Building effective communication with wetland scientists through sound biology. Presentation in symposium “Mosquitoes and wetland concerns: Issues and approaches” organized by N. Read and W. Meredith, at the American Mosquito Control Association Annual Meeting in Lexington, KY.

Smith, M. 2010. Evaluation of late summer treatments to suppress *Coquillettidia perturbans* emergence the following spring. Presentation at the American Mosquito Control Association Annual Meeting in Lexington, KY.

APPENDICES

APPENDIX A Mosquito Biology

There are 51 species of mosquitoes in Minnesota. Thirty-nine species are found within the MMCD. 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, and the cattail mosquito.

Disease Vectors

Aedes triseriatus Also known as the eastern treehole mosquito, *Ae. triseriatus*, is the vector of La Crosse encephalitis (LAC). It breeds in tree holes and artificial containers, especially discarded tires. The 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.

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 artificial containers, and feeding shifts from birds to horses or humans. New Jersey light traps and CO_2 traps are used to monitor this species.

Other *Culex* *Culex pipiens, Cx. restuans,* and *Cx. salinarius* are also vectors of WNV. All deposit eggs in permanent and semi-permanent sites and *Cx. pipiens* and *Cx. restuans* use storm sewers and catch basins as well.

Culiseta melanura *Culiseta melanura* is the enzootic vector of eastern equine encephalitis. Its preferred larval habitats are spruce tamarack bogs. Adults do not fly far from their breeding sources. Adult females feed primarily on birds, but will also feed on small mammals and snakes. Adults readily enter light traps. Overwintering occurs as mature larvae. Surveillance relies on collections from CO_2 traps and aspirator samples taken near their larval habitats.

Floodwater Mosquitoes

Spring Snowmelt *Aedes* Spring snowmelt mosquitoes are the earliest mosquitoes to hatch in the spring. They breed in woodland pools, bogs, and marshes that are flooded with snow melt water. There is only one generation per year and overwintering is in the egg stage. Adult females live throughout the summer and can take up to four blood meals. These mosquitoes do not fly very far from their breeding sites, so localized hot spots of biting can occur both day and night. Our most common spring species are *Ae. abserratus/punctor, Ae. excrucians* and *Ae. stimulans*. Adults are not attracted to light, so human or CO_2-baited trapping is recommended.

Summer Floodwater *Aedes* Summer floodwater eggs hatch in late April and early May. Mosquitoes lay at the margins of grassy depressions, marshes, and along river flood plains. There are multiple generations per year resulting from rainfalls greater than one inch. Overwintering is in the egg stage. Adult females live about three weeks. 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. cinereus, Ae. sticticus,* and *Ae. trivittatus*. New Jersey light traps, CO_2 traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans Larvae of this summer species develop in cattail marshes and are known as cattail mosquitoes. A unique characteristic of this mosquito is that larvae can obtain oxygen by attaching its specialized siphon to the roots of cattails and other aquatic plants, overwintering in this manner. Adults begin to emerge in late June, with peak emergence around the first week of July. They are very aggressive biters, even indoors, and will fly up to five miles from breeding sites. Peak biting activity is at dusk and dawn. Surveillance of adults is best achieved with CO_2 traps.

Permanent Water Species

Other mosquito species not previously mentioned breed 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 singly or in rafts on the surface of the water. The adults prefer to feed on birds or livestock, but they will also bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. The District targets four *Culex* species and one *Culiseta* species for surveillance and/or control.

Exotic or Rare Species

Aedes albopictus This exotic species is called the Asian tiger mosquito. It breeds in tree holes and containers. This mosquito is a very efficient vector of several diseases, including La Crosse encephalitis. *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 has established itself in areas as far north as Chicago, IL. An individual female will lay her eggs a few at a time in several containers, which may contribute to rapid local spread of the species. This mosquito has transmitted dengue fever in southern areas of the United States. Females feed predominantly on mammals but will also feed on birds.

Aedes japonicus This exotic species was first detected in Minnesota in 2007. In 2008, we determined they were established in the District and southeast Minnesota and in 2009, we tracked their spread throughout the District. Larvae are found in a wide variety of natural and artificial containers, including rock holes and used tires. Preferred sites usually are shaded and contain water rich in organic matter. The transport of eggs, larvae, and pupae in used tires may be an important mechanism for introducing the species into previously uninfested areas. Eggs are resistant to desiccation and can survive several weeks or months under dry conditions. Overwintering is in the egg stage.

Aedes cataphylla The first occurrence of this mosquito was detected in 2008. It is a very early spring species whose range is western US and Canada, no further east than Colorado. This species is not a vector; however, it is an aggressive pest in Canada. We will continue to monitor for *Ae. cataphylla* to determine if this species is established in Minnesota.

APPENDIX B Average Number of Common Mosquito Species Collected/Night in 4 New Jersey Light Traps and Average Yearly Rainfall - 1965-2009

Year	*Aedes abs/punct*	*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	95.50	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	0.61	0.59	0.27	0.06	48.42	19.23	5.16	86.42	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	0.07	0.15	0.43	2.00	33.80	0.13	1.59	40.51	16.79
2004	0.03	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	23.60
2006	0.04	0.08	0.14	0.01	6.73	0.08	1.85	10.04	18.65
2007	0.22	0.27	0.01	0.01	8.64	0.26	0.94	13.20	17.83
2008	0.39	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

APPENDIX C Description of Control Materials

The following is an explanation of the control materials currently in use by MMCD. The specific names of products used in 2009 are given. The generic products will not change in 2010, although the specific formulator may change.

Altosid® (methoprene) 150-day briquets Wellmark International/Zoecon - Altosid® XR Extended Residual Briquet)

Altosid® briquets are applied to mosquito breeding 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 which may flood and then dry up (Types 1 & 2) are treated completely. Sites which 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.

Cattail mosquito (*Cq. perturbans*) breeding 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.

Altosid® (methoprene) pellets Wellmark International/Zoecon-Altosid® Pellets

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 which are greater than three acres in size at the same rate as ground sites, primarily for *Cq. perturbans* control.

Altosid® (methoprene) SR-20 liquid Wellmark International/Zoecon-Altosid® Liquid Larvicide Concentrate-A.L.L. Liquid

Altosid® liquid is mixed with water and applied in the spring to mosquito breeding sites containing spring *Aedes* mosquito larvae. Typical applications are to woodland pools. Sites greater than three acres in size are treated by the helicopter at a rate of twenty milliliters of concentrate per acre. The dilution is adjusted to achieve the best coverage of the site. Altosid® liquid treatments are ideally completed by June 1 of each season.

Altosid® (methoprene) XR-G sand Wellmark International/Zoecon-Altosid® XR-G Sand

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.

***Bacillus thuringiensis israelensis* (*Bti*) corncob** Valent Biosciences-VectoBac® G

Bti corncob may be applied in all types of mosquito breeding. *Bti* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical applications are by helicopter in sites which are greater than three acres in size at a rate of 5-10 lb per acre. In sites less than three acres, *Bti* is applied with cyclone seeders or power back packs to pockety sites.

***Bacillus thuringiensis israelensis* (*Bti*) liquid** Valent Biosciences-VectoBac® 12AS

Bti liquid is applied directly to small streams and large rivers to control black fly larvae. Treatments are applied 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. *Bti* is applied at pre-determined sites, usually at bridge crossings applied from the bridge, or by boat.

Bacillus sphaericus (Bs) Valent Biosciences-VectoLex® CG

Bacillus sphaericus corncob may be applied in all types of *Culex* mosquito breeding. It can be effectively applied during the first three instars of the mosquito breeding 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, *Bs* is applied to pockety sites with cyclone seeders or power back packs at rates of 8 lb per acre. This product is also being evaluated as a control material for catch basin applications.

***Bti*/*Bacillus sphaericus (Bs)* corncob** Valent Biosciences-VectoMax® CG

Bti/Bs corncob may be applied in all types of *Culex* mosquito breeding. It combines the rapid kill of *Bti* and the residual activity of *Bs*. 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, *Bs* is applied with cyclone seeders or power back packs at a rate of 8 lb per acre to pockety sites. This product is also being evaluated as a control material for catch basins and other small stormwater management structures.

Natular™ (spinosad) Clarke Mosquito Control- Natular® XRG, T30, XRT

Natular™ is a new formulation of spinosad, a biological toxin extracted from the soil bacterium *Saccharopolyspora spinosa* being developed for larval mosquito control. Spinosad has been used by organic growers for over ten years. Natular™ is formulated as long release tablets (T30, XRT) and granules (XRG) and can be applied to dry and wet sites. This product is also being evaluated as a control material for catch basins, other small stormwater management structures, and small ground sites.

Agnique® Mono-Molecular Film (MMF) liquid Cognis Corporation-Agnique® MMF

Agnique® liquid is applied directly to small mosquito breeding sites to control pupae. Experimental treatments are applied when mosquito larvae are no longer actively feeding or

affected by other larvicides. Application rates are 0.2-0.3 gal per acre. Agnique® is applied by hand using a squirt bottle or pressurized sprayer to the surface of the water creating a thin self-spreading film layer and applications lowers the surface tension of the water's surface. This loss of surface tension does not allow the pupae to easily access the water's surface and breathe without significant effort. Therefore, pupae will eventually drown and control is obtained.

Permethrin Clarke Mosquito Control Products-Permethrin 57% OS

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

Adult control is initiated when MMCD surveillance (sweep net and light trap collections) indicates nuisance populations of mosquitoes, when employee conducted landing rate collections document high numbers of mosquitoes, or when a large number of citizen complaints of mosquito annoyance are received from an area. In the case of citizen complaints, MMCD staff evaluates mosquito levels to determine if treatment is warranted. Staff 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 District mixes permethrin with soybean and food grade mineral oil and applies it to wooded areas with a power backpack mister at a rate of 25 oz of mixed material per acre (0.0977 lb active ingredient per acre).

Resmethrin Bayer-Scourge® 4+12

Resmethrin is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Resmethrin 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. Resmethrin is applied at a rate of 1.5 oz of mixed material per acre (0.0035 lb active ingredient per acre). Resmethrin is a restricted used compound and is applied only by Minnesota Department of Agriculture licensed applicators.

Sumithrin Clarke-Anvil® 2+2

Sumithrin is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Sumithrin 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. Sumithrin is applied at a rates 1.5 and 3.0 oz of mixed material per acre (0.00175 and 0.0035 lb active ingredient per acre). Sumithrin is a non-restricted use compound.

Natural Pyrethrin Bayer-Pyrenone® 25-5

Pyrenone 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. Pyrenone 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 enables 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. Pyrenone is applied at a rate of 1.5 oz of mixed material per acre (0.00172 lb active ingredient per acre). Pyrenone is a non-restricted use compound.

Natural Pyrethrin MGK-Pyrocide® 7396 (5+25)

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 enables 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. Pyrocide is applied at a rate of 1.5 oz of mixed material per acre (0.00217 lb active ingredient per acre). Pyrocide is a non-restricted use compound.

APPENDIX D 2009 Control Materials: Active Ingredient (AI) Identity, Percent AI, Per Acre Dosage, AI Applied Per Acre and Field Life

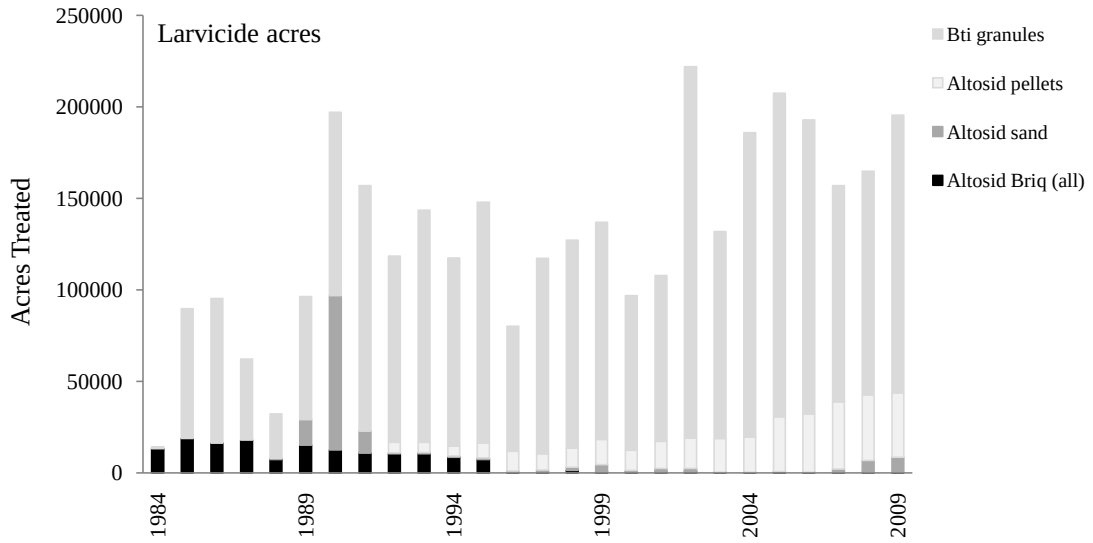
Material	AI	Percent AI	Per acre dosage	AI per acre (lb)	Field life (days)
Altosid® briquets [a]	Methoprene	2.10	220	0.4481	150
			330	0.6722	150
			440	0.8963	150
			1*	0.0020*	150
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063	30
			4 lb	0.1700	30
			0.0077 lb* (3.5 g)	0.0003*	30
Altosid® SR-20 [b]	Methoprene	20.00	20 ml	0.0091	10
Altosid® XR-G	Methoprene	1.50	10 lb	0.1500	20
Altosand	Methoprene	0.05	5 lb	0.0025	10
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
VectoMax® CG	*Bti/Bs*	7.20	8 lb	0.5760	7-28
			0.0077 lb* (3.5 g)	0.00055*	7-28
Permethrin 57%OS [c]	Permethrin	5.70	25 fl oz	0.0977	5
Scourge® [d]	Resmethrin	4.14	1.5 fl oz	0.0035	<1
Anvil® [e]	Sumithrin	2.00	3.0 fl oz	0.0035	<1
			1.5 fl oz	0.00175	<1
Pyrenone® [f]	Pyrethrins	2.00	1.5 fl oz	0.00172	<1
Pyrocide® [g]	Pyrethrins	2.50	1.5 fl oz	0.00217	<1

