50 YEARS 1958-2008
METROPOLITAN MOSQUITO CONTROL DISTRICT

2008 Operational Review & Plans for 2009

Annual Report to the Technical Advisory Board

Aedes japonicus – dorsal view

Aedes japonicus – lateral view

Metropolitan Mosquito Control District
Metro Counties Government Center, 2099 University Avenue West, St. Paul, MN 55104-3431, www.mmcd.org

Metropolitan Mosquito Control District

Mission

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

Governance

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

Metropolitan Mosquito Control Commission 2009

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

Technical Advisory Board

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

Technical Advisory Board Members 2008-2009

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

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

METROPOLITAN MOSQUITO CONTROL DISTRICT

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May 06, 2009

Dear Reader:

The following report is the Metropolitan Mosquito Control District's (MMCD) 2008 Operational Review and Plans for 2009. It outlines program operations based on the policies set forth by the Metropolitan Mosquito Control Commission (MMCC), MMCD's governing board of elected county commissioners.

The report has been reviewed by the Commission's Technical Advisory Board (TAB). TAB's charge is to comment on and make recommendations for improvements in the District's operations, on an annual basis. The minutes and recommendations from the TAB meeting in February 2009 are included in this report.

TAB's recommendations and report were accepted by the Commission at their April 2009 meeting. The Commission approved the MMCD 2008 Operational Review and Plans for 2009 and thanked the TAB for their work.

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

Sincerely,

James R. Stark

James R. Stark
Executive Director

UNIVERSITY OF MINNESOTA

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

Dear Commissioner Peterson,

The Technical Advisory Board (TAB) met on February 11, 2009 to review and discuss MMCD operations in 2008 and plans for 2009. 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 the TAB revise last year's resolution regarding adulticide testing to strike the words "on only those materials." (Pertaining to 2008 resolution: "The District should continue using adulticide materials currently proven and continue to do rigorous testing on only those materials.")

2. The TAB recognizes current District response to the discovery of *Aedes cataphylla*, and supports their continued surveillance efforts.

3. MMCD should continue to look at ways adulticides are used for control of summer nuisance mosquitoes in an attempt to reduce applications where practical.

4. The TAB recognizes the efforts of the MMCD Black Fly program and their history of cooperation with the MDNR. [Resolution in honor of the 25th anniversary of the Black Fly program]

Respectfully,

Roger D. Moon
Chair, Technical Advisory Board
and Professor of Entomology

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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 2008 through surveillance, disease monitoring, mosquito and black fly control, testing new products, data management, and public information.

The 2008 season marked the District's 50th year of service to citizens of the Twin Cities metro area. As detailed in this report to MMCD's Technical Advisory Board, the year was characterized by a delayed spring, very low incidence of West Nile virus (WNV), and an increase in citizen demand for service.

Surveillance

Below normal temperatures prolonged and delayed the spring mosquito hatch. The major mosquito peak occurred in June. Rainstorms produced only three major broods of mosquitoes during 2008. Staff identified 17,839 larval samples although drought conditions existed for most of the season. 2008 also marked the first field collections of larval and adult *Aedes japonicus* mosquitoes in Minnesota. Another first occurred when *Aedes cataphylla* was detected in Minnesota, well outside its North American range.

Disease

West Nile virus (WNV) cases in Minnesota declined during 2008. After correcting for early false-positive test results, the Minnesota Department of Health (MDH) reported just 10 WNV cases – one of which occurred in the District (Anoka County). WNV was detected in 23 mosquito samples and in only 7 birds. There were no La Crosse encephalitis cases in the District during 2008. The District also conducted product efficacy tests against *Culex* vectors in catch basins and stormwater structures.

Tick-borne disease risk for metro area citizens remains high. Although the 2008 tick and human data is not yet available for comparison, in 2007 staff collected *Ixodes scapularis* from at least one site in all seven District counties – a first during a single sampling season. Human case totals for Lyme disease in 2007 were 1,239 and human granulocytic anaplasmosis (HGA) cases totaled 322 – both new all-time high records according to the MDH.

Control

Larvicide applications increased by 8,053 acres from 2007 to 2008. Large scale applications of Altosid® XR-G sand significantly increased acres MMCD can treat to control *Coquillettidia perturbans* with current budget resources. 77,054 more acres of adulticides were applied in 2008 than in 2007 and a cumulative total of 195,833 catch basin treatments were made, many treated four times, to control vectors of WNV. In 2009 the District will concentrate on the stormwater management structure treatment program to maintain efficacy and reduce workload to enable staff to provide additional mosquito control services.

Product and Equipment Testing

VectoBac® G *Bti* achieved the same high level of control of *Aedes vexans* in air sites as in previous years. Two controlled release formulations (Natular® 150-day tablets and FourStar® 14-g briquets) controlled WNV vector larvae in catch basins for the entire season. Two Natular® formulations controlled floodwater mosquitoes in ground sites. Permethrin controlled vector and other mosquitoes in woodlots for up to seven days after treatment. Pyrocide® effectively controlled adult mosquitoes, including *Culex*, in croplands. 2009 plans include continued testing of control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy. We will also continue tests of Natular® formulations in stormwater management and natural ground sites to better determine how long they control mosquito larvae. We also plan to continue tests of adulticides in different situations emphasizing control of *Culex*.

Black Fly Program

In 2009, MMCD marks 25 years of black fly control. Monitoring has consistently shown a dramatic reduction in adult black fly populations within the District's control area.
A statistical analysis of the non-target monitoring data collected between 1995 and 2005 was completed in 2008. Based on those results, MMCD and the MnDNR agreed to revised protocols that allow the District to reduce the multiplate lab processing time significantly.

Field samples for the Mississippi River non-target invertebrate monitoring program were processed in 2008. Taxonomic identification and the final report are scheduled for completion in spring 2009. Results from the non-target monitoring work done in 1995-2005 have not indicated that any large-scale changes have occurred within the invertebrate community in the *Bti*-treated reaches of the Mississippi River.

Data Management and Public Information

MMCD developed a web-based system for tracking and mapping customer calls which includes a geocoder web service for the metro area. Other data management and information highlights include continued data support for aerial treatments, updated wetland and stormwater structure maps, continued education efforts on the subject of stormwater and mosquitoes, and another in a series of biennial public opinion surveys.

MMCD's 50 years of service to the metro area was highlighted in a 30-minute documentary which continues to air on Twin Cities Public television. MMCD staff also continued to stress its presence in metro area schools through its three-day curriculum "Mosquito Mania."

Chapter 1 Mosquito Surveillance

2008 Highlights

- Below normal temperatures prolonged the spring hatch
- Drought conditions existed for most of the season
- Rainstorms produced only 3 major mosquito broods
- The major mosquito peak occurred in June
- Staff identified 17,839 larval samples
- First occurrence of *Aedes japonicus* adult in Minnesota
- First occurrence of *Aedes cataphylla* in Minnesota

2009 Plans

- Continue *Aedes* surveillance strategies as in 2008
- Re-evaluate placements of both CO_2 traps and gravid traps
- Search for presence of *Ae. cataphylla*
- Continue to improve relay of surveillance results from lab to field
- Monitor spread of *Ae. japonicas*
- Develop best surveillance methods for detecting *Ae. japonicus*

Background

The MMCD conducts larval and adult mosquito surveillance to determine levels of mosquitoes present, measure annoyance, and to detect the presence of disease vector species. Since different species of mosquitoes have different habits and habitat preferences, a variety of surveillance methods are used. Knowing which species are present in an area and at what levels, helps the District direct its control measures effectively.

