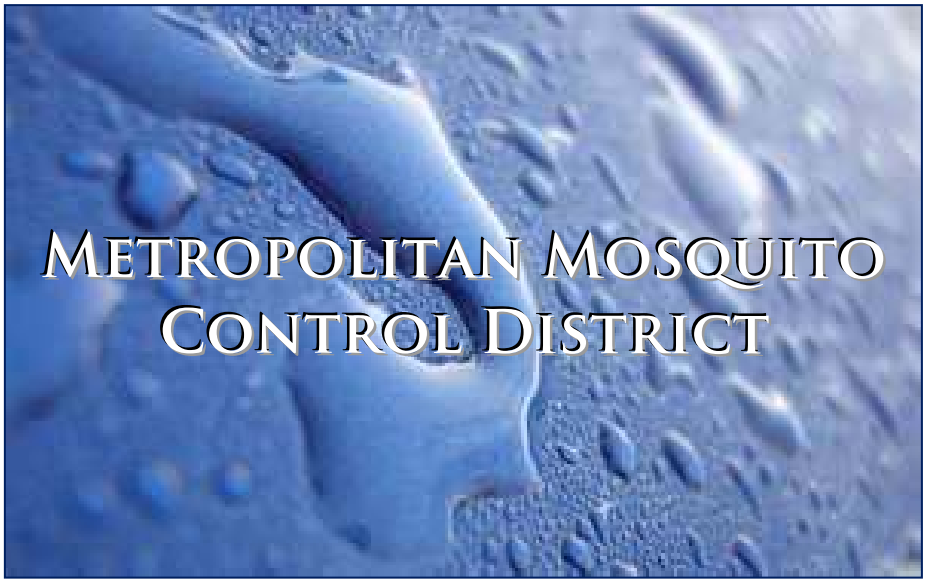
2010 Operational Review & Plans for 2011

Annual Report to the Technical Advisory Board



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

Metropolitan Mosquito Control District

Mission

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

Governance

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

Metropolitan Mosquito Control Commission 2011

Matt Look	Anoka County
Rhonda Sivarajah	Anoka County
Robyn West	Anoka County
James Ische	Carver County
Tom Workman	Carver County
Thomas Egan	Dakota County
Nancy Schouweiler	Dakota County
Liz Workman	Dakota County
Jan Callison	Hennepin County
Jeff Johnson	Hennepin County
Randy Johnson	Hennepin County
Tony Bennett	Ramsey County
Jim McDonough	Ramsey County
Janice Rettman	Ramsey County
Barbara Marschall	Scott County
Dave Menden	Scott County
Gary Kriesel	Washington Co.
Lisa Weik	Washington Co.

Technical Advisory Board

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

Technical Advisory Board Members 2010-2011

Gary Montz, Chair	Mn Dept. of Natural Resources
Rick Bennett	US EPA
Laurence Gillette	Three Rivers Park District
Steve Hennes	Mn Pollution Control Agency
Robert Koch	Mn Dept. of Agriculture
Roger Moon	University of Minnesota
David Neitzel	Mn Department of Health
Karen Oberhauser	University of Minnesota
Susan Palchick	Hennepin Co. Comm. Health
Robert Sherman	Independent Statistician
Vicki Sherry	US Fish & Wildlife Service
Sarma Straumanis	Mn Dept. of Transportation

Metropolitan Mosquito Control District Contributing Staff

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

Minnesota Department of Natural Resources
500 Lafayette Road • St. Paul, MN • 55155-40

Minnesota
DEPARTMENT OF
NATURAL RESOURCES

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

Dear Commissioner Rettman,

The Technical Advisory Board (TAB) met on February 8, 2011 to review and discuss MMCD operations in 2010 and plans for 2011. As you know, the TAB was originally formed to provide annual independent review of field control programs and to enhance inter-agency cooperation.

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

1. That MMCD examine adult thresholds for annoyance mosquitoes and what the impact would be of raising these thresholds.

2. That the District evaluate the merits and costs of various mosquito surveillance methods it currently uses and report back to the TAB at its next meeting.

3. That MMCD consider climate change adaptation in control strategy and budget planning.

Sincerely,

Gary Montz
Chair, Technical Advisory Board

Table of Contents

APPENDICES

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 2010 through surveillance, disease monitoring, mosquito and black fly control, new product testing, data management, and public information.

The 2010 season was warm and wet for the region, with multiple significant rain events leading to floodwater and vector mosquito production. Despite these conditions, mosquito levels were held to a tolerable level through much of the season, as resources allowed. This was reflected in the volume of calls/emails from citizens requesting service as well as in direct surveillance. Levels of the West Nile virus (WNV) vector, *Culex tarsalis*, also were high, but there was little virus activity found in mosquitoes or birds and relatively few human disease cases in the District.

The exotic species *Aedes japonicus* spread throughout the District in 2010. Monitoring for this species continued to be a high priority, as did control efforts including tire pick-up and clean up of container-filled sites.

Since 2005, MMCD has worked to expand larvicide services within the District through strategies designed to stretch each dollar of funding. Cost-effective strategies will help MMCD minimize the impact of budget limitations on service delivery. In 2011, MMCD will review all aspects of its integrated mosquito management program to ensure that budgetary resources are being used as effectively as possible with the goal of maximizing mosquito control services per budget dollar and complying with any NPDES (National Pollution Discharge Elimination System) related permit requirements.

Surveillance

The 2010 spring mosquito season was very dry and warm. No snow fell in March. All accumulated snow melted by mid-March and caused an early hatch of spring *Aedes*. Mid-April rains induced more spring and some summer *Aedes* to hatch. Our first summer brood of floodwater mosquitoes resulted from a week of rain starting on May 8. Cool temperatures slowed the hatch, and high winds limited helicopter treatments. An inch of rain fell in early June in most of the District, with some areas getting two inches. A third major brood occurred at the end of June. The biggest brood of the season resulted from 2-4 inches of rain the week of August 10.

September 2010 was the wettest in Minnesota history. Rainfall was 2-3 inches above normal for the month and heavy rains caused many watersheds to flood, some exceeding all previous measured flood crests (most notably at Henderson on the Minnesota River). The Mississippi River at St. Paul reached its all-time high autumn flow rate at 77,400 cfs on September 30.

Two major broods resulted from two major September rain events. Staff decided not to treat the second September brood given the budget and the diminished likelihood of the mosquitoes causing any nuisance late in the season.

The District continued to sample the distribution of ticks in the metro area as part of its mandate to provide information and education on prevention of Lyme disease. Again, in 2010, distribution study results showed continued evidence of an elevated *I. scapularis* population, and new all-time highs were detected in several areas.

Disease

Mosquito-borne disease activity continued to be low in 2010 compared to previous years. There were no La Crosse encephalitis cases in the District, and West Nile virus activity remained low in 2010. Even though vector populations were adequate for rapid amplification of WNV, the virus spread slowly. There were four WNV illnesses reported in residents of the District, two in Hennepin County and two in Ramsey County. The Minnesota Department of Health determined that one of the Ramsey County individuals was exposed to WNV in Blue Earth County. Additionally, the only viremic blood donor from Minnesota was from Carver County. As part of its disease prevention efforts, MMCD has worked with city crews to survey and treat underground Best Management Practice structures (BMPs) since 2005. In 2010, we continued the cooperative mosquito control plan for underground habitats. Twenty municipalities volunteered their staff to assist with material applications. The 2009 human case totals for Lyme disease (~1,065) and human granulocytic anaplasmosis (~317) were again high. Case data for 2010 is not yet available. Tick-borne disease statistics for 2010 will be available through the Minnesota Department of Health early in 2011.

Control

In 2010, a total of 297,000 acres of larvicide were applied, the highest amount on record for the District, in response to early, frequent, and prolonged larval mosquito production. Spring *Aedes* larvae began hatching in the early snowmelt in mid-March, and the first larvicide applications were earlier than any time in the last 10 years. April rains triggered hatch of both spring and summer *Aedes*, and led to additional widespread larviciding. Large-scale aerial *Bti* or prehatch pellet treatments were done April through July. By July 26, the budget for helicopters and materials was almost 90% expended and the decision was made to focus treatments on P1 only, and ask the Commission for use of reserve funds (first time since 2002). Larvicide response to the significant District-wide rainfall August 9-13 and early September rain was limited to P1 areas. Rains in mid-September continued to result in widespread but mixed larval hatch. A decision was made September 20 to end treatments based on expected low survival from cool water temperatures, but a warmer than normal October led to some unusual late adult emergence. MMCD will continue to review all aspects of its integrated mosquito management program to ensure that budgetary resources continue to be used as effectively as possible and that any new permit requirements are met.

For black fly control, liquid *Bti* is applied to sites when the target species reaches the treatment threshold. In 2010, larval mortality following *Bti* treatment on the large rivers averaged 94%. The black fly larval population was monitored weekly between May and early September on the Rum, Mississippi, Crow, South Fork Crow and Minnesota rivers. A total of 549 samples were collected to determine if the treatment threshold was met. The amount of *Bti* used in 2009 and again in 2010 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 use 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 2010, 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 stormwater management and mosquitoes. Total requests for treatment – both phoned-in and emailed – were up sharply again in 2010.

Chapter 1 Mosquito Surveillance

2010 Highlights

- Rainstorms produced six major mosquito broods
- The major mosquito peak occurred in August
- Staff identified a record number 31,745 larval samples
- First detection of *Aedes melanimon* in Minnesota
- Higher levels of *Aedes triseriatus* detected than in the past four years
- *Culiseta melanura* populations were up and more widespread than in recent years
- *Culex tarsalis* levels in August were the second highest observed over the last decade
- Collected *Aedes albopictus* for the 9th season in the last 20
- *Aedes japonicus* collected for the first time from wetlands, catch basins and tree holes
- *Ae. japonicus* collected from multiple locations in 271 sections in each of the 7 District counties (89 sections in 2009)

2011 Plans

- Evaluate Monday Night Network methods and locations
- Continue search for presence of *Aedes cataphylla* and *Aedes melanimon*
- Monitor spread of *Ae. japonicus*
- Develop best surveillance methods for detecting *Ae. japonicus*

Background

The Metropolitan Mosquito Control District (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.

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, mosquitoes differ in their peak activity periods and in how strongly they are attracted to humans or trap baits (e.g., light or CO_2). Therefore, a variety of adult mosquito collection methods is used in order to capture targeted species.

The District focuses on four major groups of human-biting mosquito species: spring *Aedes*, summer *Aedes*, *Coquillettidia perturbans*, and disease vectors. Snowmelt induces spring *Aedes* (14 species) eggs to hatch in March and April and adults emerge in late April to early May. They have one generation each season and adults can live for three months. Rainfall prompts the summer *Aedes* (five species) to begin hatching in early May. They can have several generations throughout the summer and adults can live up to two weeks. *Coquillettidia perturbans*, the cattail mosquito, develops in cattail marshes and has one generation per year, peaking in early July. Disease vectors include *Aedes triseriatus*, *Culiseta melanura*, and *Culex* mosquitoes (4 species). Adults are evident in early summer and they can produce multiple generations per year. Appendix A contains detailed descriptions of the mosquitoes occurring in the District.

Surveillance 2010

Rainfall

Rainfall surveillance is an important tool used to estimate the amount of larval production and to determine where to dispatch work crews following a rain event. Generally, an inch or more of rain can produce a hatch of floodwater mosquitoes. 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.

Average rainfall in the District from May 1 through September 30, 2010 was 24.66 inches (Table 1.1) – 10.77 inches more than last year and 5.23 inches above the 52-year District average (19.43 inches). Dakota and Scott counties had the most rainfall, which were 9 and 7 inches above their average, respectively. The remaining counties received rain at least 3-5 inches more than their averages.

Table 1.1 Average rainfall received in each county from May through September 2006-2010 and 52-year District average

Year	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
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
2010	23.29	23.47	29.03	22.92	24.99	26.63	24.65	24.66
52-Year Avg	18.94	*20.26	19.83	19.53	19.74	19.35	20.02	19.43

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

We experienced 11 rainfall events that were sufficient to produce broods of mosquitoes (Figure 1.1). The size of the brood is determined by the amount of area in the District affected by rainfall, the amount of rainfall received, and the amount of mosquito production that resulted. In 2010, six large broods occurred District-wide and another five small-medium sized broods occurred in various parts of the District.

Water temperature can influence how quickly larvae develop in sites. From May – December 2010, temperatures and precipitation were mostly above normal as depicted by Figure 1.2, which displays the monthly departures from normal for both (source: National Weather Service, Twin Cities Station). Typically, spring *Aedes* mosquitoes larvae develop over a period of months, and summer species develop over a period of days.

The spring mosquito season in 2010 was very dry and warm (Figure 1.2). For the first time ever there was no snowfall in March. All the snow melted by mid-March and caused an early hatch of spring *Aedes* species. Mid-April rains induced more spring *Aedes* to hatch, as well as some summer *Aedes*.

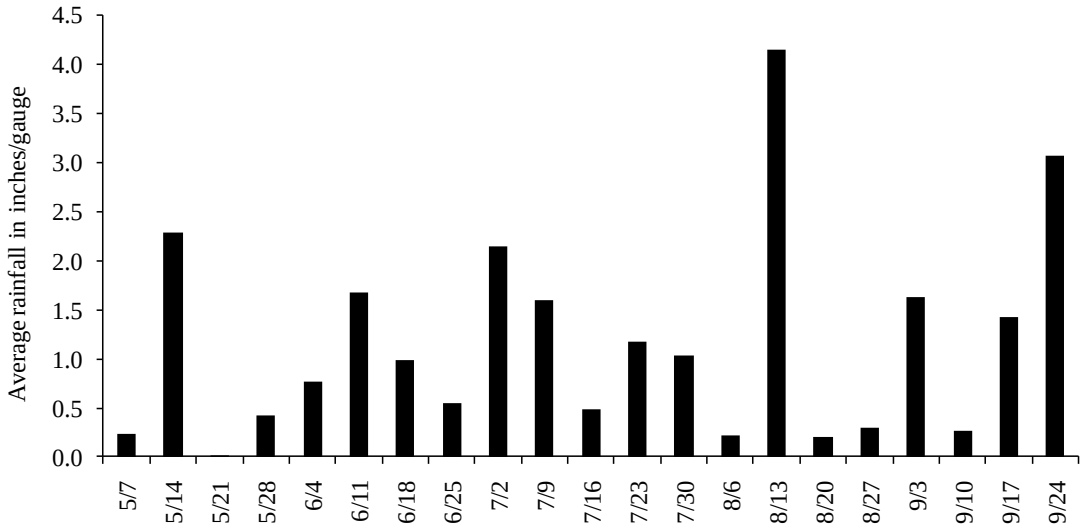


Figure 1.1 Average rainfall amounts per gauge per week (Saturday – Friday), 2010. Dates on the graph are Fridays.

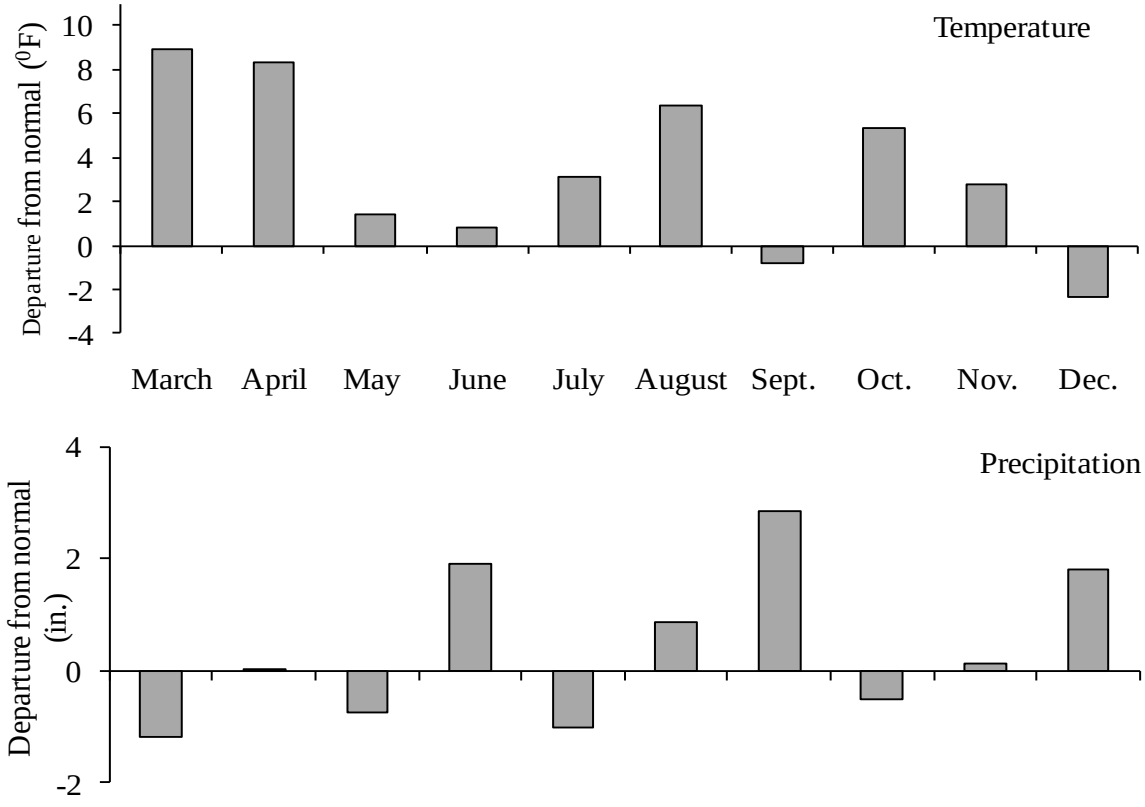


Figure 1.2 Monthly departures from normal for temperature and precipitation March-December, 2010.

Our first summer brood of floodwater mosquitoes resulted from a week of small, soaking rains starting on May 8. Cool temperatures slowed the hatching and high winds limited our ability to do helicopter treatments. A rain event in early June produced one inch of rain in most of the District, with some areas getting two inches. The third major brood occurred at the end of June with rain amounts of 1.5-2.5 inches across the District. Our biggest brood of the season resulted from 2-4 inches of rain on August 10.

Because of frequent and intense rainfall, September was the wettest recorded month in Minnesota history. Rainfall was 2-3 inches above normal for the month and heavy rains caused many watersheds to flood, some exceeding all previous measured flood crests (most notably at Henderson on the Minnesota River). The Mississippi River at St. Paul reached its all-time high autumn flow rate at 77,400 cfs on September 30.

Two major broods resulted from two major rain events: September 2 with 1-2 inches, September 23 with 2-4 inches. Staff made the decision not to treat the September 23 brood given the budget and the unlikelihood of the mosquitoes causing any nuisance late in the season. Larval sampling on October 6 detected 4th instar larvae and pupae still present in ground sites. Figure 1.3 depicts the geographic distribution and magnitude of weekly rainfall received in District gauges from May through September 2010.

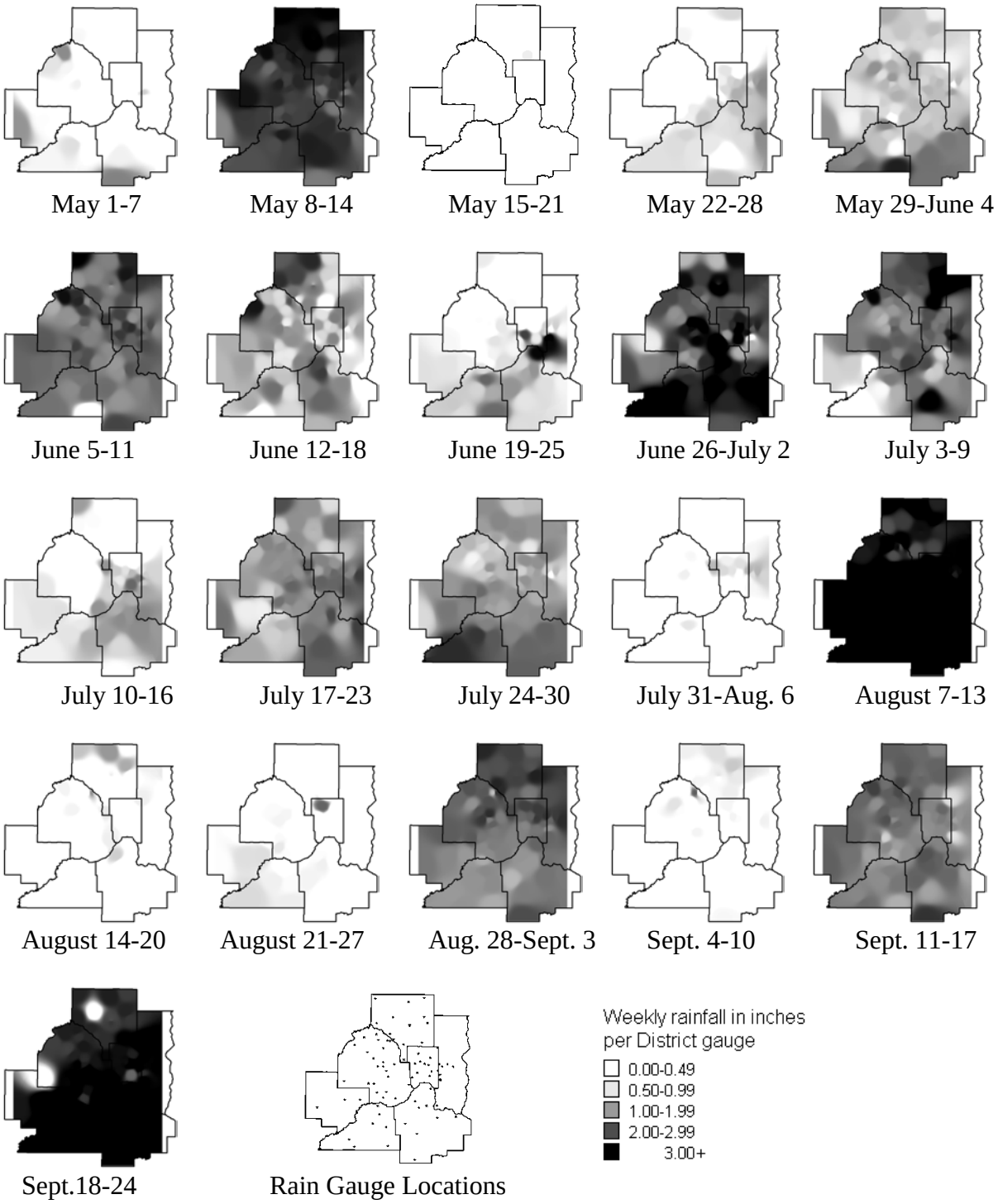


Figure 1.3 Weekly rainfall in inches per District gauge, 2010. The number of gauges varied from 68-73. A map of the rain gauge locations is included. Inverse distance weighting was the algorithm used for shading of maps.

Larval Collections

Larval mosquito inspections are done to determine if targeted species are present at threshold levels or to obtain species history in breeding sites. A variety of habitats are inspected to monitor the diverse fauna. Habitats include wetlands for *Aedes* and *Culex*; catch basins and stormwater structures for *Cx. pipiens, Cx. restuans*; cattail marshes for *Cq. perturbans*; tamarack bogs for *Cs. melanura*; and containers, tires, and tree holes for *Ae. triseriatus, Ae. albopictus*, and *Ae. japonicus*. The majority of larval collections are taken from floodwater sites using a standard 4-inch dipper. Threshold levels are determined by counting the number of larvae in each dip. Larvae are placed in sample vials and sent to the Entomology Lab for species identification.

In 2010, lab staff identified 31,745 larval collections, the most ever collected, and 70% higher than average for the last 20 years (Fig. 1.4). The increased sampling of wetlands [79% more in large and 52% more in small (< 3 acres) wetlands] was a direct result of the increased rainfall and increased capacity of field staff this year.

To accelerate the identification of samples from sites to be treated by helicopter, larvae are identified to genus only, except for *Culex* larvae, which are identified to species to differentiate vectors. Staff process lower priority samples as time permits and those are identified to species.

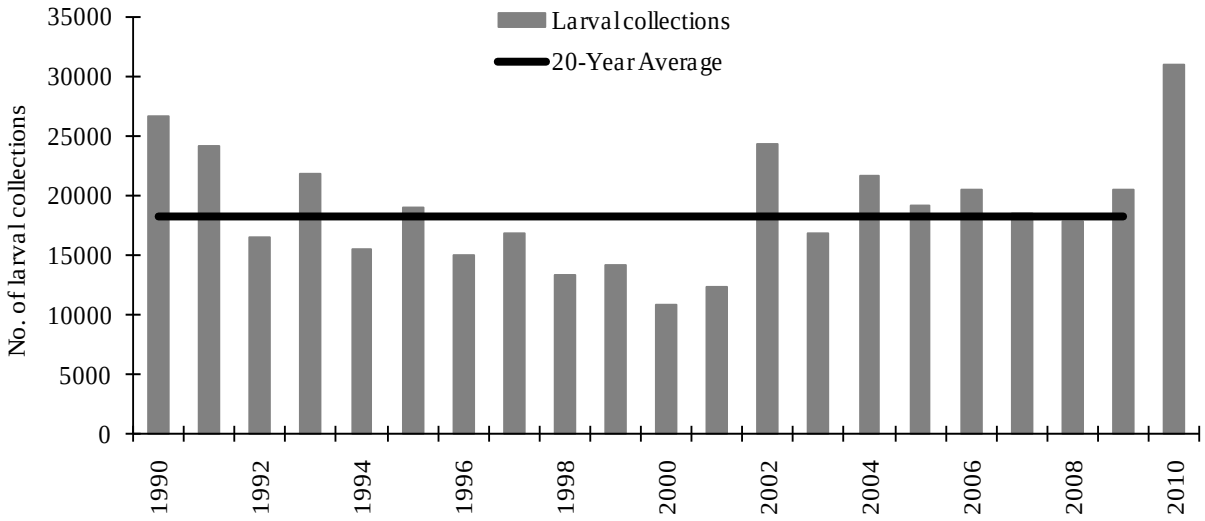


Figure 1.4 Yearly total larval collections and 20-year average.

Table 1.2 shows the results of the 15,776 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, stormwater structures, and other man-made features (e.g., swimming pool, culvert, artificial pond); those results (shaded column) are displayed separately from the natural breeding area (i.e., wetlands and cattail marshes) results in Table 1.2.

The most frequently collected species from natural breeding areas was our usual winner, *Ae. vexans*, occurring in 37.6% of the samples (Table 1.2). An unusual second place winner was *Culiseta inornata*, which often inhabits the same sites as *Ae. vexans* and is typically a nonhuman biter. Third and fifth place were taken by the spring species *Ae. stimulans* and *Ae. excrucians*. *Culex territans*, which prefers cold-blooded hosts, ranked fourth. The West Nile virus (WNV) vector, *Cx. tarsalis*, occurred in only 1.8% of the samples, ranking 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 pipiens and *Cx. restuans* are the dominant species developing in catch basins and other stormwater structures. *Culex restuans* was found in 63.0% of the structure samples and *Cx. pipiens* in 39.4% (Table 1.2). *Aedes* species sometimes develop in stormwater structures and were identified in 18.6% of the larval samples. However, surveillance for *Culex* species often occurs after the *Aedes* have emerged from the sites. 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 larval specimens of *Ae. japonicus* in floodwater sites and in catch basins—the typical larval habitat is containers, so it is unusual to collect them in other types of sites. More discussion of *Ae. japonicus* surveillance follows in the exotic species section of this chapter.

In 2008, larval *Aedes cataphylla*, were collected for the first time in Minnesota (Minnetonka). *Aedes cataphylla* is a very early spring species whose range is the western US and Canada, no further east than Colorado. Extensive larval sampling conducted in 2009 and 2010 in the area of the 2008 detection has been negative for *Ae. cataphylla*. A CO_2 trap operated near the location of the detection has also been 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 wetland collections by facility and District total, and the District total for structure samples, 2010; the total number of samples processed to species is in parentheses.

	Percent of samples where species occurred by facility							
Species	North (1,844)	East (3,594)	South Rosemount (1,924)	South Jordan (1,535)	West Plymouth (2,231)	West Maple Grove (1,831)	Wetland Total (13,049)	Structures Total (2,727)
Aedes abserratus	0.4	0.5	0.2		0.4	0.2	0.3	
aurifer								
canadensis	0.2	0.6	1.7	1.0	0.3	0.4	0.7	<
cataphylla								
cinereus	13.2	9.5	4.1	9.8	10.6	8.6	9.3	0.2
communis								
dorsalis	<	0.3	0.1	0.5	0.2	0.9	0.3	<
euedes								
excrucians	13.6	11.4	14.6	2.9	10.3	13.1	12.0	<
fitchii	10.0	7.9	8.3	0.8	1.7	3.6	5.7	<
flavescens		<			<	<	<	
hendersoni								<
implicatus	0.2	0.7	0.4		0.4	0.7	0.4	
intrudens		<				<	<	
japonicus			<	0.1			<	1.0
nigromaculis	<	0.2	0.2		<	<	0.1	<
punctor	0.2	0.4	0.2		0.3	0.2	0.2	
riparius	0.5	0.5	0.5	0.3	2.1	1.3	0.9	
spencerii	<		<				<	
sticticus	0.5	0.3	1.1	0.9	0.3	0.4	0.5	<
stimulans	17.0	17.2	25.8	9.8	22.3	23.8	19.4	<
provocans	0.7	0.8	0.5		0.3	0.2	0.5	
triseriatus	0.3	<	0.1	0.1	<	0.2	0.1	0.7
trivittatus	1.6	3.5	4.2	6.0	1.2	0.7	2.8	0.3
vexans	43.3	39.8	39.3	42.8	27.8	33.5	37.6	18.7
Ae. species	23.4	15.3	18.9	10.0	15.0	17.6	16.6	6.5
Anopheles earlei	0.5	<	0.1	<	<		0.1	<
punctipennis	3.1	2.5	0.7	0.7	0.9	0.2	1.6	2.1
quadrimaculatus	1.3	0.2		0.3	0.1		0.3	<
walkeri	0.2	<	<	0.1	<		<	0.1
An. species	8.9	6.7	1.4	3.6	3.4	0.8	4.5	5.0
Culex pipiens	4.3	4.6	2.4	3.2	3.8	4.9	4.0	39.7
restuans	6.1	7.6	8.3	8.1	8.8	5.5	7.5	63.0
salinarius		<		0.2	0.2	<	<	
tarsalis	2.6	2.2	1.5	2.1	1.4	1.0	1.8	3.5
territans	23.0	19.3	8.0	18.9	14.0	6.3	15.3	11.0
Cx. species	2.5	2.6	2.3	2.7	2.5	2.2	2.5	38.7
Cx. pipiens/restuans	0.2	0.1		0.1	<	<	0.1	
Culiseta inornata	16.7	21.0	21.6	26.2	20.9	26.1	21.8	3.0
melanura								
minnesotae	1.3	2.5	1.0	0.5	2.4	0.5	1.6	0.2
morsitans	0.2		0.1	0.2		0.1	<	
Cs. species	2.8	4.0	2.4	1.5	4.1	3.1	3.2	0.3
Psorophora ferox			0.3		<		<	
horrida		<					<	
Ps. species	<	<	<		<		<	
Ur.sapphirina	3.9	2.5	0.7	1.7	1.6	0.3	1.9	0.4

< = percent of total is less than 0.1%

Adult Mosquito Collections

As stated earlier, the District employs a variety of surveillance strategies to target different behaviors of adult mosquitoes. Sweep nets are used to survey the mosquitoes attracted to a human host. Carbon dioxide-baited (CO_2) traps are used to monitor host-seeking, phototactic species. New Jersey light traps monitor only phototactic mosquitoes. A vacuum aspirator captures mosquitoes resting in the understory of wooded areas in the daytime, primarily *Ae. triseriatus,* the vector of La Crosse encephalitis (LAC), and *Cs. melanura,* the vector of eastern equine encephalitis (EEE). Gravid traps are used to capture egg-laying *Culex* vectors of West Nile virus (WNV) and western equine encephalitis (WEE). Ovitraps are used to collect eggs of container-inhabiting vector species (i.e., *Ae. triseriatus, Ae. japonicus, Ae. albopictus*). The information obtained from sampling is used to direct control activities and to monitor vector populations and disease activity (i.e., specimens collected are tested for disease). Treatment thresholds are discussed in Chapter 3.

Monday Night Network The sweep net and CO_2 trap data reported here 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 from May - September. To achieve a District-wide distribution of CO_2 traps, other locations such as parks or wood lots are chosen for surveillance as well. Sweeps were taken for 18 weeks and CO_2 traps operated for 22 weeks, starting two weeks earlier than the sweeps and continuing two weeks later.

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

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 83-170 per evening. Sweep net collection locations in 2010 are shown in Figure 1.5.

Staff took 2,569 collections containing 3,643 mosquitoes. In 2010, the average number of summer *Aedes* collected in the evening sweep net collections was more than double than in the past four years, but still below the 10-year average (Table 1.3). Populations of *Cq*. *perturbans* were low again in 2010. Weather conditions the past three years have been favorable for the production of spring *Aedes* mosquitoes. The number of spring *Aedes* declined from the record high in 2008 to slightly above the 10-year average in 2010

(Figure 1.6). *Culex tarsalis*, which are infrequently collected in sweep net samples, showed a slight increase in 2010.