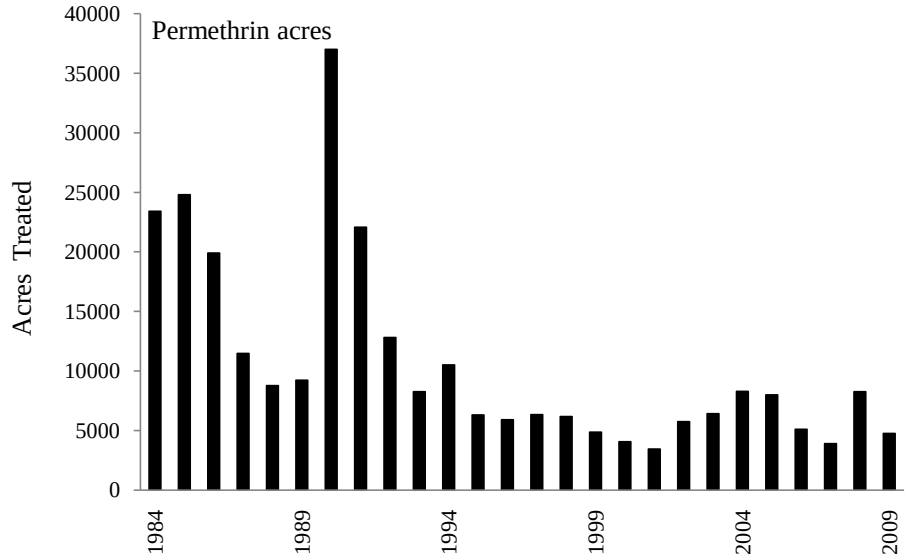
[a] 44 g per briquet total weight (220 briquets=21.34 lb total weight)
[b] 1.72 lb AI per 128 fl oz (1 gal); 0.45 lb AI per 1000 ml (1 liter)
[c] 0.50 lb AI per 128 fl oz (1 gal) (product diluted 1:10 before application, undiluted product contains 5.0 lb AI per 128 fl oz)
[d] 0.30 lb AI per 128 fl oz (1 gal)
[e] 0.15 lb AI per 128 fl oz (1 gal)
[f] 0.147 lb AI per 128 fl oz (1 gal) (product diluted 1:1.5 before application, undiluted product contains 0.367 lb AI per 128 fl oz)
[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.

APPENDIX E Acres Treated with Control Materials Used by MMCD for Mosquito and Black Fly Control for 2001-2009; the actual geographic area treated is smaller because some sites are treated more than once

Control Material	2001	2002	2003	2004	2005	2006	2007	2008	2009
Altosid® XR Briquet 150-day	589	628	323	398	635	352	290	294	225
Altosid® Sand-Products	1,889	1,822	0.5	0	0	0	1,776	6,579	8,320
Altosid® SR-20 liquid	91	51	33	0	0	0	0	0	0
Altosid® Pellets 30-day	14,791	16,521	18,458	19,139	29,965	31,827	36,818	35,780	35,161
Altosid® Pellets Catch Basins	0	0	135,978	148,023	145,386	167,797	161,876	195,973	219,045
Altosid® XR Briquet Catch Basins	0	0	0	0	0	5,210	6,438	40	0
VectoLex® CG granules	0	0	0	0	810	540	27	6	0
VectoMax® CG granules	0	0	0	0	0	0	0	182	5
Bti Corncob granules	90,527	202,875	113,198	166,299	176,947	160,780	118,128	122,251	151,801
Bti Liquid Black Fly (gallons used)	4,047	3,169	3,408	2,813	3,230	1,035	1,348	2,063	2,181
Permethrin Adulticide	3,444	5,734	6,411	8,292	7,982	5,114	3,897	8,272	4,754
Resmethrin Adulticide	41,311	43,302	68,057	71,847	40,343	29,876	24,102	64,142	12,179
Sumithrin Adulticide	8,423	32,230	14,447	15,508	25,067	5,350	5,608	35,734	7,796
Pyrenone® Adulticide	0	0	0	0	0	0	0	2,214	943
Pyrocide® Adulticide	0	0	0	0	0	0	0	299	0

APPENDIX F Larvicide and Permethrin Acres Treated from 1984 - 2009





APPENDIX G Control Material Labels

Altosid® XR Extended Residual Briquets

Altosid® Pellets

Altosid® Liquid Larvicide Concentrate

Altosid® XR-G

VectoBac® 12AS

VectoBac® G

VectoBac® WDG

VectoLex® CG

VectoMax® CG

FourStar™ Bti Briquets 150

Natular™ XRT

Agnique® MMF

Permethrin 57% OS

Scourge® 4+12

Anvil® 2+2 ULV

Pyrenone® 25-5

Pyrocide®

Altosid® XR
EXTENDED RESIDUAL BRIQUETS

A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

ACTIVE INGREDIENT:	
(S)-Methoprene (CAS #65733-16-6)	
(Dry Weight Basis)	2.1%
OTHER INGREDIENTS:	97.9%
Total . . .	100.0%

This product contains water; therefore the weight of the briquet and percent by weight of active ingredient will vary with hydration. The ingredient statement is expressed on a dry weight basis.

EPA Reg No. 2724-421

KEEP OUT OF REACH OF CHILDREN
CAUTION

INTRODUCTION

ALTOSID® XR BRIQUETS are designed to release effective levels of methoprene insect growth regulator over a period up to 150 days in mosquito breeding sites. Release of 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 those 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* and *Psorophora* spp.) from treated water. Treated larvae continue to develop normally to the pupal stage where they die.

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

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. 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.

APPLICATION TIME

Placement of **ALTOSID XR BRIQUETS** should be at or before the beginning of the mosquito season. **ALTOSID XR BRIQUETS** can be applied prior to flooding when sites are dry, or on snow and ice in breeding sites prior to spring thaw. Under normal conditions, 1 application should 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 and *Psorophora* spp.: For control in non-(or low-) flow shallow depressions (≤ 2 feet in depth), treat on the basis of surface area, placing 1 briquet per 200 ft^2. Briquets should be placed 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 ft^2.

Coquillettidia and *Mansonia* spp.: For application to cattail marshes and water hyacinth beds. For control of these mosquitoes, place 1 briquet per 100 ft^2.

Culex sp. in storm water drainage areas, sewers, and catch basins: For catch basins, place 1 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 1 briquet per 100 feet square of surface area up to 2 ft deep. In areas that are deeper than 2 feet, use 1 additional briquet per 2 feet of water depth.

Large water flows may increase the dissolution of the briquet thus reducing the residual life of the briquet. Regular inspections (visual or biological) in areas of heavy water flow may be necessary to determine if the briquet is still present. The retreatment interval may be adjusted 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 – 1500	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, 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 phospate 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, all of the water-holding sites in the system should be treated to maximize the efficiency of the treatment program.

STORAGE AND DISPOSAL

STORAGE

Store in a cool place. Do not contaminate water, food, or feed by storage or disposal. Do not reuse empty container.

DISPOSAL

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, express 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, or in case of an emergency, call **1-800-248-7763** or visit our web site: **www.altosid.com**

Wellmark

ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

22 - 24 - 001

Made in the U.S.A.

January 2002
Schaumburg, IL

Altosid® Pellets
MOSQUITO GROWTH REGULATOR

A GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

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
ENVIROMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midge) larvae. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. 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

ALTOSID® Pellets release ALTOSID® Insect Growth Regulator as they erode. The 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* 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. Treatment should be continued through the last brood of 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

MOSQUITO HABITAT	RATES (Lb/Acre)
Floodwater sites	
Pastures, meadows, ricefields, freshwater swamps and marshes, salt and tidal marshes, cattail marshes, woodland pools, flood-plains, tires, other artificial water-holding containers	2.5-5.0
Dredging spoil sites, waste treatment and settling ponds, ditches and other manmade depressions	5.0-10.0
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, treeholes, other artificial water-holding containers	2.5-5.0
Storm drains, catch basins, roadside ditches, cesspools, septic tanks, waste settling ponds, vegetation-choked phosphate pits	5.0-10.0

Use lower rates when water is shallow, vegetation and/or pollution are minimal, and mosquito populations are low. Use higher rates when water is deep (>2 ft), vegetation and/or pollution are high, and mosquito populations are high.

APPLICATION METHODS

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 10.0 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. ALTOSID Pellets may be applied to artificial containers, such as tires and catch basins, etc.

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

STORAGE

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 DISPOSAL

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, 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, express 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 or visit our web site: www.altosid.com.

Wellmark International
Schaumburg, Illinois U.S.A.

Zoecon®, A Wellmark International Brand
ALTOSID® Pellets, ALTOSID® Insect Growth Regulator and ZOECON® are registered trademarks of Wellmark International.

20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Altosid® Liquid Larvicide CONCENTRATE

PREVENTS EMERGENCE OF ADULT FLOODWATER MOSQUITOES

SPECIMEN LABEL

ACTIVE INGREDIENT:

(S)-Methoprene*	20.0%
OTHER INGREDIENTS:	80.0%
Total	100.0%

* CAS # 65733-16-6

Formulation contains 1.72 lb/gal (205.2 g/l) active ingredient.

EPA Reg No. 2724-446

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE ADDITIONAL PRECAUTIONARY STATEMENTS

Because of the unique mode of action of **A.L.L.**™, successful use requires familiarity with special techniques recommended for application timing and treatment evaluation. **See Guide to Product Application** or consult local Mosquito Abatement Agency.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

CAUTION

Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. 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.

CHEMIGATION

Refer to supplemental labeling entitled "**Guide to Product Application**" for use directions for chemigation. Do not apply this product through any irrigation system unless the supplemental labeling on chemigation is followed.

MIXING AND HANDLING INSTRUCTIONS

1. **SHAKE WELL BEFORE USING**. **A.L.L.** may separate on standing and must be thoroughly agitated prior to dilution.
2. Do not mix with oil; use clean equipment.
3. Partially fill spray tank with water; then add the recommended amount of **A.L.L.**, agitate and complete filling. Mild agitation during application is desirable.
4. Spray solution should be used within 48 hours; always agitate before spraying.

RECOMMENDED APPLICATIONS

INTRODUCTION

A.L.L. must be applied to 2nd, 3rd, or 4th larval instars of floodwater mosquitoes to prevent adult emergence. Treated larvae continue normal development to the pupal stage where they die. This insect growth regulator **has no effect when applied to pupae or adult mosquitoes. A.L.L.** has sufficient field life to be effective at recommended rates when applied to larval stages under varying field conditions. For further information, see **Guide to Product Application**.

METHODS OF APPLICATION

AERIAL
Use the recommended amount of **A.L.L.** listed below in sufficient water to give complete coverage. One-half to 5 gallons of spray solution per acre is usually satisfactory. Do not apply when weather conditions favor drift from areas treated.

GROUND
Determine the average spray volume used per acre by individual operators and/or specific equipment. Mix **A.L.L.** in the appropriate volume of water to give the rate per acre recommended below.

APPLICATION RATE
Apply ¾ to 1 fl oz of **A.L.L.** per acre (55 to 73 ml/hectare) in water as directed.

APPLICATION SITES

PASTURES
A.L.L. may be applied after each flooding without removal of grazing livestock.

RICE
A.L.L. must be applied to 2nd, 3rd, and/or 4th instar larvae of mosquitoes found in rice, usually within 4 days after flooding. **A.L.L.** treatment may be repeated with each flooding.