2008 Mosquito Surveillance Results

Rainfall

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

Spring arrived late this year. There was snow in April, cool temperatures and late ice-out on the lakes. The five months of February-June all had below normal temperatures, the first time this has happened since 1979. The prolonged cold in the spring resulted in mosquito larvae hatching slowly over a longer period of time.

In addition to snow melt, a rain event ≥ 1 inch can produce a brood of floodwater mosquitoes. We experienced four major District-wide rain events in 2008 (Figure 1.1), but only three broods resulted. The three major broods occurred in May and June, but rainfall was still below normal for those months.

The dry weather continued the rest of the summer; scattered storms produced nine small-medium broods District-wide. The fourth major rain event occurred in August, but due to the

dry conditions, much of the rain soaked into the ground and did not produce many mosquitoes.

Average rainfall in the District from May 1 through September 30, 2008 was 14.15 inches (Table 1.1). This is 3.68 inches less than last year and 5.40 inches below the 50-year District average. Carver, Anoka and Dakota counties received the most rain. Figure 1.2 depicts the geographic distribution of weekly rainfall received from May through September 2008.

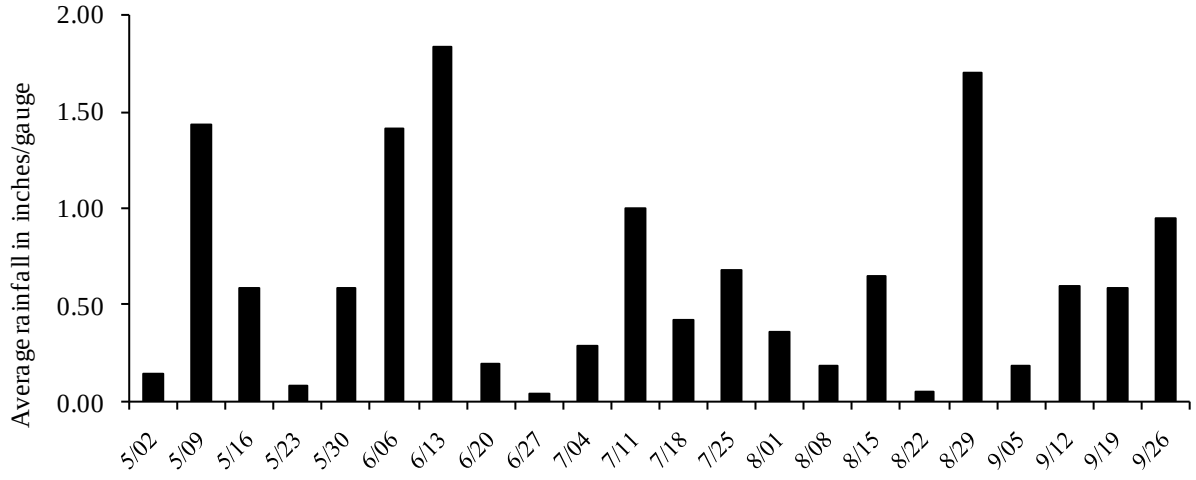


Figure 1.1 Average rainfall amounts per gauge per week, 2008.

Table 1.1 Average rainfall received in each county from May through September, 2004-2008 and 50-year District average

	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
2004	20.26	25.22	21.89	22.18	20.73	23.50	20.62	21.65
2005	22.20	22.75	21.53	22.75	23.00	24.25	23.87	23.60
2006	19.78	17.90	17.46	18.71	19.06	19.50	17.21	18.65
2007	16.01	17.26	20.89	17.92	16.93	16.58	19.02	17.83
2008	15.19	16.90	15.03	13.55	12.60	14.08	14.15	14.15
50-Year Avg	18.93	*20.23	19.73	19.59	19.78	19.32	20.06	19.44

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

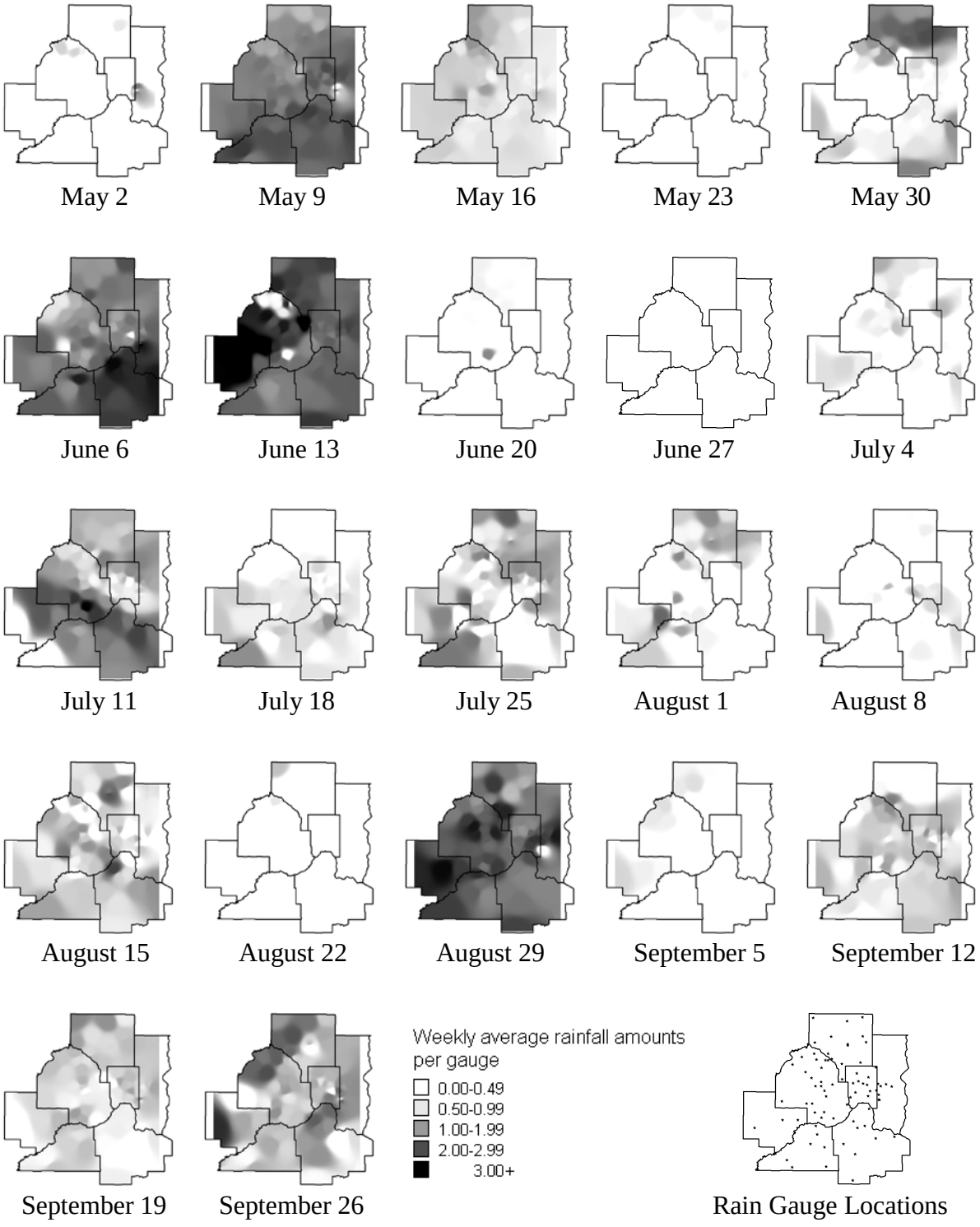


Figure 1.2 Weekly average rainfall per District gauge, 2008. The number of gauges varied from 71-73. A map of the rain gauge locations is included.