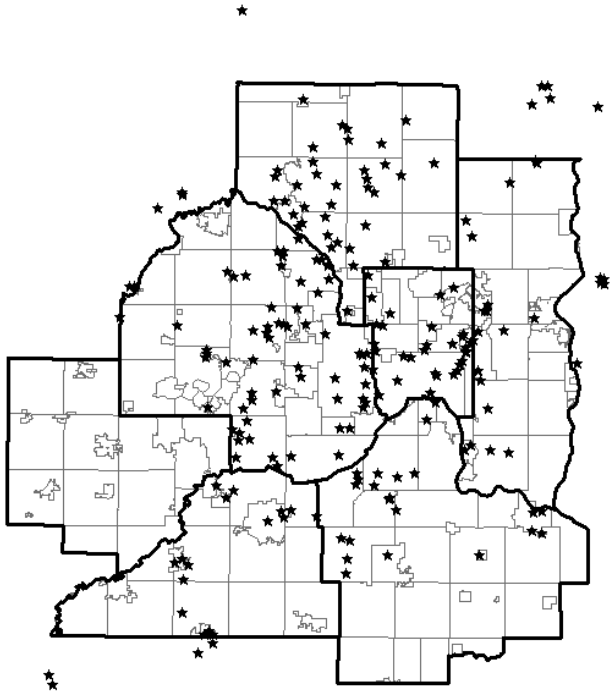


Figure 1.5 Locations of weekly evening sweep net collections, 2010.

Table 1.3 Average number of mosquitoes collected per evening sweep net collection within the District, 2006-2010 and average of the last ten years, 2000-2009

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2006	0.30	0.30	0.03	0.004
2007	0.20	0.10	0.08	0.010
2008	0.50	0.20	0.57	0.003
2009	0.20	0.20	0.15	0.003
2010	1.10	0.10	0.13	0.009
10-yr Avg.	2.00	0.40	0.13	0.011

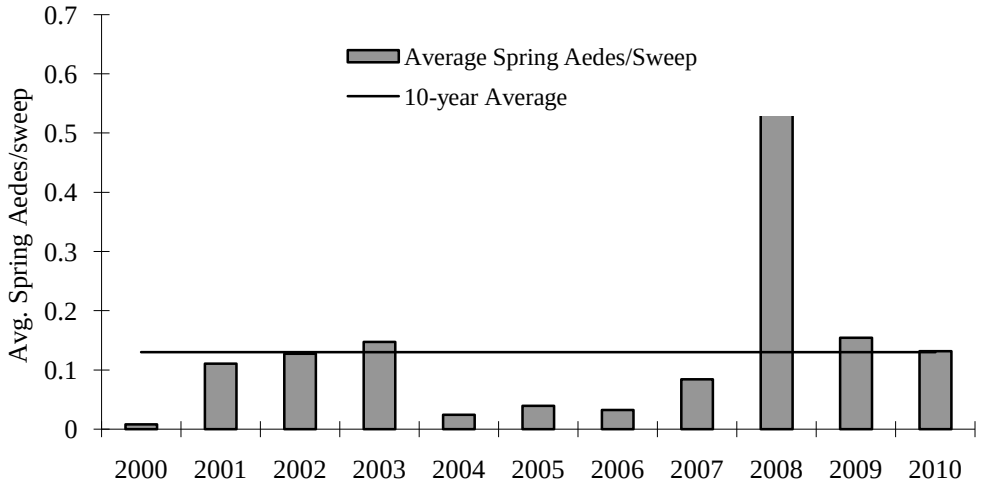


Figure 1.6 Average spring *Aedes* per sweep net 2000-2010 vs. 10-year average.

CO_2 Trap CO_2 traps baited with dry ice are used to monitor host-seeking mosquitoes and the presence of disease vector species. The standard placement for these traps is approximately 5 ft off the ground, the level where *Aedes* mosquitoes fly. In 2010, we operated 132 traps at 119 locations to allow maximum coverage of the District. At 13 locations, additional traps are placed ~25 ft above ground in the tree canopy to collect *Culex* spp., which are active where birds are resting. *Culex* specimens collected from 31 of these locations are tested for WNV; however, *Cx. tarsalis* from all locations are tested as well. Six trap locations in the network, one also with an elevated trap, have historically captured *Cs. melanura*, and are used to monitor this vector's populations. The total number of traps operated per night varied from 86-125. Figure 1.7 shows the CO_2 trap locations and their uses (i.e., general monitoring, virus testing, EEE vector monitoring).

A total of 2,474 trap collections were processed, containing 578,088 mosquitoes. *Aedes vexans* regained its normal position of being the predominant species collected in CO_2 traps, but was below the 10-year average (Table 1.4). The number of *Cq. perturbans* was half the amount collected last year and well below average. The spring *Aedes* were more numerous than last year, but lower than average. *Culex tarsalis* numbers jumped to more than twice the normal amount and are discussed later in the Vector Surveillance section of this chapter.

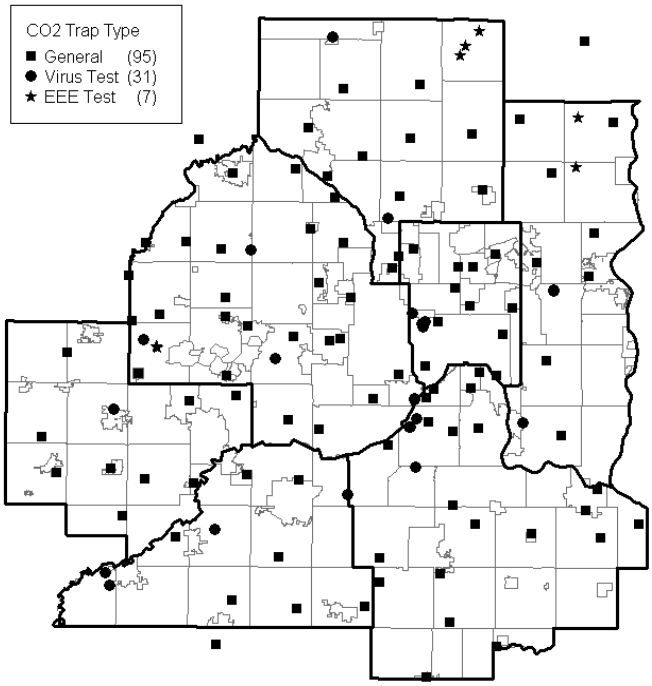


Figure 1.7 Locations of CO_2 traps to monitor general mosquito populations, WNV vectors and the eastern equine encephalitis vector, 2010.

Table 1.4 Average numbers of mosquitoes collected in CO_2 traps within the District, 2006-2010 and 10-yr average (2000-2009)

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
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
2010	191.4	15.3	9.4	4.6
10-yr Avg.	216.0	48.5	10.9	2.0

Geographic Distribution The weekly geographic distributions of the three major groups of nuisance mosquitoes (i.e., spring *Aedes*, summer *Aedes*, and *Cq. perturbans*) collected in CO_2 traps are displayed in Figures 1.8, 1.9, and 1.10. 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 outer edges of the District (Figure 1.8). The trap collections of summer *Aedes* were above threshold throughout the District after the emergence of the June 27th brood and especially after the large August brood (Figure 1.9). *Coquillettidia perturbans* populations occurred in their usual hot spots in the northern counties and near the District borders of Carver and Scott counties (Figure 1.10).

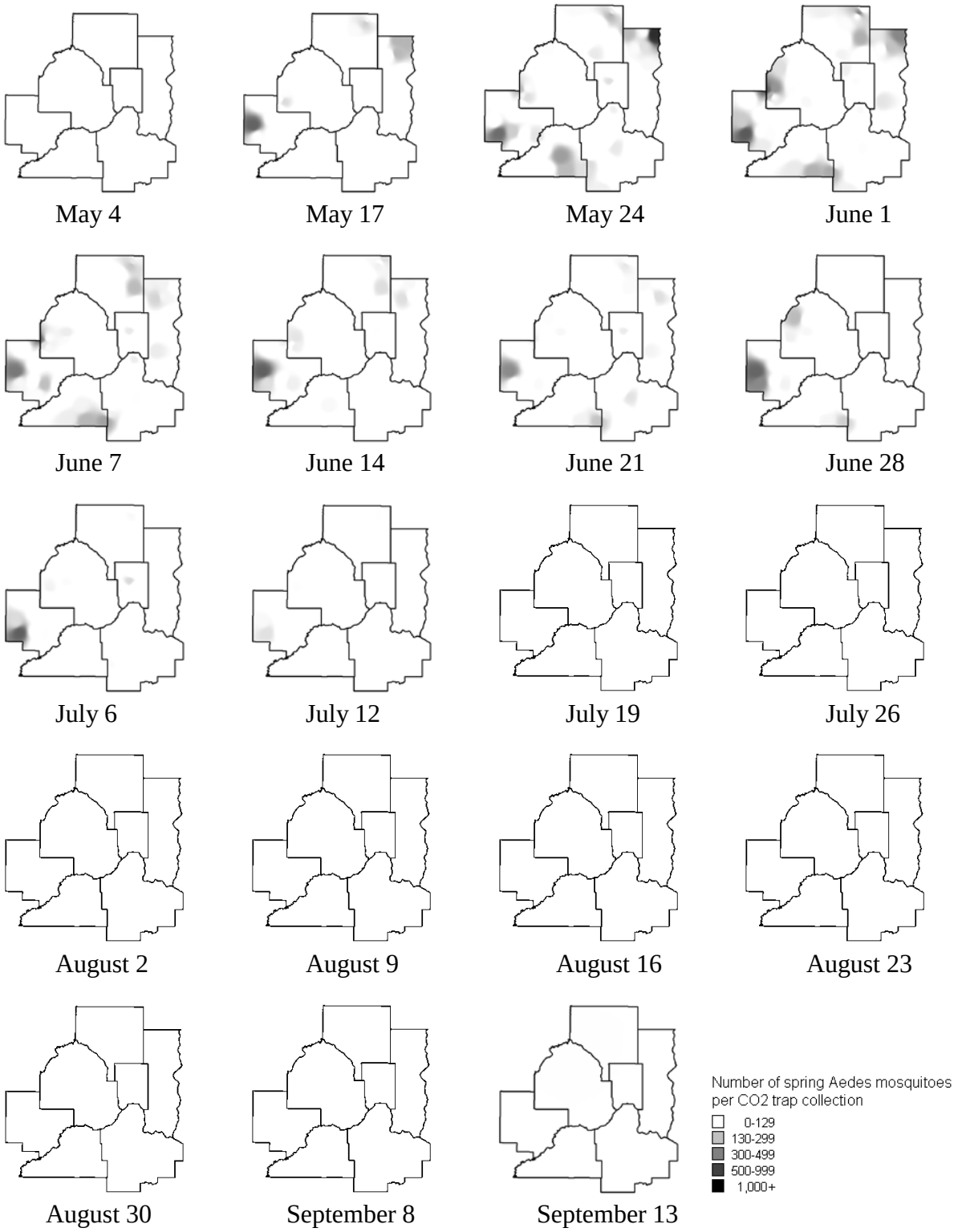


Figure 1.8 Number of spring *Aedes* in District low (5 ft) CO_2 trap collections, 2010. The number of traps operated per night varied from 103-112. Inverse distance weighting was the algorithm used for shading of maps. Sampling was cancelled the week of 5/10/2010.

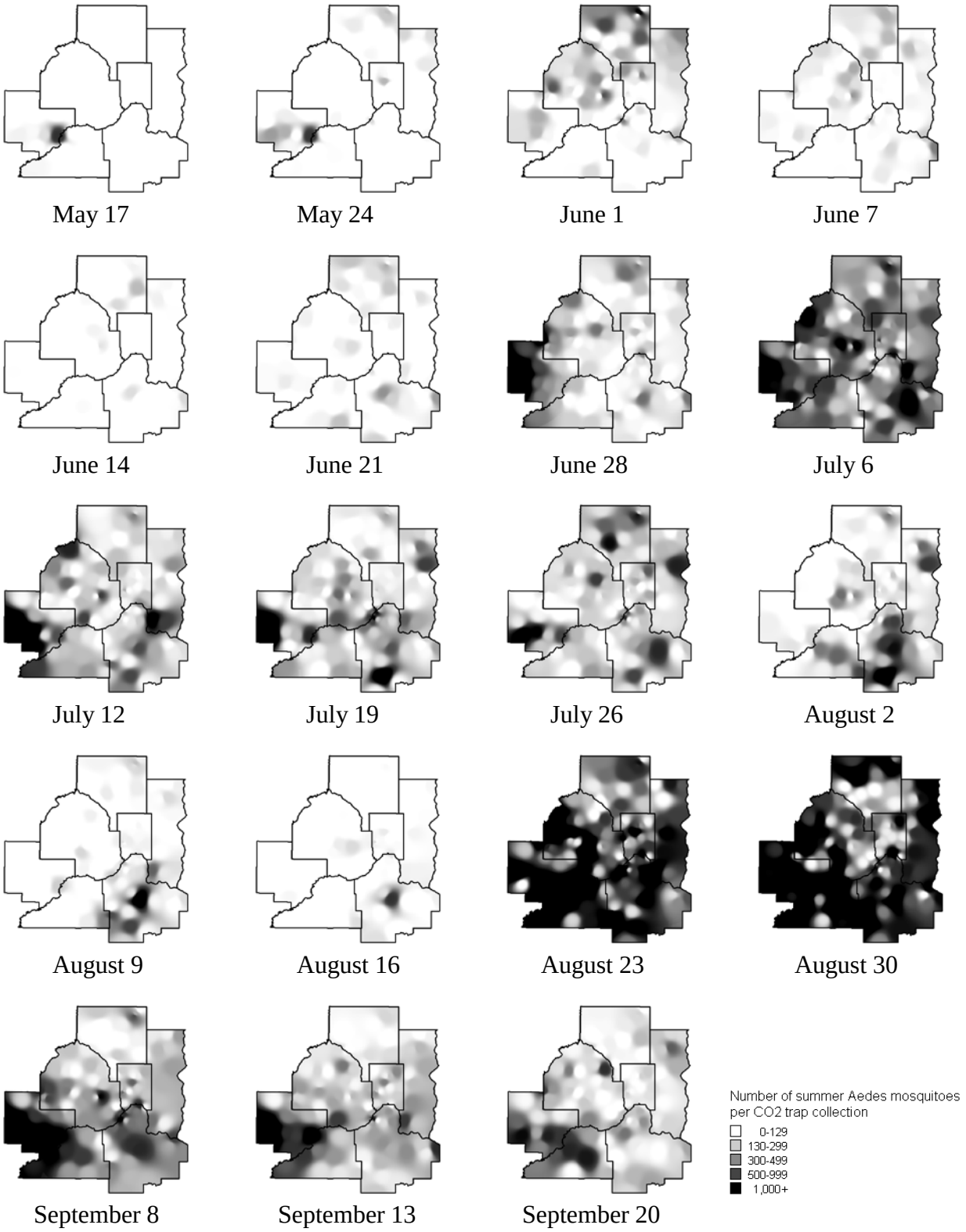


Figure 1.9 Number of summer *Aedes* in District low (5 ft) CO_2 trap collections, 2010. The number of traps operated per night varied from 103-112. Inverse distance weighting was the algorithm used for shading of maps.

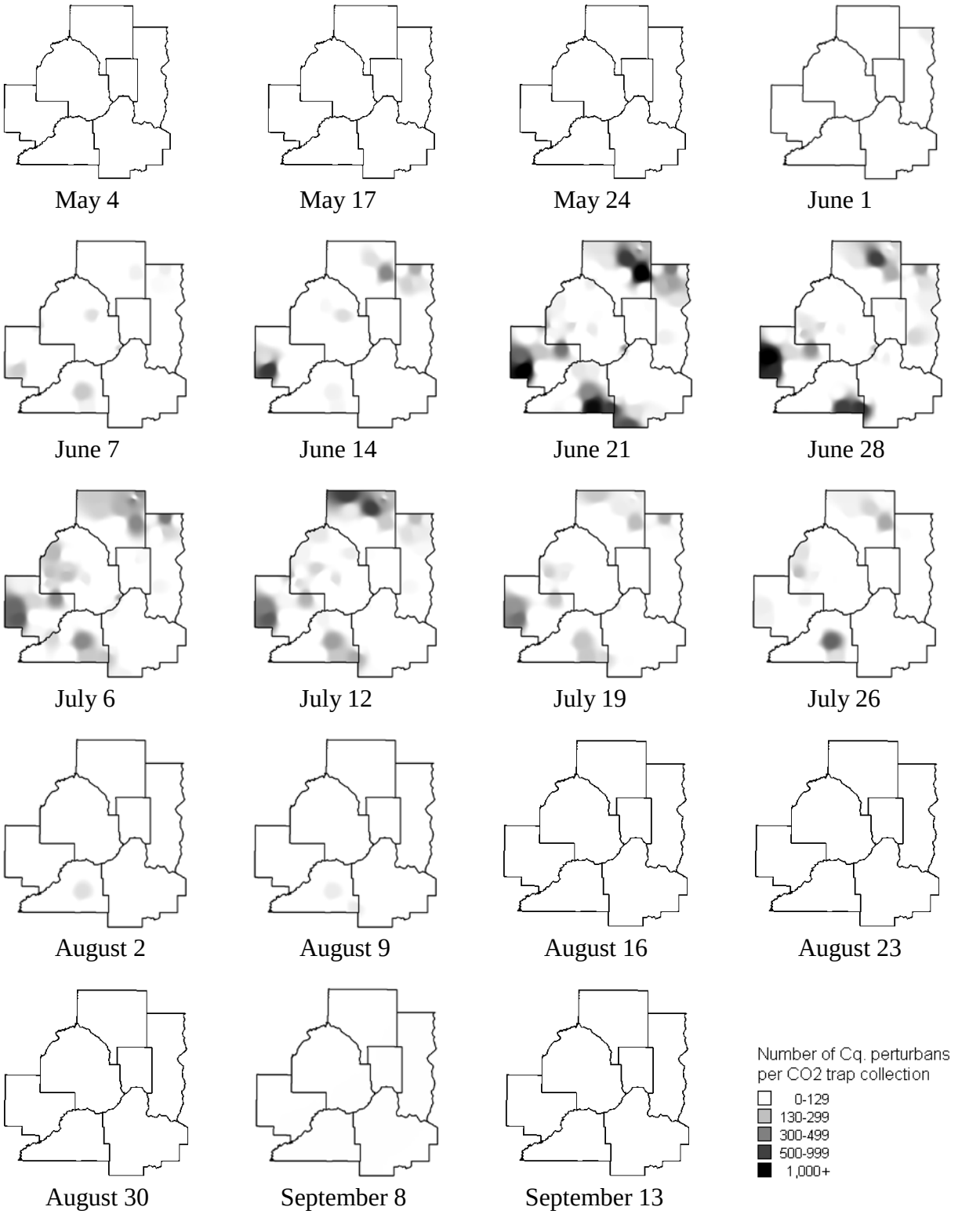


Figure 1.10 Number of *Cq. perturbans* in District low (5 ft) CO_2 trap collections, 2010. The number of traps operated per night varied from 103-112. Inverse distance weighting was the algorithm used for shading of maps. Sampling was cancelled the week of 5/10/2010.

Seasonal Distribution As described earlier, spring *Aedes*, summer *Aedes*, and *Cq. perturbans* have different patterns of occurrence during the season based on their phenology and the surveillance method used. Additionally, temperatures can affect mosquito flight activity. The temperatures on sampling nights this season were all above the minimum (55° F) for mosquito activity except for the week of May 10 which was cold, windy and rainy (Fig. 1.12); no sampling occurred the week of May 10.

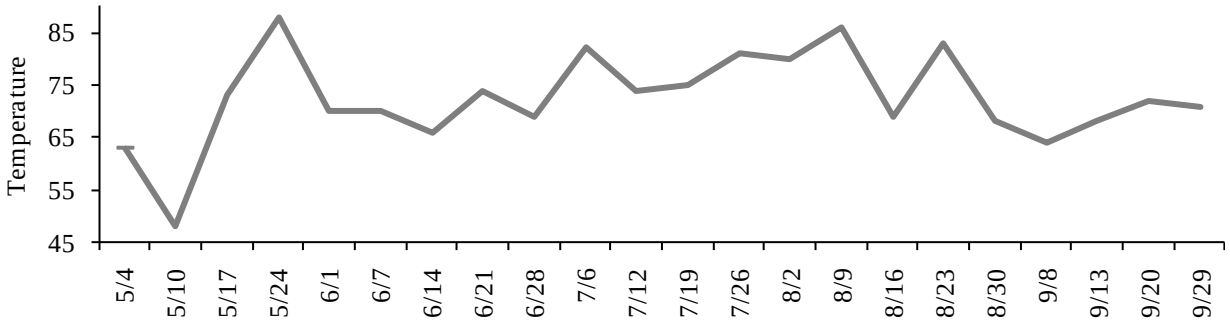


Figure 1.11 Temperature at 9:00 P.M. on Monday night surveillance dates.

Figure 1.12 shows the seasonal distribution of the three major groups of mosquitoes from mid-May through mid-September, detected by sweep netting. Collections detected the spring *Aedes* emergence near the end of May; populations were relatively low, and diminished by the end of July (Figure 1.12). Summer *Aedes* populations were low until the emergence of the late June brood. Small broods in July maintained low levels of adults. A large peak occurred in mid-late August. Levels quickly declined in September. *Coquillettidia perturbans* populations were very low this season and hardly visible in Figure 1.12. Emergence began in early June and peak populations occurred July 6.

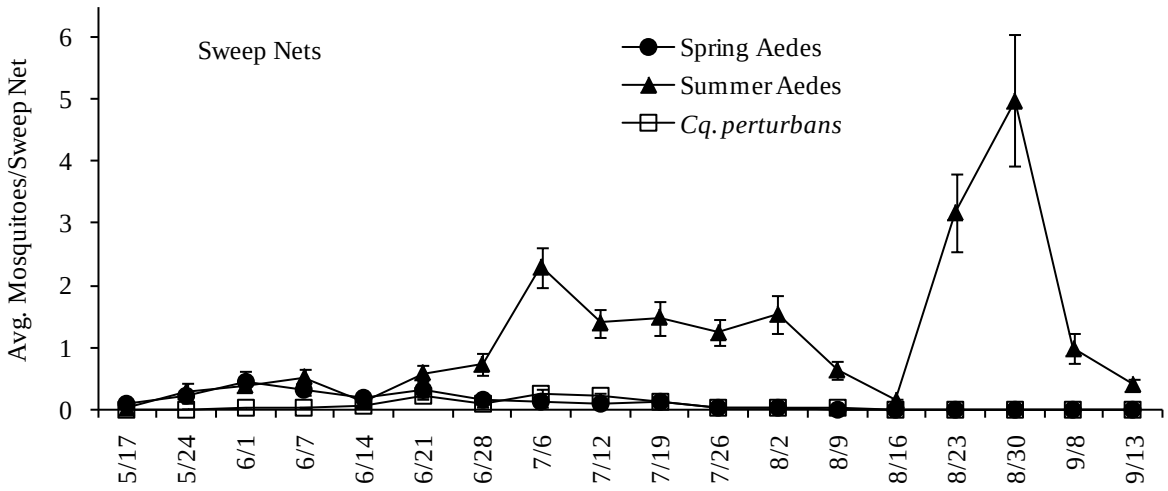


Figure 1.11 Average number of spring *Aedes*, summer *Aedes*, and *Cq. perturbans* per evening sweep net collection, 2010. Error bars equal ± 1 standard error of the mean.

CO_2 traps are placed at selected locations throughout the District to measure the abundance of mosquitoes. The traps detected the same pattern as the sweeps this season, with the peak activity on August 30 (Figure 1.13). The *Cq. perturbans* peak was June 21, earlier than the sweeps' peak and earlier than the usual peak of July 4.

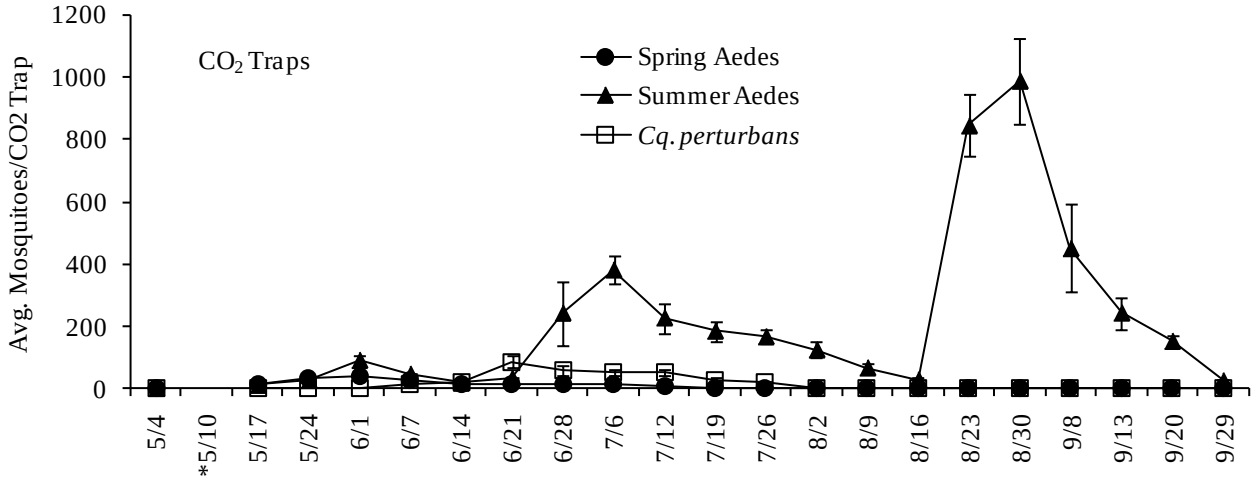


Figure 1.13 Average number of spring *Aedes*, summer *Aedes* and *Cq. perturbans* per CO_2 trap, 2010. Error bars equal ± 1 standard error of the mean. *No sampling the week of 5/10.

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 to the shift toward 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 is 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 trap MN in Minnetrista (Figure 1.14). 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 1965. A comparison of the major species collected from 1965-2010 from those four traps is shown in Appendix B.

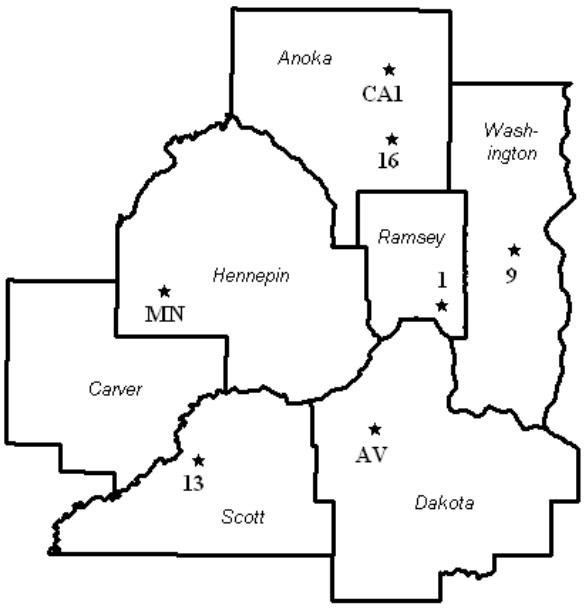


Figure 1.14 New Jersey light trap locations, 2010

The most numerous species collected in NJ traps was *Ae. vexans*, whose total was nearly 80% of all female mosquitoes captured (Table 1.5). Two traps were responsible for collecting the majority of the *Ae. vexans*—Minnetrista with 58% and Carlos Avery with 22%. *Coquillettidia perturbans* came in second, which is typical. The spring *Aedes* species combination of *Ae. abserratus* and *Ae. punctor* came in fourth place. These two species are difficult to identify, but it is possible to know that they are either one or the other. In those instances, we record them as *Ae.abs/punct*.

Anopheles punctipennis and *An. walkeri* were the highly unusual fourth and fifth place finishers. *Anopheles* can be locally abundant, which is exemplified by the large number of *An. punctipennis* collected at the Minnetrista trap and *An. walkeri* at Carlos Avery (Table 1.5). In 2009, *Ae. japonicus* were collected for the first time in NJ light traps (Minnetrista). In 2010, 10 *Ae. japonicus* were captured in three traps: Lake Elmo, Apple Valley, and Minnetrista.

Anopheles quadrimaculatus is a species of interest because it is capable of transmitting malaria. It is rare in the District, but in recent years, it has occurred in traps more frequently than in the past. For the first ten years of the District's existence, varying amounts were collected in the NJ traps. During the period from 1970-2002, they were only captured in four years. *Anopheles quadrimaculatus* started to reappear in 2003 (Fig. 1.15), with a large population occurring in 2007. Populations in 2010 were highest since 2007.

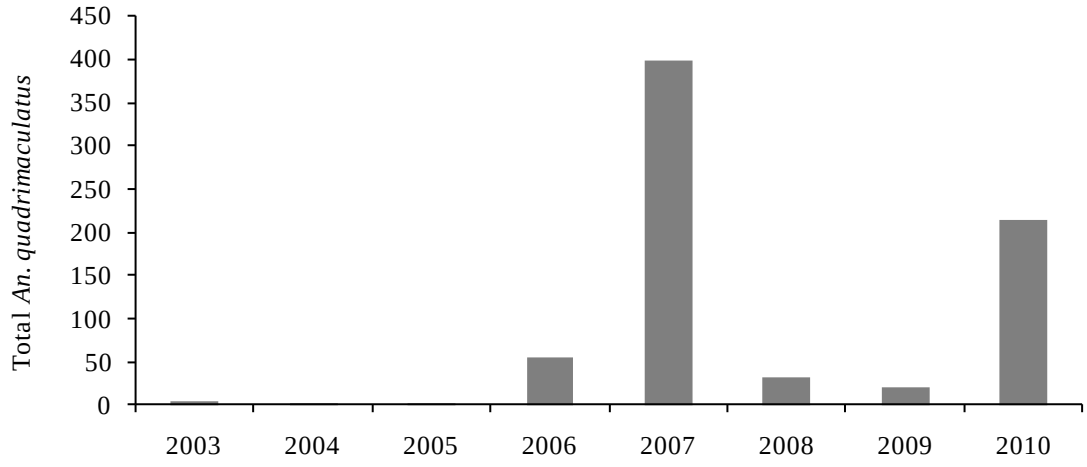


Figure 1.15 Yearly total *Anopheles quadrimaculatus* in New Jersey light traps, 2003-2010.

Table 1.5 Total number and frequency of occurrence for each species collected in New Jersey light traps, May 8 – September 24, 2010

	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	138	140	140	138	136	125	138	955	Total	Night
1. Ae. abserratus	0	0	0	1	245	0	8	254	0.25%	0.27
3. aurifer	0	0	0	0	0	0	0	0	0.00%	0.00
6. canadensis	0	0	8	0	16	0	0	24	0.02%	0.03
7. cinereus	11	11	7	18	253	8	376	684	0.68%	0.72
10. dorsalis	1	0	0	0	0	2	0	3	0.00%	0.00
11. excrucians	1	4	3	0	26	1	36	71	0.07%	0.07
12. fitchii	0	1	0	1	4	1	11	18	0.02%	0.02
13. flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
14. implicatus	0	0	0	0	0	0	0	0	0.00%	0.00
52. japonicus	0	4	0	0	0	1	5	10	0.01%	0.01
16. nigromaculus	0	0	0	0	1	0	1	2	0.00%	0.00
18. punctor	0	1	3	1	119	0	10	134	0.13%	0.14
19. riparius	0	0	0	0	10	0	2	12	0.01%	0.01
20. spenceri	0	0	0	0	0	0	0	0	0.00%	0.00
21. sticticus	0	1	35	0	0	0	4	40	0.04%	0.04
22. stimulans	2	1	2	0	12	0	190	207	0.21%	0.22
23. provocans	0	0	0	0	2	0	0	2	0.00%	0.00
24. triseriatus	5	9	0	2	2	8	117	143	0.14%	0.15
25. trivittatus	12	63	19	1	10	214	123	442	0.44%	0.46
26. vexans	3,109	2,707	3,033	3,258	17,076	4,312	45,904	79,399	79.44%	83.14
118. abs/punct.	2	3	3	2	1,940	0	40	1,990	1.99%	2.08
261. Aedes species	24	15	5	16	19	35	275	389	0.39%	0.41
262. Spring *Aedes*	2	2	3	3	87	1	121	219	0.22%	0.23
264. Summer *Aedes*	1	1	5	0	3	0	4	14	0.01%	0.01
27. An. barberi	0	0	0	0	0	0	2	2	0.00%	0.00
28. earlei	0	0	3	1	13	0	17	34	0.03%	0.04
29. punctipennis	33	83	101	32	216	76	1582	2,123	2.12%	2.22
30. quadrimac.	2	41	114	11	45	26	132	371	0.37%	0.39
31. walkeri	3	13	55	68	1321	5	260	1,725	1.73%	1.81
311. An. species	3	8	63	6	195	23	68	366	0.37%	0.38
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	10	35	5	35	8	15	55	163	0.16%	0.17
35. salinarius	0	1	0	3	0	1	43	48	0.05%	0.05
36. tarsalis	54	18	21	35	28	15	57	228	0.23%	0.24
37. territans	6	6	6	47	53	29	229	376	0.38%	0.39
371. Cx. species	7	3	0	3	2	0	4	19	0.02%	0.02
372. Cx. pip/rest	156	125	29	87	59	76	204	736	0.74%	0.77
38. Cs. inornata	26	11	20	32	80	65	424	658	0.66%	0.69
39. melanura	1	0	0	2	3	0	0	6	0.01%	0.01
40. minnesotae	26	12	9	209	71	10	82	419	0.42%	0.44
41. morsitans	1	5	0	12	21	0	6	45	0.05%	0.05
411. Cs. species	3	0	0	7	168	0	26	204	0.20%	0.21
42. Cq. perturbans	25	6	3	166	4,343	18	3197	7,758	7.76%	8.12
43. Or. signif.	0	1	0	0	0	0	0	1	0.00%	0.00
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	8	8	0.01%	0.01
48. Ur. sapphirina	24	88	27	12	32	60	185	428	0.43%	0.45
501. Unident.	3	23	0	23	77	6	44	176	0.18%	0.18
Female Total	3,553	3,302	3,582	4,094	26,560	5,008	53,852	99,951	82.93%	104.66
Male Total	1,477	1,133	883	1,522	3,944	1,681	9,937	20,577	17.07%	21.55
Grand Total	5,030	4,435	4,465	5,616	30,504	6,689	63,789	120,528	100.00%	126.21

Rare Detections Lab staff were excited about the first occurrence of *Aedes melanimon* in Minnesota! One specimen was collected in a CO_2 trap at the U of M St. Paul campus on July 6. The range for this species is western US, as far east as central North Dakota. Other rare species found this season are *Ae. diantaeus*, *Anopheles barberi*, *Orthopodomyia signifera*, and two species of *Psorophora*: *ciliata* and *columbiae*.