INTERMITTENTLY FLOODED NONCROP AREAS
A.L.L. may be applied as directed above when flooding may result in floodwater mosquito hatch. Typical sites include: freshwater swamps and marshes, salt marshes, woodland pools and meadows, dredging spoil sites, drainage areas, waste treatment and settling ponds, ditches and other natural and manmade depressions.

CROP AREAS
A.L.L. may be applied to irrigated croplands after flooding to control mosquito emergence. Examples of such sites are: vineyards, rice fields (including wild rice), date palm orchards, fruit and nut orchards, and berry fields and bogs. Irrigated pastures may be treated after each flooding **without** the removal of livestock.

DENSE VEGETATION OR CANOPY AREAS
Apply an **A.L.L.** sand mixture using standard granular dispersal equipment. For detailed preparation instructions, refer to **Guide to Product Application**.

STORAGE AND DISPOSAL

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

STORAGE
Store in cool place away from other pesticides, food, and feed. In case of leakage or spill, soak up with sand or another absorbent material

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
Triple rinse or equivalent. 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.

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

For information call 1-800-248-7763

Always read the label before using the product.

Wellmark

ZOËCON Professional Products

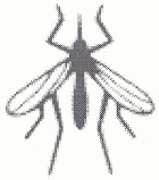
Wellmark International
Schaumburg, Illinois U.S.A.

21-24-004

Made in the U.S.A.

October 2000
Schaumburg, IL

Altosid® XR-G



AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

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

Avoid contact with skin or eyes. Due to the size and abrasiveness of the granule, use protective eyewear and clothing to minimize exposure during loading and handling.

FIRST AID

In case of contact, immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midges). Using it in a manner other than that described by the label could result in harm to aquatic dipteran (mosquitoes) and chironomid (midges). 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.

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, livestock runoff lagoons, retention ponds, harvested timber stacks, swales, storm water drainage areas, sewers, catch basins, tree holes, water-holding receptacles (e.g., tires, urns, flower pots, cans, and other containers), and other natural and manmade 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 croplands, pastures, rangeland, 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.

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, express 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 or visit our web site: www.altosid.com.

Wellmark

ZOECON Professional Products

Wellmark International
Bensenville, Illinois U.S.A.

Zoecon A Wellmark International Brand.
ALTOSID® Insect Growth Regulator, ALTOSID® XR-G and ZOECON® are registered trademarks of Wellmark International.

20 - 24 - 023

Made in the USA

January, 2000
Bensenville, IL

VectoBac® 12AS

Biological Larvicide
Aqueous Suspension

Active Ingredient:
Bacillus thuringiensis, subspecies *israelensis*, 1200 International Toxic Units (ITU) per mg (Equivalent to 4.84 billion ITU per gallon; 1.279 billion ITU per liter) 1.2%
Inert Ingredients 98.8%
Total 100.0%

EPA Reg. No.73049-38
EPA Est. No. 33762-IA-001 List No. 5605

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

If In Eyes: Flush with plenty of water. Get medical attention if signs of irritation persists.

If on Skin: Wash thoroughly with plenty of soap and water. Get medical attention if signs of irritation persists.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS)

CAUTION

Hazards to Humans

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.

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 finished drinking water reservoirs or drinking water receptacles.

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

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 [59°-86° F (15°-30° C)], dry place.

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

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then 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.

5.0 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 needed per acre 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 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.

CONTINUED

[redacted]

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 for VectoBac 12AS 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.

6.0 APPLICATION DIRECTIONS

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

Suggested Rate Range*

Mosquito Habitat	VectoBac 12AS
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	0.25 - 1 pt/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 late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

Suggested Rate Range*

Black flies Habitat	VectoBac 12AS
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 carry of Bti. Use higher rate or increase volume by water dilution in low discharge rivers or streams under low volume (drought) conditions.

7.0 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 nonuniform 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.

7.1 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 if water flow stops.

VectoBac 12AS is metered or dripped into rice floodwater at application stations positioned at the point of introduction (levee cut) 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.

8.0 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

9.0 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.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 • 800-323-8697

Valent BioSciences Corporation

VectoBac® G

Biological Larvicide Granules

ACTIVE INGREDIENT:
Bacillus thuringiensis, subspecies *israelensis*, 200 International Toxic Units (ITU) per mg (Equivalent to 0.091 billion ITU per pound) 0.2%
INERT INGREDIENTS 99.8%
TOTAL 100.0%

EPA Reg. No. 73049-10
EPA Est. No. 33762-IA-001 List No. 5108

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION
For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

If in Eyes: Flush eyes with plenty of water. Get medical attention if irritation persists.

2.0 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 treated, finished drinking water reservoirs or drinking water receptacles.

3.0 STORAGE AND DISPOSAL

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

Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from 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.

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, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields	2.5 - 10 lbs / acre

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

* Use 10-20 lbs. / acre when late 3rd 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.

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

5.0 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.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-9597

VectoBac® WDG

Biological Larvicide

ACTIVE INGREDIENT:

Bacillus thuringiensis, subsp. *israelensis* fermentation solids and solubles	37.4%
INERT INGREDIENTS	62.6%
TOTAL	100.0%

[potency: 3000 International toxic units (ITU) per mg]
Equivalent to 1.36 billion ITU/lb.

EPA Reg. No. 73049-56
EPA Est. No. 33762-IA-001 List No. 60215

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

Inhaled: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

If in Eyes: Flush eyes with plenty of water. Call a physician if irritation persists.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if inhaled. Avoid breathing dust. Remove contaminated clothing and wash before reuse. Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling.

As a general precaution when exposed to potentially high concentrations of living microbial products such as this, all 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.

2.2 ENVIRONMENTAL HAZARDS

Do not apply directly to treated finished drinking water reservoirs or drinking water receptacles when 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.

3.1 Chemigation

Do not apply this product through any type of irrigation system.

4.0 STORAGE AND DISPOSAL

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

Storage: Store in cool [59-86°F (15-30°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: Triple rinse (or equivalent). Then 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.

5.0 APPLICATION DIRECTIONS

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

Mosquito Habitat *(Such as the following examples):*	Suggested Rate Range*
Irrigation ditches, roadside ditches, flood water, standing pools, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	1.75 - 7.0 oz/acre (50 - 200 g/acre) (125 - 500 g/ha)

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)	7.0 - 14.0 oz/acre (200 - 400 g/acre) (0.5 - 1.0 kg/ha)

[redacted]

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

6.0 SMALL QUANTITY DILUTION RATES

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

VectoBac WDG

Rates in		Final concentration, ounces/gallon spray		
Ounces/Acre	Grams/A	10 Gal/A	25 Gal/A	50 Gal/A
1.75	50	0.175	0.07	0.04
3.5	100	0.35	0.14	0.07
7	200	0.7	0.28	0.14
14	400	1.4	0.565	0.28

7.0 GROUND AND AERIAL APPLICATION

VectoBac WDG may be applied using conventional ground or aerial application equipment with quantities of water sufficient to provide uniform coverage of the target area. For application, first add the VectoBac WDG to water to produce a final spray mixture.

The amount of water will depend on weather, spray equipment, and mosquito habitat characteristics. For application, fill the mix tank or plane hopper with the desired quantity of water. **Start the mechanical or manual agitation to provide moderate circulation of water before adding the VectoBac WDG.** Backpack and compressed air sprayers may be agitated by shaking after adding VectoBac WDG to the water in the sprayer. VectoBac WDG 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. Do not mix more VectoBac WDG than can be used in a 48 hour period. AVOID CONTINUOUS AGITATION OF THE SPRAY MIXTURE DURING SPRAYING.

For ground spraying, apply 1.75-14 oz/acre (50-400 g/acre; 123-988 g/ha) of VectoBac WDG in 5-100 gallons of water per acre (47-950 liters/ha) using hand-pump, airblast, mist blower, or other spray equipment.

For aerial application, apply 1.75 - 14 oz/acre (50-400 g/acre; 123-988 g/ha) of VectoBac WDG in 0.25-10 gallons of water per acre (2.4-9.5 liters/ha) through fixed wing or helicopter aircraft equipped with either conventional boom and nozzle system or rotary atomizers to provide uniform coverage of the target area.

7.1 AERIAL APPLICATION

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 grower are responsible for considering all of these factors when making decisions.

Rinse and flush spray equipment thoroughly following each use.

8.0 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.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-9597

Valent BioSciences Corporation

VectoLex® CG

Biological Larvicide
Granules

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

Potency: This product contains 50 BsITU/mg or 0.023 Billion BsITU/lb.

EPA Reg. No.73049-20
EPA Est. No. 33762-IA-001 List No. 5722

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION
For MEDICAL and TRANSPORT EmergenciesONLY
Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

If In Eyes: Immediately flush eyes with plenty of water. Get medical attention if irritation persists.

If on Skin: Wash thoroughly with plenty of soap and water. Get medical attention if irritation persists.

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.

2.2 Environmental Hazards

Do not contaminate water when 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.

4.0 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 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.

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

I. 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**
Stormwater/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 and streams	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(1)

(1) .5-2 lbs/1000 sq. ft

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

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

Apply uniformly by aerial or conventional ground equipment. Reapply as needed after 1-4 weeks.

* Mosquito species effectively controlled by VectoLex CG:

Culex spp.	*Psorophora columbiae*
Aedes vexans	*Psorophora ferox*
Aedes melanimon	*Aedes triseriatus*
Aedes stimulans	*Aedes sollicitans*
Aedes nigromaculis	*Anopholos quadrimaculatus*
	Coquillettidia perturbans

**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.

CONTINUED

[redacted]

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.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-9597

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.
If Inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further 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 1-877-315-9819 (24 hours) for emergency medical treatment and or transport emergency information. For all other information, call 1-800-323-9597.

PRECAUTIONARY STATEMENTS

Hazards To Humans & Domestic Animals

CAUTION

Harmful if inhaled or absorbed through the skin. Causes moderate eye irritation. Prolonged or frequent repeated skin contact may cause allergic reactions in some individuals. Avoid breathing dust. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling. Remove and wash contaminated clothing before reuse.

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.

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.

DIRECTIONS FOR USE

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

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 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.

Biological Larvicide

VectoMax™ CG

FOR ORGANIC PRODUCTION

ACTIVE INGREDIENTS:

Bacillus sphaericus Serotype H5a5b, strain 2362 Fermentation Solids, Spores, and Insecticidal Toxins	2.7%
Bacillus thuringiensis Subsp. *israelensis* Serotype H-14, Strain AM65-52 Fermentation Solids, Spores, and Insecticidal Toxins	4.5%
OTHER INGREDIENTS	92.8%
TOTAL	100.0%

Potency: This product contains 50 BsITU/mg or 0.023 Billion BsITU/lb.

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

EPA Reg. No. 73049-429
EPA Est. No. 33762-IA-001

KEEP OUT OF REACH OF CHILDREN

CAUTION

Net Contents: 40 Pounds (18.2 Kg)

Expiration Date: (Two years from the date of manufacture)

Lot Number:

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY, SUITE 100
LIBERTYVILLE, IL 60048

List Number: XXXXX-04 23-0369/R1

DIRECTIONS FOR USE

APPLICATION DIRECTIONS

MOSQUITO CONTROL

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

I. 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 Water/Drainage Systems: Storm sewers, catch basins, drainage ditches, retention, detention, and seepage ponds.	5-20 lbs/acre**
Marine/Coastal Areas: Soft 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(1)

(1) 0.5-2 lbs/1000 sq. ft.

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

Habitats:	5-20 lbs/acre**
Rice, pastures/hay fields, orchards, citrus groves, irrigated crops.	

Apply uniformly by aerial or conventional ground equipment. Reapply as needed after 1-4 weeks.

*Mosquito species effectively controlled by VectoMax CG:

Culex spp.	
Aedes vexans	
Ochlerotatus melanimon	*(Aedes melanimon)*
Ochlerotatus stimulans	*(Aedes stimulans)*
Ochlerotatus nigromaculis	*(Aedes nigromaculis)*
Psorophora columbiae	
Psorophora ferox	
Ochlerotatus triseriatus	*(Aedes triseriatus)*
Ochlerotatus sollicitans	*(Aedes sollicitans)*
Anopheles quadrimaculatus	
Coquillettidia perturbans	

**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 coordinator are responsible for considering all these factors when making decisions.

NOTICE TO USER

To the fullest extent permitted by law, 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.

FourStar™ Bti Briquets 150

A Sustained Release 150 day Bti Mosquito Larvicide Briquet

ACTIVE INGREDIENT:	
Bacillus thuringiensis subspecies *israelensis* Strain BMP 144 solids, spores and insecticidal toxins*	7.00%
OTHER INGREDIENTS:	93.00%
TOTAL:	100.00%

* Equivalent to 490 International Toxic Units (ITU/mg) Potency units should not be used to adjust rates beyond those specified in the Directions for Use Section. Note: The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN

CAUTION

See attached booklet for additional precautionary statements

NET CONTENTS: 3.5 LBS (1.6 KG) CONTAINS 50 BRIQUETS

EPA Reg. No.: 69504-2 | EPA Est. No.: 39579-TX-1

APPLICATION TIME

Apply **FourStar™ Bti Briquets 150** to known mosquito breeding sites before, or at any time during the mosquito season. Apply **FourStar** to known breeding sites when the sites are dry and briquets will begin releasing Bti when flooding occurs. Under typical environmental conditions, one (1) application will control for 150 days or more. Alternate wetting and drying will not reduce briquet effectiveness. **FourStar** briquets perform optimally under shaded conditions.