Larval Collections

Larval mosquito collections are taken to determine if targeted species are present at threshold levels or to obtain species history in a breeding site. In 2008, staff identified 17,839 larval collections. To accelerate the identification of samples from sites to be treated by helicopter, larvae were identified to genus only, except for *Culex* larvae, which were identified to species to differentiate vectors. Lower priority samples are processed as time permits and were identified to species. Table 1.2 shows the results of the 10,840 samples identified to species and calculated as the percent of samples in which the species was present. A significant amount of sampling is done in catch basins and other man-made structures. These stormwater structures sample results are displayed separately from the natural breeding area results in Table 1.2.

The floodwater species, *Aedes vexans,* was the most abundant species in standard dipper larval collections, occurring in 31.7% of the samples (Table 1.2). The two most common spring species, *Ae. stimulans* and *Ae. excrucians,* ranked second and fifth , respectively. The typically non-human biting species, *Culiseta inornata,* is found frequently in floodwater sites and had the third highest frequency overall. *Culex territans* prefers cold-blooded hosts and ended up in fourth place. *Culex restuans,* which prefers to bite birds, was tied for fifth with *Ae. excrucians*. *Culex tarsalis* larvae occurred in 2.5% of the samples, ranking seventh. A few mosquitoes can be identified to species in the 1st instar stage, but most cannot. The high amount of "*Aedes* species" and "*Culex* species" is normal and represents 1st instar larvae that are not identifiable to species.

Culex mosquitoes commonly breed in catch basins and other stormwater structures. *Culex restuans* was found in 75.3% of the structure samples and *Cx. pipiens* in 18.1% (Table 1.2). A detailed discussion of the larval *Culex* surveillance in structures can be found in *Chapter 2: Vector-borne Disease*.

We had an exciting event in the Technical Services Lab this season. A species not known to occur in Minnesota, *Aedes cataphylla,* was identified in a larval sample from Minnetonka. Two 4th instar larvae were collected on April 30, but the sample was low priority for processing and was not identified until September. Dr. Harold Savage at the Centers for Disease Control in Fort Collins, Colorado verified our identification. *Aedes cataphylla* is a very early spring species whose range is the western US and Canada, no further east than Colorado. Surveillance will be conducted in the spring around the site where it was collected to determine if this is an established population.

Table 1.2 Percent of samples where larval species occurred in standard dipper collections by facility and District total, and the District total for stormwater structure samples, 2008; the total number of samples processed to species is in parentheses

	Percent of samples where species occurred by facility							Stormwater
Species	North (1,022)	East (2,297)	South Rosemount (1,520)	South Jordan (981)	West Plymouth (1,800)	West Maple Grove (738)	District Total (8,358)	Structure District Total (2,482)
Aedes abserratus	0.5	0.3	0.3	0.2	0.3	0.3	0.3	
aurifer			<				<	
canadensis	0.3	0.5	2.4	0.5	1.3	0.1	1.0	0.1
*cataphylla**					<		<	
cinereus	6.5	7.3	7.9	7.1	11.1	9.1	8.3	0.2
dorsalis	0.1	0.2	0.4	0.4	<	0.3	0.2	
excrucians	14.2	13.2	9.3	2.8	9.8	7.6	10.2	
fitchii	2.6	2.9	4.2	0.3	0.6	1.5	2.2	
implicatus	1.2	1.2	0.1	0.8	0.5	1.4	0.8	
japonicus								<
nigromaculis		0.1	0.3	0.2	<		0.1	
punctor	0.2	0.7	0.1	0.1	0.2	0.1	0.3	
riparius	1.1	0.6	0.3	0.4	1.2	1.8	0.8	
spencerii					<		<	
sticticus	2.2	1.1	2.7	1.0	0.6	1.1	1.4	<
stimulans	18.6	20.5	20.7	11.7	26.7	14.4	20.1	<
provocans	1.2	1.4	0.3		0.1	0.1	0.6	
triseriatus		<			<		<	0.4
trivittatus	0.4	1.3	3.7	1.8	0.9	1.8	1.6	0.2
vexans	39.9	31.0	40.5	29.2	23.4	27.9	31.7	12.2
Ae. species	32.0	27.6	30.8	28.1	33.1	27.4	29.9	4.7
Anopheles earlei	0.1	0.2					<	<
punctipennis	0.4	0.3	0.4	0.4	0.2	0.1	0.3	0.5
quadrimaculatus	0.1	0.2	0.1				<	
walkeri	0.1	0.1					<	<
An. species	3.3	1.9	0.9	1.0	0.4	0.3	1.3	1.4
Culex pipiens	1.0	2.4	1.1	0.6	1.0	1.6	1.4	18.1
restuans	7.6	11.7	9.3	8.9	10.0	13.7	10.2	75.3
salinarius	0.1	0.1		0.1	0.1		<	0.2
tarsalis	2.2	3.1	2.5	4.9	0.8	1.8	2.5	3.3
territans	15.9	16.8	6.1	22.7	7.2	11.4	12.9	9.6
Cx. species	1.4	3.4	2.6	4.1	2.2	4.5	2.9	38.7
Culiseta inornata	10.2	12.0	19.3	9.9	13.1	15.9	13.4	6.4
melanura								
minnesotae	0.5	0.9	0.3	0.7	1.1	0.9	0.8	<
morsitans		<		0.1	<		<	
Cs. species	1.1	1.0	0.5	1.6	1.8	2.0	1.2	
Psorophora ferox					<		<	
Ps. species								
Ur. sapphirina	0.8	2.0	0.1	0.3	0.4	0.3	0.8	<

< = percent of total is less than 0.1%

* 1st known occurrence in Minnesota

Adult Collections

There are 51 species of mosquitoes known to occur in Minnesota and different species exhibit a variety of host preferences. About 45 of these species, 20 of which are human biting, occur in the District. Other species prefer to feed on birds, large mammals, reptiles, or amphibians. Additionally, species of mosquitoes differ in their peak activity periods and in how strongly they are attracted to humans or trap baits (e.g., light or CO_2). Therefore, a variety of adult mosquito collection methods are used in order to capture targeted species.

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

Spring *Aedes* larvae hatch in March and April as a result of snow melt and adults emerge in late April to early May. They have one generation each season and adults can live for three months. The summer *Aedes* (*Ae. vexans, Ae. sticticus, Ae. trivittatus*) begin hatching in early May as a result of rainfall. They can have several generations throughout the summer. *Coquillettidia perturbans*, the cattail mosquito, develops in cattail marshes and has one generation per year, peaking in early July. A more detailed description of the biologies of mosquitoes occurring in the District is in Appendix A.