The *Psorophora* collections are especially interesting because the documented northern limit of their ranges is southern Minnesota. The single *Ps. ciliata* adult collected this year was in a NJ trap in Jordan. They were collected twice previously: one specimen in 1986 in Lake Elmo and two in 2002 in Jordan. Three *Ps. columbiae*, formerly named *confinnis*, were collected in CO_2 traps in New Prague (2) and Farmington (1) this year. Larvae of both species were found sporadically in the early years of the District, 1958-1966, and only a couple years since then, the most recent being *columbiae* in 2002 and *ciliata* in 2005. Most occurrences were in southern areas of the District.

Vector Mosquito Surveillance

Aedes triseriatus Staff use a vacuum aspirator to sample the understory for resting mosquitoes in the daytime. This method is used primarily for the La Crosse encephalitis (LAC) vector, *Ae. triseriatus.* Sampling began during the week of May 16 and continued through mid-September. Frequent rainfall in 2010 allowed the *Ae. triseriatus* population to recover following the population suppression of the past four dry summers. The peak rate of capture of 3.0 *Ae. triseriatus* per sample occurred during the week of June 13 (Figure 1.16). Following the early season population peak, mean rates of capture were consistently between 1.1 and 2.0 *Ae. triseriatus* per aspirator sample for seven weeks. In August and September, we observed the general population decline that is typical of that time of year.

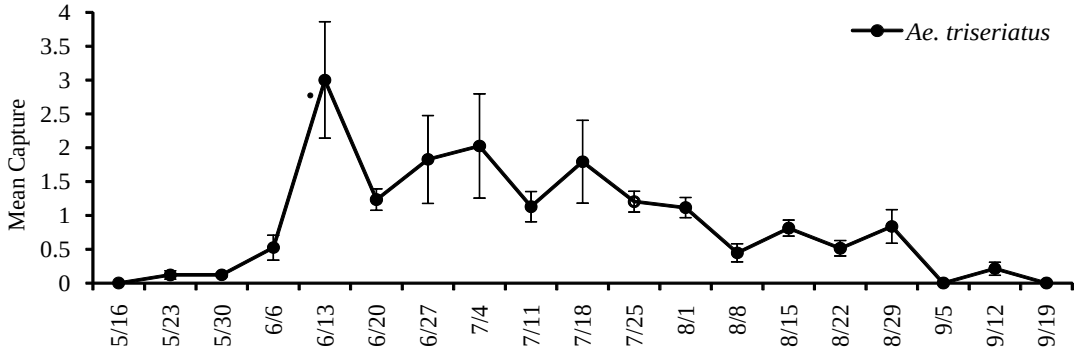


Figure 1.16 Mean number of *Ae. triseriatus* adults in aspirator samples, plotted by week, 2010. Dates listed are the first sampling day of each week. Sites sampled varied by week, although several locations were monitored repeatedly during the season. Error bars equal ± 1 standard error of the mean.

Culiseta melanura *Culiseta melanura* is the vector of EEE. District staff monitored six locations for *Cs. melanura* using seven CO_2 traps. *Culiseta melanura* have been collected from each of the locations in the past. Three of the sites are located in Anoka County, two in Washington County, and one site in Hennepin County (Figure 1.7). The Hennepin County location had one trap at ground level and one elevated into the tree canopy. In addition to CO_2 trap monitoring, six aspirator samples were collected from wooded habitats surrounding potential *Cs. melanura* larval habitat (i.e., tamarack bogs). There was one *Cs. melanura* collected in Anoka County by aspirator in 2010.

Each of the seven traps monitored for *Cs. melanura* was positive for the species in 2010. A total of 143 *Cs. melanura* were collected in 142 trap placements (Figure 1.17). Outside of the targeted trapping locations, *Cs. melanura* were found in one gravid trap sample, six NJ trap samples, and 21 additional CO_2 trap samples during the season. They were captured in six of the seven District counties, with Carver being the only county without a *Cs. melanura* collection.

The *Cs. melanura* population appeared to reach its peak near the end of September. This may have been a result of larval habitat improvement that occurred over the course of the summer. Bog sites in the District had experienced water level declines during the previous four dry summers. The precipitation of 2010 was sufficient to recharge these sites and brought the water level of many to or near the surface.

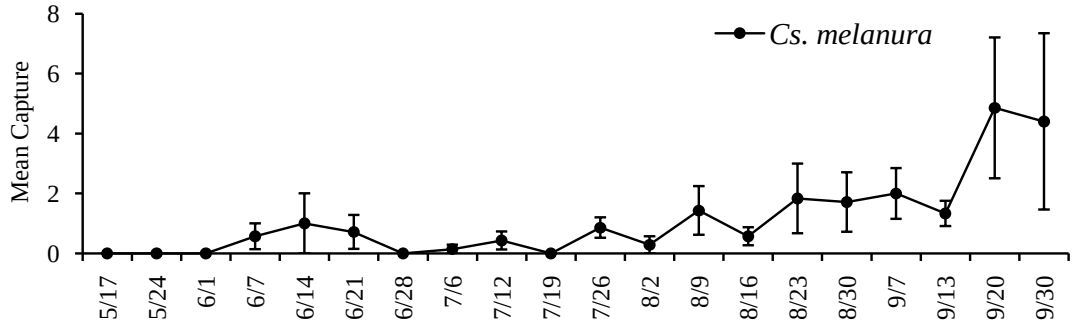


Figure 1.17 Mean number of *Cs. melanura* adults in CO_2 traps from selected sites, 2010. Error bars equal ± 1 standard error of the mean.

Culiseta melanura overwinter as larvae. Larvae of the 2010 - 2011 overwintering generation are the progeny of adults that were active during the 2010 population peak. Provided the water levels in *Cs. melanura* habitats do not recede, the first generation of 2011 could be larger than we have observed during the past several years.

***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. The District uses CO_2 traps to monitor host-seeking *Culex* mosquitoes and gravid traps to monitor egg-laying *Culex* mosquitoes. The District operated 132 CO_2 traps (see Monday Night Network) and 36 gravid traps in 2010.

Culex tarsalis has been identified as the most likely vector of WNV to humans in our area. *Culex tarsalis* captured in Monday night CO_2 traps, gravid traps, sweeps, and aspirators were tested for WNV (see Chapter 2, Table 2.3). As is typical, few *Cx. tarsalis* were collected by gravid trap in 2010; only 57 were collected during the entire season. Capture rates in CO_2 traps were high by comparison to most other years. For seven consecutive weeks from mid-July to late August, the mean rate of capture exceeded eight per CO_2 trap. The season peak of 26.1 *Cx. tarsalis* per CO_2 trap occurred on August 16 (Figure 1.18). This was the second highest rate of capture observed over the past decade, exceeded only by a mean of 34.0 on May 21, 2007.

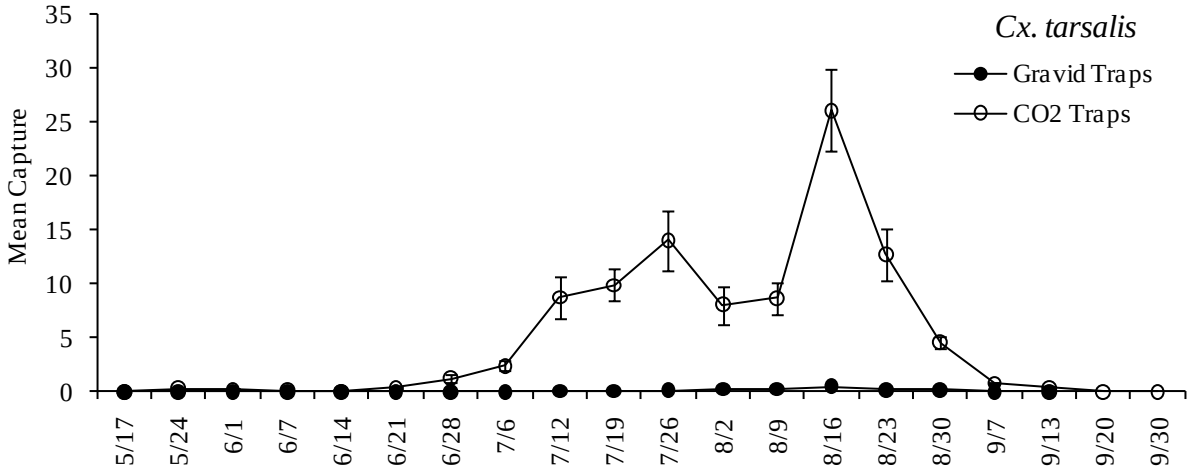


Figure 1.18 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2010. Error bars equal ± 1 standard error of the mean.

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 collected in moderate numbers in CO_2 traps from late June through July (Figure 1.19). Gravid trap collections of *Cx. restuans* indicated that the population grew steadily through mid-July. A falling population was observed during the latter half of the season, as is typical for the species.

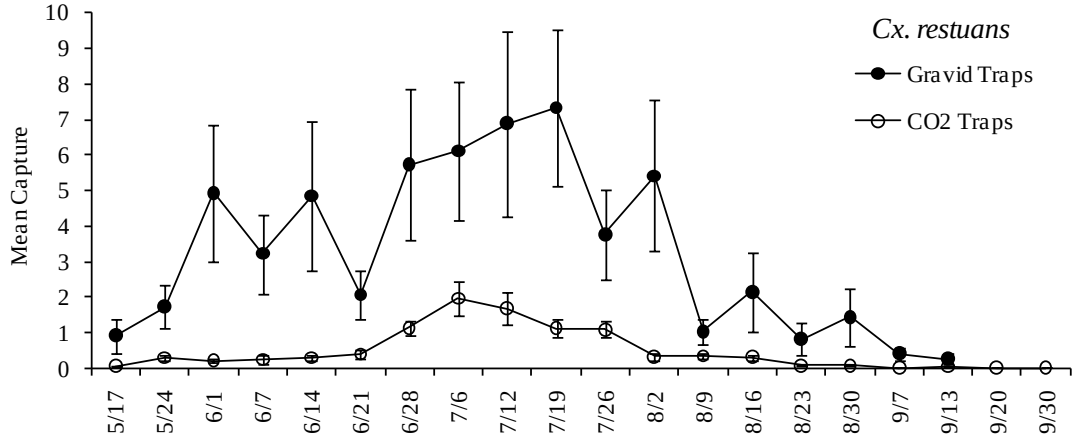


Figure 1.19 Average number of *Cx. restuans* in CO_2 traps and gravid traps, 2010. Error bars equal ± 1 standard error of the mean.

Culex pipiens has been an important vector of WNV in much of the United States. The species prefers warmer temperatures than *Cx. restuans*; therefore, populations of *Cx. pipiens* in the District tend to remain low and peak late in the summer when temperatures are typically warmer. Even though capture rates were low in 2010, both gravid traps and CO_2 traps consistently collected *Cx. pipiens* throughout the season, which is unusual in the District (Figure 1.20). The peak gravid trap capture of 2.7 occurred during the week of July 26 and the peak CO_2 trap capture occurred on July 6.

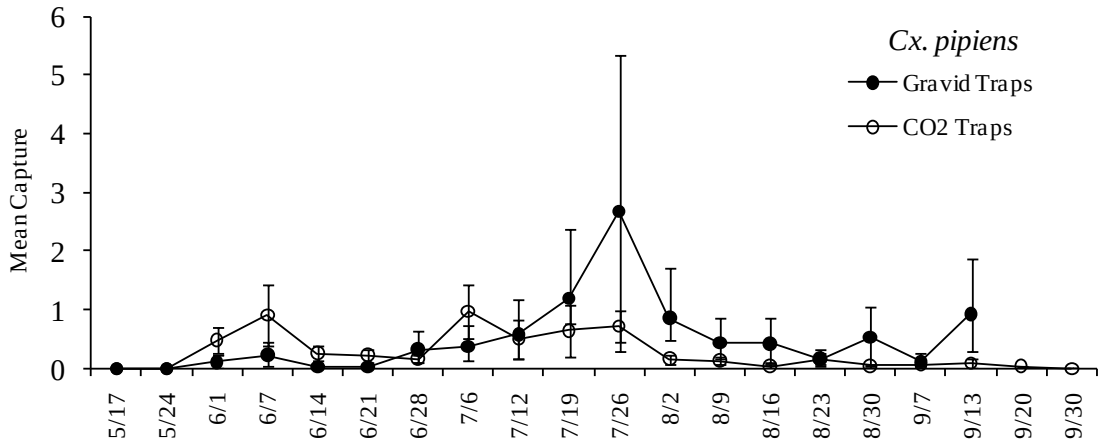


Figure 1.20 Average number of *Cx. pipiens* in CO_2 traps and gravid traps, 2010. Error bars equal ± 1 standard error of the mean.

When *Cx. pipiens* and *Cx. restuans* are difficult to separate they are grouped together and identified as *Cx. pipiens/restuans*; when only a genus level identification can be made, as *Culex* species. 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 2010, more *Cx. pipiens* were identified than is typical, and the species may have comprised more of the *Cx. pipiens/restuans* and *Culex* species groups than usual. The numbers of *Cx. pipiens/restuans* (Figure 1.21) and *Culex* species (Figure 1.22) captured in gravid traps increased steadily from late June to early August, then they fell to lower levels for the remainder of the season. Few adults from CO_2 traps were grouped into the *Culex* species category as most could be identified to species or to the *Cx. pipiens/restuans* group. Captures of *Cx. pipiens/restuans* in CO_2 traps were elevated from late June to late August.

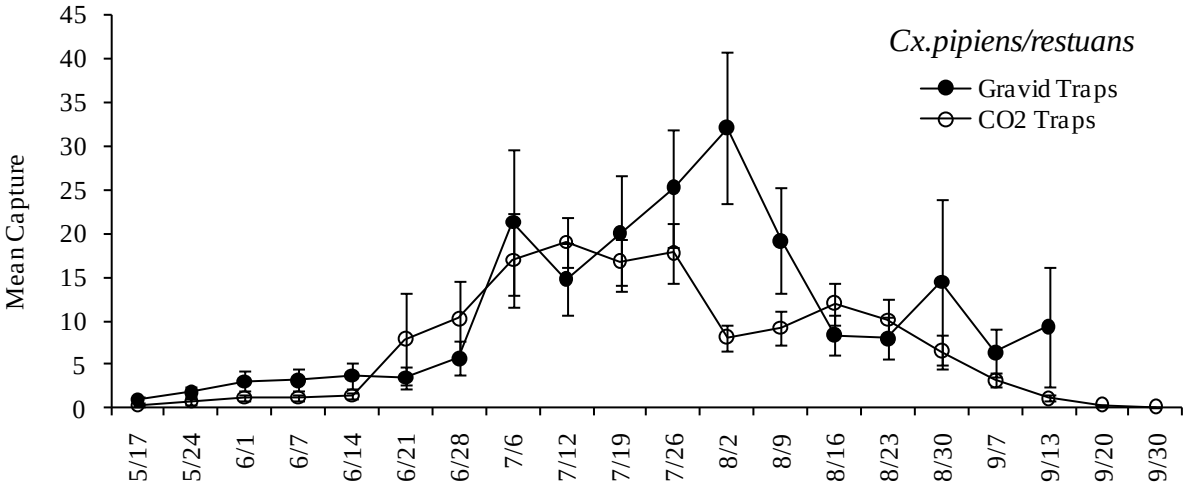


Figure 1.21 Average number of *Cx. pipiens/restuans* in CO_2 traps and gravid traps, 2010. Error bars equal ± 1 standard error of the mean.

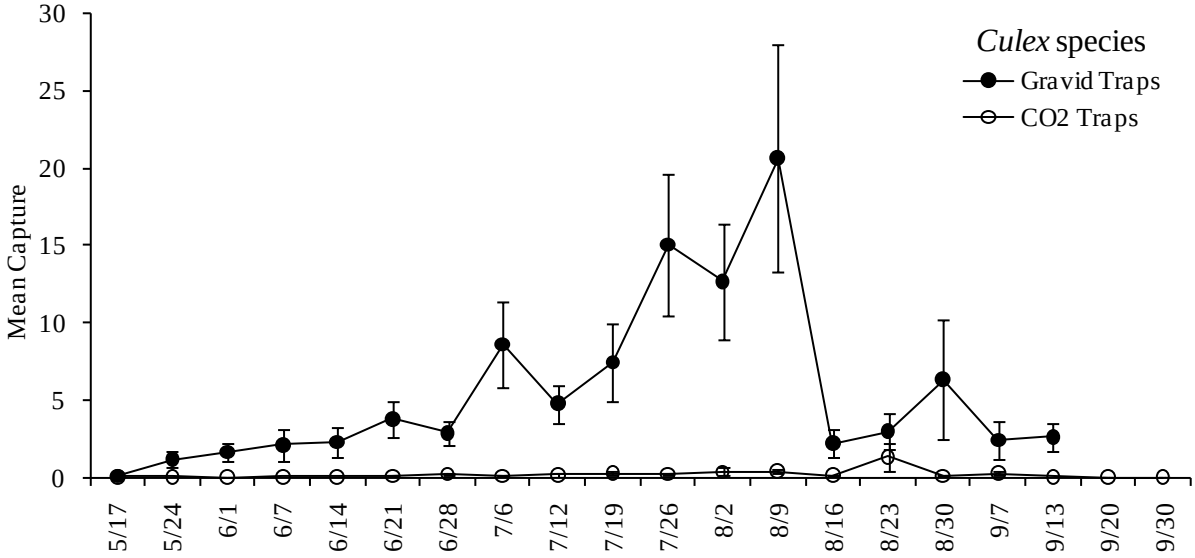


Figure 1.22 Average number of *Culex* species in CO_2 traps and gravid traps, 2010. Error bars equal ± 1 standard error of the mean.

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

Aedes japonicus recently became established in Minnesota. *Aedes albopictus* are established in many states to the south and east of Minnesota and are frequently introduced to the District in shipments of used tires and by other means. Both species were collected in the District in 2010.

Aedes albopictus *Aedes albopictus* eggs were collected from three ovitraps in 2010. Each was collected adjacent to a tire recycling facility in Savage in Scott County. One sample was collected on July 13 and two were collected on August 3. Additionally, one adult was captured in a gravid trap near the same facility on August 11. This is the eighth year the species was collected in Scott County. They were found in 1991, 1996, 1999, 2005, 2006, 2007 and 2009. They were also previously collected in Wright County in 1997 and Dakota County in 2009. There were no *Ae. albopictus* larvae collected in 2010.

Aedes japonicus Following multiple Dakota County collections in 2008, early 2009 surveillance confirmed that *Ae. japonicus* were able to overwinter in Minnesota. Consequently, they were collected in numerous locations in each of the seven District counties that summer. In 2010, anticipating continued spread and population growth, we worked to integrate *Ae. japonicus* surveillance and control into the array of services provided by the District. We continued to focus control efforts on eliminating small container type larval habitats. Additional larval and adult control supported that work. *Aedes japonicus* specimens were obtained from a variety of habitats through numerous sampling techniques in 2010.

Aedes japonicus were found in 631 larval samples. Most were from containers (431) and tires (167). Eleven samples were collected from artificial or ornamental ponds and eight were from stormwater structures. The remaining samples were from catch basins (7), wetlands (4), and tree holes (3); this was the first year when we detected larvae in these habitat types. In addition, *Ae. japonicus* larvae hatched from eggs from five of 74 ovitraps collected from two locations, Savage and Castle Rock Township.

Aedes japonicus were identified in 108 adult mosquito samples. They were found in 63 aspirator samples, 16 New Jersey trap samples, 13 gravid trap samples, 13 CO_2 trap samples, and three two-minute sweep samples. This was the first year when *Ae. japonicus* were collected in CO_2 traps and sweep samples in the District. The aspirator was the only adult collection device that captured more than one *Ae. japonicus* in a sample. There were 16 aspirator samples with two or more specimens. The greatest number of adults collected was eight, which occurred twice.

Aedes japonicus were collected from 271 one square mile sections in 2010 (Figure 1.23). The spread of the species through the District is evident when this is compared to the number of sections where they were found in previous seasons: 86 in 2009, 13 in 2008, and one in 2007.

Another indication of the spread of *Ae. japonicus* and of the growth of the population in the District is in the ratio of larval samples that contained the species. In 2010, 23.5% of container samples, 15.5% of tire samples and 8.8% of tree hole samples contained *Ae. japonicus*. In 2009, those ratios were 4.2%, 2.9%, and 0.0%, respectively.

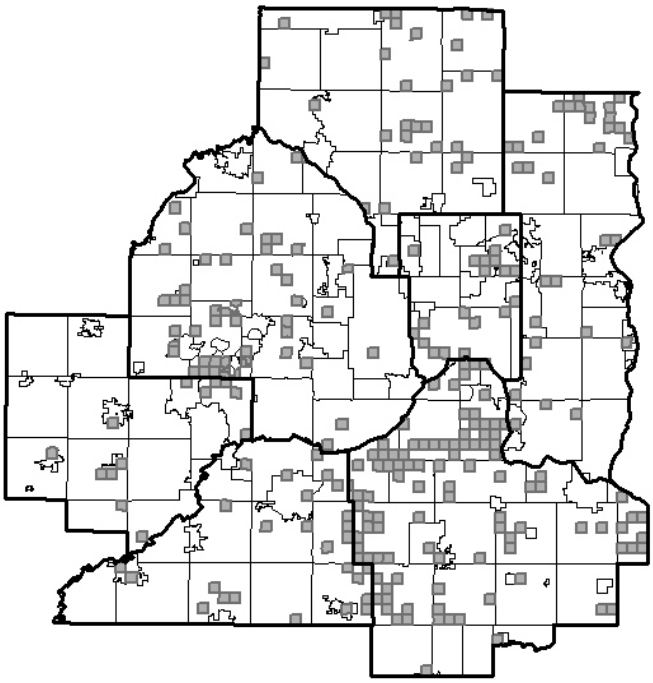


Figure 1.23 *Aedes japonicus* distribution in MMCD. Areas shaded in gray represent locations where *Ae. japonicus* were collected in 2010.

Plans for 2011

The District assembled a team to evaluate the costs and benefits of the Monday night collection network. Depending on the outcome, there may be changes in method used and locations of collections.

Staff will continue to search for the species new to the District, *Ae. cataphylla* and *Ae. melanimon*.

We will continue to monitor for *Ae. albopictus* and *Ae. japonicus. Aedes japonicus* are now permanently established throughout the District, and their populations will undoubtedly continue to grow and expand over the coming years. We are still unsure of the roles the species will occupy in mosquito-borne disease transmission, if any. Also of interest are competitive interactions with other mosquito species and how native mosquitoes will be affected by the presence of *Ae. japonicus*. Until we know more, our goal will be to maintain an effective population control program to minimize the potential for disease transmission.

Chapter 2 Vector-borne Disease

2010 Highlights

- There were no La Crosse encephalitis cases in the District in 2010
- WNV illness confirmed in 8 Minnesotans – 4 cases occurred in the District
- WNV detected in 11 District mosquito samples
- Made 227,952 catch basin treatments
- Collected and recycled 23,445 waste tires
- In 2010, 70% of sampling sites had at least one *I. scapularis*
- *I. scapularis* detected in all 7 metro counties; new locations include Waconia, Maple Plain, Bloomington, and Independence
- Average *I. scapularis* per mammal was 0.845 in 2010, comparable to the elevated averages since 2000
- Lyme disease and HGA cases in 2009 were close to the records set in 2007 (source MDH)
- *Amblyomma americanum* found in Eagan, Mound, and Orono/Lake Minnetonka area
- Collected *D. variabilis* for MDH Rocky Mountain Spotted Fever case surveillance
- Signs posted in 25 dog parks to facilitate tick collections from the public

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. MMCD targets these areas 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 *Culex tarsalis*, the vector of WEE which can cause severe illness in horses and humans. The last WEE outbreak in Minnesota occurred in 1983.

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.

2011 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Continue to improve surveillance and control of *Ae. japonicus*
- Continue catch basin larvicide treatments to manage WNV vectors
- Communicate disease prevention strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Continue to monitor for *Ae. albopictus* and other exotic species
- Surveillance at 100 sampling locations for *I. scapularis* will continue
- Continue with tick-borne disease education, tick identifications, and homeowner consultations
- Continue to post signs at dog parks and expand to additional locations
- Continue to track collections of *A. americanum* or other new or unusual tick species

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.

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

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

As described in this and prior operational reports, the Metropolitan Mosquito Control District uses sophisticated surveillance techniques to determine the geographic distribution and estimated population levels of both mosquito and tick vectors in the metropolitan area. We continue to modify our surveillance efforts as new or different diseases and disease vectors are detected. This information is useful as we can target control (including public education) where needed. However, knowing the location and population levels of the vectors is only one part of the vector-borne disease cycle; knowing where vector-borne disease pathogens may

be circulating is also important. To date, MMCD lacks the capacity to test vectors or reservoir hosts for pathogens in-house. Samples are sent to the MDH for testing.

In 2009, MMCD began examining ways to expand its programs to be more proactive in the area of vector-borne diseases. We contacted various agencies and held a Lyme Disease Tick Advisory Board meeting to solicit technical expertise. We would ultimately like to increase our ability to 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*).

2010 Mosquito-borne Disease Services

Breeding Source Reduction

Water-holding containers such as tires, buckets, tarps, and even plastic toys provide developmental habitat for many mosquito species including the LAC vector *Ae. triseriatus*, the exotic species *Ae. albopictus* and *Ae. japonicus*, and the WNV vectors *Cx. restuans* and *Cx. pipiens*. Eliminating these container habitats is an effective strategy for preventing mosquito-borne illnesses. In 2010, District staff recycled 23,445 tires that were collected from the field (Table 2.1). Since 1988, the District has recycled 534,472 tires. In addition, MMCD eliminated 5,880 containers and filled 275 tree holes in 2010. This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities, including the 3,437 property inspections by MMCD staff.

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

Year	Tires	Containers	Tree holes	Total
2010	23,445	5,880	275	29,600
2009	39,934	8,088	529	48,551
2008	16,229	1,615	93	17,937
2007	14,449	1,267	107	15,823
2006	10,513	2,059	228	12,800
2005	10,614	2,656	1,008	14,278
2004	15,751	1,415	1,128	18,294
2003	14,654	1,542	518	16,714
2002	15,412	2,799	1,432	19,643
2001	16,278	4,043	2,880	23,201

La Crosse Encephalitis

***Aedes triseriatus* Surveillance and Control** *Aedes triseriatus* is a container inhabiting, floodwater mosquito whose preferred natural habitat is tree holes. MMCD staff sample wooded mosquito habitats by vacuum aspirator to monitor adult *Ae. triseriatus* populations and to direct adult and larval control efforts. Frequent rainfall allowed *Ae. triseriatus* populations to rebound in 2010 following four consecutive years of mid-summer drought conditions.

In 2010, MMCD staff collected 2,213 aspirator samples to monitor *Ae. triseriatus* populations. The District's treatment threshold (≥ 2 adult *Ae. triseriatus*/aspirator collection) was met in 356 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when *Ae. triseriatus* adults were collected. Additionally, 180 adulticide applications to wooded areas were prompted by collections of *Ae. triseriatus* in aspirator samples.

Adult *Ae. triseriatus* were captured in 570 of 1,698 individual wooded areas sampled. This ratio, as well as the mean number of *Ae. triseriatus* captured per sample, was similar to the 2005 findings, the season preceding the last four dry seasons, 2006 - 2009 (Table 2.2).

Table 2.2 *Aedes triseriatus* aspirator surveillance data, 2000 – 2010

Year	Total areas surveyed	No. with *Ae. triseriatus*	Percent with *Ae. triseriatus*	Total samples collected	Mean per sample
2000	1,037	575	55.4	1,912	1.94
2001	1,222	567	46.4	2,155	1.32
2002	1,343	573	42.7	2,058	1.70
2003	1,558	470	30.2	2,676	1.20
2004	1,850	786	42.5	3,101	1.34
2005	1,993	700	35.1	2,617	0.84
2006	1,849	518	28.0	2,680	0.78
2007	1,767	402	22.8	2,345	0.42
2008	1,685	495	29.4	2,429	0.64
2009	2,258	532	24.0	3,125	0.56
2010	1,698	570	33.6	2,213	0.89

La Crosse Encephalitis in Minnesota There was one LAC case reported in Minnesota in 2010. It occurred in a resident of Houston County. This was the fifth consecutive year with no La Crosse illnesses in the District. Since 1970, there has been an average of 2.2 LAC encephalitis cases reported per year from the seven District counties (range 0 – 10, median 2). Since 1990, the mean is 1.5 cases per year (range 0 – 8, median 0).

Eastern Equine Encephalitis

In 2010, eastern equine encephalitis (EEE) virus was detected in 20 states. There were 10 human illnesses diagnosed: four in Florida; three in Michigan; and one each in Massachusetts, New York, and Rhode Island. There were 231 veterinary reports of EEE illnesses in domestic animals,

primarily horses, from 17 states. There were several veterinary cases in the Great Lakes Region including 57 in Michigan, 10 in Indiana, four in Ohio, and one each in Illinois and Wisconsin.

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* specimens are occasionally collected in other areas of the District, as was the case in 2010.

The precipitation of 2010 was sufficient to recharge the water level of many bog sites following the extended dry pattern of the past four years. Surveillance results indicated a rising *Cs. melanura* population, which reached its peak at the end of the season (Chapter 1, Fig. 1.17). These factors, along with its ability to over-winter in the larval stage, combine to suggest that the early summer *Cs. melanura* population will be higher in 2011 than we have experienced in recent years.

Western Equine Encephalitis

Western equine encephalitis (WEE) circulates among mosquitoes and birds in Minnesota. Occasionally, the virus causes illness in horses and less frequently in people. *Culex tarsalis* is the species most likely to transmit the virus to people and horses. In both 2004 and 2005, the virus was detected in *Cx. tarsalis* specimens collected in southern Minnesota. The virus has not been detected in Minnesota since then. However, due to resource limitations *Cx. tarsalis* were not submitted to outside laboratories for WEE analysis in 2010.

West Nile Virus

WNV in the United States West Nile virus (WNV) transmission was documented in 48 states in 2010. There were no WNV findings in Alaska or Hawaii. The U.S. Centers for Disease Control and Prevention received reports of 981 West Nile illnesses from 40 states and the District of Columbia. Fatalities occurred in 45 cases. Arizona, California, and New York reported the greatest number of WNV illnesses with 163, 104, and 127 respectively. Screening of the American blood supply detected WNV in 117 donors from 22 states. Additionally, West Nile illness was diagnosed in 145 domestic animals, mainly horses, from 30 states.

WNV in Minnesota MDH reported eight WNV illnesses in residents of six Minnesota counties. There were no WNV related fatalities. The earliest onset of a WNV illness in the state was July 21. There was one presumptively viremic blood donation from a Minnesota resident. The only Minnesota veterinary report of a WNV infection was in an alpaca from Goodhue County.

West Nile Infections in the District There were four WNV illnesses reported in residents of the District, two in Hennepin County and two in Ramsey County. The Minnesota Department of Health determined that one of the Ramsey County individuals was exposed to WNV in Blue Earth County. Additionally, the only presumptively viremic blood donor from Minnesota was from Carver County.

Since WNV arrived in the Minnesota, there has been an average of 9.9 WNV illnesses diagnosed each year in residents of the District (range 0 – 25, median 6). When cases with known exposure locations outside of the District are excluded, the mean is 5.9 cases per year (range 0 – 17, median 4).

Surveillance for WNV West Nile virus activity was low in 2010. Even though vector populations were adequate for rapid amplification of WNV, the virus spread slowly. The earliest detection of WNV in the District was from an American crow collected on July 30. This was the latest date for the first observation of WNV in the District since it first arrived in Minnesota in 2002. The first WNV positive mosquito sample was collected on August 11. West Nile virus positive mosquitoes were subsequently captured over the next four consecutive weeks suggesting that the peak of the 2010 transmission season occurred sometime in late August or early September.

Staff conducted surveillance for WNV in mosquitoes and wild birds. Several mosquito species from 38 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 and sweep samples were processed for viral analysis. MMCD tested 1,245 mosquito pools using Response Biomedical Corporation's RAMP® method. Eleven pools were positive for WNV. Table 2.3 is a complete list of mosquitoes MMCD processed for viral analysis.

Table 2.3 Number of MMCD mosquito pools processed for viral analysis and minimum infection rate (MIR) by species, 2010

Species	Number of mosquitoes	Number of pools	WNV+ pools	MIR per 1000
Aedes japonicus	21	20	0	0
Aedes triseriatus	50	7	0	0
Culex pipiens	395	22	0	0
Culex restuans	1,683	79	1	0.59
Culex salinarius	26	5	0	0
Culex tarsalis	10,774	577	5	0.46
Culex species	5,678	244	4	0.7
Culex pipiens/restuans	8,122	291	1	0.12
Total	26,749	1,245	11	0.41

Bird mortality, especially among corvids, can be a sensitive indicator of WNV activity. MMCD 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. Forty-two reports of dead birds were received by telephone, internet or from employees in the field. RAMP® tests

were done on nine birds. Three birds, all American crows, were positive for WNV. The dates of collection for the three positive birds were July 30, August 16, and August 27.