The active ingredient Bti has no effect on mosquitoes that have reached the pupal or adult stage prior to treatment. Allow a minimum of 48 hours for control.

APPLICATION RATES

For control of mosquito larvae, place one (1) briquet in sites up to 100 square feet of surface area. For large sites, apply 1 additional briquet for each additional 100 square feet of water surface, regardless of water depth. When mosquito populations are high, water is heavily polluted, and/or algae are abundant, double the above application rate.

STORAGE AND DISPOSAL

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

PESTICIDE STORAGE: Store in a cool, dry place.

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

CONTAINER DISPOSAL: Do not reuse empty carton or packaging material. Perforate or crush and discard carton in a sanitary landfill or by incineration or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

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 label instructions.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, express or implied, concerning the use and handling of this product other than indicated on the label. To the fullest 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.

Always read the label before using this product.

For product information, call 1-888-846-7233 or visit our web site: **www.fourstarbti.com**

Meridian LLC, Sherwood, OR USA

U.S. Patent Pending

FS1031006 RCV050806

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

ENVIRONMENTAL HAZARDS

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

FIRST AID	
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth to mouth if possible. • Call 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 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, and then continue rinsing eyes. • Call 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 1-800-222-1222 for emergency medical treatment information.	

DIRECTIONS FOR USE

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

FourStar™ Bti Briquets 150 is a highly selective microbial insecticide effective against mosquitoes in a variety of habitats for up to 150 days or more. **FourStar** briquets release effective levels of ***Bacillus thuringiensis*** subspecies ***israelensis*** (Bti) to the water surface over time as the briquet dissolves.

FourStar can be applied to areas that contain aquatic life, fish and plants. **FourStar** can be applied to areas used by or in contact with humans, animals, horses, livestock, pets, birds or wildlife. Apply **FourStar** to any water sites except treated, finished water reservoirs or drinking water receptacles.

APPLICATION SITES

Examples of application sites include, but are not limited to: storm drains, catch basins, underground drainage systems, storm water retention areas, detention ponds, abandoned swimming pools, ornamental fountains and ponds, fish ponds, water gardens, tree holes, animal drinking troughs, standing water, water holding receptacles (old tires, urns, flower pots, cans and other containers), man made and natural sites where mosquitoes may develop.

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PRP 011609/ 8329-84

Natular XRT

An insecticide for the control of mosquito larvae.

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

Group	5	INSECTICIDE

Active Ingredient (dry weight basis):	
spinosad (a mixture of spinosyn A and spinosyn D)*	6.25%
Other ingredients	93.75%
Total	100.00%

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

Natular XRT is a 6.25% tablet. This product may absorb moisture; therefore, the weight of the tablet and percent by weight of active ingredient will vary with hydration.

Keep Out of Reach of Children
CAUTION

EPA Reg. No. 8329-84 EPA Est.8329-IL-02

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

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 of 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 1-800-992-5994 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 XRT is a Naturalyte® insect 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 XRT tablets release effective levels of spinosad over a period up to 180 days in mosquito breeding sites. The tablet is designed for easy application to catch basins.

Release of spinosad is affected by the dissolution of the Natular XRT tablet. If tablets become covered by obstructions such as debris, vegetation, or loose sediment as a result of high rainfall or flow, normal dispersion of the active ingredient can be inhibited. Water flow may increase the dissolution of the tablet, thus reducing the residual life of the tablet. Inspect areas of water flow to determine appropriate re-treatment intervals. To assure positive results, place Natular XRT tablets where they will not be swept away by flushing action.

General Use Precautions
Integrated Pest Management (IPM) Programs
Natular XRT 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 XRT 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 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.
- Do not use less than the labeled rates.
- 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 within agricultural/crop sites, and permanent marine and freshwater sites, do not make more than 3 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 Mosquito Control 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 Mosquito Control 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. Natular XRT tablets can be applied prior to flooding, on snow and ice in breeding sites prior to spring thaw, or at any time after flooding in listed sites. Under normal conditions, one application

P1/2

PRP 011609/ 8329-84

will last the entire mosquito season, or up to 180 days, whichever is shorter. Natular XRT tablets will be unaffected in dry down situations and will begin working again during subsequent wetting events until the tablet is exhausted. Note: Natular XRT has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

Application Sites and Rates
Natular XRT tablets are designed to kill mosquitoes in natural and manmade depressions that hold water. Do not apply to water intended for irrigation. Examples of application sites are:

Storm water drainage areas, sewers and catch basins, woodland pools, snow pools, roadside ditches, retention ponds, freshwater dredge spoils, tire tracks, rock holes, pot holes and similar areas subject to holding water.

Natural and manmade aquatic sites, fish ponds, ornamental ponds and fountains, other artificial water-holding containers, flooded crypts, transformer vaults, abandoned swimming pools, construction and other natural or manmade depressions.

Stream eddies, creek edges, detention ponds.

Freshwater swamps and marshes including mixed hardwood swamps, cattail marsh, common reed wetland, water hyacinth ponds, and similar freshwater areas with emergent vegetation.

Brackish water swamps and marshes, intertidal areas.

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.

Also for use in dormant rice fields (for application only during the interval between harvest and preparation of the field for the next cropping cycle) and in standing water within pastures/hay fields, rangeland, orchards, and citrus groves where mosquito breeding occurs. Do not apply to waters intended for irrigation.

For mosquito kill in non- or low-flow, shallow depressions (up to 2 feet in depth), treat on the basis of surface area placing 1 Natular XRT tablet per 100 sq ft. Place tablets in the lowest areas of mosquito breeding sites to maintain continuous kill as the site alternately floods and dries up.

For applications in storm water drainage areas, sewers and catch basins, place 1 Natular XRT tablet into each catch basin.

For application sites connected by a water system, i.e., storm drains or catch basins, treat all of the water holding sites in the system to maximize the efficiency of the treatment program.

For application to small contained sites which may not be amenable to a rate of a single tablet per 100 sq ft, use 1 tablet per contained site (e.g., cesspools and septic tanks, transformer vaults, abandoned pools, and other small artificial water-holding containers).

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.

Lot:_____ **Net Weight:**_____

® Trademark of Dow AgroSciences LLC

P2/2

AGNIQUE® MMF

MOSQUITO LARVICIDE & PUPICIDE

MONOMOLECULAR SURFACE FILM FOR CONTROL OF IMMATURE MOSQUITOES AND MIDGES

ACTIVE INGREDIENT

Poly(oxy-1,2-ethanediyl),α-isooctadecyl-ω-hydroxyl (100%)

CAUTION

KEEP OUT OF THE REACH OF CHILDREN

FIRST AID TREATMENT

IF ON SKIN: Wash with plenty of soap and water. Get medical attention if irritation develops.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation develops.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. To be used in governmental mosquito control programs, by professional pest control operators, or in other mosquito or midge control operations.

This product is for the control of immature mosquitoes and midges in ponds, lakes, swamps, ditches, floodwater areas and many other areas where they breed and develop. This product may be used in potable and irrigation waters, permanent and semi-permanent waters, and in croplands and pastures.

STORAGE AND DISPOSAL

DO NOT CONTAMINATE WATER, FOOD, OR FEED BY STORAGE OR DISPOSAL.

PESTICIDE STORAGE: Do not allow storage containers to rust. Rust contamination may clog spray nozzles. Do not allow product to freeze.

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: Triple rinse, then offer for recycling or reconditioning; or puncture and dispose of in a sanitary landfill, or by other procedures approved by state or local authorities.

APPLICATION DIRECTIONS

This product may be applied by both ground and aerial applications. To use, spray the desired rate of neat MMF onto the surface of the water. No dilution is required. The MMF will spread to cover hard to access areas. A fan spray is recommended. Do not pour or inject a stream spray directly into water.

AGNIQUE® MMF is not visible on the surface of the water. Excess MMF on the water surface will form a globule.

APPLICATION NOTES

Rate of kill: The rate of kill when using MMF is dependent on the species, the life stage, the habitat and the temperature. Pupicidal action will typically result in 24 hours. Larvicidal action will usually result in 24 – 72 hours. If the film is present, as indicated by the Indicator Oil, control will be achieved.

Indicator Oil: AGNIQUE® MMF is not visible on the surface of the water. To check the habitat for the presence and persistence of the product, add a drop of AGNIQUE® MMF Indicator Oil to several locations in the habitat. If the Indicator Oil forms a tight bead on the surface of the water, then the MMF is present for control.

Persistence: The AGNIQUE® MMF surface film typically persists on the water's surface for 5 – 22 days. Polluted waters will cause more rapid degradation of the film. Higher application rates will prolong film life and extend the interval between retreatment.

Species: Mosquitoes and midges that require little or no surface contacts for breathing will be affected by the product during the pupae and emerging adult life stages.

Winds: The high end of the dosage rate is recommended when spraying habitats where multi-directional winds of 10 mph (16 km/hr) or greater are expected to persist. While the film will be pushed by the winds, it will re-spread quickly once the winds have subsided. If persistent unidirectional winds of 10 mph (16 km/hr) or greater are expected, the displacement of the surface film may result in poor control.

Spray Tank: Thoroughly clean the spray system of contaminants such as petroleum oils, water, detergents and conventional toxicants prior to adding AGNIQUE® MMF. Detergents will destroy the film-forming of the MMF; other contaminants (water and oil) will result in the formation of an unsprayable paste.

Dilution: AGNIQUE® MMF is typically applied to the water's surface without dilution. However, if it is desired to spray higher volumes of liquid, AGNIQUE® MMF may be diluted using a high shear injection system, that dilutes the MMF at the nozzle to a maximum of 10% in water. Do not add AGNIQUE® MMF to water in non-agitated spray systems. Conventional bypass recirculation will not provide adequate agitation to effectively mix MMF with water.

Expanding Waters: Significant expansion of the habitat's surface area due to rain or tidal fluxes can be compensated for by using a dosage that is based on the largest expected surface area. This will ensure complete coverage, and eliminate the need for re-treatment of the flooded area.

NOTICE

Cognis Corporation 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, storage or handling not in strict accordance with the label.

MOSQUITO HABITAT	Suggested Rate Range*
Fresh and brackish waters Examples include salt marshes, ponds, storm water and retention & detention basins, roadside ditches, grassy swales, fields, pastures, potable water containers, reservoirs, irrigated croplands, woodland pools, tidal water, etc...	**0.2 – 0.5 gallons/acre** **2 – 5 liters/hectare**
Polluted waters Examples include sewage lagoons, animal waste effluent lagoons, septic ditches, etc...	**0.35 – 1.0 gallons/acre** **3.5 – 10 liters/hectare**

* Use higher rates when emergent or surface vegetation is present, due to the wicking action of the product. The more vegetation or the drier the vegetation, the higher the rate.

* The lower rates may be used when only pupae are present.

MIDGE HABITAT	Suggested Rate Range^
Fresh water Examples include ponds and lakes	**0.5 gallons/acre** **5 liters/hectare**
Polluted waters Examples include sewage lagoons and percolation ponds	**0.5 – 1.0 gallons/acre** **5 – 10 liters/hectare**

^ Reapplication is recommended every two weeks during the midge season.

cognis agrosolutions

COGNIS CORPORATION,
4900 ESTE AVENUE
CINCINNATI, OH 45232-1419
1-800-254-1029

24 HOUR EMERGENCY PHONE
CHEMTREC 1-800-424-9300

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Telecommunications Network at 1-800-858-7378.

EPA REG NO. 53263-28 EPA Establishment Number 53263-SC-01

PERMETHRIN 57% OS

CLARKE

For Application Only By Public Health Officials and Trained Personnel of Mosquito Abatement Districts and Other Mosquito Control Programs. A SYNTHETIC PYRETHROID FOR EFFECTIVE CONTROL AND REPELLENCY OF ADULT MOSQUITOES. For Use As An Effective ULV and Barrier Spray for Control of Adult Mosquitoes, Gnats, Biting and Non-Biting Midges, Blackflies, Deer Flies and Other Biting Flies.

Precautionary Statements

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes or clothing. Wash thoroughly after handling.

STATEMENT OF PRACTICAL TREATMENT

If Swallowed: call a physician or Poison Control Center. Do not induce vomiting. This product contains aromatic petroleum solvent. Aspiration may be a hazard.

ENVIRONMENTAL HAZARDS

This product is highly toxic to fish and aquatic invertebrates. Do not apply directly to water, 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 area may be hazardous to aquatic organisms in neighboring areas. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges or water supplies. Do not contaminate water when disposing of equipment washwaters.