The sweep net and CO_2 trap data reported in this chapter are weekly collections referred to as the Monday night network. Employees took 2-minute sweep net collections and/or set overnight CO_2 traps in their yards every Monday night for 19 weeks. To achieve a District-wide distribution of CO_2 traps, other locations such as parks or harborage areas are chosen for surveillance.

CO_2 trap, sweep net and New Jersey light trap surveillance methods

Sweep Net Collections 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 72-153 per evening. Sweep net collection locations in 2008 are shown in Figure 1.3.

A total of 2,348 collections were taken containing a total of 3,054 mosquitoes. For the first time, spring *Aedes* were the predominant species in the evening sweep net collections (Table 1.3). The number of spring *Aedes* was elevated the entire season (Figure 1.4) and much higher than the 8-year average (Figures. 1.5, 1.6). A possible reason for this may be the long, slow hatch of larvae in the spring and the timing of our treatments. Sites inspected early in the spring may not have been breeding at that time, but did eventually breed later than expected.

Summer *Aedes* species were higher than the last two years but still below normal. *Coquillettidia perturbans* remained at low levels. *Culex tarsalis* is not effectively collected in sweep net sampling.

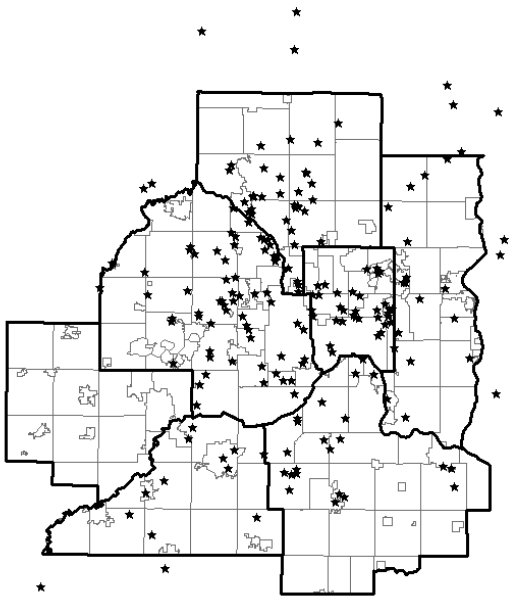


Figure 1.3 Locations of weekly evening sweep net collections, 2008.

Table 1.3 Average number of mosquitoes collected per evening sweep net collection within the District, 2004-2008

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2004	3.4	0.3	0.02	0.010
2005	1.1	0.3	0.04	0.010
2006	0.3	0.3	0.03	0.004
2007	0.2	0.1	0.10	0.010
2008	0.5	0.2	0.60	0.003

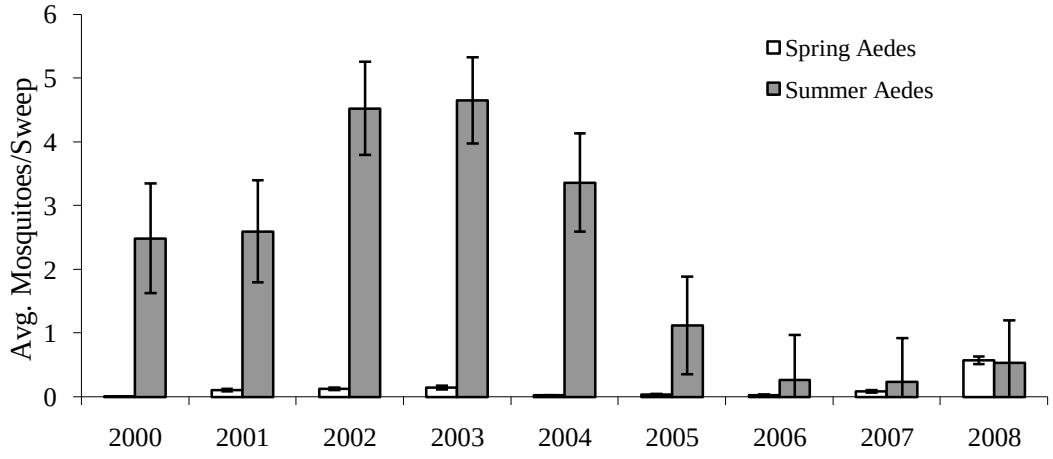


Figure 1.4 Average number of spring *Aedes* vs. summer *Aedes* in sweep nets, 2000-2008.

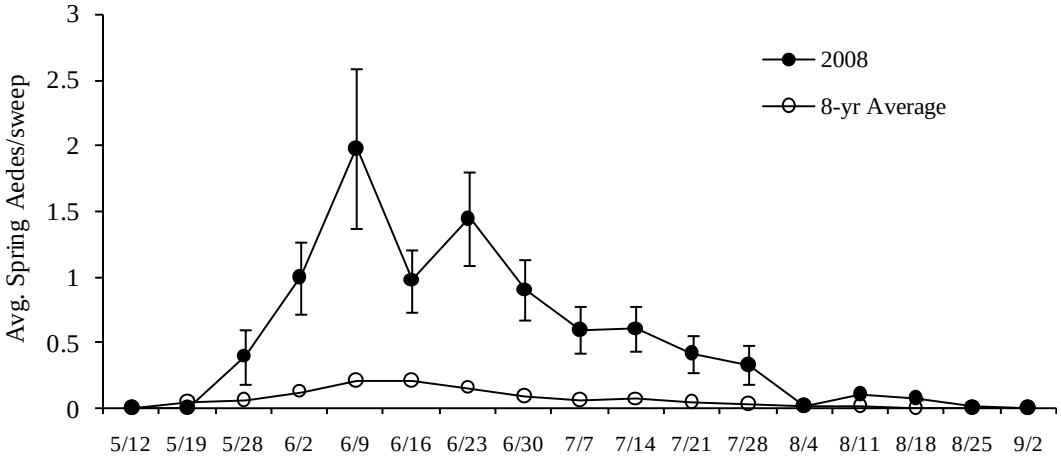


Figure 1.5 Weekly average number of spring *Aedes* in sweep nets, 2008 vs. 8-year average. Error bars equal ± 1 standard error of the mean.