The first pool of mosquitoes to return a WNV positive result was collected on August 11. West Nile virus was detected in ten additional mosquito pools over the next four weeks (Figure 2.1). The WNV infection rate increased each week in mosquitoes tested. Seasonal weather and mosquito behavioral changes reduced WNV circulation in September.

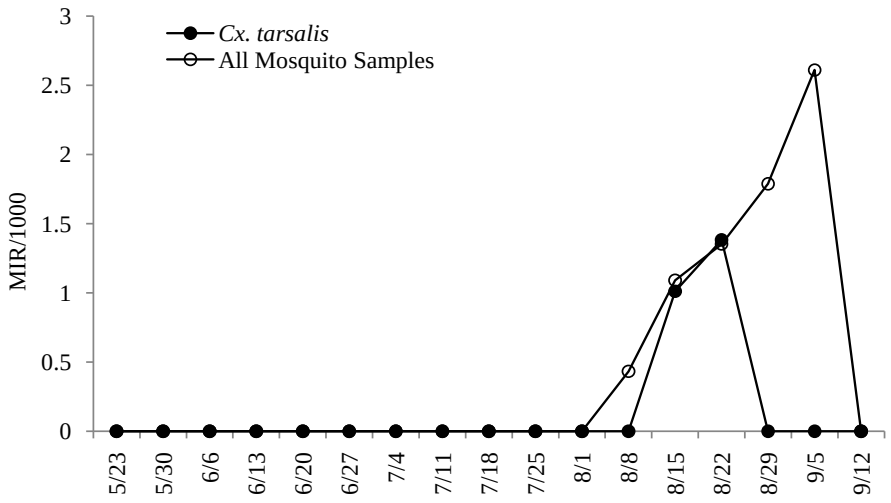


Figure 2.1 Weekly minimum WNV infection rates for *Cx. tarsalis* and for all mosquito samples collected, 2010.

Larval *Culex* Surveillance

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

Stormwater Management Structures and Other Man Made Habitats Since 2006, MMCD field staff have been working to locate stormwater structures, evaluate habitat, and provide larval control. A classification system was devised to categorize potential habitats. Types of structures included culverts, washouts, riprap, risers (pond level regulators), underground structures, swimming pools, ornamental ponds, and intermittent streams. In 2010, crews concentrated on surveying and applying larvicides to confirmed *Culex* habitats.

Staff made 17,053 inspections of 8,468 structures in 2010. Mosquito larvae were found in 2,750 of the 9,382 habitats that were wet on the date of inspection. Inspectors collected 2,020 larval samples from stormwater structures and other man-made habitats. West Nile virus vector *Culex* species were found in 77.4% of the samples (Table 2.4).

Table 2.4 Frequency of *Culex* vector species collected from stormwater management structures and other man made habitats (N=2,020), 2010

Species	% occurrence
Cx. pipiens	31.8
Cx. restuans	64.2
Cx. salinarius	0.0
Cx. tarsalis	4.5
Any *Culex* vector species	77.4

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 U.S. Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES). MMCD has worked with city crews to survey and treat underground BMPs since 2005. In 2010, we continued the cooperative mosquito control plan for underground habitats. Twenty municipalities volunteered their staff to assist with material applications (Table 2.5). Altosid® XR briquets were used at the label rate of one briquet per 1,500 gal of water retained. Briquets were placed in 674 underground habitats.

Table 2.5 Cities that assisted in treating underground stormwater habitats; 674 structures were treated and a total of 973 briquets were applied, 2010

City	Structures treated	Briquets used	City	Structures treated	Briquets used
Arden Hills	6	6	Lino Lakes	10	10
Blaine	8	21	Maplewood	140	140
Bloomington	70	92	Mendota Heights	27	37
Brooklyn Park	4	15	Minneapolis	164	164
Crystal	4	12	New Brighton	5	8
Eagan	20	20	New Hope	6	12
Eden Prairie	12	20	Plymouth	150	335
Fridley	14	35	Roseville	11	14
Hastings	2	2	Savage	6	15
Lauderdale	13	13	Spring Lake Park	2	2

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 Surveillance in Catch Basins The amount and frequency of rainfall in 2010 inhibited mosquito development in catch basins. Even though mosquitoes may be found frequently in catch basins during wet periods, many larvae are swept away by flushing rainfall before emerging as adults.

Most of the 2010 surveillance occurred while conducting an efficacy trial for Natular® tablets (see Chapter 5). Field staff inspected additional catch basins for other purposes such as for training or for locating sources of mosquitoes in adult traps. Sixty to 100 sites were inspected most weeks from the middle of May through August. Larvae were found during 643 of 1,245 catch basin inspections (51.6%) in 2010. There were five weeks when larvae were found in more than 70 % of catch basins inspected (Figure 2.3).

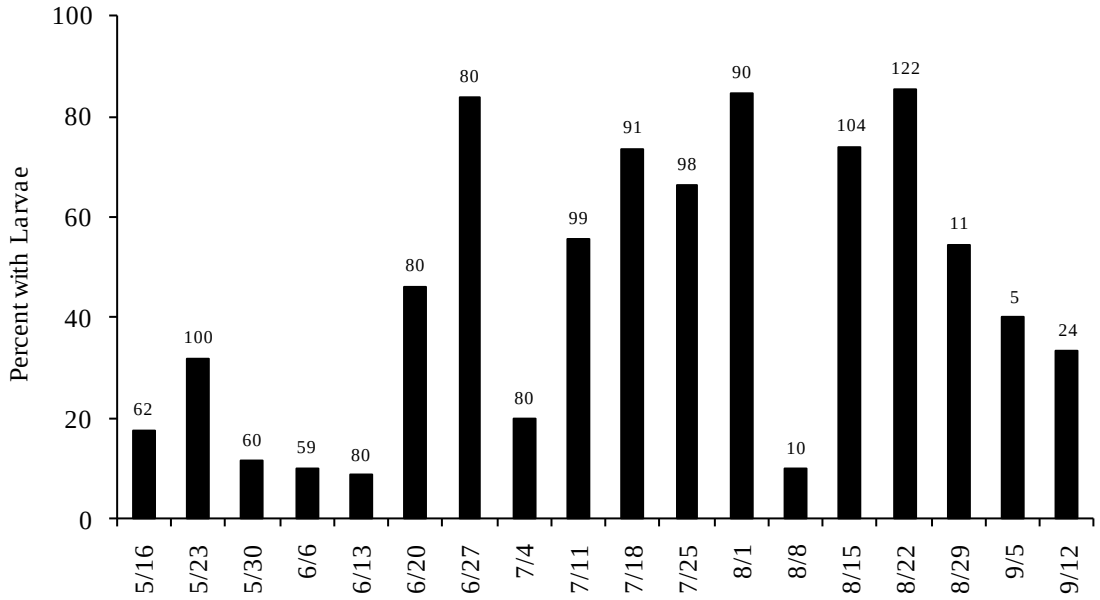


Figure 2.3 Ratios of catch basins inspected with mosquitoes present. Bars are labeled with the number of inspections occurring during the week, 2010.

Mosquito larvae were identified from 619 catch basin samples (Figure 2.4). For the first time since MMCD started conducting surveillance in catch basins, *Cx. pipiens* were found more frequently than *Cx. restuans*. *Culex pipiens* were found in 66.4% of catch basin larval samples which exceeds all previous observations. *Culex restuans* were found in 58.6% of samples. At least one *Culex* species was found in 99.4% of samples. Additionally, *Ae. japonicus* were found for the first time in MMCD catch basins; the species was identified in seven samples in 2010.

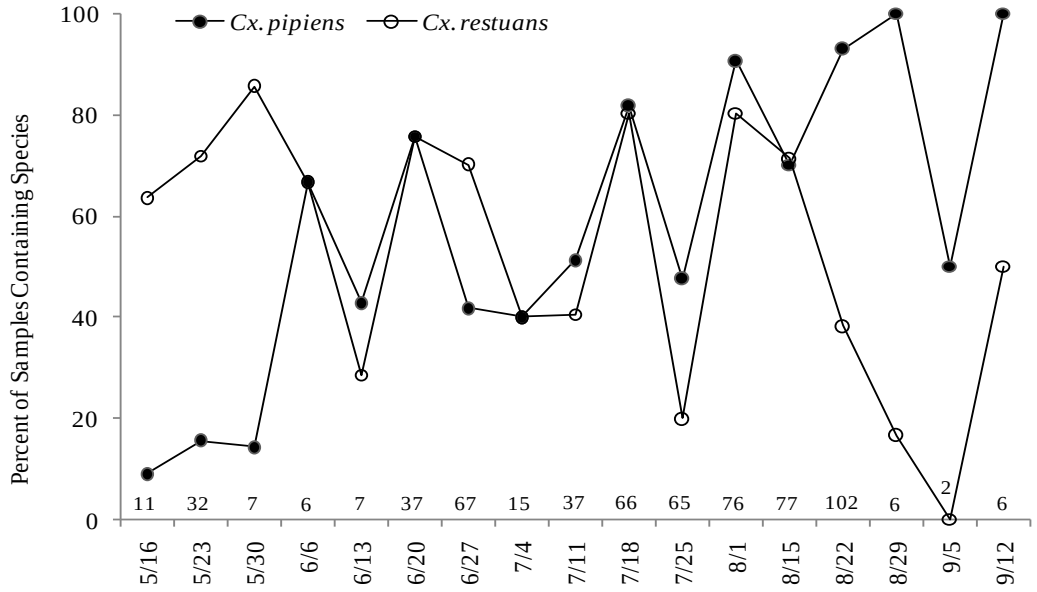


Figure 2.4 Percent occurrence of *Cx. pipiens* and *Cx. restuans* in catch basin larval samples by week, 2010. The number of samples identified each week appears above the X-axis. No samples were collected during the week of August 8.

Plans for 2011 – Mosquito-borne Disease

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

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

MMCD will continue to conduct surveillance for WNV and other mosquito-borne viruses in coordination with MDH and others involved in surveillance for WNV in Minnesota. Surveillance in 2010 detected late summer amplification of the virus. We will prepare for early season transmission and amplification of WNV with the assumption that more chronically infected overwintering mosquitoes will be active next spring than we experienced in the spring of 2010.

Environmental conditions improved for *Cs. melanura* locally in 2010 and the EEE virus has been active recently in other parts of the country. We will 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.

2010 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 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 in sites located south of the Mississippi River and they appear to be prevalent now in any wooded area in Dakota County. The 2010 report will be available on our website (www.mmcd.org) in April. Following are some 2010 highlights.

Again in 2010, distribution study results showed continued evidence of an elevated *I. scapularis* population and we set new all-time highs in several areas. We collected *I. scapularis* from all seven counties that comprise our service area for the fourth consecutive year and tabulated a new record number of positive sites – sites where at least one *I. scapularis* was collected. There were 70 positive sites in 2010 (Figure 2.5). Comparatively, the yearly positive site totals during 1990-1999 ranged from 24-46, and since 2000 it has been common for us to tabulate positive site totals in the 50s; the previous all-time high positive site total of 57 occurred in 2009.

We also continued to observe higher than typical numbers of positive sites from counties south of the Mississippi River. The total of 24 this year is another new record, surpassing our previous high of 19 from 2008 and 2009. As has been typical in recent years, the majority of the Dakota County sites (10 of 14) were positive in 2010. However, we were surprised to find that the majority of the Scott County sites (6 of 8) were positive also. Sites positive for the first time included three Hennepin County parks (all Bloomington Township sites), and one large wooded area each in Scott (Spring Lake Township) and Carver (Chanhassen Township) counties.

Although the average number of *I. scapularis* collected per mammal (0.845) in 2010 was comparable to the recent elevated averages of 2000 – 2002, 2004, 2005, 2007 and 2009 (all $\geq$ .806), for the first time *I. scapularis* comprised >70% of our overall tick collections (Table 2.5). Larval *I. scapularis* collections alone comprised 65% of all of the ticks collected, but we also collected 107 nymphs - a nymph count in the 100s for only the sixth time – all since 2000 (Table 2.6).

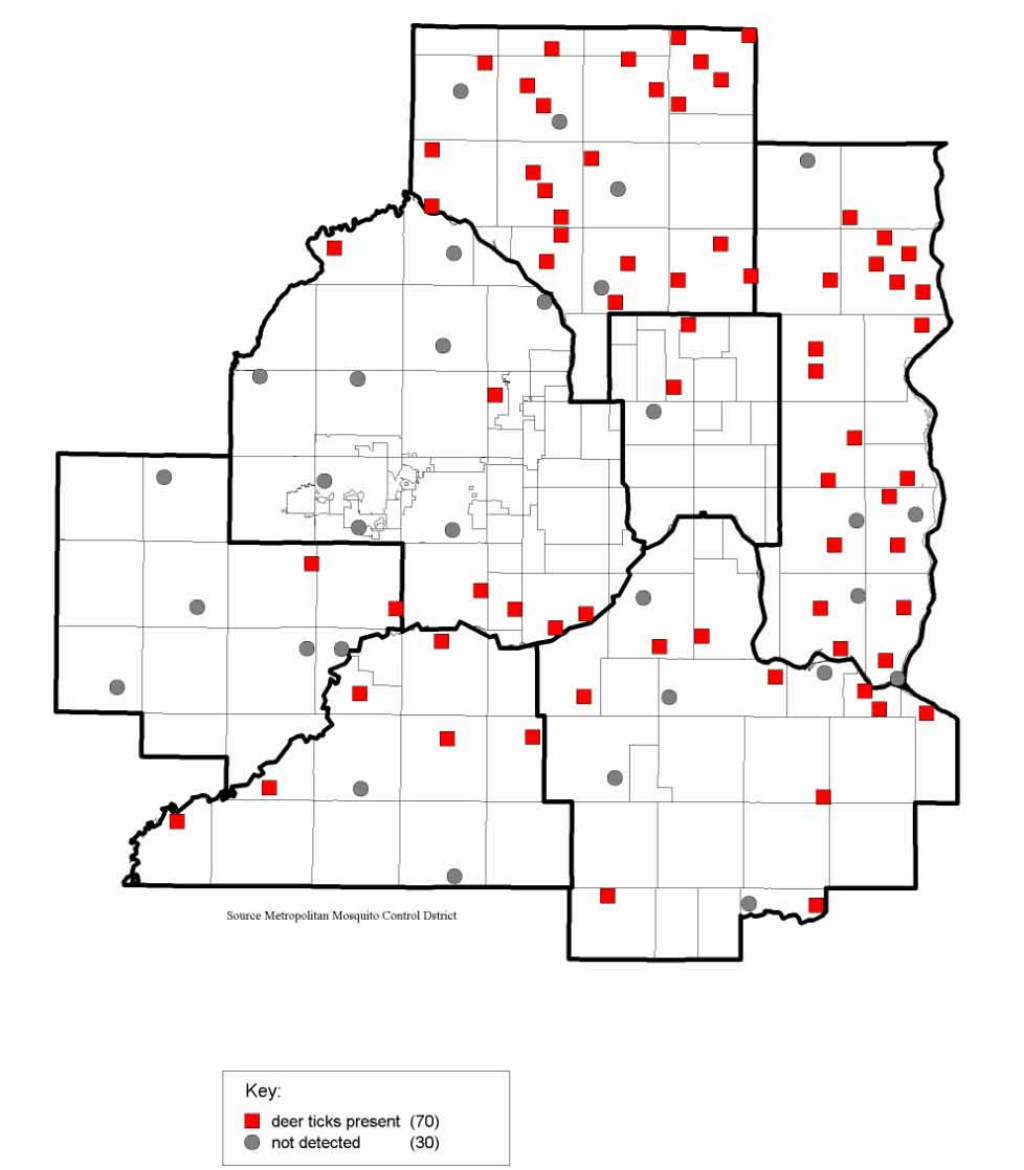


Figure 2.5 Presence/absence of *I. scapularis* at 100 sampling stations in the 7-county metropolitan area – 2010.

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

Year	No. sites	Total ticks collected	*Dermacentor variabilis* Percent larvae (n)	*Dermacentor variabilis* Percent nymphs (n)	*Ixodes scapularis* Percent larvae (n)	*Ixodes scapularis* Percent nymphs (n)	Other species[b] percent (n)
1990 [a]	250	9957	83 (8289)	10 (994)	6 (573)	1 (74)	0% (27)
1991	270	8452	81 (6807)	13 (1094)	5 (441)	1 (73)	0% (37)
1992	200	4130	79 (3259)	17 (703)	3 (114)	1 (34)	0% (20)
1993	100	1785	64 (1136)	12 (221)	22 (388)	1 (21)	1% (19)
1994	100	1514	53 (797)	11 (163)	31 (476)	4 (67)	1% (11)
1995	100	1196	54 (650)	19 (232)	22 (258)	4 (48)	1% (8)
1996	100	724	64 (466)	20 (146)	11 (82)	3 (20)	1% (10)
1997	100	693	73 (506)	10 (66)	14 (96)	3 (22)	0% (3)
1998	100	1389	56 (779)	7 100)	32 (439)	5 (67)	0% (4)
1999	100	1594	51 (820)	8 128)	36 (570)	4 (64)	1% (12)
2000	100	2207	47 (1030)	10 (228)	31 (688)	12 (257)	0% (4)
2001	100	1957	54 (1054)	8 (159)	36 (697)	2 (44)	0% (3)
2002	100	2185	36 (797)	13 (280)	42 (922)	8 (177)	0% (9)
2003	100	1293	52 (676)	11 (139)	26 (337)	11 (140)	0% (1)
2004	100	1773	37 (653)	8 (136)	51 (901)	4 (75)	0% (8)
2005	100	1974	36 (708)	6 (120)	53 (1054)	4 (85)	0% (7)
2006	100	1353	30 (411)	10 (140)	54 (733)	4 (58)	1% (11)
2007	100	1700	47 (807)	8 (136)	33 (566)	10 (178)	1% (13)
2008	100	1005	48 (485)	6 (61)	34 (340)	11 (112)	1% (7)
2009	100	1897	48 (916)	9 (170)	39 (747)	3 (61)	0% (3)
2010	100	1553	21 (330)	7 (101)	65 (1009)	7 (107)	0% (6)

[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

Figure 2.6 illustrates these increases in *I. scapularis* collections over time. The first graphs show total number of mammals collected each year, and the number of mammals with at least one *I. scapularis.* The next graphs show the yearly averages of *I. scapularis* per mammal, and the average number of *I. scapularis* per infested mammal only. The final graph provides the yearly total number of sites where at least one *I. scapularis* was collected (positive sites). All graphs contain data from only our repeated sampling network. All data from 1990 include only 75 sites as our network had not been fully set, but 1991 forward represent our current network of 100 sites, including the 75 sites from 1990.

Comparing 2010 with past years, it is evident that *I. scapularis* collections have risen over time. However, the rise appears to be as much attributable to a geographic component (higher number of positive sites) as it is to an increase in number of infested mammals (second graph) or increased *I. scapularis* per infested mammal (fourth graph). The change from 2000 forward compared to the first ten years (1990-1999) of this study is also apparent in all measures except the overall number of mammals.

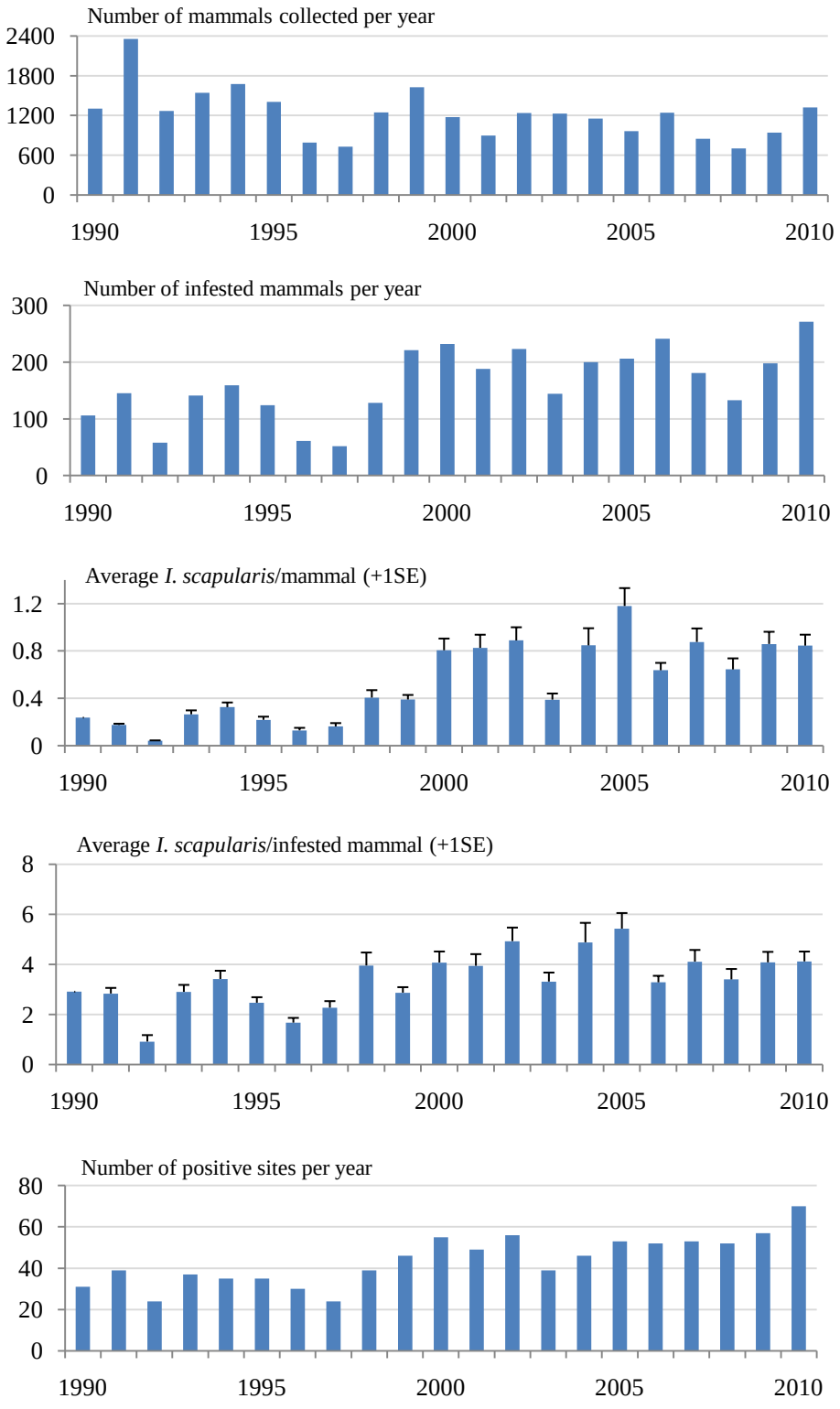


Figure 2.6 Historic trends in mammal collections, infestation rates with *I. scapularis*, and positive sites from 100 sampling stations in the 7-county metro area. In 1990 there were 75 stations, 25 additional stations were added in 1991.

Similarly, MDH has been documenting record-setting human tick-borne disease case totals since 2000. Pre-2000, the highest Lyme case total was 302. The Lyme case totals since 2000 have ranged from 463 to 1,239 cases, while the total human granulocytic anaplasmosis (HGA) case numbers averaged roughly 15 cases per year through 1999 and had ranged from 78 to 186 from 2000 – 2006. The all-time high, statewide Lyme disease and HGA case records were set 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 2009 human case totals for Lyme disease (~1,065) and HGA (~317) were again high. Case data for 2010 is not yet available.

Additional Updates – New Strategies 2010

Update of 2009 Metro Rocky Mountain Spotted Fever (RMSF) Case To date, RMSF is very rarely documented in Minnesota and even more rarely documented as having been acquired in our service area. In July 2009, MMCD was notified by MDH of a locally-acquired RMSF case. Although it was post peak for the American dog tick vector (*Dermacentor variabilis*), MMCD attempted an aggressive tick collection effort. We also provided archived ticks from our tick surveillance efforts to the MDH. In a follow up to our 2009 efforts, in spring 2010 we collected additional ticks for the MDH. Testing results will not be available for some time.

New Collection Strategies At the suggestion of the Technical Advisory Board (TAB), we visited vet offices and dog parks as part of our outreach to collect more unusual tick data (species and atypical locations for ticks). Roughly 86 vet clinics were visited and our interest in obtaining ticks was expressed; materials were also dropped. A total of 42 dog parks were evaluated for sign potential. Staff posted signs in approximately 21 parks and four active dog walking areas, including at the Stubbs Bay Park Luce Line Trail Entrance. Occasionally signs were removed from posted parks, primarily in Hennepin (probably park staff) and Ramsey (vandals) counties; to compensate for this, staff distributed tick cards at dog park entrance gates on several occasions. Staff retrieved signs at all dog parks in fall 2010. Although we did receive calls inquiring about our signs, we did not directly receive ticks from these efforts.

Re-sampling Waconia On July 21, 2009, a staff member turned in an *I. scapularis* that had been collected in Waconia (Carver County). Because it was unusual to collect *I. scapularis* from this area, we decided to further investigate despite it likely being past peak for *I. scapularis*. A trapline was set at the suspected tick collection location for the week of July 27 but no ticks of any species were collected. MMCD re-sampled this area in 2010 and were successful in collecting *I. scapularis* (14L; 4N) even though our results continue to be negative from a distribution study site located approximately 3 miles away. As with our study sites, the Waconia area was sampled for three rounds, as an extra site.

Additional Deer Ticks Staff collected an adult deer tick in Maple Plain in June and at Lake Rebecca Park Reserve (Independence Township) in November. Hennepin County dog owners have also been reporting deer tick collections, including from the Mississippi River corridor, when we have spoken during our tick card distribution and posting efforts.

***Amblyomma americanum* (Lone Star Tick) Found in the Metro Again** *Amblyomma americanum* is an aggressive human biter and can transmit human monocytic ehrlichiosis

(HME), among other potential pathogens. Both the tick and HME are more common in 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*). However, for the first time in a number of years, *Amblyomma* were submitted to MDH and MMCD by the public in 2009 (Minneapolis and Circle Pines). This trend continued in 2010, with *Amblyomma* submitted to MMCD from Eagan, Mound, and the Orono/Lake Minnetonka areas of the metro. All 2009 and 2010 records were of single ticks. Dakota County staff attempted to collect more ticks at the Eagan location via dragging, but did not collect any more ticks.

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services were maintained in 2010 using previously described methods and tools although we did expand our outreach efforts by posting signs and distributing materials at dog parks.

2011 Plans for Tick-borne Services

We plan to continue the metro-based *I. scapularis* distribution study that began in 1990 unchanged.

We will maintain our tick-borne disease education activities and services (including tick identifications and homeowner consultations) using previously described methods and tools. 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 continue to offer an encompassing slide presentation.

We will continue to post at dog parks and plan to expand to additional areas. We intend to create a more generic sign than was used in 2010 and to use more permanent materials than the laminated paper signs we used in 2010. As in 2010, signs will be posted in the spring and removed in late fall after *I. scapularis* activity ceases for the year.

MMCD and MDH continue to discuss strategies that would enable both agencies to detect possible establishment of *A. americanum* in Minnesota. MMCD will continue to monitor for this tick in our surveillance and to track collections turned in by the public as part of our tick identification service. Both MMCD and MDH plan to maintain our current notification process to the other agency upon identifying an *A. americanum* or other new or unusual tick species.

Chapter 3 Mosquito Control

2010 Highlights

- 101,581 more acres worth of larvicides were applied to wetlands in 2010 than in 2009
- A cumulative total of 227,611 catch basin treatments were made in three rounds to control vectors of WNV
- Enhanced surveillance and larval habitat removal operations detected *Aedes japonicus* in three times as many sections and in all seven District counties compared to 2009
- 39,937 more acres worth of adulticides were applied in 2010 than in 2009

2011 Plans

- Continue to test larvicides and strategies to reduce the amount of time and personnel required for effective season-long control of mosquitoes breeding in many kinds of sites
- 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 *Ae. vexans*, several species of spring *Aedes*, the cattail mosquito *Cq. perturbans*, and several disease vectors including: *Ae. triseriatus* which can transmit La Crosse encephalitis (LAC); *Cx. 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 potential vector species, *Ae. japonicus*, which arrived on the scene in 2007, has also increased control needs.

Due to the large size of the metropolitan region (~ 2,900 square miles), larval control was considered the most cost-effective control strategy in 1958 and remains so today. Consequently, larval control is the focus of the control program and the most prolific mosquito habitats (over 70,000 potential sites) are scrutinized for all human-biting mosquitoes. An insect growth regulator (Altosid® or methoprene) and a soil bacterium (*Bacillus thuringiensis israelensis* or *Bti*) are the primary larval control materials; other materials are being evaluated as well. Adult control augments the larval control program when necessary.

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.

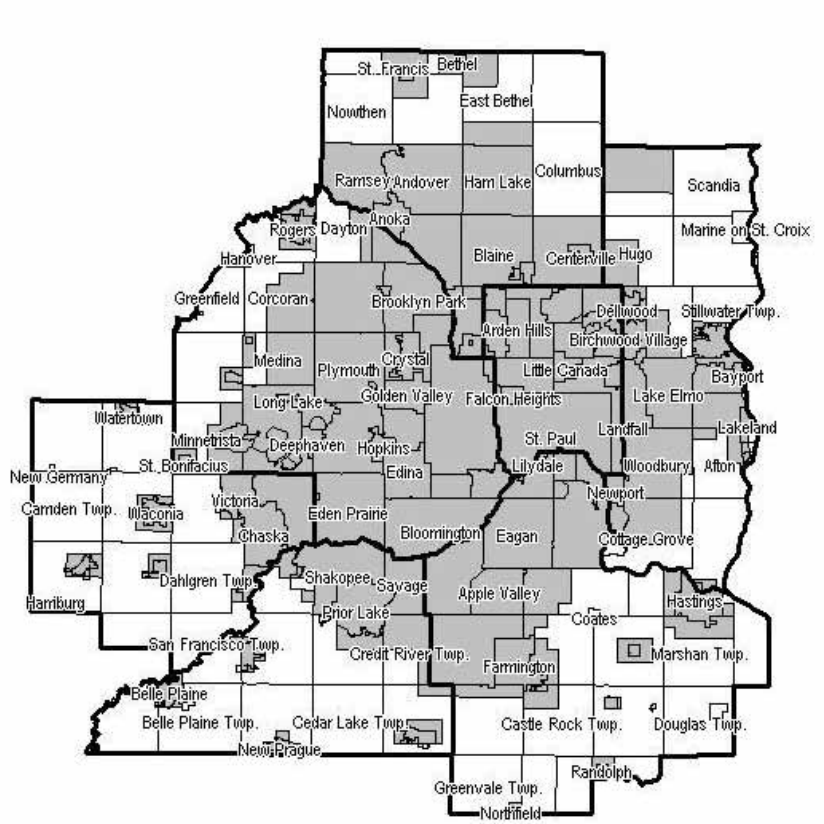


Figure 3.1 Priority Zones 1 (shaded) and 2 (white), with District county and city/township boundaries, 2010.

To supplement the larval control program, adulticide applications are performed after sampling detects mosquito populations meeting 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. Sumithrin and two formulations of natural pyrethrins, Pyrenone® and Pyrocide®, are used in agricultural areas. A description of the control materials is found in Appendix C. Appendix D indicates the dosages of control materials used by MMCD, both in terms of amount of formulated (and in some cases diluted) product applied per acre and the amount of active ingredient (AI) applied per acre. Appendix E contains a historical summary of the number of acres treated with each control material (2002-2010). Pesticide labels are located in Appendix F.

2010 Mosquito Control

Larval Mosquito Control

Thresholds Treatments are only done where larvae are present, as measured by taking 10 dips with a standard 4" diam. dipper, or (for pre-hatch) where there is a history of larvae present. For aerial treatments, the average number of larvae per 10 dips must be over a threshold value to warrant treatment. P1 and P2 areas have different thresholds to help focus limited time and materials on productive sites near human population centers. Spring *Aedes*, which tend to be long-lived, aggressive biters, have lower thresholds (.1/dip in P1 and .5/ dip in P2). After mid-May, when most larvae found are floodwater summer species, thresholds are increased to 2/dip in P1 and 5/dip in P2. The threshold for "*Culex*4" (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*) is 1/dip in all priority zones at any time of the season. If *Aedes* and *Culex* are both present in a site and neither meet their respective threshold, the site can be treated if the combined count meets the 2/dip (P1) or 5/dip (P2) threshold.

Season Overview The 2010 season was notable for its early, frequent, and prolonged larval mosquito production. Precipitation was above average and included several large (>2 inch) rainfall events (Figure 1.1). Spring *Aedes* larvae began hatching in the early snowmelt in mid-March, and the first larvicide applications were earlier than any time in the last 10 years. April rains triggered hatch of both spring and summer *Aedes,* and led to additional widespread larviciding (Figure 3.2). Overall, there were six large and five small-medium broods of *Ae. vexans* (a typical season has four large broods). Large-scale aerial *Bti* or prehatch pellet treatments were done April through July. By July 26, the budget for helicopters and materials was almost 90% expended and the decision was made to focus treatments on P1 only, and ask the Commission for use of reserve funds (first time since 2002). Larvicide response to the significant District-wide rainfall August 9-13 and early September rain was limited to P1 areas. Rains in mid-September continued to result in widespread but mixed larval hatch. A decision was made September 20 to end treatments based on expected low survival from cool water temperatures, but a warmer than normal October led to some unusual late adult emergence (anecdotal reports).