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.

CONDITIONS and RATES to USE for MOSQUITO CONTROL FOR A BARRIER SPRAY

This product is effective for reducing mosquito annoyance and control of mosquitoes that may transmit diseases such as La Crosse encephalitis, dog heartworm, dengue fever and western encephalitis. Apply product with mist blower, power backpack or ULV machine. If ULV machine is used, adjust pressure to deliver particles from 35-200 microns. Do not allow spray treatment to drift on pasture land, crop land, poultry ranges or water supplies. Do not use on crops used for food, forage or pasture.

Normal use pattern of product requires a residual application on plant and other surfaces where mosquitoes may rest. Product commonly provides sustained control in wooded areas lasting up to 14 days in shaded areas. Secondary activity of product is through repellency. Apply product by ground application equipment such as mist blower, ULV equipment, power backpack or pressure sprayer. Not to be used within 100 feet (30 meters) of lakes and streams. To kill or repel mosquitoes, midges, deer flies and other biting flies, mix with enough oil mixture so as to easily apply 0.1 pounds of Permethrin per acre. The oil-mixture is obtained by mixing one part of soybean oil to two parts of mineral oil. Non-phytotoxic oils must be used. The following chart represents some possible dilutions based on a 2 MPH walking speed with a fifty (50) foot swath. If a different dilution ratio or walking speed is used, adjust flow rate accordingly so as to achieve 0.1 pounds of Permethrin per acre.

For A Two (2) Mile Per Hour Walking Speed And A 50 Foot Application Swath—The Following Are Typical Field Dilutions.

Permethrin 57%	Oil	Fl. oz. Finished Spray Per Acre	Fl. oz./Min.
1 Part	9.0 Parts	25.0	5.0
1 Part	5.8 Parts	17.5	3.5
1 Part	4.0 Parts	12.5	2.5

ACTIVE INGREDIENT:

Permethrin (3-Phenoxyphenyl)methyl (±) cis; trans-3-(2,2-dichlorethenyl)-2,2-dimethyl-cyclopropanecarboxylate	57.00%
INERT INGREDIENTS	43.00%
	100.00%

Contains petroleum distillates.

Cis/trans isomers ratio: min. 35%(+)cis and max. 65%(+)trans.

Contains 5 lb./gal. Permethrin

CAUTION

KEEP OUT OF REACH OF CHILDREN

MANUFACTURED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 N. GARDEN AVENUE
ROSELLE, ILLINOIS 60172

E.P.A. EST. No. 8329IL01
EPA Reg. No. 8329-44

NET CONTENTS_____

LOT NO. _____

NOTICE: Seller makes no warranty, expressed or implied concerning the use of this product other than 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.

This is equivalent to 0.1 lb. of Permethrin/Acre. Apply the product with sufficient carrier to allow distribution over the area to be treated using particle sizes from 35-200 microns mmd. To obtain optimum results, cover the immediate surroundings of housing, buildings including plant surfaces where mosquitoes may rest. For large recreational areas such as football fields, stadiums, racetracks, and public parks, spray the insecticide-oil mixture at the above mentioned application rate on the interface of woods surrounding the main area where the event is to take place. Spray may also be applied in any vegetated area where mosquitoes may rest causing infestations in residential areas.

To Kill Gypsy Moths and Tentcaterpillars infesting woodland and forest areas: Apply the insecticide-oil mixture (as described above) directly to insect nests and vegetation by backpack applicator using 62 Fl. Oz. / acre at a walking speed of 2 MPH over a swath of 50 feet, applying 12.6 Fl. Oz. / minute. This is equivalent to 0.25 lb. of Permethrin/acre. Apply thoroughly to all foliage and insect nests.

TRUCK MOUNTED -ULV- EQUIPMENT

PERMETHRIN 57% is recommended for application as an ultra low volume (U.L.V.) nonthermal aerosol (cold fog) to control adult mosquitoes in residential and recreational areas where these insects are a problem, such as but not limited to parks, campsites, woodlands, athletic fields, golf courses, residential areas and municipalities, gardens, playgrounds, recreational areas and overgrown waste areas. Do not apply this product within 100 feet (30 Meters) of lakes and streams. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges, or water supplies. For best results treat when mosquitoes are most active and weather conditions are conducive to keeping the fog close to the ground, e.g. cool temperatures and wind speed not greater than 10 mph. Applications during the cool hours of the night or early morning is usually preferable. Repeat treatment as needed.

U.L.V. Nonthermal Aerosol (Cold Fog) Application: To control Mosquitoes, Midges and Blackflies, apply PERMETHRIN 57% using any standard U.L.V. ground applicator capable of producing a nonthermal aerosol spray with droplets ranging in size from 5 to 30 microns and a mass median diameter (MMD) of 10 to 20 microns. Apply the product undiluted at a flow rate of 0.54 to 3.25 fluid ounces per minute at an average vehicle speed of 10 mph. If a different vehicle speed is used, adjust rate accordingly. These rates are equivalent to 0.0035 to 0.021 pounds of Permethrin per acre. Vary flow rate according to vegetation density and mosquito population. Use higher flow rate in heavy vegetation or when populations are high. An accurate flow meter must be used to ensure the proper flow rate. PERMETHRIN 57% may also be applied by diluting with a suitable solvent such as a non-phytotoxic mineral oil. The following charts represent some suggested dilution and application rates for ground U.L.V. applications. If an alternate dilution rate is used, adjust flow rate accordingly.

FOR A 1:4 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with four (4) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	15MPH	Fl. oz. finished spray per acre
0.007	2.70	5.40	8.1	0.90
0.0035	1.35	2.70	4.0	0.45
0.00175	68	1.35	2.0	0.23

FOR A 1:9 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with nine (9) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	Fl. oz. finished spray per acre
0.007	5.40	10.75	1.80
0.0035	2.70	5.40	0.90
0.00175	1.35	2.70	0.45

FOR A 1:14 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with fourteen (14) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	15MPH	Fl. oz. finished spray per acre
0.007	8.0	16.0	32.0	2.70
0.0035	4.0	8.0	16.0	1.35
0.00175	2.0	4.0	8.0	0.68

For proper application, mount the fog applicator so that the nozzle is at least 4½ feet above ground level and directed out the back of the vehicle. Failure to follow the above directions may result in reduced effectiveness. Aerial applications should be done by suitable aerial U.L.V. equipment capable of producing droplets with an MMD of 50 microns or less with no more than 2.5% exceeding 100 microns. Flow rate and swath width should be set so as to achieve 0.2 to 0.6 fluid ounces of PERMETHRIN 57% per acre. PERMETHRIN 57% may also be diluted with a suitable diluent such as mineral oil and applied by aerial ULV equipment so long as 0.6 fluid ounces per acre of PERMETHRIN 57% is not exceeded. Both aerial and ground applications should be made when wind is less than 10 MPH.

FLORIDA: Do not apply by aircraft except in emergency situations and with the approval of the Florida Department of Agriculture and Consumer Services.

STORAGE & DISPOSAL

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

PESTICIDE STORAGE AND SPILL PROCEDURES: Do not store at temperatures below 40°F (4.5°C). If this material has been exposed to temperatures below 40°F (4.5°C), 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 on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved state and local procedures.

CONTAINERS ONE GALLON AND SMALLER: Do not reuse container. Wrap containers in several layers of newspaper and discard in trash.

CONTAINERS LARGER THAN ONE GALLON: Metal Containers—Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities. Plastic Containers—Triple rinse or equivalent. Then offer for recycling or reconditioning, 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. Then dispose of in a sanitary landfill or by other approved state and local procedures.

IN CASE OF EMERGENCY, CALL INFO TRAC 1-800-535-5053

FOR MORE INFORMATION CALL:
1-800-323-5727

12/97

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 SBP-1382®/PIPERONYL BUTOXIDE 4% + 12% MF FORMULA II

Specimen Label

- *A READY TO USE SYNTHETIC PYRETHROID FOR EFFECTIVE ADULT MOSQUITO (INCLUDING ORGANOPHOSPHATE RESISTANT SPECIES), MIDGE (BITING AND NON-BITING), AND BLACK FLY CONTROL*
- *TO BE APPLIED BY MOSQUITO ABATEMENT DISTRICTS, PUBLIC HEALTH OFFICIALS AND OTHER TRAINED PERSONNEL IN MOSQUITO CONTROL PROGRAMS.*
- *CONTAINS 0.3 lb/gal (36 g/L) OF SBP-1382 AND 0.9 lb/gal (108 g/L) OF PIPERONYL BUTOXIDE*
- *FOR AERIAL AND GROUND APPLICATION*

ACTIVE INGREDIENTS:	
* Resmethrin	4.14%
**Piperonyl Butoxide Technical	12.42%
INERT INGREDIENTS†:	83.44%
	100.00%

*Cis/trans isomers ratio: max. 30% (±) cis and min. 70% (±) trans.
**Equivalent to 9.94% (butylcarbityl) (6-propylpiperonyl) ether and 2.48% related compounds.
†Contains Petroleum Distillates.

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.)

EPA REG. NO. 432-716 EPA EST. NO.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

IF SWALLOWED: Call a doctor or get medical attention. Do not induce vomiting. Do not give anything by mouth to an unconscious person. Avoid Alcohol. This product contains aromatic petroleum solvent. Aspiration may be a hazard.
IF ON SKIN: Wash with soap and plenty of water. Get medical attention.

See Side Panel For Additional Precautionary Statements

For product information Call Toll-Free: 1-800-331-2867

In case of *Medical* emergencies or health and safety inquiries or in case of fire, leaking or damaged containers, information may be obtained by calling 1-800-334-7577.

NET CONTENTS:

BAYER ENVIRONMENTAL SCIENCE
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road • Montvale, NJ 07645

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 highly toxic to fish. For terrestrial uses, do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff from treated sites may be hazardous to fish in adjacent waters. Consult your State's Fish and Wildlife Agency before treating such waters. Do not contaminate water by cleaning of equipment or disposal of equipment wash waters.

DIRECTIONS FOR USE

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

STORAGE AND DISPOSAL

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

Storage: Store product in original container in a locked storage area.

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: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and Local authorities.

READ ENTIRE LABEL FOR DIRECTIONS

For use only by certified applicators or under the supervision of such applicators, for the reduction in annoyance from adult mosquito infestations and as a part of a mosquito abatement program.

IN THE STATE OF CALIFORNIA: For use only by local districts or other public agencies which have entered into and operate under a cooperative agreement with the Department of Public Health pursuant to Section 2426 of the Health and Safety Code.

This product is to be used for control of adult mosquitoes (including organophosphate resistant species), midges (biting and non-biting) and blackflies by specially designed aircraft capable of applying ULTRA LOW VOLUME of finished spray formulation or by ground application with non-thermal or mechanical spray equipment that can deliver spray particles within the aerosol size range and at specified dosage levels.

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.

ULTRA LOW VOLUME APPLICATIONS

For use in nonthermal ULV portable backpack equipment similar to the Hudson B.P., mix 70 fl oz (2068 ml) of this product with 1 gal (3.79 L) of refined soybean oil, light mineral oil of 54 second viscosity or other suitable solvent or diluent. Adjust equipment to deliver fog particles of 18-50 microns mass median diameter. Apply at the rate of 4.25-8.50 fl oz of finished formulation per acre (311-621 ml/ha) as a 50 ft (15.2 m) swath while walking at a speed of 2 mph (3.2 kph). This is equivalent to 0.0035-0.0070 lb ai SBP-1382/A (3.92- 7.85 gm/ha) plus 0.0105- 0.0210 lb ai piperonyl butoxide tech./A (11.77-23.54 gm/ha). Where dense vegetation is present, the higher rate is recommended.

For truck mounted nonthermal ULV equipment similar to LECO HD or MICRO-GEN or WHISPERMIST-XL, adjust equipment to deliver fog particles of 8-20 microns mass median diameter. Consult the following chart for application rates.

Treatment lb ai/A of Scourge Wanted SBP-1382/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(90 ml)	9.0(266.2ml)	18.0(532.3ml)
0.0035/0.0105	1.5(45 ml)	4.5(133.1 ml)	9.0(266.2 ml)
0.00175/0.00525	0.75(22.5 ml)	2.25(66.6 ml)	4.5(133.1 ml)
0.00117/0.00351	0.50(15 ml)	1.50(45 ml)	3.0(90 ml)

Where dense vegetation is present, the use of the higher rates and/or slower speed is recommended.

For best results, fog only when air currents are 2-8 mph (3.2-12.9 kph). It is preferable to fog during early morning and evening when there is less breeze and convection currents are minimal. Arrange to apply the fog in the direction with breeze to obtain maximum swath length and better distribution. Direct spray head of equipment in a manner to insure even distribution of the fog throughout the area to be treated. Avoid prolonged inhalation of fog.