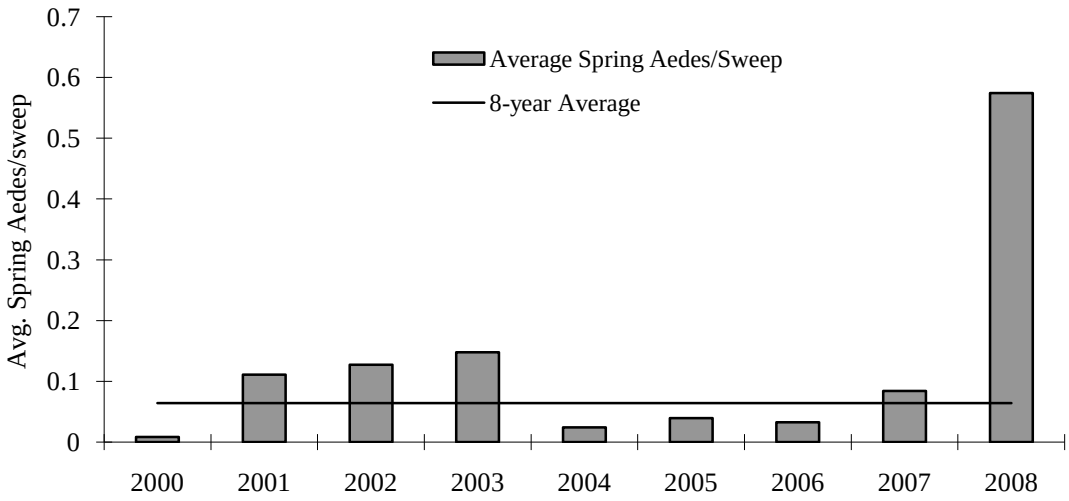


Figure 1.6 Average spring *Aedes* per sweep net 2000-2008 vs. 8-year average. Error bars equal ± 1 standard error of the mean.

CO_2 Trap Collections CO_2 traps baited with dry ice are used to monitor mosquito population levels and the presence of disease vector species. In 2008, we operated 133 traps at 120 locations to allow maximum coverage of the District. At 13 of the locations, we operated a low (5 ft) and an elevated (25 ft) trap. Some traps were placed in locations more likely to collect the vector species *Cx. tarsalis* for WNV testing and *Culiseta melanura* for eastern equine encephalitis testing (Figure 1.7). The number of traps operated per night varied from 109-123. A total of 2,270 trap collections were processed, containing 270,358 mosquitoes.

Summer *Aedes*, the predominant species captured in the traps this season, were higher than the last two years, but low compared to wetter years 2004 and 2005 (Table 1.4). *Coquillettidia perturbans* was in second place with populations the lowest of the past four years. The spring *Aedes* were twice as numerous as the past two years and 14 times higher than in 2004. *Culex tarsalis* numbers were about normal this season and are discussed later in this chapter.

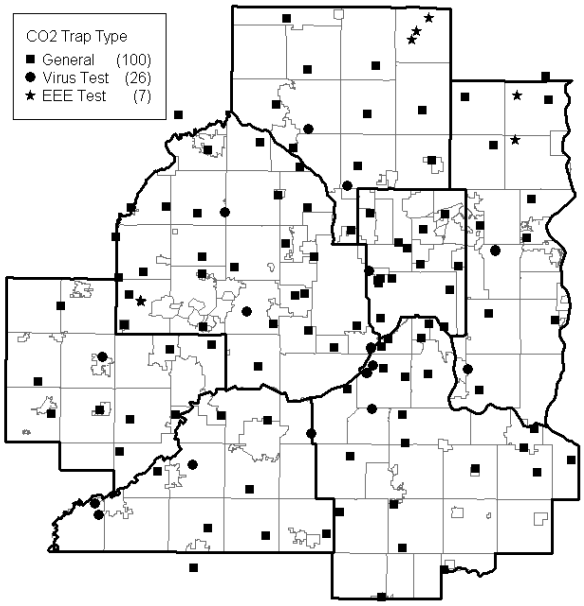


Figure 1.7 Locations of CO_2 traps to monitor general mosquito populations, WNV vectors and the eastern equine encephalitis vector, 2008.

Table 1.4 Average number of mosquitoes collected in CO_2 traps within the District, 2004-2008

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2004	391.9	35.3	1.5	2.3
2005	201.5	42.0	6.9	1.6
2006	51.7	75.8	10.2	1.5
2007	43.7	31.9	10.2	5.2
2008	60.5	31.2	21.3	1.3

Geographic Distribution The geographic distribution of mosquitoes collected in CO_2 traps is 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. Spring *Aedes* were present from late May to the end of August (Fig. 1.8). The highest populations occurred in the outer boundaries of the District, especially in the northern counties. Except for four weeks during June and July, the summer *Aedes* populations remained low for most of the season throughout the District. There were some hot spots of *Cq. perturbans* in the northern counties, Carver County, and in the river bottoms in the center of the District.

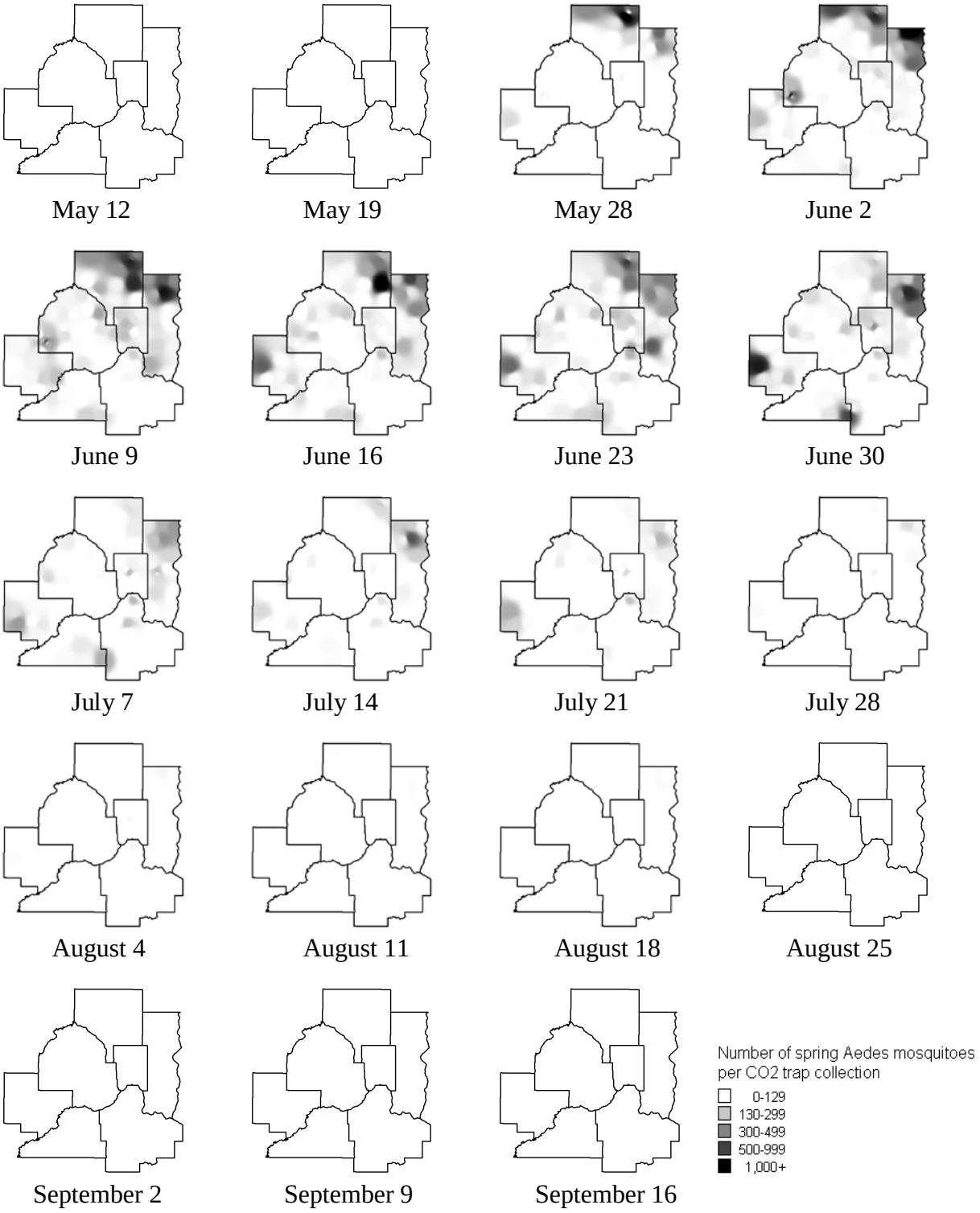


Figure 1.8 Number of spring *Aedes* mosquitoes in District CO_2 trap collections, 2008. The number of collections taken each week varied from 114-123. Inverse distance weighting was the algorithm used for shading the maps.