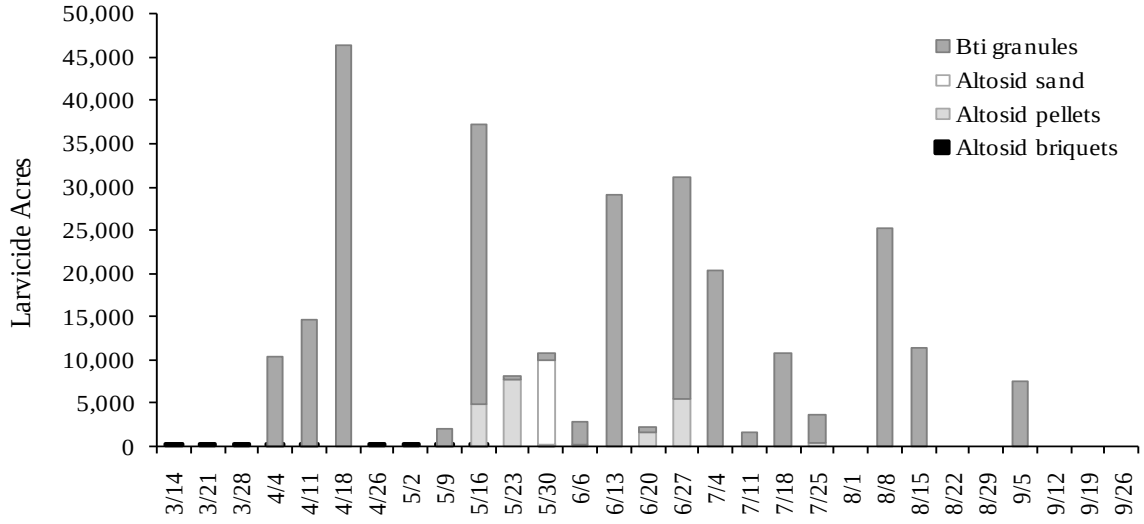


Figure 3.2 Acres of larvicide and adulticide treatments each week (April-September 2010). Date represents start date of week (Sun.-Sat.)

Total larval control material use in 2010 was markedly higher than 2009 (a relatively dry year) (Table 3.1), and in fact was the highest recorded acre treatment in over 25 years of records (Figure 3.3). In addition to the rainfall pattern, several operational factors contributed to the District's increased capacity for applying treatments:

- more helicopters (increased from 5 to 6 in 1998, and to 7 in 2005), allowing for coverage of more area during the limited time window of each brood after a rainfall
- increased number of field staff to check sites quickly and support helicopter treatments (2 foremen and 6-person crews added in 2009)
- changing workflow patterns to increase efficiency after a rain event to get helicopters in use quickly and to handle using multiple helicopters per facility
- changing material handling to store more control materials at facilities, close to field operations (2009)
- for newer pilots, use of Ag-Nav guidance system may help locate sites quickly
- increased use of pre-hatch materials in core treatement areas allows more time to dip sites in outer areas and list them for treatment

A primary limiting factor for treatments now appears to be budgetary. The District is actively looking at ways to reduce cost while maintaining treatment capacity, for example by testing new materials or formulations.

The control pattern of 2010 also provides interesting data related to the effectiveness of the larvicide program. Despite frequent rain events, adult mosquito levels were relatively moderate throughout the early part of the year, with sweep net collections averaging below threshold (Figure 1.12), CO_2 trap counts peaking just above threshold (Figure 1.13), and moderate levels of calls (Figure 6.2). After limiting treatments to P1 areas, there was a marked spike in adult mosquito numbers especially in P2 areas (Figure 1.2), and a concurrent spike in customer calls.

Table 3.1 Comparison of larval control material usage in wetlands (including stormwater structures other than catch basins) and in stormwater catch basins for 2009 and 2010 (research tests not included).

	2009		2010	
Material	Amount used	Area treated	Amount used	Area treated
Wetlands				
Altosid® briquets	375.36 cases	225 acres	268.53 cases	174 acres
Altosid® pellets	117,869.02 lb	35,161 acres	122,015.15 lb	36,516 acres
Altosid® XR-G	83,200.00 lb	8,320 acres	99,240.00 lb	9,924 acres
VectoLex® CG	0.00 lb	0 acres	0.00 lb	0 acres
VectoMax® CG	39.77 lb	5 acres	0.00 lb	0 acres
VectoBac® G	1,214,478.44 lb	151,801 acres	2,003,869.60 lb	250,478 acres
Larvicide subtotals		195,511 acres		297,092 acres
Catch basins				
Altosid® briquets	0.00 cases	0 CB[1]	0.00 cases	0 CB[1]
Altosid® pellets	1,776.46 lb	219,045 CB	1,842.39 lb	227,611 CB
CB subtotals		219,045 CB		227,611 CB

[1]CB=catch basin treatments

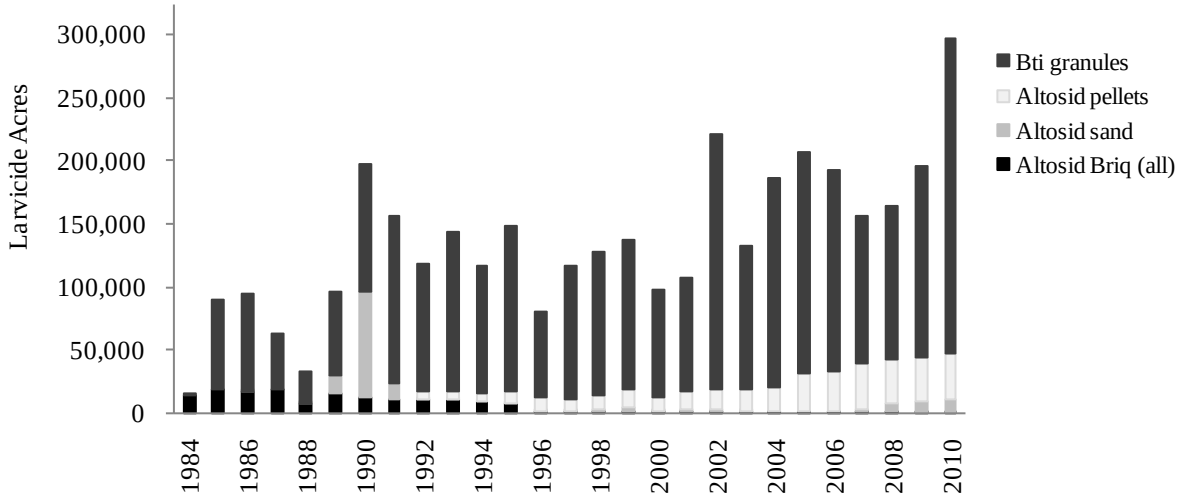


Figure 3.3 Annual total acres of larvicide treatments (area treated may be smaller because many sites are treated more than once).

In 2010, we continued expanding large-scale treatments of Altosid® XR-G sand to control *Cq. perturbans*. Over 1,600 additional cattail acres were treated in 2010 than in 2009 (Table 3.1). The per acre material cost of XR-G sand is lower than Altosid® pellets, meaning that funds formerly used for pellets can be used to purchase enough material to treat about 25% more acres with XR-G sand. In September, we treated 89.5 acres of cattail sites with VectoLex® (*B. sphaericus*) to evaluate two dosages against the cattail mosquito. Emergence cages will be placed in these sites in June – August 2011. The goal is to provide more time for aerial cattail treatments by adding a late summer window to our current spring treatment program.

Stormwater catch basin treatments to control *Culex* mosquitoes began in early June and ended in early September. Most catch basins were treated three times with Altosid® pellets (3.5 grams per catch basin) from June through mid-September (Table 3.1). Natular (spinosad) was tested in catch basins as well, to verify the consistency of long-term control achieved by Natular® XRT and to investigate the impact of heavy rain (see Chapter 5 for results).

Surveillance has now detected *Ae. japonicus* in three times as many sites than in 2009 (Figure 1.23), and throughout all District counties. Although most larvae have been found in containers, they have also been found in a wide variety of habitats, including stormwater structures and catch basins. Control efforts for this species continued to focus on removal of artificial container larval breeding habitat, plus treatment of other habitat as needed.

We continued to study how to reduce the amount of time and personnel required for effective season-long control of mosquitoes breeding in many kinds of sites. In 2010, we focused on testing larvicides designed to control multiple broods of vector and annoyance mosquitoes when applied to dry sites (see Chapter 5).

Adult Mosquito Control

Thresholds Adult mosquito control operations are considered when mosquito levels rise above established thresholds of two mosquitoes in a 2-minute sweep or 2-minute slap count or 130 mosquitoes in an overnight CO_2 trap. In 2004, we established treatment thresholds for adult control specific to the *Culex*4 species: *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, and *Cx. tarsalis*. The thresholds are one of any of these *Culex* species in a 2-minute sweep, five in an overnight CO_2 trap, five in a 2-day gravid trap, and one *Cx. tarsalis* in a vacuum aspirator sample. Adulticide treatments were also considered when two or more *Ae. triseriatus* were captured in a vacuum aspirator sample. One *Ae. japonicus* captured using any adult surveillance method was the threshold established in 2009. We may modify this threshold as we learn more about the impacts of *Ae. japonicus*' expansion in the District.

Season Overview In 2010, adult mosquito levels were moderate most of the season except for peaks in early July and late August (Figure 1.13); at those times counts over threshold were fairly widespread (Figure 3.4 and map Figure 1.9). MMCD applied 39,937 more acres-worth of adulticides than in 2009 (Table 3.2), but amounts were less than 2008 (Appendix E). Figure 3.4 shows weekly adulticide acres treated (line). The peak in early July reflects a response to both widespread *Ae. vexans* emergence and increasing numbers of *Cx. tarsalis*. The number of traps over the vector threshold remained high for much of the summer (compare with Figure 1.18). By August the budget for overtime hours was running low, and measures were taken to reduce use of overtime. However, evening adulticiding is difficult to schedule effectively without using overtime, and this plus low levels of virus activity was related to a reduction in late-season work.

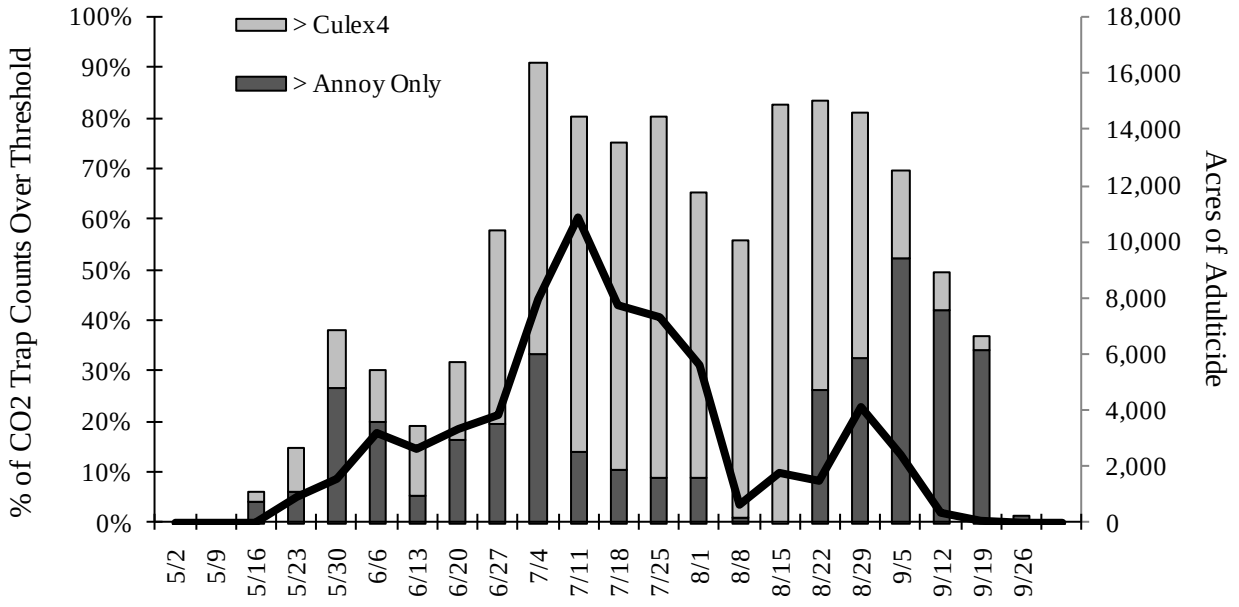


Figure 3.4 Percent of Monday CO_2 trap locations with counts over threshold (date is start of week), showing subtotals by annoyance or *Culex* vector thresholds, with acres of adulticides applied, 2010.

In 2010, staff continued to improve linkages of adulticide treatments with surveillance that includes identified mosquito samples (compared to landing rates only). In 2010, 89% of ULV treatments were associated with identified samples, up from 65% in 2009 and 33% in 2008. In

2010, 85% of permethrin (barrier) treatments were linked to identified samples, up from 69% in 2009 and 38% in 2008.

In 2010, 26% of ULV treatments were in direct response to above-threshold vector detections; the remaining 74% were in response to annoyance thresholds. Similarly, 32% of barrier treatments were in direct response to above-threshold vector detections; the remaining 68% were in response to annoyance thresholds.

Table 3.2 Comparison of adult control material usage in 2009 and 2010.

	2009		2010	
Material	Gallons used	Acres treated	Gallons used	Acres treated
Permethrin	874.23	4,754	1,723.66	8,826
Resmethrin	149.50	12,179	330.78	27,794
Sumithrin*	161.04	7,796	498.01	26,429
Pyrocide*	0.00	0	0.00	0
Pyrenone*	11.05	943	30.00	2,560
Total		25,672		65,608

* Products labeled for use in agricultural areas

2011 Plans for Mosquito Control Services

Integrated Mosquito Management Program

In 2011, MMCD will review all aspects of its integrated mosquito management program to ensure that budgetary resources are being used as effectively as possible with the goal of maximizing mosquito control services per budget dollar and complying with any NPDES-related permit requirements. Further discussion regarding the Clean Water Act's National Pollution Discharge Elimination System (NPDES) permit requirements is in Chapter 6.

Larval Control

Cattail Mosquitoes In 2011, control of *Cq. perturbans* will use a strategy similar to that employed in 2010. MMCD will focus control activities on the most productive cattail marshes near human population centers. Altosid® briquet applications will start in early March to frozen sites (e.g., floating bogs, deep water cattail sites, remotely located sites). 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. More acres will be treated with Altosid® XR-G sand and fewer with Altosid® pellets to decrease per-acre treatment costs. Staff will continue evaluating the success of late summer VectoLex® applications.

Floodwater Mosquitoes The primary control material will again be *Bti* corn cob granules. Budgeted *Bti* (VectoBac® G) and Altosid® pellet needs in 2011 are expected to be similar to the five-year average usage (201,297 acres). As in previous years, to minimize shortfalls, control material use may be more strictly rationed during the second half of the season, depending upon the amount of the season remaining and control material supplies. Regardless of annoyance levels, MMCD will maintain sufficient resources to protect the public from potential disease risk.

Staff will treat ground sites (small, temporary wetlands <3 acres) with methoprene products (Altosid® pellets, Altosid® briquets) or *Bti* corncob granules. During a wide-scale mosquito brood, breeding sites in highly populated areas will receive treatments first. The District will then

expand treatments into less populated areas where treatment thresholds are higher. Larval treatment thresholds will be the same as in 2010.

Staff annually review ground site histories to identify those sites that produce mosquitoes most often which helps us to better prioritize which sites to inspect before treatment, which sites to pre-treat with Altosid® products before flooding and egg hatch, and which sites to not visit at all. The ultimate aim is to provide larval control services to a larger part of the District by focusing on the most prolific 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).

MMCD has expanded control to four *Culex* species since the arrival of WNV in 2002. Ground and aerial larvicide treatments of wetlands have been increased to control *Culex*. Catch basin treatments control *Cx. restuans* and *Cx. pipiens* breeding in urban areas. Most catch basins will be treated with Altosid® pellets. About 2,200 will be treated with Natular® XRT as part of a large-scale operational test. 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® XRT 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).

Intensive surveillance for *Ae. japonicus* will continue in 2011 to determine abundance and common larval habitats and refine larval and adult control methods.

Adult Mosquito Control

Staff will continue to review MMCD's adulticide program to ensure effective resource use and minimize possible non-target effects. Budgeted adulticide needs in 2011 are similar to 2010 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 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. We plan to continue testing additional ULV adulticides (see Chapter 5) to prepare for the disappearance of Scourge® (resmethrin); Bayer, the manufacturer, has withdrawn its re-registration. We are making sure that all employees that may apply adulticides have passed applicator certification testing, in preparation for a shift in label status of permethrin to Restricted Use (certified applicators only).

Our primary barrier treatment adulticide (Permethrin 57-OS Concentrate) is undergoing re-registration with the Environmental Protection Agency (EPA) and this last phase of review may be completed by mid-2011. This product, along with many other pyrethroid products undergoing re-registration, will become a restricted use pesticide. MMCD has established new procedures to have all our applicators properly trained and licensed to use this product in 2011.

Chapter 4 Black Fly Control

2010 Highlights

- Larval mortality following *Bti* treatment on the large rivers averaged 94%
- Processed non-target monitoring samples collected on the Mississippi River in 2009
- Monitored adult populations weekly using overhead net sweeps and CO_2 traps

2011 Plans

- Threshold for treatment will be the same as previous years
- Monitor adult populations by the overhead net sweep and CO_2 trap methods
- Increase larval surveillance in Scott and Carver counties
- Complete the non-target monitoring report for samples collected in 2009

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 Fig. 4.1.

2010 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 and early May, 160 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 79 sites on 19 streams met the threshold and were treated once with VectoBac® 12AS formulation of *Bti*. A total of 34.8 gallons of *Bti* was used (Table 4.1).

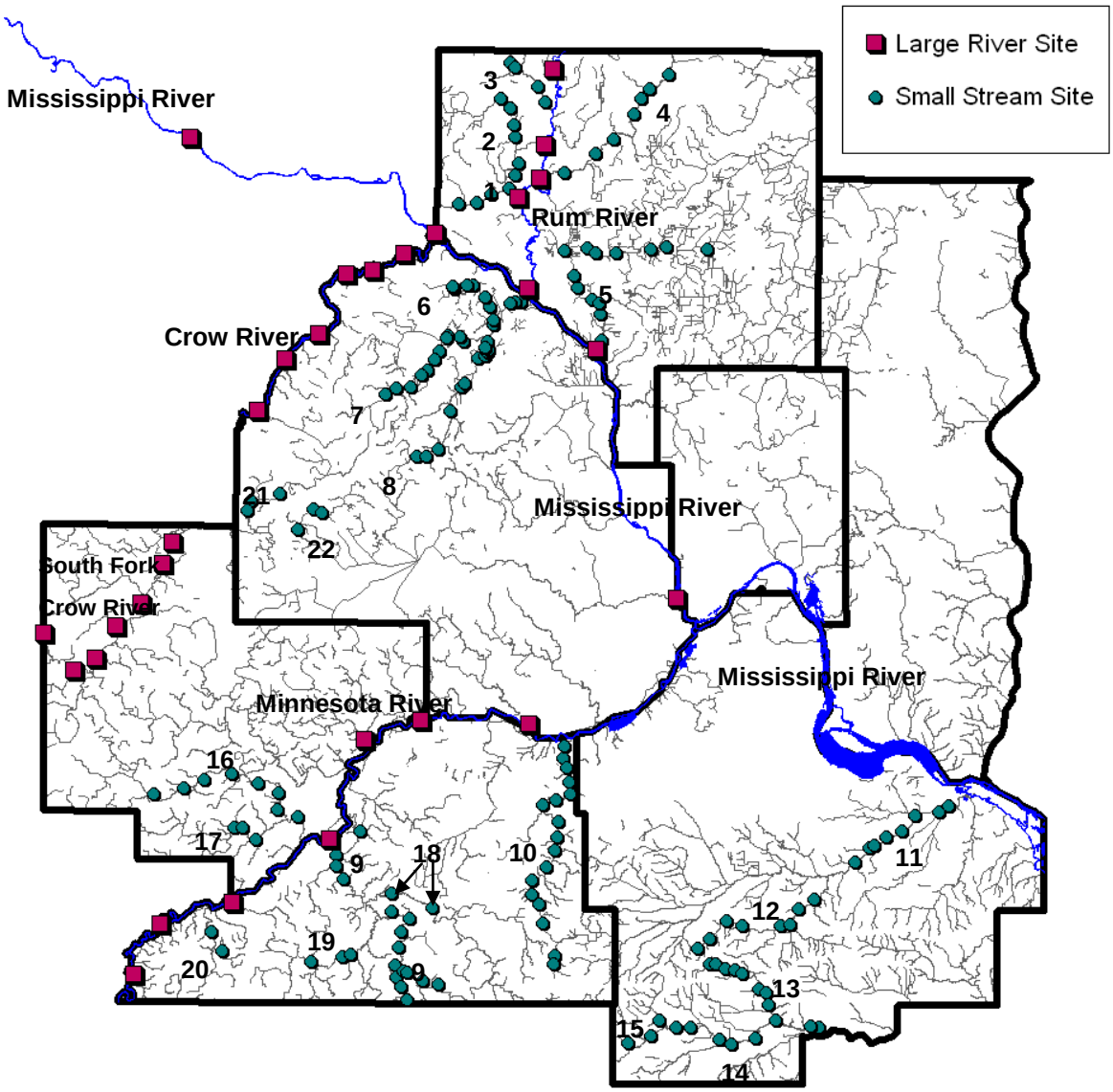


Figure 4.1 Large river and small stream black fly larval monitoring/treatment locations, 2010. Note: the large river site located outside the District on the Mississippi River is for monitoring only. The numbers on the map refer to the small stream names listed below:

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	

Table 4.1 Summary of *Bti* treatments for black fly control by the MMCD in 2009 and 2010

	2009			2010		
Water body	No. treatment sites	No. treatments	Gallons of *Bti* used	No. treatment sites	No. treatments	Gallons of *Bti* used
Small Stream Total	74	74	27.1	79	79	34.8
Large River						
Mississippi	2	17	1129.0	2	7	605.4
Crow	2	4	27.5	0	0	0.0
South Fork Crow	5	12	32.5	5	7	74.9
Minnesota	7	16	887.0	6	15	1707.8
Rum	4	18	77.7	5	27	207.4
Large River Total	20	67	2153.7	18	56	2595.5
Grand Total	94	141	2180.8	97	135	2630.3

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 549 samples were collected to determine if the treatment threshold was met. The treatment thresholds were the same as those used since 1990. Fifty-six *Bti* treatments totaling 2,595.4 gallons of VectoBac® 12AS were used to control large river-breeding black fly larvae in 2010 (Table 4.1). The Crow River did not meet the treatment threshold on any of 54 monitoring samples collected in 2010 and no treatments were made. Discharge levels were above average for the Minnesota River for the entire season. At the end of June, discharge levels reached flood stage on the Minnesota River which caused one treatment to be cancelled due to the river exceeding its banks at that location. The amount of *Bti* used in 2009 and again in 2010 was below the yearly average of approximately 3,000 gal.

Bti treatment effectiveness was excellent in 2010. 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, 91% on the Minnesota River, 88% on the Rum River, and 99% on the South Fork Crow River. Overall, the average post-treatment mortality recorded on the large rivers in 2010 was 94%.

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 2010 was 2.2 (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 1.5 (1996-2010).

The most abundant black fly collected in the overhead net-sweep samples in 2010 was *S. luggeri*, comprising 89% of the total black flies captured. The overall average number of *S. luggeri* captured per net-sweep sample in 2010 was 1.9 (Table 4.2). *Simulium luggeri* was most abundant in Anoka County in 2010, as it has been since the program began. The average number of *S. luggeri* captured in Anoka County was 10.7 in 2010. The average number of *S. luggeri* captured in Ramsey County was 1.8 and in Hennepin County, it was 1.5. In Carver, Dakota, Scott and Washington Counties the number of *S. luggeri* captured was less than 0.5 per sample. 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 2010 was *S. meridionale*, averaging 0.1 per sample (Table 4.2) and comprising 5.3 % of the total black flies collected. *Simulium meridionale* was most abundant in Carver County in 2010 where the average was 0.3 per net-sweep.

Black Fly Specific CO_2 Trap Collections Adult black fly populations were also monitored in 2010 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 2010 was 21.8 in Anoka County, 44.6 in Scott County, and 77.0 in Carver County. The average number of *S. venustum* captured per trap between 1998 and 2009 was 12.2 in Anoka County, 44.4 in Scott County, and 112.2 in Carver County. The reason for the higher numbers of *S. venustum* captured in the CO_2 traps in 2007 – 2010, particularly in Scott and Carver counties, is not known.

The average number of *S. johannseni* captured per trap in 2010 was 0.03 in Anoka County, 6.2 in Scott County, and 219.4 in Carver County. The average number of *S. johannseni* captured per trap between 1998 and 2009 was 0.9 in Anoka County, 12.0 in Scott County, and 79.1 in Carver

County. The average number of *S. meridionale* captured per CO_2 trap in 2010 was 0.5 in Anoka County, 256.9 in Scott County, and 271.1 in Carver County. The average number of *S. meridionale* captured per trap between 1998 and 2009 was 1.9 in Anoka County, 100.4 in Scott County, and 365.1 in Carver County. The higher numbers of *S. meridionale* and *S. johannseni* in Scott and Carver County are due to the fact that their primary larval habitat is the Crow, South Fork Crow, and Minnesota Rivers.

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
2010	2.16	1.92	0.03	0.11

[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
	2010	21.75	0.03	0.05
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
	2010	44.60	6.18	256.90
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
	2010	77.00	219.38	271.08

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 2010. Because these traps are operated for mosquito surveillance, samples are not placed in ethyl alcohol making black fly species-level identification difficult. Results are represented geographically in Figure 4.2.

The areas in dark gray and black represent the highest numbers collected, ranging from 250 to more than 500 per trap. The highest number of black flies was observed in May and June in parts of Scott, Carver, and Dakota counties (Figure 4.2). The results in Scott and Carver counties are similar to those obtained from the standard black fly CO_2 trap sampling.

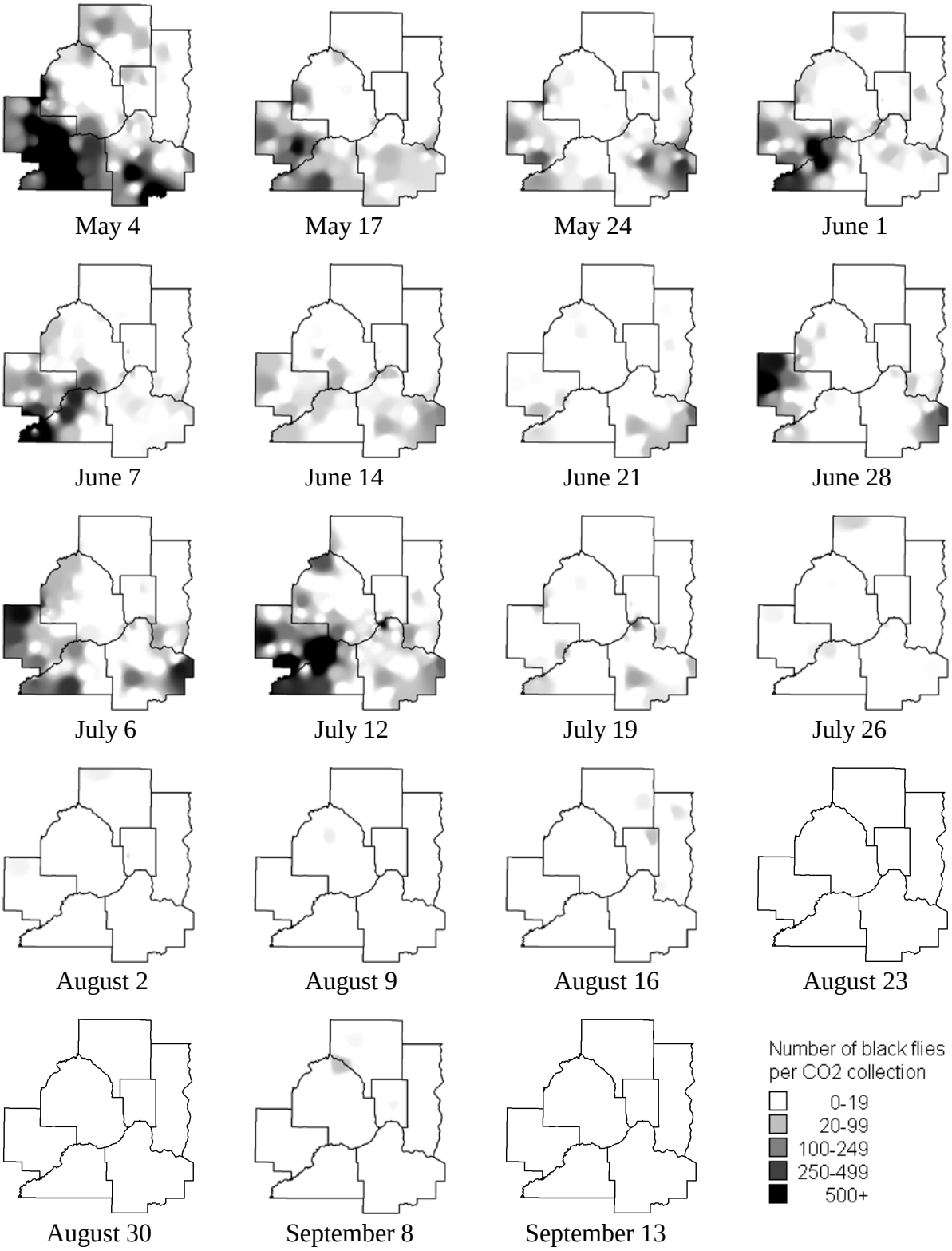


Figure 4.1 Number of black flies collected in mosquito surveillance District low (5 ft) and elevated (25 ft) CO_2 traps, 2010. The number of traps operated per night varied from 115-131. Inverse distance weighting was the algorithm used for shading of maps. No sampling occurred the week of 5/11/2010.

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. This monitoring began in 1995. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. Results from monitoring data collected and analyzed through 2007 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 will be completed in early 2011 and a report is scheduled for completion in spring 2011. Non-target monitoring samples will be collected in 2011.

2011 Plans

2011 marks the 27th year of black fly control in the District. Our goal in 2011 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 2011 black fly control permit application request will be submitted to the MnDNR in January 2011. Sorting, identification and enumeration of the non-target monitoring samples collected in 2009 will be completed. Data will be analyzed and report submitted to the MnDNR in the spring. Non-target monitoring samples will be collected on the Mississippi River in 2011. Increased larval surveillance will continue in those areas of Carver and Scott counties that had elevated adult black fly populations in 2009 and 2010 based on CO_2 trap data. Program development will continue to emphasize improving future program effectiveness, surveillance, and efficiency.

Chapter 5 Product & Equipment Tests

2010 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 until after a 2-inch rainfall
- Natular™ XRG controlled two broods of floodwater mosquitoes in ground sites
- Natular™ XRG controlled spring *Aedes* larvae for at least seven weeks in April and May
- An experimental larvicide (VBC- 60215) controlled floodwater mosquitoes in ground sites for at least four weeks

2011 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 spring and summer in wetlands to verify effectiveness and optimize treatment dosage
- Continue late summer cattail treatments of VectoLex® CG to verify effectiveness and optimize treatment dosage
- Continue tests of adulticides in different situations emphasizing control of vectors and effectiveness of barrier treatments

Background

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

2010 Projects

Quality assurance processes focused on product evaluations, equipment, and waste reduction. Before being used operationally, all products must complete a certification process that consists of tests to demonstrate how to use the product to effectively control mosquitoes. The District continued certification testing of 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, *Cq. perturbans*. The adulticide was tested for use in croplands. These additional materials will provide MMCD with more tools to use in our operations.

Control Material Acceptance Testing

Altosid® Briquets and Pellets Warehouse staff collected random Altosid® product samples from shipments received from Central Life Sciences for methoprene content analysis. MMCD contracts an independent testing laboratory, Legend Technical Services, to complete 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 2010 samples were within acceptable values of the label claim of percent methoprene (Table 5.1). Pellet samples were slightly low, but manufacturer's certificates of analysis at the time of

production was acceptable at 4.28% (n=50, SE=0.0172). Technical Services staff will closely monitor AI content of future pellet purchases.

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	10	2.10%	2.14%	0.0070
Pellets	18	4.25%	4.19%	0.0254
XR-G Sand	18	1.50%	1.53%	0.0158

Adult Mosquito Control Products MMCD requests certificates of AI analysis from the manufacturers to verify product AI levels at the time of manufacture. MMCD 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 is building a database on warehoused adult control materials to assist in inventory management and purchasing decisions. Therefore, voucher samples of the 2010 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 2010 adulticides

Product	No. Samples Analyzed	% AI Content: Label Claim	% AI Content: Analysis Average	SE
Permethrin 57% Concentrate	2	57.00	57.05	0.1500
Permethrin 5.7% Mix	4	5.70	5.94	0.2704
Resmethrin 4%	2	4.00	4.09	0.0200
PBO 12%	2	12.00	12.18	0.0750
Sumithrin 2%	2	2.00	2.08	0.0150
PBO 2%	2	2.00	2.17	0.0350

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 2010. Efficacy calculated using pre- and post-treatment larval counts from randomly selected sites was similar in 2010 and 2009 (Table 5.3).

Table 5.3 Efficacy of aerial VectoBac® G applications in 2009 and 2010 (SE=standard error)

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2009	272	92.3	100.0	1.4%	0.0	100.0
2010	724	91.2	100.0	0.9%	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 2010 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 goals of control material tests in 2010 was to find a longer lasting material to decrease the number of times per season catch basins required treatment to control WNV vectors and determine how much rain during a 24-hour period was required to degrade effectiveness. In 2010, we selected 60 catch basins in St. Paul that we dipped weekly (three dips per catch basin per inspection) beginning May 21 and ending August 27. We identified and tallied the developmental stages of immature mosquitoes (larvae and pupae) in all samples. Immediately after the May 28 inspection, 40 catch basins were treated with Natular® XRT; 20 were not treated and served as untreated controls. Data from the untreated catch basins were compared to catch basins treated with Natular®XRT.