Where practical, guide the direction of the equipment so that the discharge nozzle is generally maintained at a distance of more than 6 feet (1.83 m) from ornamental plants and 5-15 feet (1.5-4.5 m) or more from painted objects. Temperature fluctuations will require periodical adjustment of equipment to deliver the desired flow rate at the specified speed of travel. The flow rate must be maintained to insure the distribution of the proper dosage of finished formulation.

Spray parks, campsites, woodlands, athletic fields, golf courses, swamps, tidal marshes, residential areas and municipalities around the outside of apartment buildings, restaurants, stores and warehouses. Do not spray on cropland, feed or foodstuffs. Avoid direct application over lakes, ponds and streams.

DIRECTIONS FOR STABLE FLY, HORSE FLY, DEER FLY CONTROL:

Treat shrubbery and vegetation where the above flies may rest. Shrubbery and vegetation around stagnant pools, marshy areas, ponds and shore lines may be treated. Application of this product to any body of water is prohibited.

For control of adult flies in residential and recreational areas, apply this product undiluted at a rate of 178 fl oz/hr (5.26 L/hr) by use of a suitable ULV generator travelling at 5 mph (8 kph) or at a rate of 356 fl oz/hr (10.53 L/hr) while travelling at 10 mph (16 kph). When spraying, apply across wind direction approximately 300 ft (91.4 m) apart.

Apply when winds range from 1-10 mph (1.6-16.0 kph). Repeat for effective control.

DIRECTIONS FOR AERIAL APPLICATIONS
FOR USE WITH FIXED-WING AND ROTARY AIRCRAFT

This product is used in specially designed aircraft capable of applying ultra low volume of undiluted spray formulation for control of adult mosquitoes (including organophosphate resistant species), midges (biting and non-biting) and blackflies.

Aerial application should be made preferably in the early morning or evening. Application should be made preferably when there is little or no wind.

It is not recommended to make application when wind speeds exceed 10 mph (16 kph). Repeat applications should be made as necessary. Apply preferably when temperatures exceed 50°F (10°C).

May be used as a mosquito adulticide in recreational and residential areas, and in municipalities, around the outside of apartment buildings, golf courses, athletic fields, parks, campsites, woodlands, swamps, tidal marshes, and overgrown waste areas.

Do not spray on cropland, feed or foodstuffs. Avoid direct application over lakes, ponds and streams.

lb ai/A Wanted SBP-1382/PBO	Fl oz/A of Undiluted Spray to be Applied
0.007/0.021	3.0 (90 ml)
0.0035/0.0105	1.5 (45 ml)
0.00175/0.00525	0.75 (22.5 ml)
0.00117/0.00351	0.50 (15 ml)

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 should be followed carefully.However, because of manner of use and other factors beyond Bayer Environmental Science's control, it is impossible for Bayer Environmental Science to eliminate all risks associated with the use of this product. As a result, crop injury or Ineffectiveness is always possible. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: BAYER ENVIRONMENTAL SCIENCE 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 Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for special, incidental or consequential damages resulting from the use or handling of this product.

LIMITATIONS OF LIABILITY: 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 ENVIRONMENTAL SCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

Bayer Environmental Science
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road
Montvale, NJ 07645
S4-12-SL-9/02

CLARKE

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.

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Harmful if absorbed through the skin. Do not induce vomiting because of aspiration pneumonia hazard. Avoid contact with skin, eyes or clothing. In case of contact flush with plenty of water. Wash with soap and water after use. Obtain medical attention if irritation persists. Avoid contamination of food and feedstuffs.

ENVIRONMENTAL HAZARDS

Do not contaminate untreated water by cleaning of equipment. Cleaning of equipment or disposal of wastes must be done in a manner that avoids contamination of bodies of water or wetlands. This product is toxic to fish. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark.

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 AREAS: For use in mosquito adulticiding programs involving outdoor residential and recreational areas where adult mosquitoes are present in annoying numbers in vegetation surrounding parks, woodlands, swamps, marshes, overgrown areas and golf courses.

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.

For best results, apply when mosquitoes are most active and weather conditions are conducive to keeping the fog close to the ground. i.e. cool temperatures and wind speed not greater than 10 mph.

E.P.A. EST. No. 8329-IL-01
EPA Reg. No.1021-1687-8329

NET CONTENTS

LOT NO.

ACTIVE INGREDIENTS:	
3-Phenoxybenzyl-(1RS, 3RS; 1RS, 3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl) cyclopropanecarboxylate	2.00%
* Piperonyl Butoxide, Technical	2.00%
** INERT INGREDIENTS	96.00%
	100.00%

* Equivalent to 1.60% (butylcarbityl) (6-propylpiperonyl) ether and .40% related compounds

** Contains a petroleum distillate

Contains 0.15 pounds of Technical SUMITHRIN®/Gallon and 0.15 pounds Technical Piperonyl Butoxide/Gallon

SUMITHRIN®- Registered trademark of Sumitomo Chemical Company, Ltd.

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.

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Call a physician or Poison Control Center immediately. Do not induce vomiting because of aspiration pneumonia hazard.

IF IN EYES: Flush eyes with plenty of water. Call a physician if irritation persists.

IF ON SKIN OR CLOTHING: Remove contaminated clothing and wash before reuse. Wash skin with soap and warm water. Get medical attention if irritation persists.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth.

For information regarding medical emergencies or pesticide incidents, call the International Poison Center at 1-888-740-8712.

DISTRIBUTED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.

159 N. GARDEN AVENUE • ROSELLE, ILLINOIS 60172

NOTICE: Seller makes no warranty, expressed or implied concerning the use of this product other than 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.

GROUND ULV APPLICATION

APPLICATION AND DILUTION DIRECTIONS: Consult the following table for examples of various dosage rates using a swath width of 300 feet for acreage calculations. This product should be used in cold aerosol generators capable of producing droplets with a MMD of 5 to 25 microns.

Dosage Rate	Flow Rates in fluid oz./minute at truck speeds of:			
lbs.A.I./acre	5MPH	10MPH	15MPH	20MPH
0.0036	9.3 oz.	18.6 oz	27.9 oz	37.2 oz
0.0024	6.2 oz	12.4 oz	18.6 oz	24.8 oz
0.0012	3.1 oz	6.2 oz	9.3 oz	12.4 oz

ANVIL 2 + 2 ULV may be applied undiluted with a non-thermal ULV portable "backpack" spray unit capable of delivering particles in the 5 to 25 micron range. Apply at a walking speed 2 mph, making sure that the same amount of A.I. is applied per acre.

ANVIL 2 + 2 ULV may be applied with suitable thermal fogging equipment. Do not exceed the maximum rates listed above. May be applied at speeds of 5 to 20 mph. 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.

AERIAL APPLICATION

Prohibition on aerial use: Not for aerial application in Florida unless specifically authorized by the Bureau of Entomology, Florida Department of Agriculture and Consumer Service.

Dosage Rate	Flow Rates in fluid oz./acre
lbs.A.I./acre	ANVIL® 2 + 2 ULV
0.0036	3.0 oz
0.0024	2.0 oz
0.0012	1.0 oz

Aerial applications should be done by suitable aerial ULV equipment capable of producing droplets with an MMD of 50 microns or less with no more than 2.5% exceeding 100 microns. Flow rate and swath width should be set so as to achieve 1.0 to 3.0 fluid ounces of ANVIL® 2+2 ULV per acre. Both aerial and ground applications should be made when wind is less than 10 MPH. For application by Public Health Officials and personnel of Mosquito Abatement Districts and other mosquito control programs.

ANVIL 2 + 2 ULV cannot be diluted in water. Dilute this product with light mineral oil if dilution is preferred.

STORAGE & DISPOSAL

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

STORAGE: Store in a cool, dry place. Keep container closed.

CONTAINER DISPOSAL: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved state and local procedures.

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

FOR MORE INFORMATION CALL: 1-800-323-5727

12/11/00

PYRENONE® 25-5

PUBLIC HEALTH INSECTICIDE

Specimen Label

* *FOR USE BY TRAINED PERSONNEL ONLY.*
* *TO BE APPLIED ONLY BY OR UNDER THE SUPERVISION OF PEST CONTROL OPERATORS, MOSQUITO ABATEMENT DISTRICTS, PUBLIC HEALTH ORGANIZATIONS AND OTHER TRAINED PERSONNEL RESPONSIBLE FOR INSECT CONTROL PROGRAMS.*
* *FOR INDOOR AND OUTDOOR APPLICATION AS A SPACE, AREA OR CONTACT SPRAY.*
* *DEPENDENT UPON PESTS TO BE CONTROLLED AND THE AREA TO BE TREATED, MAY BE APPLIED THROUGH MECHANICAL AEROSOL GENERATORS (ULV) OR THERMAL FOGGING EQUIPMENT AS WELL AS CONVENTIONAL FOGGING OR SPRAYING EQUIPMENT.*
* *MAY BE USED OVER ALL CROPS.*
* *THE ACTIVE INGREDIENTS ARE EXEMPT FROM TOLERANCES WHEN APPLIED TO GROWING CROPS [see 40 CFR § 180.1001 (b)]*

ACTIVE INGREDIENTS	
♦Pyrethrins	5.0%
*▲Piperonyl Butoxide, Technical	25.0%
†OTHER INGREDIENTS	70.0%
	100.0%

*Equivalent to 20% (butylcarbityl) (6-propylpiperonyl) ether and 5% related compounds.
†Contains Petroleum Distillate
♦Contains 0.367 pounds of Pyrethrins per gallon.
▲Contains 1.83 pounds of Piperonyl Butoxide per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

See Rear Panel For Additional Precautions

EPA REG. NO. 432-1050

EPA EST. NO.

NET CONTENTS:

BAYER ENVIRONMENTAL SCIENCE
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road • Montvale, NJ 07645

FIRST AID

IF SWALLOWED: Call a doctor or get medical attention. Do not induce vomiting. Do not give anything by mouth to an unconscious person. Avoid Alcohol.

IF INHALED: Remove victim to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. Get medical attention.

IF IN EYES: Flush eyes with plenty of water. Call a physician if irritation persists.

IF ON SKIN: Wash with plenty of soap and water. Get medical attention if irritation persists.

In case of Medical emergencies or health and safety inquiries or in case of fire, leaking or damaged containers, information may be obtained by calling 1-800-471-0660.

For Product Information Call Toll-Free: 1-800-331-2867

PRECAUTIONARY STATEMENTS
Hazards To Humans & Domestic Animals

CAUTION

Harmful if swallowed or inhaled. Avoid breathing spray mist. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash clothing before re-use. Remove pets, birds and cover fish aquaria before spraying.

Do not apply as a space spray while food processing is underway. Except in Federally inspected meat and poultry plants, when applied as a surface spray with care and in accordance with the directions and precautions given above, food processing operations may continue. Foods should be removed or covered before treatments. In food processing areas all surfaces must be washed and rinsed in potable water after spraying.

When using in animal quarters, do not apply directly to food, water or food supplements. Wash teats of dairy animals before milking.

Environmental Hazards

This product is toxic to fish. For terrestrial uses, do not apply directly to water, 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 areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources. Apply this product only as specified on this label.

DIRECTIONS FOR USE

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

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: Pesticide, spray mixture or rinse water that cannot be used according to label instructions may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved State and local procedures.

CONTAINERS ONE GALLON AND SMALLER: Do not re-use container. Wrap container in several layers of newspaper and discard in trash.

SPACE AND/OR CONTACT USE AREAS:

Homes	Poultry Houses
Horse Barns	Schools
Hotels	Supermarkets
Industrial Installations	Swine Houses
Motels	Truck Trailers
Office Buildings	Wineries

OUTDOOR USE AREAS:

Recreational areas	Golf courses	Corrals
Drive-in Restaurants	Municipalities	Zoos
Drive-in Theaters	Swine Yards	Parks
Residences	Feedlots	Playgrounds
Vineyards		

PYRENONE® 25-5 Public Health Insecticide is effective in the control of the indicated insects if the applicator follows directions for use as enumerated below:

All Common Diptera	
Deer Flies	***Lice***
Fruit Flies	***Mosquitoes***
Gnats	***Small Flying Moths***
Horn Flies	***Stable Flies***
Horse Flies	***Wasps***
House Flies	

INDOOR USE AS A SPACE SPRAY, DILUTED:
For use in conventional mechanical fogging equipment, to kill ***Flies, Fruit Flies, Mosquitoes and Gnats.*** Cover or remove exposed food and food handling surfaces. Close room and shut off all air conditioning or ventilating equipment. Dilute 1 part of Pyrenone 25-5 plus 49 parts of oil or suitable solvent and mix well. Apply at the rate of 1-2 fl. oz. per 1000 cu. ft. filling the room with mist. Keep area closed for at least 15 minutes. Vacate treated area and ventilate before reoccupying. Repeat treatment when reinfestation occurs.

SURFACE SPRAY: As an aid in the control of ***Mosquitoes, Gnats and Wasps.*** Treat walls, ceilings, moldings, screens, door and window frames, light cords and similar resting places.