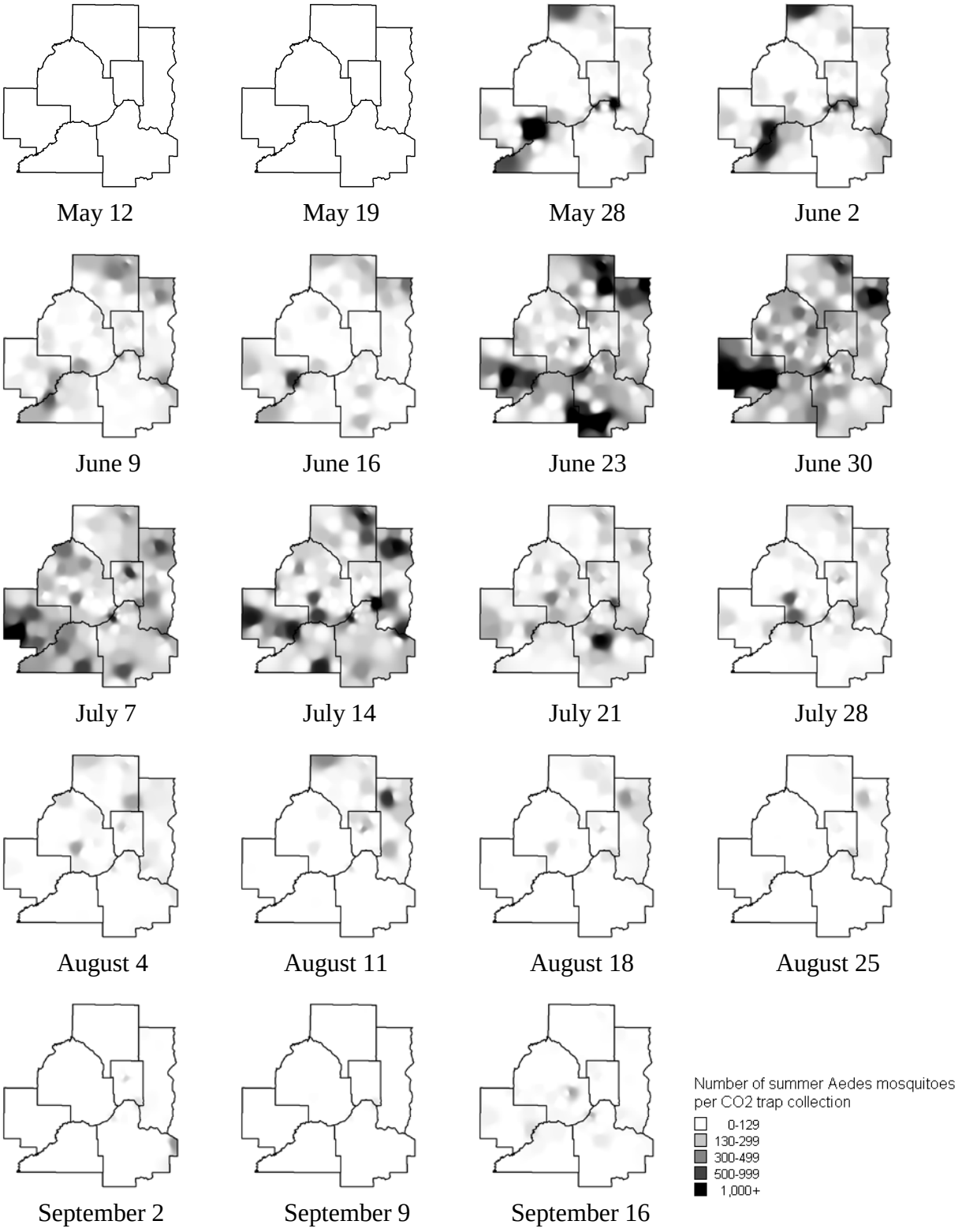


Figure 1.9 Number of summer *Aedes* mosquitoes in District CO_2 trap collections, 2008. The number of traps operated per night varied from 114-123. Inverse distance weighting was the algorithm used for shading the maps.