Clarke Natular® XRT in catch basins Natular® contains a biological active called spinosad that is isolated from the soil bacterium *Saccharopolyspora spinosa*. Organic growers have used spinosad for over 10 years (WHO 2008), and in 2009, mosquito larvicides containing spinosad became commercially available.

Soon after the May 28 treatment, 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 11 until the end of the season (August 27) (Figures 5.1 and 5.2). Significantly fewer larvae had been collected from Natular® XRT-treated catch basins than the untreated control through July 16 and July 30. By the end of the season (August 27), no difference between untreated and Natular® XRT-treated catch basins was observed (Table 5.4).

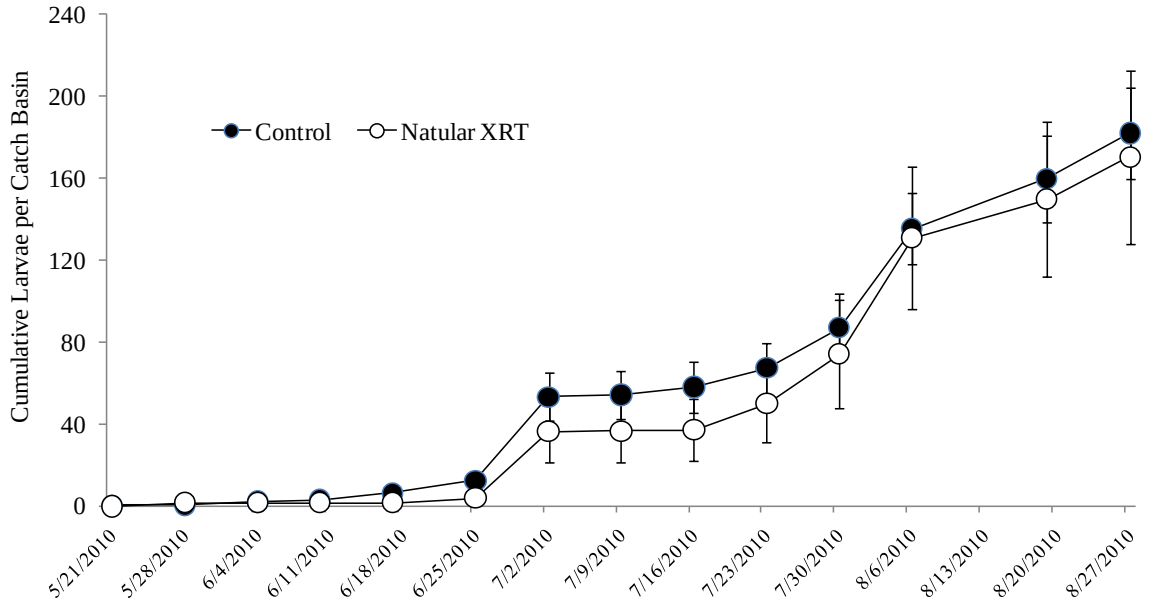


Figure 5.1 Cumulative mean larvae per catch basin collected from catch basins treated with Natular® XRT on May 28 and from untreated catch basins (Control) (mean ±SE).

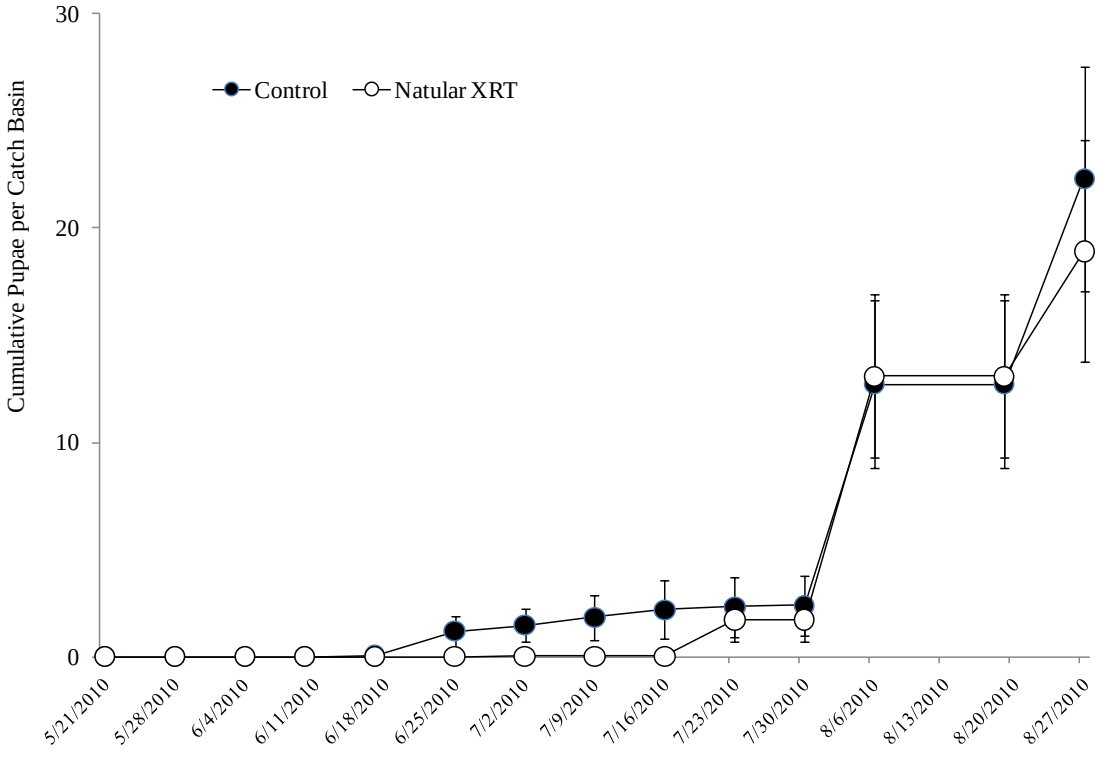


Figure 5.2 Cumulative mean pupae per catch basin collected from catch basins treated with Natular® XRT on May 28 and from untreated catch basins (Control) (mean ±SE).

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)

Life Stage	Period	Kruskal-Wallis p-value	Treatment Group: Control	Treatment Group: Natular® XRT
Larvae				
	5/28 – 7/16	0.0025	58.01 ± 12.39	39.11 ± 13.64
	5/28 – 7/30	0.0086	87.16 ± 16.64	74.41 ± 23.34
	5/28 – 8/27	0.2396	182.16 ± 22.12	180.54 ± 31.15
Pupae				
	5/28 – 7/16	0.0168	2.19 ± 1.37	0.02 ± 0.01
	5/28 – 7/30	0.3648	2.39 ± 1.40	1.77 ± 0.94
	5/28 – 8/27	0.1995	22.32 ± 5.25	20.28 ± 4.02

Significantly fewer pupae were collected from Natular® XRT-treated catch basins than the untreated control through July 16 (Table 5.4, Figure 5.3), the second sampling date after two significant rain events (24-hour rainfall >2 inch) on June 26 and 27. Pupal abundance in untreated and Natular-treated catch basins on July 30 and August 27 did not differ significantly (Table 5.4). This strongly suggests that rainfall of at least two inches in a 24-hour period may flush control materials from catch basins (Figure 5.3). This pattern agrees with an apparent lack of effectiveness observed in samples collected after significant rainfall events on August 16 and August 21, 2009 (see 2009 Operational Review for details). A sample of treated catch basins should be dipped two-three weeks after such rain events to search for pupae to determine if retreatment is required.

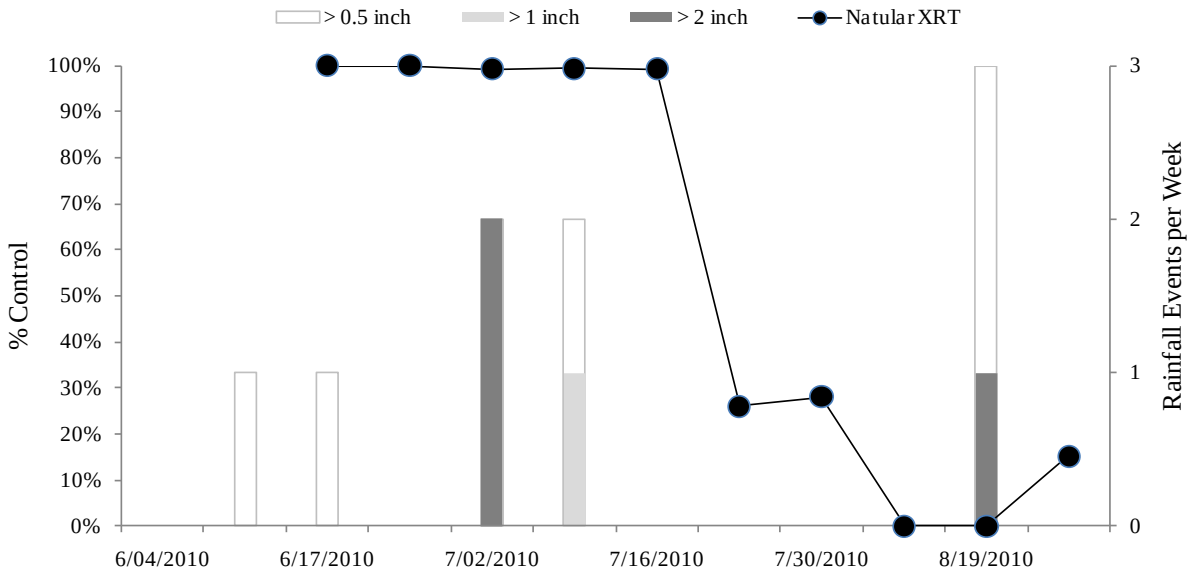


Figure 5.3 Percent control achieved by Natular® XRT compared to rainfall events (bars) during the week ending with the catch basin sampling date.

Control of Spring *Aedes* in Ground Sites The primary goals of control material tests in 2010 was to find a longer lasting material to decrease the number of times per season staff need to treat breeding sites in April and May to control multiple broods of various spring *Aedes* mosquitoes. Few larvicides effectively control spring *Aedes* larvae because of low water temperatures. VectoBac® G (*Bti*) works well, but lasts only 24-48 hours. Many sites require multiple VectoBac® G treatments in April and May.

We chose 52 ground sites (small, temporary wetlands < 3 acres) with histories of consistent high levels of spring *Aedes*. Ten were treated with Natular® XRG (10 lb/acre), 10 with Altosid® XRG (10 lb/acre), 16 with Altosid® pellets (2.5 lb/acre), and 16 remained untreated. All sites were dipped before any were treated. Treatments were made between April 1 and April 6, 2010. All sites were dipped each week thereafter through June 4, 2010.

Clarke Natular® XRG Before treatment, larval abundance was similar in sites treated with Natular® XRG on April 3 and those chosen to remain untreated (Figure 5.4). Larvae virtually disappeared from Natular® XRT-treated sites through the remainder of the test beginning one week after treatment while larvae remained abundant in untreated sites (Figure 5.4). Natular® XRG was effective at water temperatures between 38 and 84˚F. We conclude that Natular® XRG was effective for at least seven weeks after treatment.

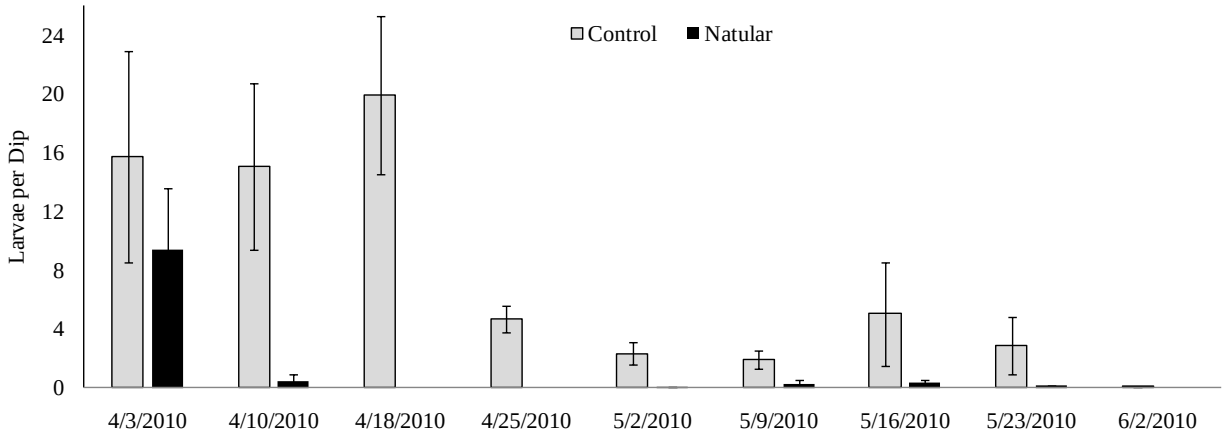


Figure 5.4 Mean larvae per dip in untreated and Natular® XRG-treated ground sites (treatment on April 3, 2010 immediately after sites were dipped). (mean±SE)

Altosid® XRG and Altosid® pellets Efficacy of Altosid® XRG and Altosid® pellets was determined using pupal bioassays. Bioassays of pupae taken from the 16 untreated sites were used to assess background mortality and correct bioassay results from Altosid-treated sites. Altosid® pellets were very effective two weeks after treatment (Figure 5.5, Table 5.5). Pupae could not be recovered from these sites later after treatment.

Altosid® XRG did not consistently control spring *Aedes* in this test (Figure 5.5, Table 5.5). The overall mean emergence inhibition (EI) was low. Only five of 19 bioassays were greater than the

upper 95% confidence limit (CL) for untreated mortality. These five bioassays were collected throughout the sampling period (Figure 5.5) as were the fourteen that did not differ significantly from untreated mortality.

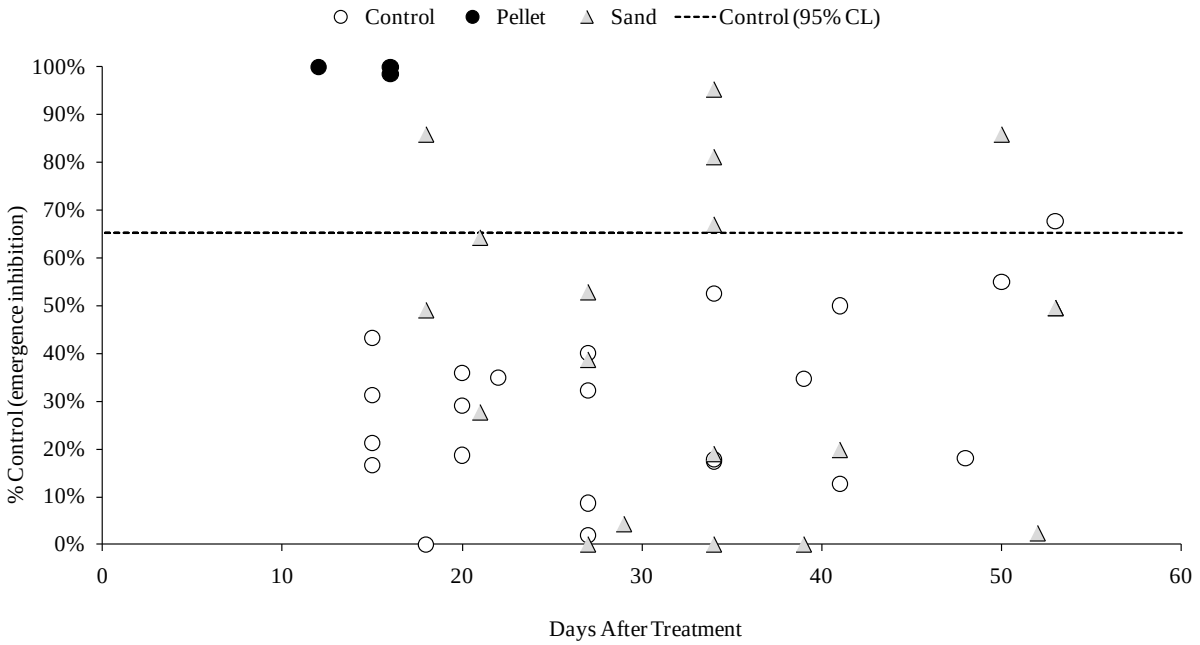


Figure 5.5 Bioassay results (emergence inhibition) of samples collected in untreated and Altosid®-treated sites. Emergence inhibition from Altosid®-treated sites were corrected for untreated control mortality.

Table 5.5 Bioassay results (emergence inhibition=EI) of samples collected in Altosid®-treated sites compared to the upper 95%CL for untreated control bioassays*.

Treatment (Altosid®)	Bioassays (n)	Corrected EI (Mean±SE)	Bioassays >95%CL (%)	Days after Treatment Mean±SE (min-max)
Pellet	4	99.65% (±0.35%)	4 (100%)	15 (±1.00) (12-16)
XRG	19	41.68% (±7.48%)	5 (26%)	34 (±2.65) (18-53)

* Untreated Control: mean EI=29.35% (SE=3.61%)(n=23); upper 95%CL=65.3%

Summer Treatments of Clarke Natular® XRG in Ground Sites Tests completed in 2008 and 2009 demonstrated that Natular® XRG can control the first brood of mosquitoes induced by rainfall in ground sites either treated before the rain or after larvae were present. In 2008 and 2009, Natular® XRG-treated sites did not reflood after they dried up, thereby preventing us from evaluating effectiveness against subsequent mosquito broods. In 2010, we were able to apply Natular® XRG (10 lb/acre) to four flooded ground sites that dried up completely and were flooded again by rainfall over a month later (Table 5.6). Two broods of mosquitoes, one each in August and September, were effectively controlled in all four sites treated with Natular® XRG, based on comparisons with breeding in nearby untreated control

sites (Table 5.9). These results justify larger scale tests in 2011 to verify that Natular® XRG can consistently control at least two broods of summer floodwater (e.g., *Ae. vexans*) mosquitoes.

Table 5.6 Larvae per dip in Natular® XRG-treated ground sites compared to untreated control sites after significant (>1 inch) rain events that flooded treated and control sites (SE=standard error; n= number of sites), 2010.

Inches of rain (mean, SE)		Date	Days post-treat	Larva per dip (mean±SE) (n)	
				Natular® XRG	Untreated Control
3.03	0.35	8/13			
		8/17*	0	7.90±4.42 (4)	40.00±10.00 (3)
		8/18	1	0.20±0.12 (4)	
1.46	0.08	9/23			
1.59	0.04	9/24	38	0.48±0.28 (4)	
		9/27	41	0.00±0.00 (4)	6.08±0.96 (6)

* Natular® XRG application made immediately after sites were dipped.

Experimental Products (various manufacturers) MMCD staff are working individually with multiple manufacturers to evaluate new products and/or formulations. In 2010, Technical Services conducted various trials and swath characterizations to evaluate, develop, and provide operational insight into these formulations. Due to various agreements, MMCD cannot disclose specific information about these products during a pre-agreed test period. MMCD conducted very preliminary small-scale tests of a mosquito larvicide under development by Valent Biosciences (VBC-60215). Efficacy of VBC-60215 is evaluated using pupal bioassays. We tested VBC-60215 in four sites and collected comparative bioassays from nearby untreated sites.

Both the 2.5 lb/acre and 4 lb/acre significantly controlled mosquitoes breeding in small ground sites in the summer (Table 5.7, Figure 5.6). The most complete data were collected from sites treated with 4 lb of VBC-60215 per acre. These data indicate consistent effectiveness for over 30 days after treatment in sites that dried up and reflooded. No pupae could be collected from sites treated with 2.5 lb of VBC-60215 per acre until 31 days after treatment. Effectiveness was significantly above background for all bioassays except the final pupal collection 50 days after treatment (Table 5.7, Figure 5.6). These results justify larger-scale tests in 2011 to verify that VBC-60215 can consistently control mosquitoes in the summer for at least 30 days after treatment.

Table 5.7 Bioassay results (Emergence inhibition=EI) of samples collected in VBC-60215 treated sites compared to the upper 95%CL for untreated control bioassays*, 2010.

Treatment dosage	bioassays (n)	Corrected EI Mean (±SE)	bioassays >95%CL (%)	Days After Treatment Mean (±SE)(min-max)
2.5 lb/acre	5	40.00% (±15.01%)	4 (80%)	40 (±4.14) (31-50)
4.0 lb/acre	11	67.41% (±12.72%)	9 (81.8%)	31.2 (±4.87) (7-50)

* Untreated Control: mean EI=4.38% (SE=1.09%)(n=4); upper 95%CL=11.35%

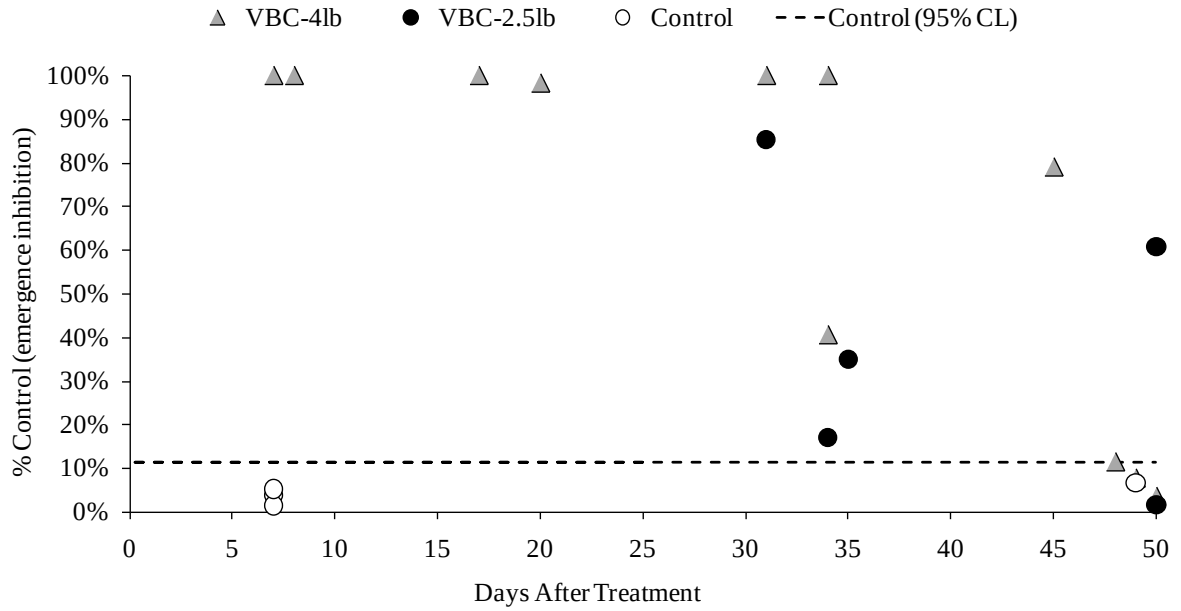


Figure 5.6 Bioassay results (emergence inhibition) of samples collected in untreated and VBC-60215-treated sites. Emergence inhibition from VBC-60215-treated sites were corrected for untreated control mortality.

VectoLex CG® for *Cq. perturbans* Control *Coquillettidia perturbans* is an abundant pest that lays its eggs in mid- to late summer and overwinters as larvae attached to aquatic vegetation, primarily cattail roots. Our current 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® CG (*B. sphaericus* 30-day granules) can provide good control for the subsequent season's cattail mosquitoes.

VectoLex CG® (20 lb/acre) applied in September 2008 to seven cattail marshes in Anoka and Washington counties while water temperatures were approximately 50°F achieved 95.7% control

of *Cq. perturbans* throughout the June-August emergence period (see 2009 Operational Review for details).

In August 2010, MMCD received 1,600 lb of VectoLex® granules for evaluation in *Cq. perturbans* sites. In September 2010, we treated 15 sites with VectoLex® granules, eight sites with 10 lb/acre and seven with 20 lb/acre. We plan to place emergence cages in these sites and up to nine untreated sites in June-August 2011 to verify the effectiveness of the 20 lb/acre dose and investigate the feasibility of using a lower dose (10 lb/acre).

Cognis Agnique MMF G® (30-day granules) Agnique MMF G is designed to control immature mosquitoes in the non-feeding life stage (i.e., late 4th instar and pupae) prior to emergence. This product could be beneficial when weather limits control operations during the few days when larvicides are effective following the beginning of a brood.

At the end of April 2010, we treated four small sites (10 lb/acre) containing spring *Aedes* that had become pupae. These sites contained plant debris that is typical for small sites in late April. The product sank and did seem to produce an oily sheen soon after application. It was also very dusty and seemed to break up easily. Post-treatment checks (dip counts) one, two, and five days after treatment revealed no changes in mosquito density.

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

Permethrin and Onslaught® barrier We completed two permethrin tests and one Onslaught® barrier test in 2010. All tests were conducted in woodlots where operational permethrin treatments could potentially be made and all tests included untreated woodlots. Efficacy was evaluated using CO_2 trap data and Mulla's equation (a correction that accounts for natural changes in the untreated control site, as well as the treatment site). It compares mean mosquito captures before and at various times after treatment. The goal of all tests was to better evaluate the duration and consistency of control achieved by barrier treatments. The first test was ended 24 hours after treatment because of problems with CO_2 traps in the permethrin-treated woodlot. This resulted in three CO_2 traps providing untreated control data and only two CO_2 traps providing permethrin data. The second test included two barrier adulticides, permethrin and Onslaught®. Onslaught® is a water-mixable formulation of microencapsulated esfenvalerate, another pyrethroid. Three CO_2 traps in each treated woodlot and in the untreated woodlot operated correctly throughout the test, which included sampling seven days after treatment.

Permethrin effectively controlled all species of mosquitoes for at least 24 hours in both tests; some efficacy persisted for seven days in the second test (Table 5.8). Efficacy of Onslaught® was comparable to permethrin in the second test (Table 5.8).

Sufficient WNV vectors (*Culex*4=*Cx. tarsalis*, *Cx. restuans*, *Cx. pipiens*, and *Cx. salinarius*) were captured during both tests to estimate vector-specific efficacy. Effectiveness against vectors lasted at least 24 hours (Table 5.10). These results are the same as results of previous vector-specific evaluations (tests in 2008) (see 2008 Operational Review for details).

Table 5.8 Results of two tests of permethrin* and Onslaught®** barrier treatment efficacy in 2010: one woodlot per treatment, three traps per woodlot. Efficacy percent calculated using Mulla's formula***

		All mosquito species		*Culex*4	
Test 1 June 30- July 2	Collection	CO_2 trap catch§	Efficacy	CO_2 trap catch§	Efficacy
Permethrin	Pre-treat	168.0 (±36.0)	---	1.0 (±1.0)	---
	Post-treat	17.5 (±7.5)	96%	0.0 (±0.0)	100%
	Post-24 hr	79.5 (±26.5)	77%	0.5 (±0.5)	90%
Untreated control	Pre-treat	193.3 (±33.3)	---	0.7 (±0.3)	---
	Post-treat	522.3 (±156.3)	---	1.0 (±0.6)	---
	Post-24 hr	396.0 (±313.4)	---	3.3 (±3.3)	---
Test 2 July 14-22					
Permethrin	Pre-treat	221.7 (±50.2)	---	8.3 (±4.7)	---
	Post-treat	55.0 (±21.9)	72%	6.3 (±3.5)	92%
	Post-24 hr	132.3 (±38.8)	58%	6.0 (±3.1)	71%
	Post-7 day	164.0 (±29.6)	22%	3.3 (±1.8)	52%
Untreated control	Pre-treat	308.7 (±135.2)	---	2.0 (±1.0)	---
	Post-treat	271.7 (±141.2)	---	18.7 (±9.0)	---
	Post-24 hr	443.3 (±224.9)	---	5.0 (±4.0)	---
	Post-7 day	294.0 (±77.2)	---	1.7 (±0.7)	---
Onslaught	Pre-treat	383.7 (±65.1)	---	8.7 (±7.2)	---
	Post-treat	132.7 (±77.4)	61%	7.3 (±4.3)	91%
	Post-24 hr	370.7 (±17.3)	33%	4.7 (±1.5)	78%
	Post-7 day	233.3 (±16.7)	36%	5.3 (±3.0)	26%

* Permethrin included in both tests

** Onslaught® included only in second test

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

§ Mean (±SE), n=3

In six previous tests (two in 2006, one in 2007, three in 2008), permethrin achieved high levels of control 24-48 hours after treatment. Effective control (≥80%) persisted for seven days in two of the four tests that were sampled seven days after treatment; control was lower in the other two tests (27%, 57%). Onslaught® effectively controlled mosquitoes for seven days in the 2007 test; it was not included in other tests until 2010. Enough WNV vectors were captured in two tests in

2008 to evaluate efficacy. Permethrin effectively controlled WNV vectors for at least 24 hours in both of these tests (see 2006, 2007 and 2008 Operational Reviews for details).

Zenivex® (ULV) compared to Anvil® Zenivex® is a new formulation of the pyrethroid etofenprox. Like Anvil® (sumithrin), Zenivex® is a softer adulticide, both because of its pyrethroid active and the lack of PBO in the formulation. We tested Zenivex® to increase the number of ULV adulticides we have available since Bayer has withdrawn the re-registration of Scourge® and it soon will no longer be available.

We tested Zenivex® in campgrounds in Anoka County. Efficacy was evaluated using Mulla's equation that compares mean mosquito captures from treated and untreated sites on the first night of trapping (pre-treatment counts) with mean mosquito captures the second and third nights of trapping (post-treatment counts). Three CO_2 traps were placed three consecutive nights in each untreated control and treated site. Test materials were applied at sundown on the second night of trapping; CO_2 traps were placed 30 minutes after the treatments were completed at both treated locations and the untreated control location. CO_2 traps were placed at sundown the first and third trapping nights.

Adult mosquitoes were effectively controlled in both tests completed in 2010 (Table 5.9). Efficacy waned 24 hours after treatment in the first test but remained high 24 hours after treatment in the second test. Both tests involved local area ULV treatments. Mosquitoes moving in from outside the treated area probably caused the rebound in mosquitoes 24 hours after treatment in the first test.

Anvil® effectively suppressed WNV vectors in both tests. Insufficient *Culex*4 vectors were captured in the Zenivex®-treated site during the first test to evaluate vector-specific effectiveness. Zenivex® effectively controlled WNV vectors in the second test (Table 5.9)

Table 5.9 Results of two tests of ULV Zenivex® (compared to Anvil®) in 2010; Mulla's formula incorporates untreated control trap counts to correct for changes in the treated traps that are not due to the treatment.

		All mosquito species		*Culex*4	
Test 1 June 22-24	Collection	CO_2 trap catch*	Efficacy	CO_2 trap catch*	Efficacy
Zenivex®	Pre-treat	758.3 (±206.3)	---	0.0 (±0.0)	---
	Post-treat	9.7 (±6.7)	97%	0.0 (±0.0)	N/A
	Post-24 hr	247.7 (±169.1)	62%	0.3 (±0.3)	N/A
Untreated control	Pre-treat	607.0 (±101.2)	---	0.7 (±0.7)	---
	Post-treat	287.7 (±92.7)	---	3.3 (±1.8)	---
	Post-24 hr	521.0 (±235.5)	---	1.3 (±1.3)	---
Anvil®	Pre-treat	563.7 (±86.7)	---	0.7 (±0.7)	---
	Post-treat	5.3 (±3.9)	98%	0.0 (±0.0)	100%
	Post-24 hr	293.3 (±66.4)	39%	4.7 (±4.2)	0%

Continued on next page

Test 2 July 12-15	Collection	All mosquito species CO_2 trap catch*	Efficacy	*Culex*4 CO_2 trap catch*	Efficacy
Zenivex®	Pre-treat	503.7 (±255.2)	---	14.7 (±11.8)	---
	Post-treat	9.0 (±2.6)	99%	2.0 (±1.5)	N/A
	Post-24 hr	40.3 (±19.4)	93%	2.7 (±2.7)	95%
Untreated control	Pre-treat	525.3 (±177.7)	---	1.0 (±0.6)	---
	Post-treat	781.3 (±33.5)	---	0.0 (±0.0)	---
	Post-24 hr	575.7 (±234.9)	---	3.7 (±1.2)	---
Anvil®	Pre-treat	1,271.3 (±482.4)	---	31.3 (±14.3)	---
	Post-treat	13.7 (±6.8)	99%	1.3 (±0.9)	N/A
	Post-24 hr	86.7 (±43.1)	94%	4.0 (±2.3)	97%

* Mean (±SE), n=3

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services staff and field staff conducted seven aerial calibration sessions for dry, granular materials during the 2010 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 eleven 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, the District works with vendors to use blank materials (no active ingredients) during these calibration sessions to remove and/or reduce the amount of active ingredients released into the environment. The District continues to strive to optimize equipment and improve methodologies to reduce the amount of products used in our operations.

Helicopter Swath Characterization of New and Developmental Larvicides Staff worked directly with five manufacturers to determine the aerial applicability of their products in MMCD operations. Swath characterization and application rate analysis assists MMCD in determining the viability of new products and their future use. All of these confidential evaluations met our application requirements and MMCD is hopeful that these products will continue to move forward to become significant tools in our future operations.

Preliminary Review of Larger Capacity Helicopter for Larvicide Applications MMCD conducts large-scale aerial applications in which the helicopter's efficiency may be limited by the access to landing sites and its hopper's carrying capacity. Technical Services is working with the helicopter contractor to evaluate if a different model helicopter with a larger load capacity could effectively treat more acres per day. We discussed options for a new experimental hopper design for a Bell Huey helicopter. This system would fit internally within the hold and be bulk loadable. The contractor will review the developmental, operational, and regulatory costs in this proposed system. Staff will review areas where a larger capacity helicopter might be applicable

and evaluate other possible benefits of this equipment. This equipment holds the potential to reduce the amount of staff required at landing sites, improve operational efficiency, save budgetary funds, and extend treatments to other areas.