ANIMAL QUARTER USE: (cattle barns, horse barns, poultry houses, swine houses, zoos): As a space spray diluted for use in conventional mechanical fogging equipment to kill ***Flies, Mosquitoes, Small Flying Moths and Gnats.*** Dilute 1 part of Pyrenone 25-5 Public Health Insecticide plus 49 parts oil or suitable solvent and mix well. Apply at a rate of 2 fl. oz. per 1,000 cu. ft. of space above the animals. Direct spray towards the upper portions of the enclosure. Keep area closed for at least 15 minutes. Vacate treated area and ventilate before reoccupying. Repeat treatment when reinfestation occurs.

TEMPORARY REDUCTION OF ANNOYANCE from ***Flies, Mosquitoes and Small Flying Moths*** outdoors. The directions for outdoor ground application noted below will afford temporary reduction of annoyance from

these pests in public theaters, golf courses, municipalities, parks, playgrounds and recreational areas. Direct application into tall grass, shrubbery and around lawns where these pests may hover or rest. Apply while air is still. Avoid wetting foliage. Application should be made prior to attendance. Repeat as necessary.
In additional outdoor areas (corrals, feedlots, swine lots and zoos), cover water, drinking fountains and animal feed before use. Treat area with mist, directing application into tall grass, shrubbery and around lawns where these pests may hover or rest. Apply while air is still. Avoid wetting foliage. In zoos, avoid exposure of reptiles to the product. Repeat as necessary.

FOR USE ON ANIMALS: To protect beef and dairy cattle and horses from ***Horn Flies, House Flies, Mosquitoes and Gnats,*** dilute 1 part of Pyrenone 25-5 plus 49 parts oil or suitable solvent, mix well and apply a light mist sufficient to wet the tips of the hair. To control ***Stable Flies, Horse Flies and Deer Flies*** on beef and dairy cattle and horses, apply 2 oz. per adult animal, sufficient to wet the hair but not to soak the hide. Repeat treatment once or twice daily or at intervals to give continued protection.

USE IN MOSQUITO CONTROL

Pyrenone 25-5 Public Health Insecticide may be used for mosquito control programs involving residential, industrial, recreational and agricultural areas as well as swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur. Pyrenone 25-5 Public Health Insecticide may be used over agricultural crops because the ingredients are exempt from tolerance when applied to growing crops. For best results, apply when meteorological conditions create a temperature inversion and wind speed does not exceed 10 miles per hour. The application should be made so the wind will carry the insecticidal fog into the area being treated. Treatment may be repeated as necessary to achieve the desired level of control.

When used in cold aerosol generators that produce a fog with the majority of droplets in the 10-25 micron VMD range, Pyrenone 25-5 Public Health Insecticide should be diluted with light mineral oil or suitable solvent (specific gravity of approximately 0.8 at 60°F; boiling point: 500-840°F). An N.F. grade oil is prefered.

GROUND APPLICATION: To control adult mosquitoes and all common diptera, apply up to 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Truck-Mounted ULV Application: The delivery rate and truck speed may be varied as long as the application rate does not exceed 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Backpack Spray Application: Dilute 1 part Pyrenone 25-5 Public Health Insecticide with 10 parts oil or suitable solvent and apply at the rate of 7 ounces per acre (based on a 50 foot swath, 7 ounces should be applied while walking 870 feet).

AERIAL APPLICATION (FIXED WING AND HELICOPTER): To control adult mosquitoes and biting flies, apply up to 0.0025 pounds of pyrethrins per acre with equipment designed and operated to produce a ULV spray application.

IMPORTANT: READ BEFORE USE

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 should be followed carefully. However, because of manner of use and other factors beyond Bayer Environmental Science's control, it is impossible for Bayer Environmental Science to eliminate all risks associated with the use of this product. As a result, crop injury or Ineffectiveness is always possible. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WHICH EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for incidental or consequential damages, including, but not limited to, liability arising out of breach of contract, express or implied warranty (including warranties of merchantability and fitness for a particular purpose), tort, negligence, strict liability or otherwise.

LIMITATIONS OF LIABILITY: 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 ENVIRONMENTAL SCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

Bayer Environmental Science
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road
Montvale, NJ 07645

Py 25-5 PH-SL-9/02 Bayer

7396-902

PYROCIDE® Mosquito Adulticiding Concentrate for ULV Fogging 7396

Recommended for use by Commercial or Governmental Mosquito Control Personnel

ACTIVE INGREDIENTS:

	Pyrethrins	5.00%
*	Piperonyl butoxide, Technical	25.00%
**	OTHER INGREDIENTS	70.00%
		100.00%

* Equivalent to 20.00% (butylcarbityl) (6-propylpiperonyl) ether and 05.00% related compounds.

** Contains petroleum distillate

PYROCIDE® - Registered trademark of McLaughlin Gormley King Co.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
IF SWALLOWED:	▪ Immediately call a poison control center or doctor. ▪ Do not give any liquid 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 eyes. ▪ 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.
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 the International Poison Center at 1-888-740-8712.

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 fish and other aquatic invertebrates. For terrestrial uses, 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 contaminate water by cleaning of equipment or disposal of wastes. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a 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 previously 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.

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 mosquitoes.

This pesticide may be applied with equipment designed and operated to produce a suitable ultra low (ULV) spray application, which meets the dosage per acre objective of not more than .0025 pounds of pyrethrins and .0125 pounds of piperonyl butoxide per acre.

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.

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

CONTAINER DISPOSAL: Triple rinse (or equivalent) and offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other approved State and Local procedures.

Net Contents _____

Manufactured by:

Mc LAUGHLIN GORMLEY KING COMPANY

8810 Tenth Avenue North

EPA Reg. No. 1021-1569 Minneapolis, MN 55427 EPA Est. No. 1021-MN-2

Appendix H Technical Advisory Board Meeting Notes

February 17, 2010

TAB Members Present:

Sarma Straumanis, Chair, MN Dept of Transportation
Roger Moon, University of Minnesota
Larry Gillette, Three Rivers Park District
Vicki Sherry, US Fish and Wildlife Service
David Neitzel, MN Dept of Health
Robert Sherman, Independent Statistician
Gary Montz, MN Dept of Natural Resources
Steven Hennes, MN Pollution Control Agency
Rick Bennett, US Environmental Protection Agency
Robert Koch, MN Dept of Agriculture

TAB Members absent (reviewed draft Operational Review)**:**

Susan Palchick, Hennepin County Dept of Health
Karen Oberhauser, University of Minnesota

MMCD Staff in Attendance:

Jim Stark, Nancy Read, Stephen Manweiler, Sandy Brogren, Diann Crane, Carey LaMere, Michael McLean, Mark Smith, Janet Jarnefeld, John Walz, Kirk Johnson

Guest:

Steve Molnar, ADAPCO, Inc.

Welcome and Call to Order

Chair Sarma Straumanis called meeting to order 12:30 P.M. All present introduced themselves. Sarma asked for volunteers from the TAB to capture ideas for possible resolutions, and Gary Montz volunteered.

MMCD Strategies and Budget, and NPDES Update

Sarma introduced Jim Stark, MMCD Executive Director. Jim talked about MMCD's response to challenging economic times. MMCD has adapted its long-term capital plan, which has helped the organization focus on providing expanded control. This plan was based on assumptions which included the importance of mosquito control, mosquito-borne disease risk reduction, population growth and development, and an increasing property tax base. Given current economic conditions the last two assumptions have not held. MMCD has re-evaluated and suspended the growth plan. For 2010, MMCD has reduced income from the tax levy, but is maintaining service through savings from dry years. For 2011, MMCD staff is exploring ways to reduce expenses and continue to maintain services through improving processes. The District is also focusing on risk management, and hopes to realize savings through that as well. The organization's budget document is available on www.mmcd.org.

Question submitted in advance: Can MMCD carry over funds and materials? Jim responded that, yes, MMCD operates from one general fund. We are also typically able to carry over materials which we can purchase at current year's prices. We try to budget for "normal" years based on long-term averages, and then adjust as needed. Our main cost drivers are materials, helicopters, and personnel; in a so-called "dry year", there are savings that we can take advantage of.

Larry Gillette (LG) asked: If you could carry over 100% you still couldn't use it all in the next year. Isn't MMCD limited by logistics? Jim responded that, yes, we are limited by helicopters and available time during broods. We're constantly trying to tweak our formulas for response to garner more efficiency. For instance, we're looking at longer-term materials, and how we route helicopters.
LG – asked about criteria for pre-treatment of sites – especially sites that have to be treated repeatedly. Jim replied that we are pre-treating certain sites, particularly in inner ring areas. Pre-treatment material, however, is very expensive, we have to be aware of trade-offs. It is a balancing act how to best use resources, but we do continue to use site history to improve material use.

NPDES Update Jim handed out a fact sheet from EPA that described the current situation regarding whether permits are needed to apply pesticides to waters, in keeping with a complex set of recent court rulings. We are keeping up with the situation through EPA webcasts and meetings with MN Dept of Agriculture staff, and have had some concerns regarding reasonable post-treatment monitoring and record keeping. MMCD is well-prepared with data, maps, and management plans for complying with the permit application process, regardless of how it takes shape.

Invasive / Expanding Species and MMCD's Response

Overview Mike McLean gave a brief review of the exotic species dilemma and how MMCD fits in. He discussed differences between non-native (species that move as a result of human activity), naturalized, and invasive species. Invasive species can be plants, animals, or pathogens that have the potential to negatively impact economies, health, or the environment.

TAB members were given a handout that outlined MMCD's plan to address exotic species as they appear (Appendix I). This plan involves research prior to arrival, determining local concerns, surveillance and control strategies, and reassessment of impacts and risks. Most exotics that arrive in Minnesota are probably present somewhere else on the continent and are spreading, but there is a possibility that an exotic could be found here for the first time. MMCD is monitoring plans put together by the MN Invasive Species Advisory Council. Our focus is often on changing public behavior, but we may also need to watch out for spread through our own employee actions.

Mosquitoes Kirk Johnson gave a detailed recap of MMCD's response to exotic mosquito species in 2009. Because it was a relatively dry year with little disease activity, we were able to focus on surveillance. *Aedes japonicus* is a newly arrived species of concern; in its native range it has been shown to transmit Japanese encephalitis and in the laboratory it has been shown to be a competent host for other encephalitis viruses. Until we know more about its capacity for transmitting these diseases, we have a responsibility to assume *Ae. japonicus* could transmit

them. Kirk described the current known regional distribution, and outlined our established surveillance strategy for 2009 focusing on larval habitats. This response is similar to *Ae. triseriatus* work and based on previous research. MMCD set up a plan targeting 124 selected areas with prime habitat throughout the District. We also instructed staff to check potential larval habitats during the course of their other work as time allowed. Our adult mosquito sample processing was also adapted to make sure *Ae. japonicus* were identified to species.

Kirk shared a map series (see TAB fig 1.21) which illustrated *Ae. japonicus* spread throughout 2009. Spring surveillance confirmed winter survival of this species. Its range expanded in 2009 about 65 miles to the north and west. Kirk also noted that some of the areas where we found *Ae. japonicus* and did intense control and clean-up efforts in 2008 did not have detectible levels in 2009. Our pre-selected monitoring site network may be a useful strategy for others to use to detect *Ae. japonicus* in other parts of the state. Questions remain about the role this exotic will play in disease transmission and competition with other container-breeding mosquitoes.

Roger Moon (RM) – Did other regular sampling pick up *Ae. japonicus*? Kirk (KJ) - yes.
RM suggested that other sampling measures could be matched with pre-selected samples so MMCD could evaluate which methods were most sensitive, and adult sampling could be compared with larval.
RM – Is *Ae. japonicus* was a vertical viral transmitter? Have they been tested? Which virus?
KJ - PCR testing was run by MDH, and no virus was found (tested WNV, LAC).
RM – Are we really seeing spread, or if this species is photophobic, are they being moved by humans in levels we just now can detect? KJ responded that this species will move during night hours; they can fly far enough to get from woods to woods. They may have been here awhile, but may now be getting abundant enough to detect.
RM – How far north can *Ae. japonicus* survive? KJ answered that Winnipeg latitudes are not out of the question.

Dave Neitzel (DN) asked if *Ae. japonicus* were found in both residential and commercial properties, as opposed to *Ae. albopictus* which has been found mostly in commercial areas.
KJ – seems like with this species there is a more natural expansion, although movement is aided by humans.

Robert Sherman (RS) asked, once they move, what limits their expansion in a territory?
KJ answered that *Ae. japonicus* movement is in contrast to *Ae. albopictus*, which has not become established here. We think *Ae. albopictus* can't survive winter or perhaps diapause happens too late in the fall, so their limit to northern expansion is from about the northern border of Missouri to the south and east including southern Illinois to the eastern seaboard. It remains to be seen how far *Ae. japonicus* will move to the north and west. It has moved across Iowa to Sioux Falls, S.D., but we're not sure what will happen as it moves into prairie regions.