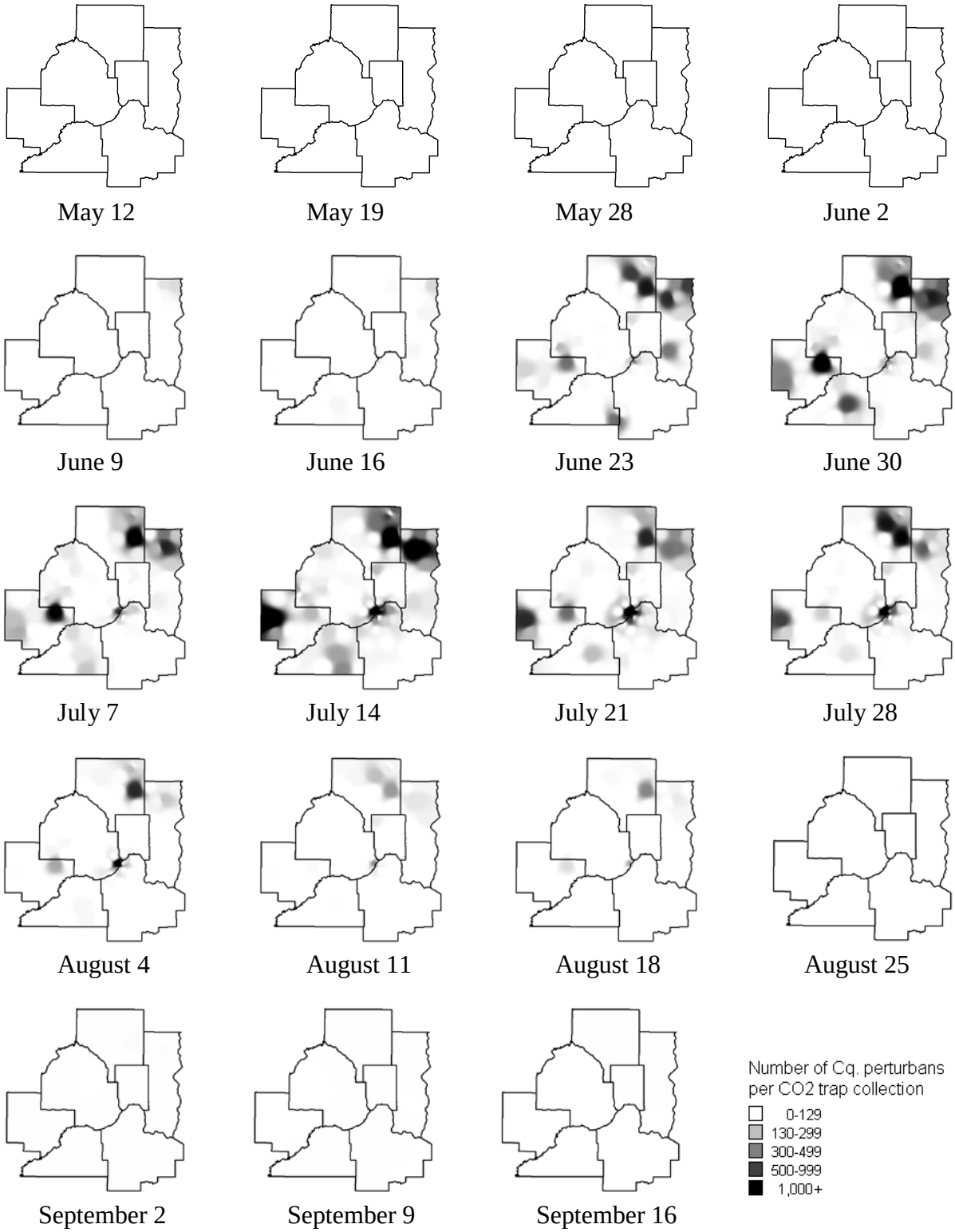


Figure 1.10 Number of *Cq. perturbans* in District CO_2 trap collections, 2008. The number of traps operated per night varied from 114-123. Inverse distance weighting was the algorithm used for shading of maps.

Seasonal Distribution The three major groups of mosquito species, spring *Aedes*, summer *Aedes* and *Cq. perturbans*, have different patterns of occurrence during the season based on their phenology and the surveillance method used. Spring *Aedes* and *Cq. perturbans* have one generation per year and the summer *Aedes* emerge after significant rainfall events. The CO_2 trap and sweep net collections detected continuous, overlapping activity of the three groups from the end of May through July in 2008 (Figures 1.11 and 1.12)**.** The night of June 16 was very cool, resulting in lower than normal activity.

CO_2 traps are placed at selected locations throughout the District to measure the abundance of mosquitoes. Emergence from the first brood of summer *Aedes* occurred on May 28 (Fig. 1.11). This was also the first detection of spring *Aedes*, whose populations peaked on June 9. A second, large summer *Aedes* brood emerged at the end of July, followed by a smaller brood in mid-July. The *Cq. perturbans* populations peaked the week of July 14, later than the usual July 4th peak. The third emergence of summer *Aedes* coincided with the *Cq. perturbans* peak. Mosquito levels of all species declined by mid-July and remained low for the rest of the season.

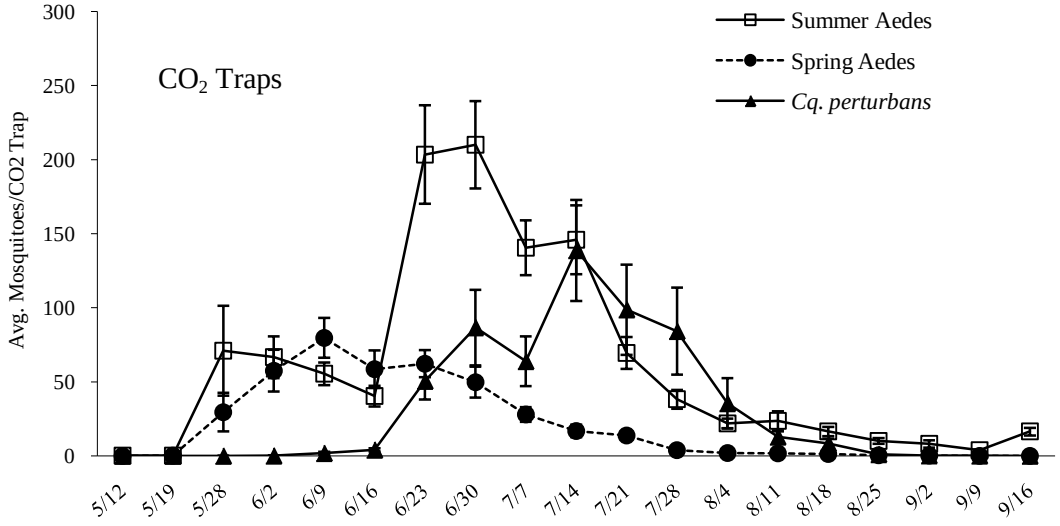


Figure 1.11 Average number of summer *Aedes*, spring *Aedes* and *Cq. perturbans* per CO_2 trap, 2008. Data are from low (5 ft) traps within District. Error bars equal ± 1 standard error of the mean.

Since the sweep net collections are taken by MMCD employees, the locations are random, not chosen. Employees collect the mosquitoes that are attracted to them, thus measuring annoyance. The timing of the mosquito peaks in the sweeps mirrors the CO_2 traps, but the volume of the three species groups differed (Fig. 1.12). This year was the first time the spring *Aedes* outnumbered summer *Aedes* and *Cq. perturbans* populations. The spring *Aedes* peak on June 9 was the highest of any species for the season. The population of spring *Aedes* remained unusually high through the season and continued to cause annoyance until late August, about two weeks longer than usual.

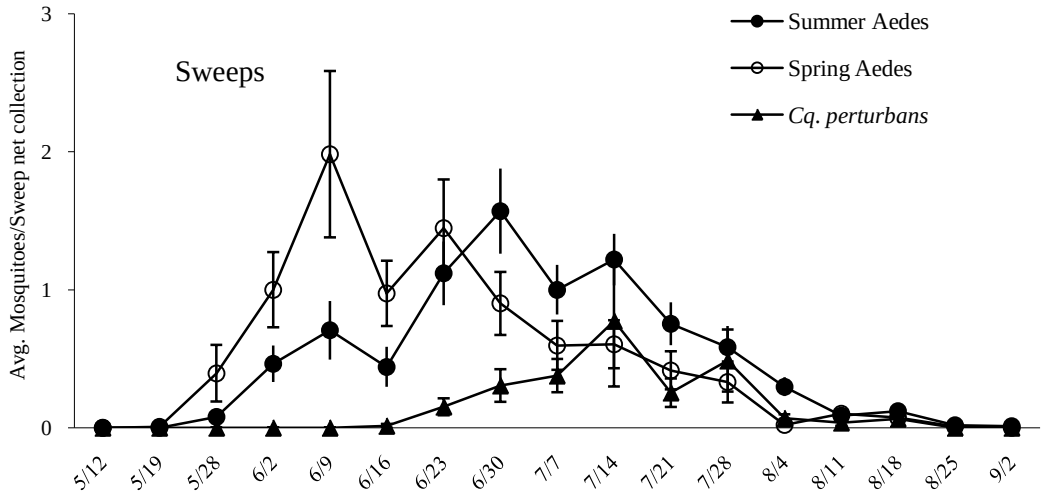


Figure 1.12 Average number of summer *Aedes*, spring *Aedes* and *Cq. perturbans* per evening sweep net collection, 2008. Error bars equal ± 1 standard error of the mean.