Droplet Analysis of Ground-based Spray Equipment During March 2010, Technical Services and the East Region staff used our 20 ft x 40 ft indoor spray booth to evaluate our adulticide application equipment. This self-contained booth collects the adulticide spray particles, which minimizes their release into the air following the calibration process, thus limiting any environmental effects. Technical Service staff optimized 51 ultra low-volume (ULV) insecticide generators (truck-mounted, ATV-mounted, or handheld) using the KLD Model DC-III portable droplet analyzer. Staff uses this analyzer to fine-tune equipment to produce an ideal droplet spectrum of 8-20 microns. Adjusting the ULV sprayers to produce a more uniform droplet range maximizes efficacy by creating droplets of the correct size to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and swath coverage throughout the District.

Guardian Truck-mounted Cold Fog Unit In 2009, ADAPCO provided a new truck-mounted Guardian 190ES fogger for evaluation. Due to dry conditions during the 2009 season, we were only able to use this equipment one time. Therefore, further evaluation was carried over to 2010. The equipment demonstrated it can fulfill all of the requirements of our adulticide program and met our certification requirements. This fogger is now qualified for our equipment bid process. MMCD purchased this demo unit for operational use.

Optimizing Efficiencies and Waste Reduction

Improvement of Warehouse Functions In 2010, warehouse staff increased our storage capacity for our permethrin barrier spray products. Staff built additional specialized pallets to increase the available mixed product in the warehouse. By eliminating the immediate need for field facilities to return pallets prior to refilling operations, warehouse staff was able to better support field operations and increase warehouse efficiency.

Manufacturer and Vendor Relationships District staff continued to improve its working relationships with manufacturers and vendors. To aid in development of products and services that meet our operational needs, MMCD invites outside entities to work directly with our staff so they can develop a thorough understanding our field operations. By acquiring firsthand experience, manufacturers can better focus their product development in areas of mutual benefit. In 2010, four manufacturers toured MMCD facilities, interacted with staff, and closely observed field operations. This on-going program has already produced many improvements in product design, packaging, application methods, and other areas. MMCD staff also benefit from vendor interactions by learning about mosquito control operations around the world.

Recycling of Pesticide Containers MMCD continued to use the Minnesota Department of Agriculture's (MDA) pesticide container recycling program. This project focuses on properly disposing of agricultural pesticide waste containers thereby protecting the environment from 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 2010.

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.

MMCD staff collected 6,881 jugs for this recycling program. The control materials that use plastic 2.5 gal containers are sumithrin (175 jugs), *Bti* liquid (1,052 jugs), Altosid® pellets (5,634 jugs), and other materials (20 jugs).

MMCD also purchases adulticides in 55-gal drums and refills 5-gal steel cans of the same-labeled material thereby reducing the need for new packaging, resulting lower 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 were brought to a local company to be refurbished and reused.

Recycling of Pesticide Pallets In 2010, MMCD operations produced 1,253 empty hardwood 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.

Plans for 2011

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 2011, 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 structures and small, temporary wetlands to better determine how long they control mosquito larvae. We plan to expand spring and summertime tests of Natular® XRG in wetlands to verify that cost effective dosages can control mosquito larvae. We also plan to repeat tests of adulticides, emphasizing control of *Culex* and effectiveness of barrier treatments.

References

Mulla's Formula:

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

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

Mir S. Mulla, R. Lee Norland, Dean M. Fanara, Husam A. Darwazeh and Donald W. McKean. 1971. Control of Chironomid Midges in Recreational Lakes. J. Econ. Ent. 64(1): 300-307.

Gibbons, J.D. 1971. Nonparametric Statistical Inference. McGraw-Hill, New York

Marascuilo, L.A. and Serlin, R. C. 1988. Statistical methods for the Social and Behavioral Sciences. W. H. Freeman and Company, New York

Steel, R. G. D., Torrie, J. H., and Dickey, D. A. 1997. Principles and Procedures of Statistics. A Biometrical Approach. McGraw-Hill, New York

World Health Organization Specifications and Evaluations for Public Health Pesticides Spinosad (2008).
www.who.int/entity/whopes/quality/Spinosad_eval_only_March_2008.pdf

Chapter 6 Supporting Work

2010 Highlights

- Developed new central web map for Aerial Treatment track review
- Updated Customer Call Tracking system, added landmark/parks look-up
- Developed vehicle mileage record system
- Contributed to new Aerial Photo acquisition
- Continued education efforts on stormwater and mosquitoes
- Requests for treatment more than doubled in 2010 compared with 2009
- Presented "Mosquito Mania" curriculum

2011 Plans

- Continue major redesign of data systems to upgrade hardware and software
- Modify "Mosquito Mania" curriculum for use with "SMART board" technology

2010 Projects

Data and Mapping Systems

A major focus in 2010 was planning and testing in preparation for a major transition in MMCD's data systems. Some key hardware and software components supporting the current data system are becoming obsolete, and new approaches may offer major benefits. The main changes planned include:

- moving to more centralized databases
- web-based access (focused on internal users)
- tighter integration of maps and data
- rapid access to useful reports ("Dashboard") to help optimize resource use
- reducing software maintenance by using fewer platforms/programs

We are hoping that a web-based approach allows easier access from mobile devices as well, as we look for cost-effective alternatives to the current handheld devices for field data entry.

The following projects demonstrate how this approach is being applied.

Aerial Treatment Tracking – Web Map and Report

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 2010. MMCD staff give digital site boundary files to pilots and retrieve treatment tracks when flights are completed. (Staff also provided marked paper maps.) In the past, staff members have reviewed the individual raw track files using desktop MapInfo at each field office.

Starting in late 2009, we worked with Houston Engineering Inc. (HEI) to develop a web-based system for AG-NAV track review. With this system, field staff can upload the flight tracks from any computer with web access. Tracks are processed and estimated treatment area compared with

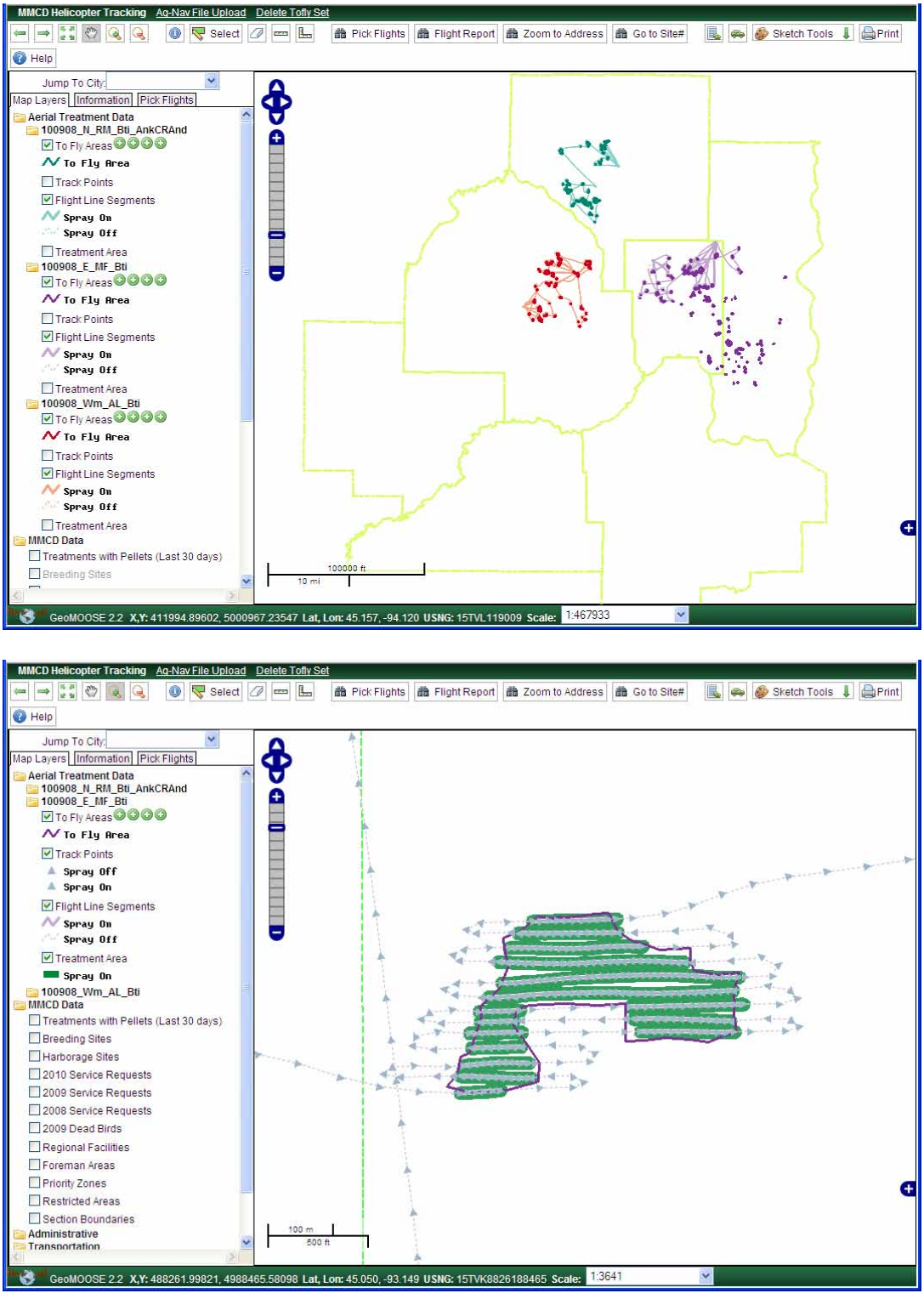


Figure 6.1 Example of screen shots of flight tracks using new web map.

the “to-fly” area given to the pilots. A “Flight Report” is produced using data from MMCD’s wetland breeding sites database as well as data from the flight tracks. The report highlights any

possible problems that field staff should review with pilots. All MMCD staff members have immediate access to uploaded flight track information, and can easily evaluate progress or compare tracks between facilities, using a simple web browser. Pilots have complete viewing access to the system through a password-protected portal.

The web map system was developed entirely with open source software (PHP for forms and scripts, PostgreSQL, PostGIS for data storage and spatial queries, GeoMoose and MapServer for map interface, jQuery for reports) and takes advantage of MMCD's existing web map applications.

The system was thoroughly tested in 2010, as we had more aerial treatments than any other time in the last 10 years. The site handled 384 separate flight tracks, totaling 7.9 million track points. There were no problems with database or query response time. Experienced users of the old system found it easier to use the new system, and reported they were more likely to review tracks and use the estimated treatment area to assess treatments. The system made it much easier for new users and for pilots to access track data. This was especially useful for working with new pilots. Customer calls can also easily be compared with helicopter tracks. Given the cost of aerial site treatments ranges from about $200 to $2000 per site, we consider the track review and flight report system a cost-effective way to ensure treatment quality.

Customer Call System Updates

The web-based customer call management system developed by HEI for MMCD in 2008 continues to provide an important conduit of information and requests for service from citizens (see results below). In late 2009-2010, the system was revised to upgrade mapping capabilities and add more extensive tracking for dead bird reports.

Capability to map locations described by landmark names (e.g., "Como Park") was also added, taking advantage of the Landmark/Point-of-Interest Geocoder developed in conjunction with MetroGIS in 2009 (for more information on the MetroGIS Geocoder Project see www.metrogis.org/data/apps/geocoder/). Geocoding is an important first step in the call system and allows calls to be automatically routed to the appropriate facility and foreman.

At the end of 2010, staff began a review of MMCD's systems to record and map requests for "Restricted Access" (people who have asked for notification before entry on their property, or asked for limited or no treatments). These calls are currently recorded in the new Customer Call system, but the field data systems had used a link to the previous call system to automate update. A project is now underway with Houston Engineering to move field verification and mapping of restricted access areas to the new web-based system, using county parcel data as a base. This will be MMCD's first web application using on-line polygon editing for map updates.

Public and Internal Web Map Sites

MMCD'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 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 2010, the public web map access page on MMCD's site received 3,318 visitors (up from 2,996 in 2009 but down from 4,623 in 2008). Activity level ranged from around 100 per month in the off-season to 1,000 per month peak (July).

A separate internal version with greater detail is available from MMCD computers that includes tools to query site data, allowing staff to explore patterns of wetland site inspections and larval treatments District-wide.

Field & Lab Data Entry and Reporting

Our electronic field and lab data entry system, "DataGate", handles inspection, treatment, sample, and physical inventory data and provides daily updates for the public web map site. Field data is entered using Palm OS-based personal digital assistants (PDAs), and uploaded to the network databases when field staff return to their base.

In 2010, the major change made to the entry forms and data structures was to add truck mileage recording. These records are designed to help MMCD evaluate costs and potential improvements.

Wetland and Stormwater Mapping

MMCD joined with MnGeo, MnDNR, Metropolitan Council, and several metropolitan counties in sponsoring aerial photography collection in the spring of 2010 (leaf-off, 1 ft resolution). This high-quality photography is being used this winter as an important part of updating MMCD's field maps of possible larval mosquito habitats. MnGeo (state Geospatial Information Office) provides these photos as a web service, which saves users like MMCD from the expense of storing and indexing this large amount of photos.

MMCD has approximately 70,000 wet areas mapped as potential larval mosquito habitat. This dataset is made broadly available through the MetroGIS "DataFinder" service.

In addition to wetlands, MMCD staff members map locations of many stormwater structures, such as street catch basins, large culverts or separators, and pond water level regulators, which provide larval habitat for species such as *Culex* vectors of West Nile virus and for *Aedes japonicus.* A total of 21,860 structures are now mapped, in addition to catch basins.

MMCD 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. In 2010, staff worked with MetroGIS and obtained Metropolitan Council funding for a pilot project run by Ramsey Washington Metro Watershed

District to test use of the standard for compiling data from multiple cities and other government units maintaining stormwater structure records (details available on MetroGIS web site).

A District staff member 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. This project will be updating the NWI for an area including the metro, using the 2010 aerial photography mentioned above.

MMCD staff continue to participate in MetroGIS, and in 2010 assisted with various projects providing benefit to metro governments, such as reviewing proposals for a renewed contract for a shared street centerline data layer (used as a base for MMCD field maps and for the geocoder in the Customer Call system and web maps).

Stormwater Management, Wetland Design, and Mosquitoes

MMCD staff 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 district staff, U of M researchers) and presented a poster on the spread of *Ae. japonicus* in metro stormwater habitats.
- The "Stormwater and Mosquitoes" page on the MMCD web site received 1,031 visits in 2010, up slightly from 2009. (see Resources – Stormwater Management, http://www.mmcd.org/storm.html)
    - The fact sheet on rain barrels recorded 636 downloads, about the same as in 2009.
    - The 2009 Rain Gardens poster (made available through the web site at the request of 2009 Water Resources Conference participants), recorded an additional 121 downloads in 2010 (after 280 downloads in Nov-Dec 2009).
    - The "Mosquitoes and Wetlands" slide show recorded 47 visits.
    - The site includes a link to the section on mosquitoes in the MPCA Stormwater Manual (http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html)

The Society of Wetland Scientists (SWS) White Paper on mosquitoes and wetlands in which MMCD staff participated was published in the June 2010 issue of the SWS journal *Wetland Science and Practice*. Staff member N. Read continued promoting this work through a symposium at the American Mosquito Control Association (AMCA) annual meeting.

Other publications of note in this area done by other members of the AMCA stormwater and wetlands committees include an article in the September 2010 issue of Stormwater magazine titled "Fighting Mosquitoes in Stormwater Systems" which highlights the importance to mosquito control of knowing where "Best Management Practice" structures are and their maintenance plans (http://www.stormh2o.com/september-2010/fight-stormwater-mosquitoes.aspx).

MMCD staff are also participating in the Minnesota Climate Change Adaptation Working Group. Composed of the state climatologist, U of MN staff, and representatives from a number of state agencies and watershed districts, the group focuses on predicting and preparing for

temperature and particularly water-related changes, and shares insights and potential challenges member's agencies face (see Presentations, below). The group sponsored a summit in 2010 (see http://www.arboretum.umn.edu/cleanwaterclimatechangeadaptationsummit.aspx).

Nontarget Studies

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 2006-2010 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	2010
SPRP Final Report, 1996		89	289	313	499	703
Long-term study brief overview		72	125	58	58	116
Results summary (1991-1998) with graphs		119	213	223	190	269
Balcer et al. 1999 Report	text	104	190	73	47	116
	figures	66	122	23	25	58
	tables	61	119	37	48	77
	appx. – cores	48	130	26	31	59
	appx. – substrates	41	107	27	26	71
Dose Report		62	131	92	116	120

The frog malformation study done by C. M. Johnson et al. (NRRI Technical Report # NRRI/TR-2001/01) showed 72 downloads in 2010, up from 12 downloads in 2009.

Permits and Treatment Plans

National Pollutant Discharge Permit Issues Starting April 9, 2011, a Clean Water Act - National Pollutant Discharge Elimination System (NPDES) permit will be required for most applications of mosquito control pesticides to water. This is a result of a January 2009 ruling by the U.S. Sixth Circuit Court of Appeals, which struck down a 2006 Environmental Protection Agency (EPA) rule saying the Clean Water Act did not regulate most pesticide applications to water if use complied with label requirements. On February 22, 2010, the Supreme Court declined industry's request to review the Sixth Circuit's decision, and in June, EPA presented a proposed General Permit for review (http://cfpub.epa.gov/npdes/home.cfm?program_id=410). A final version of the General Permit was expected in December 2010.

The EPA General Permit applies in certain areas not regulated by states; in most areas, states are expected to develop their own permit. Several states have already done so (for example, information for Washington is at http://www.doh.wa.gov/ehp/ts/Zoo/WNV/Permit.html). Minnesota is in the process of developing a permit (http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-permits-and-forms/pesticide-npdes-permit-program.html). MMCD staff will continue to work with MPCA to fulfill the permit requirements.

The EPA fact sheet on the permit describes the following steps as part of the recommended permit process:

- Identify the pest problem in the pest management area prior to the first application each calendar year.
- Establish densities for larval and adult mosquito or flying insect pest populations to serve as action threshold(s) for implementing pest management strategies.
- Develop a species-specific pest management strategy based on developmental and behavioral considerations for each target species.
- Identify known breeding sites for source reduction, larval control program, and habitat management. Mapping should also be a priority in a surveillance program utilizing mosquito traps, biting counts, complaints, and reports from the public. Analyze existing surveillance data to identify new or unidentified sources of mosquito or flying insect pest problems as well as sites that have recurring pest problems.
- Select and implement, for each pest management area, efficient and effective means of pest management that minimize discharges resulting from application of pesticides to control mosquitoes or other flying insect pests. Evaluate the following management options, considering impact to water quality, impact to non-target organisms, pest resistance, feasibility, and cost effectiveness: no action; prevention; mechanical/physical methods; cultural methods; biological control agents; and pesticides.
- Conduct larval and/or adult surveillance prior to each pesticide application to assess the pest management area and to determine when action threshold(s) are met that necessitate the need for pest management.
- Assess environmental conditions (e.g., temperature, precipitation, and wind speed) in the treatment area prior to each pesticide application to identify whether existing environmental conditions support development of pest populations and are suitable for control activities.
- Reduce the impact on the environment and on non-target organisms by applying the pesticide only when the action threshold has been met.
- In situations or locations where practicable and feasible for efficacious control, use larvicides as a preferred pesticide for mosquito or flying insect pest control when larval action thresholds have been met.
- In situations or locations where larvicide use is not practicable or feasible for efficacious control, use adulticides for mosquito or flying insect pest control when adult action thresholds have been met.

U.S. Fish & Wildlife Service – Mosquitoes and Refuges MMCD continues to do mosquito sampling on local U.S. Fish & Wildlife Service (FWS) lands under a Special Use Permit to watch for possible vector species. The "Minnesota Valley National Wildlife Refuge Mosquito-Borne Disease Human Health Emergency Response Procedure" and Pesticide Use Proposals for the larvicide, *Bacillus sphaericus* (VectoLex®), and adulticide, sumithrin (Anvil®), remain in effect. This procedure was prepared by FWS staff in 2009 to allow for treatment of disease vectors if “a mosquito-borne disease human health emergency exists in vicinity of the Refuge” (agreed on by MDH, FWS, and MMCD) and such treatment “is found to be appropriate”. In October 2007, the national FWS office released a draft mosquito and mosquito-borne disease management policy for comment, but a final version of this has not been released, and work by MMCD and local FWS staff on a more comprehensive mosquito plan for refuges inside the District was set aside until the national policy is finalized.

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 worked with the Minnesota Newspaper Association to publish a 3-column by 9-inch ad in local weekly newspapers, just prior to Memorial Day weekend, advising citizens how to find out where and when District adulticiding would take place on any given day. This ad also described the process for opting out of treatment. Aerial larvicide treatment schedules are also posted on the web site and recorded on the bite line as they become available.

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 6.2). Despite a more normal precipitation pattern in 2010, MMCD efforts to control adult mosquito populations – at least to the satisfaction of the general public – appear to have been successful. People planning outdoor activities, such as picnics, outdoor weddings, and graduation open houses continue to be responsible for many early season calls, as they anticipate the number of mosquitoes with which they may have to contend. A late season surge in mosquito numbers, as measured by weekly sweep net counts, appears to have caused a spike in the number of calls from individuals requesting treatment just prior to Labor Day weekend.

As MMCD staff continued to track the rapid spread of the exotic species *Ae. japonicus* in 2010, 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 calls requesting tire pick-up and recycling along with a greater general focus on cleaning up container-filled sites.

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 a total of 1,375, then decreased again in 2009 to a total of 594 (April through September). Total calls requesting treatment were up sharply again in 2010. Calls requesting treatment for public and private events increased significantly in 2009 but were down again in 2010. Requests to pick up dead birds for WNV testing (not included in this table) also continued to be considerably lower in 2010 due to low WNV activity.

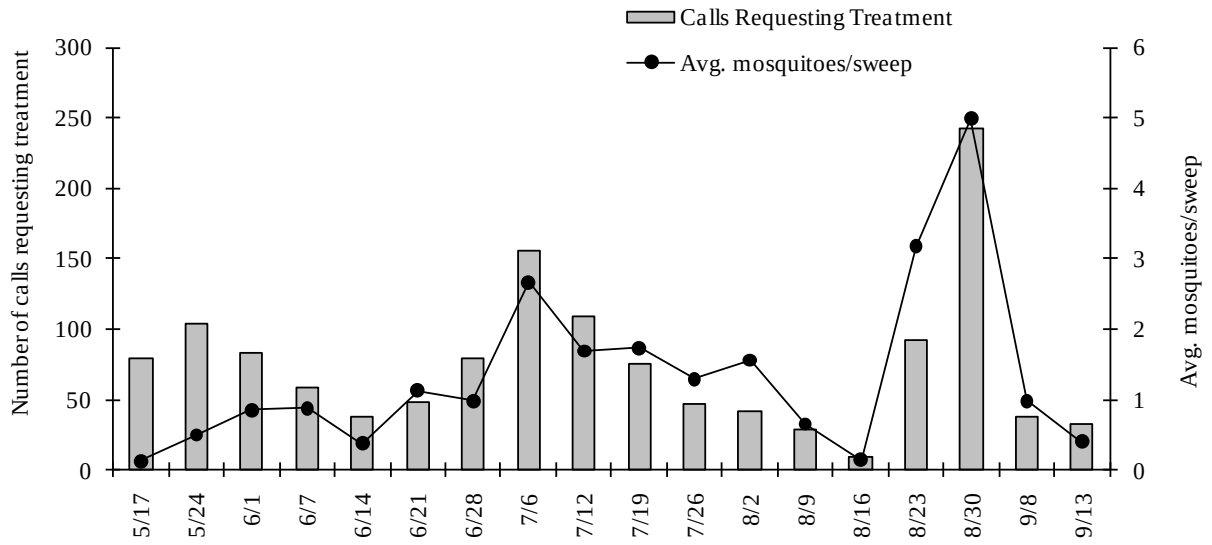


Figure 6.2 Calls requesting treatment of adults, and sweep net counts, by week, 2010.

Table 6.2 Yearly comparisons of citizen calls tallied by service request from 2002 to 2010*

	No. Calls/Year								
Caller Concern	2002	2003	2004	2005	2006	2007	2008	2009	2010
Check a breeding site	1,307	1,516	984	633	610	393	220	197	164
Request adult treatment	3,062	2,714	2,506	1,094	854	867	1375	594	1384
Public event, request treatment	171	132	135	100	72	60	109	250	78
Request tire removal	321	236	255	242	170	208	257	253	335
Request or confirm limited or no treatment	**190	60	38	36	**171	49	66	61	55

* Includes email requests for service

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

Curriculum in Schools MMCD continued 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 regional facility staff made presentations to 4,990 students in 51 schools during 2010. Plans for 2011 include modifying the curriculum for on-line delivery and using "SMART board" technology, available in most metro-area classrooms. We will also continue to monitor changes in middle-school learning standards and make the adjustments necessary to keep the curriculum relevant and useful.

Professional Association Support

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

- Jim Stark is continuing in the elected position of Regional Director for the North Central AMCA region, and serves on the AMCA Board of Directors
- 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 again in 2010.

North Central Mosquito Control Association Mark Smith serves on the Board of Directors of this regional association focused on education, communication, and promoting interaction between various regional organizations and individuals in Minnesota, North Dakota, South Dakota, Wisconsin, Iowa, and the Central Provinces of Canada. Many MMCD staff members are involved in planning the 2011 annual meeting, which will be hosted at our North facility in Andover, MN, as it was in 2008. Mark will be serving as Emcee/Moderator and giving the Treasurer's Report and Update from the Board.

Scientific Presentations, Posters, and Publications

MMCD staff attends a variety of scientific meetings throughout the year. Following is a list of papers and posters presented during 2010 and talks that are planned in 2011. Also included are publications that have MMCD staff as authors or co-authors.

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.

Jarnefeld, J. Vector Ticks and Mosquitoes. Presentation to MNDOT, May 25, 2010.

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

Johnson, K. and N. Read. 2010. New mosquito species spreads through Metro area habitats. Poster presentation at MN Water Resources Conference, Oct. 19, 2010.

Johnson, K. Exotic mosquitoes in Minnesota. Presentation at the Minnesota Structural Pest Management Conference, March 2, 2010.

Johnson, K. *Aedes japonicus* in North America: Perspectives from a neighboring state. Presentation at the South Dakota Mosquito Control Conference, April 20, 2010.

Johnson, K. Exotic mosquitoes in Minnesota. Presentation at the Minnesota Pesticide Applicator's Recertification Workshop, July 29, 2010, and August 12, 2010.

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.

McLean, M. Exotics 101: What makes an exotic exotic? Presentation at Minnesota Pesticide Applicator Recertification workshops, July 29, August 12, and November 15, 2010.

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.

Read, N. 2010. Adapting to climate change: Issues for the Metropolitan Mosquito Control District. Presentation in speaker series at MnPCA, Oct. 28, 2010.

Read, N. and L. Kne. 2010. Upload, see and understand: Spatial databases and web mapping for GPS tracks. Presentation at Mn GIS/LIS Conference, Oct. 14, 2010.

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.

Walz. J. and D. Clark, 2010. National Pollutant Discharge Elimination System (NPDES) update. Presentation at the North American Black Fly Association Meeting, Lake Placid, FL.

2010 Publications

Berg, J., Felton M., Gecy L., Laderman A., Mayhew C., Mengler J., Meredith W.H., Read N., Rey J., Roberts C., Sakolsky-Hoopes G., Walton W.E., Wolfe R. (submitted). Mosquito control in wetlands. *Wetland Science and Practice, June 2010.*

Crane, D.M. and R.D. Moon. 2010 Checklist of mosquitoes in Savanna Portage State Park, North-Central Minnesota. *J. Amer. Mosq. Control Assoc.* 26(3):324-327.

Johnson, K., S.J. Brogren, D.M. Crane, and C.A. LaMere. 2010. Status of *Aedes japonicus* in the Metropolitan Mosquito Control District, Minnesota. *J. Amer. Mosq. Control Assoc.* 26(3):328-331.

2011 Presentations & Posters

Fischer, B. and N. Read. 2011. Managing aerial GPS tracks with an enterprise web-based GIS application. Presentation at the American Mosquito Control Association Annual Meeting in Anaheim, CA.

Manweiler, S. 2011. Evaluating effectiveness of barrier adulticide treatments in Minnesota. Presentation at the Michigan Mosquito Control Association Annual Meeting, Grand Rapids, MI.

Smith, M. 2011. Budget issues – A review of your program can lead to cost savings and efficient operations. Presentation at the American Mosquito Control Association Annual Meeting in Anaheim, CA.

Stark, J. 2011. Distribution of *Aedes japonicus* in Minnesota. Presentation at the Michigan Mosquito Control Association Annual Meeting, Grand Rapids, MI.

Stark, J., S. Manweiler, and K. Johnson. 2011. One Natular XRT® treatment controls WNV vectors in Minnesota catch basins all season (June-September). Presentation at the American Mosquito Control Association Annual Meeting in Anaheim, CA.

Walz J. and D. Clark. 2011. National pollutant Discharge elimination system (NPDES): permit application guidelines for black fly control. Presentation at the North American Black Fly Association Meeting, Athens, GA.

APPENDICES

APPENDIX A Mosquito Biology

There are 51 species of mosquitoes in Minnesota, forty-five of which occur 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 flood water 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. 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. MMCD monitors this species using New Jersey light traps and CO_2 traps.

Other *Culex* Three additional species of *Culex* (*Cx. pipiens, Cx. restuans,* and *Cx. salinarius*) are vectors of WNV. All three breed in permanent and semipermanent sites and *Cx. pipiens* and *Cx. restuans* breed in storm sewers and catch basins as well.

Culiseta melanura *Culiseta melanura* is the enzootic vector of eastern equine encephalitis. Its preferred breeding sites are spruce tamarack bogs. Adults do not fly far from their breeding sources. A sampling strategy including both larvae and adults is currently being developed.

Floodwater Mosquitoes

Spring Snow Melt *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, Ae. punctor, Ae. excrucians* and *Ae. stimulans*. Adults are not attracted to light, so human or CO_2-baited trapping is recommended.

Summer Flood Water *Aedes* Eggs of summer floodwater species hatch in late April and early May. Floodwater mosquitoes lay their eggs 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. canadensis*, *Ae. cinereus*, *Ae. sticticus* and *Ae. trivittatus*. New Jersey light traps, CO_2-baited traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans This summer species breeds in cattail marshes and is called the cattail mosquito. A unique characteristic of this mosquito is that the larvae can obtain oxygen by attaching its specialized siphon to the roots of cattails and other aquatic plants. They overwinter 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 the breeding site. Peak biting activity is at dusk and dawn. Surveillance of adults is best achieved with CO_2 traps.

Permanent Water Species

Larvae of other mosquito species not previously mentioned develop in permanent and semipermanent sites. These mosquitoes comprise the remaining *Anopheles*, *Culex*, and *Culiseta* species. These mosquitoes are multi-brooded and lay their eggs in rafts on the surface of the water. The adults prefer to feed on birds or livestock but will bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. 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 that they are established in the District and southeast Minnesota. Larvae inhabit 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. It is not considered a vector, but is an aggressive pest in Canada. More surveillance is needed to determine if this species is established in Minnesota.

APPENDIX B Average Number of Common Mosquito Species Collected per Night in 4 New Jersey Light Traps and Average Yearly Rainfall - 1965-2010

Year	Spring *Aedes*	*Aedes cinereus*	*Aedes sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Cq. perturbans*	All species	Avg. Rainfall
1965	0.10	0.22	0.06	0.01	107.54	8.76	1.28	135.69	27.97
1966	0.16	0.06	0.00	0.01	17.26	0.45	1.99	22.72	14.41
1967	0.31	0.27	0.25	0.03	85.44	0.96	4.93	95.5	15.60
1968	0.21	0.71	0.04	0.19	250.29	2.62	3.52	273.20	22.62
1969	0.15	0.23	0.01	0.03	20.39	0.57	3.57	30.12	9.75
1970	0.20	0.57	0.03	0.33	156.45	0.97	3.07	179.71	17.55
1971	0.87	0.42	0.12	0.11	90.45	0.50	2.25	104.65	17.82
1972	1.05	1.79	0.19	0.07	343.99	0.47	14.45	371.16	18.06
1973	0.97	0.68	0.03	0.04	150.19	0.57	22.69	189.19	17.95
1974	0.37	0.36	0.10	0.03	29.88	0.26	5.62	38.75	14.32
1975	0.28	0.63	0.44	0.17	40.10	6.94	4.93	60.64	21.47
1976	0.24	0.04	0.01	0.00	1.69	0.25	4.24	9.34	9.48
1977	0.14	0.07	0.00	0.02	21.75	5.98	7.42	34.07	20.90
1978	0.84	0.77	0.17	0.11	72.41	4.12	0.75	97.20	24.93
1979	0.29	0.21	0.03	0.48	27.60	0.29	2.12	35.44	19.98
1980	0.03	0.19	0.05	0.79	74.94	0.93	16.88	96.78	19.92
1981	0.05	0.14	0.13	0.69	76.93	1.50	4.45	87.60	19.08
1982	0.10	0.08	0.02	0.03	19.95	0.23	3.16	25.91	15.59
1983	0.15	0.08	0.02	0.04	45.01	0.67	3.44	53.39	20.31
1984	0.08	0.09	0.15	0.36	74.68	2.97	22.60	110.26	21.45
1985	0.07	0.00	0.02	0.01	21.02	0.33	4.96	28.72	20.73
1986	0.35	0.22	0.11	0.04	30.80	1.55	2.42	40.76	23.39
1987	0.00	0.09	0.01	0.17	29.91	1.18	1.52	37.43	19.48
1988	0.01	0.09	0.00	0.00	12.02	0.84	0.18	15.31	12.31
1989	0.05	0.35	0.01	0.26	13.13	1.60	0.17	21.99	16.64
1990	0.30	3.39	0.22	0.08	119.52	4.97	0.08	147.69	23.95
1991	0.11	0.56	0.15	0.26	82.99	1.17	0.45	101.33	26.88
1992	0.04	0.04	0.03	0.13	50.30	0.62	16.31	74.56	19.10
1993	0.03	0.24	0.10	1.15	50.09	0.96	10.90	72.19	27.84
1994	0.02	0.14	0.03	0.08	23.01	0.05	15.19	40.92	17.72
1995	0.04	0.28	0.02	0.29	63.16	0.42	6.79	77.71	21.00
1996	0.12	0.10	0.01	0.04	14.28	0.05	12.06	28.81	13.27
1997	0.09	0.64	0.14	0.63	39.06	0.14	2.03	45.35	21.33
1998	0.03	0.14	0.16	1.23	78.42	0.10	6.13	91.29	19.43
1999	0.01	0.28	0.09	0.11	28.24	0.06	1.74	33.03	22.41
2000	0.01	0.07	0.00	0.22	24.09	0.15	1.36	29.50	17.79
2001	0.05	0.41	0.32	0.10	20.97	0.27	1.01	26.26	17.73
2002	0.05	0.22	0.07	2.53	57.87	0.35	0.75	65.82	29.13
2003	0.04	0.15	0.43	2.00	33.80	0.13	1.59	40.51	16.79
2004	0.02	0.33	0.22	0.63	24.94	0.16	0.99	28.91	21.65
2005	0.05	0.11	0.17	0.42	22.27	0.17	0.57	25.82	23.60
2006	0.05	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	0.38	0.32	0.17	0.01	8.17	0.10	2.01	12.93	14.15
2009	0.10	0.07	0.00	0.02	3.48	0.04	0.23	4.85	13.89
2010	0.07	0.08	0.06	0.17	16.18	0.23	0.36	26.13	24.66

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 2010 are given. The generic products will not change in 2011, although the specific formulator may change.