RM – We have been watching spread of emerald ash borer, spread largely by firewood. Are there things that are on trucks that would move *Ae. japonicus*? Would regulation of transport help?
KJ - it is hard to focus on any one factor. Anything that holds water over distance, even spare tires on trucks, could move these. DN noted that *Ae. japonicus* has almost unlimited potential habitat.

Robert Koch (RK) – when do you get to the point where you don't worry about movement anymore? KJ - we're there. There are islands of *Ae. japonicus* throughout the District and we expect them to spread. RK noted that spread of *Ae. japonicus* is similar to ash borer; originally there are pockets, then the species spreads to become continuous. KJ added that MMCD is moving toward general control policies and will continue research on questions of species biology.

Aedes albopictus KJ continued with description of *Ae. albopictus* findings; there were four larval samples and six positive ovitraps, most associated with Liberty Tire in Savage which is now taking in tires from larger geographic area. Still, there is no evidence of overwintering.

Aedes cataphylla KJ reported this species was collected in the District once in 2008, well outside of its known geographic range, and was not detected in 2009 despite intense search efforts.

Ticks Janet Jarnefeld (JJ) described MMCD's tick work and issues regarding spread of tick species and tick-borne diseases.

Ixodes scapularis In 2007-2008, this species was collected in all seven counties. This might indicate an expansion, but it might also be that increased numbers finally allow detection. MMCD received reports of *I. scapularis* in the Mississippi River corridor in the metro area. There was not much of an herbaceous layer to sample and the terrain was steep, so drag cloths were used as sampling devices instead of traps. No ticks were recovered using this method, however. There were also reports of *I. scapularis* from Waconia in Carver County which we will try verifying next season.

Amblyomma americanum (commonly called the Lone Star tick) was reported from Theodore Wirth Park in central Minneapolis, and another was submitted from Anoka Co. Finding this tick species is probably an anomaly at this time, but if we see more we will have to consider a response. The literature shows that the range of this tick is expanding northward. It is a very aggressive human biter, and also carries human monocytic ehrlichiosis.

Rocky Mountain spotted fever is also unusual in the District. MMCD assisted MDH by collecting wood ticks to help assess RMSF risk, but the surveillance was late in season. We are considering doing more follow-up. DN noted that U of M Entomology Dept may test ticks to help with this research.

LG – Noted that Parks crews are getting more deer ticks than before. He asked if MMCD is interested in submissions even in areas where they are known to occur. JJ - yes, we sample from a few locations and make assumptions about area around that; if park staff is willing, we would like samples submitted.

RM – Is there any effort to connect with companion animal vets to collect ticks? JJ - we stay in touch for disseminating public informational materials, but we haven't gone farther than that. Many dogs are treated with Frontline. RM noted ticks are still being found and are being submitted to U of M. JJ – It would be good to get unusual ticks for identification. DN suggested

that it would also help to get travel histories of affected animals. RK noted veterinarians come in for continuing education credit, and perhaps this (tick information, submission for ID) could be a useful agenda item for them. RS suggested stopping by local dog parks.

RM – Said he would like to be able to get current year tick results by the time of this meeting, and asked if it was possible to adjust resources to make this happen. JS noted that the Tick Advisory Board met this year to help give feedback and direction to our efforts.

Season Review

Black Fly Update John Walz reported on black fly work. MMCD has expanded small stream work in response to trap counts. Nontarget work results are also now available. John also noted some of the research available through the North American Black Fly Association.

Weather or Not, We Get Mosquitoes Sandy Brogren (SB) discussed 2009 seasonal weather effects on our mosquito species, noting differences between spring, summer, cattail, *Culex*, and container species groups. Given the variety of habitats, there are always some kinds of mosquitoes thriving in different rain conditions. Spring *Aedes* had a large peak in the spring and continued to hang on in significant numbers through early August. Summer *Aedes* had one peak at end of August last year because of dry conditions. *Coquillettidia perturbans*, whose numbers are dependent on the previous year's rainfall, emerged on cue in July. Other *Culex* species were found throughout the summer.

Sandy responded to LG's submitted question on New Jersey light traps; he has one in his yard (see MN in table of NJ results on page 17). She discussed how results from his trap compared with those from a nearby CO_2 trap.
LG – Noted a possible problem with a table in Appendix B. Should the data include only information from traps with continuous history? With so few traps, an individual trap has a big influence on the average. What about long-term history? SB noted that most of the existing traps are at locations that have been in place for a long time. However, we can split out those numbers for a more accurate table.

LG – regarding *Cq. perturbans*, it seems like MMCD is spending more time controlling this mosquito and is having an effect; is that because you are finding more habitats breeding or are you catching up with other activities and have more time for this surveillance? LG has been exploring the difference between broad-leaf and narrow-leaf (hybrid) cattail. Narrow-leaf is expanding widely, displacing broadleaf. It tolerates deeper water. Is this affecting cattail mosquito populations? SB – would like to get more information on the hybrid cattail. Field staff report not finding an expanded number of sites per se, but just an expansion of our treatment resources to cope with *Cq. perturbans*. Stephen Manweiler (SM) – reiterated that there has been an expansion of control, and MMCD is continuing to look at ways to be more effective. RM – Do these cattail varieties vary in amount of exposed water roots? LG – so far, he doesn't know. He tried to get a permit to control narrow-leaf cattail but MN DNR did not recognize the difference as nonnative. We've seen lots of changes in the wetlands – factors such as nutrient enrichment, but we're not sure how much is due to narrow-leaf cattail. RM – Suggested adding this subject to MMCD's list of research projects.

Improving Control Sandy finished with a description of the situation with spring mosquitoes and issues with their control. These species tend to "trickle-hatch, making the timing of aerial treatments with *Bti* difficult." She handed over the discussion to Stephen regarding new materials to help with cost-effective control of this species. He discussed problems using *Bti* in spring conditions, and would like to have a material that has long release. MMCD would also like a long-lasting material for catch basin control as it takes a lot of human resources to treat each catch basin three times per year. He also discussed tests of Natular in spring conditions, stormwater structures, and catch basins (see report). Material use for spring *Aedes* control could be reduced by almost 20% if repeat aerial treatments were not needed, based on 2009 treatment numbers.

Gary Montz (GM) noted that last year we discussed Natular and nontarget potential effects on molluscans. Are any of these sites draining into critical waters? SM noted that MMCD will be checking with Clarke (producer) on that issue before any expanded use. GM asked to have any studies MMCD becomes aware of to be passed on to him.

Cattail Mosquito Control with Late-Season VectoLex Mark Smith (MS) talked about new strategies for control of *Cq. perturbans*. Last season we treated about 13,000 acres for cattail control, using methoprene products applied in the spring, before adult emergence. Some of the aerial treatments tend to occur at the same time as resources, particularly helicopters, may be needed for other control activities. To help with this resource crunch, we tried using VectoLex (*Bacillus sphaericus*) in the fall, when water temperatures were over 50° F. Methoprene applied in fall could not be relied on to last through late June emergence. Testing a fall 2008 application of VectoLex showed good control in spring of 2009. Larval populations were not sufficient to redo tests in the fall of 2009, but we look forward to doing more testing in the future.

RM – Asked how well fall survey results predict spring mosquito production. Nancy Read (NR) referred to Darold Batzer's research. SM noted that reference sites have shown some relationship, though it is tough to get close relationships. RM noted that knowing how many larvae we're dealing with and how many would survive might help place a dollar value on this control (e.g. X billion mosquitoes prevented/$1,000 spent). SM noted that surveillance has shown CO_2 trap catches going down near treated sites.

Adulticide Use Trends Nancy Read discussed 2009 adulticiding levels. In the interest of time, she skipped the prepared slides and pointed out the results shown in the report. Figure 3.3, p. 48, showed the percent of CO_2 trap counts over threshold each week in 2009; this number was very low throughout the season, and was reflected in the low amount of acres treated. Total amount of acres treated was the lowest since 1988, an extreme drought year. Table 3.3 (p. 49) shows the number of ULV fog and permethrin treatments, and the information that can be linked to those treatment records regarding what factors triggered the action. Treatment percent noted as Events, Parks, or Other Calls (not events) has not changed much from last year. Treatment percent that can be linked to surveillance with a species ID has increased dramatically, from about 33% to 65-69%; we redesigned data systems last year to allow linking to more than one surveillance record (often one was an on-site slap count with no id) and emphasized the importance of linking this data, and plan to work on that again in 2010.

RM – we would like to be able to show justification for every treatment; events-parks-calls only adds up to about 30%, what about the other 70%? NR – field practice is to treat only when there are mosquitoes over threshold and some likely impact on humans. The numbers show data recorded; it is likely that more treatments were related to calls in the area but were not linked to a specific call in the database. We are working to make it easier for field staff to link a treatment with calls and other information related to justification of treatment.

Discussion and 2009 TAB Resolutions

LG suggested that when reporting NJ light trap data, be sure to pull out Carlos Avery results which tend to skew the data. NR – noted for next year's report.

GM – Asked if the TAB meant to resolve that it supported more assistance for MMCD's tick program, as suggested by RM. GM suggested that it might help as budget priorities are set.

***Resolution*: Whereas prevalence of Lyme disease and other tick-borne disease is increasing in the metro area, and whereas microbiologists are recognizing the presence of new pathogens, and whereas the range of *Ixodes scapularis* seems to be expanding in metro, therefore we encourage MMCD to find ways to improve tick surveillance and timeliness of reporting results, and explore additional new approaches for surveillance.**

Motion made by Roger Moon, second by Robert Sherman, **Passed**.
Suggestions for new approaches included more communication with veterinarians and with pet owners at dog parks.

LG – Stephen talked about looking at products for pre-treating areas (sites) that repeatedly produce mosquitoes, I'd like to support that.

***Resolution*: The TAB expresses support for MMCD's research efforts to reduce the cost and increase effectiveness of mosquito control by testing long-lasting, cost-effective and environmentally sensitive products that would allow pre-flood treatments to acres that repeatedly produce mosquitoes.**

Motion made by Larry Gillette, second by Roger Moon.
Discussion – in the past, we were concerned that long-lasting briquets had nontarget effects, LG suggested adding language that reflected that these methods need to be environmentally responsible/sensitive, not just inexpensive (language was inserted in above resolution). **Passed.**

RS – Noted that there is growing automation in data gathering. Do any of these new data-gathering technologies potentially apply for MMCD? Examples include solar powered rain or depth gauge devices. Staff will look into possibilities.

Meeting adjourned 3:40 P.M.

The 2009 TAB Report and Resolutions will be presented by current TAB chair, Sarma Straumanis, to MMCD Commissioners at their Apr. 28, 2010 meeting.
Next year's chair: Gary Montz, MN DNR

Appendix I Outline for MMCD Response to Exotic/Invasive/Introduced Species

2/10/2010

For exotic or invasive species known to exist elsewhere in North America and native North American species with expanding ranges

I. Research species prior to arrival
- A. Habitat requirements and preferences
- B. Behavioral characteristics
- C. Distribution on continent
- D. Vectorial capacities
- E. Host preferences
- F. Mechanisms for overwintering

II. Determine local concerns
- A. Likelihood of arrival
- B. Disease risk
- C. Nuisance factor
- D. Ecological impacts
- E. Public perceptions

III. Establish surveillance strategies
- A. Detect arrival
- B. Determine extent of infestation(s)
- C. Direct control efforts

IV. Determine control strategies
- A. No control
  1. Not vector
  2. Not nuisance
  3. No ecological impacts
- B. Eradicate infestation
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use
  4. Quarantine
- C. Slow spread
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use
  4. Quarantine
- D. Long term population control
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use

V. Reevaluate surveillance and control strategies annually

For exotic or invasive species found for the first time on continent by MMCD and unexpected North American species found in District

I. Research species upon discovery
- A. Habitat requirements and preferences
- B. Behavioral characteristics
- C. Distribution in native range
- D. Vectorial capacities
- E. Host preferences
- F. Mechanisms for overwintering

II. Establish surveillance strategies
- A. Determine extent of infestation(s)
- B. Direct control efforts

III. Determine control strategies
- A. No control
  1. Not vector
  2. Not nuisance
- B. Eradicate infestation
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use
  4. Quarantine
- C. Slow spread
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use
  4. Quarantine

IV. Reevaluate at end of first season
- A. Local concerns
  1. Disease risk
  2. Nuisance factor
  3. Ecological impacts
  4. Public perceptions
- B. Surveillance efforts
- C. Control efforts
- D. Public awareness efforts

V. Refine surveillance and control strategies if necessary
- A. Slow spread
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use
  4. Quarantine
- B. Long term population control
  1. Habitat manipulation
  2. Public awareness
  3. Pesticide use

Images used on the front cover courtesy of:
Lone Star Tick: CDC/Dr. Amanda Loftis, Dr. William Nicholson, Dr. Will Reeves, Dr. Chris Paddock
Black Fly Larvae: Dean Hanson
Mosquito Larvae: CDC/James Gathany

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