Altosid® (methoprene) 150-day briquets Central Life Sciences - Altosid® XR Extended Residual Briquet)

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

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 Central Life Sciences -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 that are greater than three acres in size at the same rate as ground sites, primarily for *Cq. perturbans* control.

Altosid® (methoprene) SR-20 liquid Central Life Sciences -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/Ochlerotatus* mosquito larvae. Typical applications are to woodland pools. Sites that are 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 Central Life Sciences -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*) corn cob** Valent Biosciences-VectoBac® G

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

***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 corn cob may be experimentally applied in all types of larval *Culex* mosquito habitats. *Bacillus sphaericus* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical experimental 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, *B. sphaericus* 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)* corn cob** Valent Biosciences-VectoMax® CG

Bti/Bs corn cob may be experimentally applied in all types of *Culex* mosquito breeding. It combines the rapid kill of *Bti* and the residual activity of *Bs*. Typical experimental 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 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 basins and other small storm water 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 10 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 storm water 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 are defined as wooded areas with good ground cover to provide a shaded, moist area for mosquitoes to rest during the daylight hours.

Adult control is initiated when MMCD surveillance (sweep net and 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. MMCD also treats functions open to the public and public owned park and recreation areas upon request and at no charge if the event is not-for-profit.

The 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.

Etofenprox Central Life Sciences-Zenivex® E20

Etofenprox is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Etofenprox 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. Etofenprox is applied at a rate of 1.0 oz of mixed material per acre (0.00175 lb active ingredient per acre). Etofenprox 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 used 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 used compound.

APPENDIX D 2010 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 (lbs)	Field life (days)
Altosid® briquets [a]	Methoprene	2.10	220	0.4481	150
			330	0.6722	150
			440	0.8963	150
			1*	0.0020*	150
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063	30
			4 lb	0.1700	30
			0.0077 lb* (3.5 g)	0.0003*	30
Altosid® 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 2002-2010; the actual geographic area treated is smaller because some sites are treated more than once

Control Material	2002	2003	2004	2005	2006	2007	2008	2009	2010
Altosid® XR Briquet 150-day	628	323	398	635	352	290	294	225	174
Altosid® Sand-Products	1,822	0.5	0	0	0	1,776	6,579	8,320	9,924
Altosid® SR-20 liquid	51	33	0	0	0	0	0	0	0
Altosid® Pellets 30-day	16,521	18,458	19,139	29,965	31,827	36,818	35,780	35,161	36,516
Altosid® Pellets Catch Basins	0	135,978	148,023	145,386	167,797	161,876	195,973	219,045	227,611
Altosid® XR Briquet Catch Basins	0	0	0	0	5,210	6,438	40	0	0
VectoLex® CG granules	0	0	0	810	540	27	6	0	0
VectoMax® CG granules	0	0	0	0	0	0	182	5	0
Bti Corn Cob granules	202,875	113,198	166,299	176,947	160,780	118,128	122,251	151,801	250,478
Bti Liquid Black Fly (gallons used)	3,169	3,408	2,813	3,230	1,035	1,348	2,063	2,181	2,595
Permethrin Adulticide	5,734	6,411	8,292	7,982	5,114	3,897	8,272	4,754	8,826
Resmethrin Adulticide	43,302	68,057	71,847	40,343	29,876	24,102	64,142	12,179	27,794
Sumithrin Adulticide	32,230	14,447	15,508	25,067	5,350	5,608	35,734	7,796	26,429
Pyrenone® Adulticide	0	0	0	0	0	0	2,214	943	2,560
Pyrocide® Adulticide	0	0	0	0	0	0	299	0	0

APPENDIX F 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®
Zenivex®

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, floodplains, 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

ZOECON

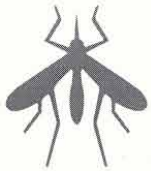
Wellmark International
Schaumburg, Illinois U.S.A.

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.

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)

* 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	*Anopholes 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 - 800-323-8397

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: Salt marshes, mangroves, estuaries.	5-20 lbs/acre**
Water Bodies: Natural and manmade aquatic sites such as lakes, ponds, rivers, canals, streams, and livestock watering ponds and troughs.	5-20 lbs/acre**
Dormant Rice Fields: Impounded water in dormant rice fields. (For application only during the interval between harvest and preparation of the field for the next cropping cycle.)	5-20 lbs/acre**
Waste Tires: Tires stockpiled in dumps, landfills, recycling plants, and other similar sites.	20-80 lbs/acre(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*	700%
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.

THIS PAGE LEFT INTENTIONALLY BLANK

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.

Scourge is a registered trademark of Bayer AG.
SBP-1382 is a registered trademark of Valent BioSciences Corporation.

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

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.

CLARKE

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
Minneapolis, MN 55427

EPA Reg. No. 1021-1569

EPA Est. No. 1021-MN-2

Zenivex® E20

For use only by federal, state, tribal, or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision

- **FOR THE CONTROL OF ADULT MOSQUITOES, NON-BITING MIDGES, AND BLACK FLIES**
- **FOR USE AS A SPACE SPRAY BY AIR AND GROUND APPLICATION TO CONTROL ADULT MOSQUITOES**
- **CAN BE USED UNDILUTED OR DILUTED**
- **CONTROLS ADULT MOSQUITOES THAT MAY CARRY WEST NILE VIRUS, EASTERN EQUINE ENCEPHALITIS, ST. LOUIS ENCEPHALITIS**
- **CONTROLS NON-BITING MIDGES, NUISANCE AND BITING FLIES**
- **QUICK PERMANENT KNOCKDOWN OF ADULT MOSQUITOES**

SPECIMEN LABEL

ACTIVE INGREDIENT:	
Etofenprox (CAS #80844-07-1).	20%
OTHER INGREDIENTS*:	80%
Total:	100%

Contains 1.48 lbs Etofenprox per gallon
*Contains petroleum distillates

EPA Reg No. 2724-791

KEEP OUT OF REACH OF CHILDREN

CAUTION

See additional Precautionary Statements, First Aid Treatments, and Directions for Use

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION

Harmful if swallowed. Causes moderate eye irritation. Avoid contact with eyes, skin, or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove contaminated clothing and launder before reuse. Repeated exposure to etofenprox can cause skin irritation.

FIRST AID

Call a poison control center or doctor immediately for treatment advice.

If swallowed • Immediately call a poison control center or doctor. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give any liquid to the person. • Do not give anything by mouth to an unconscious person.

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

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

NOTE TO PHYSICIAN: May pose an aspiration pneumonia hazard. Contains petroleum distillate.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to aquatic organisms, including fish and aquatic invertebrates. Runoff from treated areas or deposition into bodies of water may be hazardous to fish and other aquatic organisms. Do

not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or washwaters.

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Time applications to provide the maximum possible interval between treatment and the next period of bee activity. Do not apply to blooming crops or weeds when bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

PHYSICAL/CHEMICAL HAZARDS

Combustible. Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. **READ AND FOLLOW ALL LABEL DIRECTIONS.** Before making the first application of the season, it is advisable to consult with the state or tribal agency with primary responsibility for pesticide regulation to determine if other regulatory requirements exist.

GENERAL

Zenivex® is an effective insecticide used at low volumes to control adult mosquitoes, non-biting midges, biting and non-biting flies. Use Zenivex®, either undiluted as Ultra-Low Volume (ULV) or diluted with mineral oil or other suitable oil diluent, for the control of pest species in or near residential, industrial, commercial, urban, recreational areas, woodlands, golf courses, and other areas where these pests are a problem. Do not spray on or allow drift onto pastureland, cropland, or potable water supplies. In the treatment of corrals, feedlots, swine lots, and zoos, cover any exposed drinking water, drinking water fountains, and animal feed before application. Apply Zenivex® aerially (both fixed and rotary aircraft) for low volume applications or through mist-blowers, backpack, and handheld sprayers for ground applications. Zenivex® will control flies and mosquitoes and can be used as part of a total integrated pest management program for controlling disease vectors. Apply Zenivex® at rates from 0.00175 to 0.0070 pounds of etofenprox per acre. Dilute this product with oil (10-50 cps) only; do not mix with water. Apply when wind is ≥ 1 mph. Do not apply when wind speeds exceed 10 mph. A temperature inversion is preferable to keep the fog close to the ground and applications should be made when labeled insects are most active.

Do not spray more than 0.18 lbs Etofenprox per acre per site per year. Do not make more than 25 applications per site per year. More frequent treatments may be made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

GROUND APPLICATION

Use a vehicle-mounted cold aerosol ULV sprayer to apply the product. Direct the spray equipment nozzle to provide even distribution of the product. For best results, apply perpendicular to the wind direction using a swath width of 300 ft. Spray equipment must be adjusted so that the volume median diameter (VMD) is between 10-30 microns ($10\mu \leq D_{v0.5} \leq 30\mu$) and that 90% of the spray is contained in droplets smaller than 50 microns ($D_{v0.9} < 50\mu$). Directions from the equipment manufacturer or vendor, pesticide registrant, or test facility using a laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested at least annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

The appropriate application rate can be achieved by altering the dilution rate of Zenivex®. Refer to the following chart for examples.

Application rate pound A.I. per acre	Vehicle Speed MPH	Flow rates			
		Undiluted Oz/minute	Diluted 1 to 1 Oz/minute	Diluted 1 to 2 Oz/minute	Diluted 1 to 4.5 Oz/minute
0.00175	10	0.9	1.8	2.74	4.57
	15	1.4	2.7	5.40	9.90
	20	1.8	3.6	7.20	13.20
0.00350	10	1.8	3.6	5.48	9.14
	15	2.7	5.4	10.80	19.80
	20	3.6	7.2	14.40	26.40
0.00700	10	3.6	7.2	10.78	19.80
	15	5.4	10.8	16.18	39.60
	20	7.2	14.4	21.50	52.80

Use the higher label rates when spraying areas where dense vegetation is present. Conduct applications when temperatures are between 50-95° F.

Backpack Sprayer ULV Application
Apply Zenivex® diluted or undiluted through non-thermal ULV backpack sprayer capable of applying the product in the 10 to 30 micron range. Apply product to the area as evenly as possible. Apply at the rate of 0.00175 to 0.0070 pounds etofenprox per acre.

Urban ULV Mosquito Control Applications
For control of resting or flying adult mosquitoes, biting flies and non-biting midges in areas such as utility tunnels, sewers, storm drains and catch basins, pipe chases, underground basements, underground passages, parking decks, crawl spaces or uninhabited buildings, apply Zenivex® using mechanical foggers, hand-held or truck-mounted ULV equipment, thermal foggers or other spray equipment suitable for this application. Apply Zenivex® at rates up to but not exceeding 0.007 pounds of etofenprox per acre.

Thermal Fogging Application
Apply using a truck, dolly-mounted, handheld, or other thermal fogging equipment. Following the equipment manufacturer's instructions, apply this product at a rate of 0.00175 to 0.0070 pounds etofenprox per acre. Direct fog to areas where mosquitoes and other pests are located. The volume median diameter (VMD) of droplets produced by thermal foggers is less than 60 microns ($D_{v0.5}$ < 60μ) and 90% of the spray is contained in droplets smaller than 100 microns ($D_{v0.9}$ < 100μ).

AERIAL APPLICATION
Apply Zenivex® aerially, either diluted or undiluted, by fixed wing or rotary aircraft. Apply at the rate of 0.00175 to 0.0070 pounds of etofenprox per acre. Apply using ULV equipped and capable aircraft. Spray equipment must be adjusted so that the volume median diameter (VMD) produced is less than 60 microns ($D_{v0.5}$ < 60μ) and that 90% of the spray is contained in droplets smaller than 100 microns ($D_{v0.9}$ < 100μ). The effects of flight speed and, for non-rotary nozzles, nozzle angle on the droplet size spectrum must be considered. Directions from the equipment manufacturer or vendor, pesticide registrant, or test facility using a wind tunnel and laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be tested annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated. Do not apply Zenivex® at altitudes below 100 feet. Apply at altitudes from 100-300 feet. Apply when wind speed on the ground is ≥ 1 mph. Apply when labeled insects are most active. For best results, use Global Positioning System (GPS) equipped aircraft. **In Florida:** Do not apply by aircraft except with the approval of the Florida Department of Agriculture and Consumer Services.

PESTICIDE STORAGE AND DISPOSAL

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

STORAGE AND SPILL PROCEDURES: Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

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

CONTAINER DISPOSAL: Refillable 30 Gallon Drums and 275 Gallon Tote: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. If not refilled, offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration. **To clean the container before final disposal**, triple rinse (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with mineral oil or other suitable oil diluent. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Non-refillable 2.5 gallon containers: Non-refillable container.** Do not reuse or refill this container. Triple rinse (or equivalent), promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or mix tank and drain container for 10 seconds after the flow begins to drip. Fill the container ¼ full with mineral oil or other suitable oil diluent and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank. Drain container for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Once triple rinsed, recycle if available, or puncture and dispose of in a sanitary landfill, or by incineration.

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

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

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

ZOËCON. Professional Products

300505070 Made in USA July, 2009 Schaumburg, IL

APPENDIX G Technical Advisory Board Meeting Notes

February 8, 2011

TAB Members Present

Gary Montz, MN Dept. of Natural Resources
David Neitzel, MN Department of Health
Robert Koch, MN Dept. of Agriculture
Robert Sherman, Independent Statistician
Steven Hennes, MN Pollution Control Agency
Vicky Sherry, US Fish and Wildlife Service
Susan Palchick, Hennepin County Public Health
Karen Oberhauser, University of Minnesota
Roger Moon, University of Minnesota
Sarma Straumanis, MN Department of Transportation

TAB Member Absent (reviewed draft operational review)

Rick Bennett, US Environmental Protection Agency

MMCD Staff in Attendance

Jim Stark, Nancy Read, Diann Crane, Kirk Johnson, Mike McLean, Janet Jarnefeld, Carey LaMere, Sandy Brogren

(Initials are used in the notes below to designate discussion participants)

Welcome and Call to Order

Chair Gary Montz called the meeting to order at 12:30 p.m. All present introduced themselves. Gary suggested that TAB members help streamline the process of making resolutions by making note of potential resolutions as they arise, he then introduced MMCD Director, Jim Stark.

Strategic Planning and Budget

MMCD Director Jim Stark welcomed TAB members and discussed MMCD's strategic plan, and its current budget situation. Despite budget constraints, the District's basic mission and vision have not changed. Since he became Director in 2006, Jim has led an expansion of capacity to enable border-to-border larval control and reduce reliance on adult control. He outlined MMCD's strategic objectives, which include emphasis on outreach. He noted that that the more people know about MMCD, the more supportive they tend to be. A continuing challenge is balancing citizen expectations with cost of service. In addition to long-term strategic objectives, the District has added an emphasis on creating a "safety-first" organizational culture. MMCD's long-term growth plan includes some assumptions about the property tax base. These assumptions are being adjusted in light of the current economic situation, and MMCD is making necessary adjustments in the short term, while keeping long range goals intact. In 2010 MMCD reduced its property tax levy, but was able to maintain a stable level of expenditures because of surpluses accumulated during recent dry years. In 2011, MMCD's levy is flat, and the budget calls for a 3.45% reduction in expenses, mostly by shifting control material use. Budgeted expenses still exceed the levy, and the District is actively looking for ways to try to maintain service while reducing cost.

KO asked if the District does any "fee for service" work. JS answered that the District's policy is to not compete with private companies in this regard.

SP asked if cuts to local government would affect the District. JS noted that the District currently receives about $500,000 from the state as part of certain aid formulas. These aids will probably

disappear and because other Local Government Aid is being cut, our county commissioners will probably be reluctant to increase MMCD's funding to make up the difference.

2010 Season Review – Mosquito Surveillance

MMCD Entomologist Sandy Brogren reviewed the District's basic mosquito groupings – spring and summer *Aedes*, *Culex*, and the cattail mosquito – and how the dynamics of each relate to the flow of work during the season. In 2010, there was no snow in March, but an early hatch of spring mosquitoes resulted in the earliest ever start of spring aerial larval treatments. Other notable events in 2010 were the earliest finding of *Aedes japonicus*, an early hatch of summer *Aedes* (4/19) with spring *Aedes* still hatching, an early spring to summer treatment threshold transition, and an early start of adult mosquito sampling. Also, MMCD crews worked late into the fall. September was the wettest in history. Warm weather continued in October, and the District experienced the latest first frost since 1973. *Culex tarsalis* counts were second highest of the last 10 years. For 2011, we expect heavy snowmelt, but the effect may depend on temperatures. We are working on improving the precipitation monitoring network, including increasing data quality and ease of access.

SP asked if *Ae. cataphylla*, a species observed during 2009, was present again in 2010 and also asked if the species is an aggressive biter. SB responded that there were none found this year; in Canada it is reported to be aggressive.

2010 Season Review – Mosquito Control

MMCD Technical Services Coordinator Nancy Read described how the 2010 control operations season was marked by early, frequent, and prolonged mosquito production. She discussed rainfall and larvicide application patterns and amounts, and pointed out that the by the time heavy August rainfall occurred, 90% of MMCD's budget was used and treatments had to be limited to Priority Zone 1.

RS suggested that there might be probability models for rainfall events that could help predict how much material may be needed at different times of year.

LG asked about the response of the public in August to high mosquito numbers. NR responded, as her presentation continued, that the increase in mosquito numbers led to a significant increase in calls for service.

Nancy compared larvicide use in 2010 with historic use patterns, noting the increase in larvicide acres and reviewing ways that the District has increased capacity for providing larval control. The District has used patterns in larval habitat density and human population density to choose where to expand personnel numbers. She compared various measures from the high rainfall year of 2002 with measures from 2010, and discussed available evidence for the effect of expanded treatments on mosquito populations in the District.

SP noted that in the larvicide acres graph the "briquet acres" are not really the same as "Bti acres" since briquets are only used once per year. Bti is used to treat the same "acres" many times.

KO said that she would like to know the number of acres treated 1 or more times, by date.

RM suggested that the graphs could reflect what percentage of treatable lands was treated, as opposed to how much warehoused material was used. This is a question that's been around for the District for years, he noted. Can the District estimate the millions of mosquitoes prevented? There was a lot more treatment done in 2010, so how do we evaluate how valuable that is?

LG noted that the graphs show a high number of traps over threshold. He was concerned that "2 in 2 minutes" might be too low to use as a treatment threshold. He would like to see how many adult treatments were made from near-threshold levels, as opposed to treatments made when surveillance showed numbers considerably over threshold. He also suggested that the District might want to transition to a higher threshold later in the year, suggesting that people can tolerate higher numbers of mosquitoes for a couple of weeks if they know they will be gone soon.

KO said that she would like to see a weekly graph of adulticide treatments based on the vector vs. annoyance threshold.

RM noted that MMCD is a large program, and an effective surveillance system is essential for evaluating what MMCD is doing.

2010 Season Review – Black Fly Surveillance and Control

Carey LaMere, MMCD Technical Services, gave an overview of the black fly monitoring and control season. The large rivers in the District had high water flow, particularly later in the year. She gave a brief description of the sampling network and how results are used.

RS inquired about Bti liquid formulation and how units of bacterial activity are measured.

NPDES Permit Requirement (National Pollutant Discharge Elimination System)

Jim Stark described NPDES history beginning with the Clean Water Act, and contrasted NPDES with FIFRA regulation of pesticides. Problems with the law's interpretation arose with the Talent Irrigation District lawsuit 1996. Subsequent lawsuits, regulations, and court rulings ensued. As of now, the US Environmental Protection Agency is required to establish a permitting process for the application of pesticides to waters of the states, and is working with states which are in charge of their own General Permit. The Minnesota General Permit is in draft form now and is under review until Feb. 17. This state permit, which would be valid for 5 years, requires monitoring, treatment records, equipment maintenance, calibration records, and spill avoidance. The permit requires "Adverse Incident Reports" if such incidents occur and a "Notice of Intent" if substantial treatments are planned. It also requires control measures that minimize discharge, as is the case in integrated pest management (IPM) plans. The permit requires entities have an IPM plan, with action thresholds, control strategies, surveillance, evaluation of management options (including no action). Surveillance prior to each pesticide application and assessment of environmental conditions (temperature, wind) must be done. A Pesticide Discharge Management Plan and Annual Report – including identification of waters, use patterns, amounts of pesticide, and any adverse impacts – is also required. Under the permit, MPCA would then issue a Notice of Control. The District does not yet know what MPCA will charge for the permit and what it will cost to meet the requirements.

SP asked if the permit goes to the District and is not site-specific, and JS confirmed that was true. Some other states are going beyond federal requirements with more detail.

RS noted that it seems like the District is in good shape and prepared? JS agreed but added that the District still has a lot to do. The permit process also applies to a lot more than mosquito control.

KO suggested that pesticides can cause some significant problems, and that it is good that the information required for the permit will be available to anyone who needs it. This may help document your environmental work, and, while it may be tough for the first year, the process may be a benefit in the long run. If small districts are not collecting these records, they should be, and it would be good to be able to document that they are doing things right.

RM asked JS to elaborate on the nature of the "adverse impacts" that might be expected from control materials? JS said that, with the materials used by the District, there would be no expected impacts. RM suggested that if agencies can agree that Bti will not kill vertebrates this might

simplify monitoring, though there are probably more concerns about food web effects. He suggested that the District could point out to the permitting agency the work that has already been done, perhaps through literature review, but suggested that going back to sites looking for things you won't see would be costly.

RS asked if there were an established report form. JS replied that there is none at this time. RS noted that compliance could result in a lot of often unreadable paper. The principle value of this is that the work exists, and that there is evidence that the agency being regulated has done its own due diligence. He suggested that the District consider recordkeeping that could be useful internally as well.

RM suggested that there is a big disincentive if applicators are the ones looking for their own adverse impacts – a possible conflict of interest. SP noted that we have to do adverse impacts for vaccines – records of the wrong thing being given to wrong person, etc. There are reports of those events; it would be similar for misapplications.

Break 2:10-2:25

Tick Season Overview

Janet Jarnefeld, MMCD Tick Vector Services, gave an overview of the tick season. She discussed what the relevant graphs (page 40) represent. She noted that documented increases in ticks are not due to a massive rise in tick loads per mammal, although that is true to some degree, but mostly from a geographic expansion in areas where ticks now occur. Numbers of ticks in 2010 are about the same as in previous year, and surveillance detected an increase in tick-positive sites, especially south of the Minnesota and Mississippi river areas.

RS asked if data is gathered from fixed sampling sites. JJ – Yes.

RK asked once a site becomes positive, does it tend to stay positive? JJ said that it depends on the site and related circumstance. There will be a 3-color map related to this question in the upcoming Tick Distribution Study report. Continuously positive sites, said JJ, are more frequent in Anoka and Washington counties. Dakota County was on again off again, but now is mostly on; Scott County continues "blinking" on and off. She showed a table of total positive sites, especially south of the major rivers, with a new high in number of positive sites in 2010. JJ has also heard from LG and our own field staff that ticks are more common in those areas.

RS suggested number of positive samples be expressed as a ratio (e.g., out of 100). JJ agreed.

Tabulated species results are documented in Table 2.6. In other activity, staff collected some *Dermacentor variabilis* for MDH as part of a Rocky Mountain spotted fever 2009 follow-up. Since dogs make good tick collectors, District staff did some outreach at dog parks. Staff evaluated approximately 42 parks and ultimately posted signs at 21 parks and an additional 4 active dog walk areas. We received some calls from these efforts. The District also found some *I. scapularis* in Waconia. Sampling occurred as a result of a dog-collected tick from staff in 2009. Also, field staff collected *I. scapularis* in Maple Plain and Lake Rebecca. *Amblyomma* was submitted for tick identification again, in 3 places in 2010.

KO asked what kind of mammals was collected (rodents), and asked if the change in distribution related to ticks moving, or to changes in hosts. She also asked if deer increases in suburban areas had any effect. JJ answered that ticks move slowly, dropping off birds and mammals, and that rodents are not moving very far. LG suggested that pets can move ticks too, and that there are other alternative hosts; it can't all be blamed on deer.

KO noted her involvement with citizen science and that tick surveillance could be an opportunity to have people take photos or collect ticks. She suggested putting some kind of report form on the

District web site that could increase awareness of ticks and help collect useful information. JJ said she would follow up with KO about connecting to citizen science networks.

BK wondered if, as ticks become more common and more people are contracting disease, MMCD would be asked to do control. JJ said that while the state legislature mandated MMCD to do control with MDH, at this time there is no economical method of control. If something becomes available, we will review. BK noted that at a USDA meeting he heard about nootkatone as a possible control. Dave Neitzel (DN) said that Joe Piesman at CDC is looking into that material. JJ said that as of now this product is cost prohibitive even for evaluation testing purposes. [link to Jan. 2011 article: http://www.ars.usda.gov/is/AR/archive/jan11/ticks0111.htm]

Aedes japonicus Update

MMCD Vector Ecologist, Kirk Johnson (KJ) said that *Aedes japonicus* has been found as larvae in wetlands, catch basins, and treeholes for the first time, and for the first time in CO_2 traps and Monday night sweeps. Almost 20% of container samples contained *Ae. japonicus*, and the population has grown dramatically.

RK asked if finding more meant that the District is looking more. KJ said that the District increased surveillance in 2009; in 2010 the District merged that surveillance in with other work and continued training staff in what to look for.

Aedes japonicus continues to be found in more varied habitats than our other container species, including in wetlands. MMCD's main control measure continues to be reducing container habitat. The number of tires removed and recycled by District staff increased in 2009 but returned to a more normal level 2010, in part because we were spending more time on floodwater control in 2010. *Aedes japonicus* is now also present in Camp Ripley (Morrison County), beyond MMCD.

RM had submitted questions prior to the meeting, and KJ provided some answers: *Aedes japonicus* is known to be an efficient vector of SLE and WNV in the lab, but we are not sure how this will carry over in natural circulation. *Aedes japonicus* is about as efficient as *Ae. triseriatus* for transmission of LAC, so this is probably our greatest concern. They occupy similar larval and adult habitats. They are also capable of transmitting EEE. Blood meal analyses show they will bite deer and humans, possibly small mammals, and they readily feed on birds in lab colonies. There were many WNV positive results from wild-collected specimens from several states. Minnesota is one of the first areas with LAC plus *Ae. japonicus* and not *Ae. albopictus*. Conclusions: the species is established here but we do not yet know what role it will play in public health. We will continue container/tire control for source reduction, and will work with people in neighborhoods.

RS asked if sterile males might be a strategy for this species. KJ said that theoretically, yes, but practically, the emphasis should remain on removing habitats. RS suggested that by removing habitats, we would get the most benefit from the last few habitats removed, but with sterile males you could get more impact earlier.

SP asked if there were any plans for virus testing on *Ae. japonicus*? KJ said in 2009, we submitted specimens to MDH for testing for all local mosquito-borne viruses. In 2010, we only ran WNV tests in our own lab. We are considering increasing lab capacity to do PCR tests for other viruses. DN said that MDH may be able to do testing this year.

RM asked what if you remove most containers, and bait the others with something lethal? KJ said that there have been some proposals on this subject, and that this strategy could be part of an IPM approach. For instance, he added, the District has done some treating of remaining, hard-to-handle containers.

SP asked who is sampling in the southeastern part of Minnesota. KJ answered that David Geske at the La Crosse County Wisconsin Dept. of Health is doing so as part of a long-term La Crosse virus surveillance project.

Natular Nontarget Studies

Kirk presented information prepared by Stephen Manweiler, MMCD Director of Control Operations, who was unable to attend. Current plans for Natular non-target work include estimating spinosad concentration that might reach the Mississippi River by starting with studies of concentrations in treated structure habitats that will be done by the manufacturer, Clarke.

GM expressed concern about nontargets in wetlands, especially snails and fingernail clams, since there is no flushing action in the wetlands. RM noted following concentrations seems contorted, and asked about existing literature on fresh water impacts. GM added that in wetlands it's not so much an endangered species concern as more concern about the extensive mollusk populations that might be affected.

BS asked if there were particularly sensitive organisms that could be used for bioassay which could be helpful for detecting concentrations. KJ said that that is the kind of work we've been encouraging Clarke to do with independent researchers.

SP said that the physical question (water concentrations in the system) might be easy to work out, for instance, if we ask an engineer "If we have this much material, what will the concentration be when the material comes out of the storm water system?"

Adulticide Changes

Mark Smith (MS), MMCD Technical Service gave a review of anticipated adulticide label changes, specifically on permethrin becoming restricted use. The change is based on science of human risk, interactions, and possible exposures of children. The changes will not have much effect on MMCD's use, except all applicators will need to be licensed to apply permethrin. MMCD, he noted, has always used these materials as if they were restricted. The resmethrin ULV fog manufacturer has declined to re-register the product claiming it is too costly to do laboratory studies and costs may not be recouped in sales. This problem almost eliminated permethrin as well. This could result in a significant loss of a public health product. Right now it looks like there will be an end to production of resmethrin in December 2012 unless there is a successful grant of additional funding. MMCD is working with some other products to replace these as needed.

LG asked if there was more information on Zenivex. MS answered that we have done some preliminary work showing good results. This is considered a "soft" material environmentally. Steven Hennes (SH) asked what pesticide class Zenivex is. MS said that it is not a pyrethroid, and that we will forward that information soon.

Discussion and Resolutions

KO suggested TAB members would like to receive NPDES information, including MMCD response. JS said that he would see to it.

KO would also like information on what MMCD doing regarding climate change adaptation, and recommended that be presented at next year's TAB meeting.

Motion *– That MMCD examine adult thresholds for annoyance mosquitoes and what the impact would be of raising these thresholds.* Made by LG, second by RM.

Discussion – for example, if threshold were raised from 2 to 5 per 2 min, what % of treatments would not be done. This may be of interest, especially given the changes coming in adulticides. There might also be

some economic benefit to knowing the impact of changing thresholds. SP recommended looking at a number of previous years, not just the upcoming year.

Motion carried, 1 opposed.

RDM asked for more background on staff's concerns regarding MMCD's surveillance program. SB said that field staff sometimes don't find sweeps valuable, especially if there are limits on overtime. RDM said that, looking at the TAB report, there are a lot of different kinds of surveillance being used and he recommend MMCD evaluate various methods, what value they have and what they are costing.

GM asked if any of these surveillance methods are going to be needed for NPDES requirements. JS said that was a possibly. Surveillance methods are often different for justifying treatments as opposed to standard surveillance network (Monday night). GM said that he was not sure that he understood enough of the details to make any specific recommendation.

SP suggested that a recommendation would be to study the issue and bring the question back to TAB.

Motion *– That the District evaluate the merits and costs of various mosquito surveillance methods it currently uses and report back to the TAB at its next meeting.* Made by RDM, second by SP. Motion carried.

Motion *– That MMCD consider climate change adaptation in control strategy and budget planning.* Made by KO, second RS. Discussion – KO said that she has heard a number of things during the meeting that are being affected by weather patterns and climate change. There followed a general discussion on availability of information, especially localized models. The idea is to encourage the District to look into information that might be of value. Motion carried.

Next chair will be Dave Neitzel, Minnesota Department of Health.

Adjourn – 4:00 p.m.

Source page of the raindrop image used on the front cover:
http://www.fantom-xp.com/
title="Desktop Wallpaper"

Editorial Staff & Contributors

Diann Crane, M.S., Assistant Entomologist
Carey LaMere, Laboratory Technician

The following people wrote or reviewed major portions of this document:
Sandra Brogren, Janet Jarnefeld, Kirk Johnson, Carey LaMere,
Stephen Manweiler, Mike McLean, Nancy Read, Jill Sederholm, Ken Simmons,
Mark Smith, and *John Walz*

1st draft January 28, 2011
2nd draft April 18, 2011