New Jersey Light Traps Data collected from New Jersey light traps are used to compare mosquito species population levels from year to year. These are the only collections where all adult female mosquitoes are identified to species. Traps are run nightly from May to September. The District operated six traps in 2008. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap CA in Carlos Avery Wildlife Refuge, and trap AV at the Minnesota Zoo in Apple Valley (Figure 1.13). Traps 1, 9, and 16 have operated each year since 1960.

For the second year in a row, the most numerous species collected in New Jersey traps was *Cq. perturbans*, with *Ae. vexans* coming in second (Table 1.5). Typically, *Ae. vexans* is the number one pest, but prevailing drought conditions the last two seasons kept the populations very low, allowing *Cq. perturbans* to come in first place. In third place was the spring species combination of *Ae. abserratus* and *Ae. punctor*. These two species are combined together because they are morphologically very similar and thus difficult to identify separately to species. *Aedes cinereus* was the fourth most common species, occurring in both spring and summer.

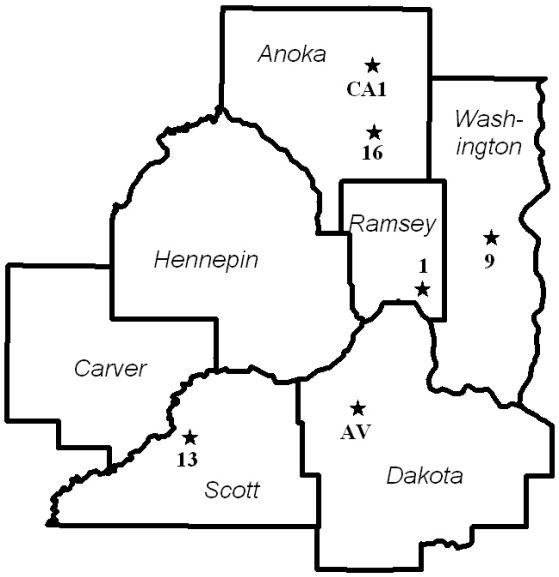


Figure 1.13 New Jersey light trap locations, 2008.

Table 1.5 Total number and frequency of occurrence for each species collected in New Jersey light traps, May 10 - September 26, 2008

	Trap Code, Location, and Number of Collections						Summary Statistics		
	1	9	13	16	CA1	AV	Season		
	St. Paul	Lk. Elmo	Jordan	Lino Lakes	Carlos	Apple Valley	Total	% Female	Avg per
Species	139	137	137	131	126	138	808	Total	Night
1. Ae. abserratus	1	1	0	15	1101	0	1,118	3.63%	1.38
3. aurifer	0	0	0	1	0	0	1	0.00%	0.00
6. canadensis	0	1	1	0	52	0	54	0.18%	0.07
7. cinereus	10	8	10	144	1,483	73	1,728	5.61%	2.14
10. dorsalis	0	1	1	0	0	0	2	0.01%	0.00
11. excrucians	5	7	1	11	357	25	406	1.32%	0.50
12. fitchii	1	5	0	5	38	12	61	0.20%	0.08
13. flavescens	0	0	0	0	0	0	0	0.00%	0.00
14. implicatus	0	0	0	0	0	0	0	0.00%	0.00
16. nigromaculus	1	0	1	0	0	0	2	0.01%	0.00
18. punctor	0	0	0	24	658	0	682	2.21%	0.84
19. riparius	0	0	0	2	25	1	28	0.09%	0.03
20. spenceri	0	0	0	0	0	0	0	0.00%	0.00
21. sticticus	0	1	92	1	8	4	106	0.34%	0.13
22. stimulans	1	5	1	4	33	28	72	0.23%	0.09
23. provocans	0	1	0	0	1	1	3	0.01%	0.00
24. triseriatus	1	2	1	1	0	1	6	0.02%	0.01
25. trivittatus	2	3	0	0	4	16	25	0.08%	0.03
26. vexans	976	473	687	2,310	2,579	1,471	8,496	27.59%	10.51
118. abs/punct.	3	1	0	82	4,755	1	4,842	15.72%	5.99
261. Aedes species	11	18	16	44	199	135	423	1.37%	0.52
262. Spring *Aedes*	3	4	2	23	382	9	423	1.37%	0.52
264. Summer *Aedes*	0	2	2	5	0	4	13	0.04%	0.02
27. An. barberi	0	0	0	0	0	0	0	0.00%	0.00
28. earlei	0	0	0	0	3	0	3	0.01%	0.00
29. punctipennis	1	4	3	5	20	10	43	0.14%	0.05
30. quadrimac.	1	11	4	10	5	12	43	0.14%	0.05
31. walkeri	0	0	40	19	578	0	637	2.07%	0.79
311. An. species	0	3	2	1	19	1	26	0.08%	0.03
32. Cx. erraticus	0	0	0	0	0	0	0	0.00%	0.00
33. pipiens	1	0	0	0	0	0	1	0.00%	0.00
34. restuans	60	95	8	37	41	33	274	0.89%	0.34
35. salinarius	0	0	3	1	0	0	4	0.01%	0.00
36. tarsalis	12	4	10	27	4	5	62	0.20%	0.08
37. territans	3	12	3	13	7	82	120	0.39%	0.15
371. Cx. species	42	17	2	14	41	25	141	0.46%	0.17
372. Cx. pip/rest	66	98	17	48	34	70	333	1.08%	0.41
38. Cs. inornata	44	14	9	40	11	78	196	0.64%	0.24
39. melanura	0	0	0	0	0	0	0	0.00%	0.00
40. minnesotae	1	2	4	25	38	2	72	0.23%	0.09
41. morsitans	3	5	1	6	83	3	101	0.33%	0.13
411. Cs. species	0	1	1	10	11	0	23	0.07%	0.03
42. Cq. perturbans	30	5	63	994	8,967	61	10,120	32.86%	12.52
44. Ps. ciliata	0	0	0	0	0	0	0	0.00%	0.00
47. horrida	0	0	0	0	0	0	0	0.00%	0.00
471. Ps. species	0	0	0	0	0	0	0	0.00%	0.00
48. Ur. sapphirina	4	18	1	0	0	7	30	0.10%	0.04
501. Unident.	3	1	3	14	41	15	77	0.25%	0.10
Female Total	1,286	823	989	3,936	21,578	2,185	30,797	76.21%	38.12
Male Total	313	604	412	1,169	5,687	1,431	9,616	23.79%	11.90
Grand Total	1,599	1,427	1,401	5,105	27,265	3,616	40,413	100.00%	50.02

Anopheles quadrimaculatus and *Culex erraticus* are two species that are considered rare in the District. In recent years, they have been collected in traps more frequently. *Culex erraticus* were first found in 1988 and have occurred sporadically since then in low numbers (Figure 1.14). *Anopheles quadrimaculatus* occurred in the early years, were absent for a long span of years, then began appearing again in 1988. In 2007, there was an especially large peak in the number collected. We are investigating the reasons for this change in occurrence. It may be a result of changing weather patterns that have allowed this species to increase its productivity. Populations of *An. quadrimaculatus* were reduced this season, down significantly from 2007. There were no *Cx. erraticus* detections this year.

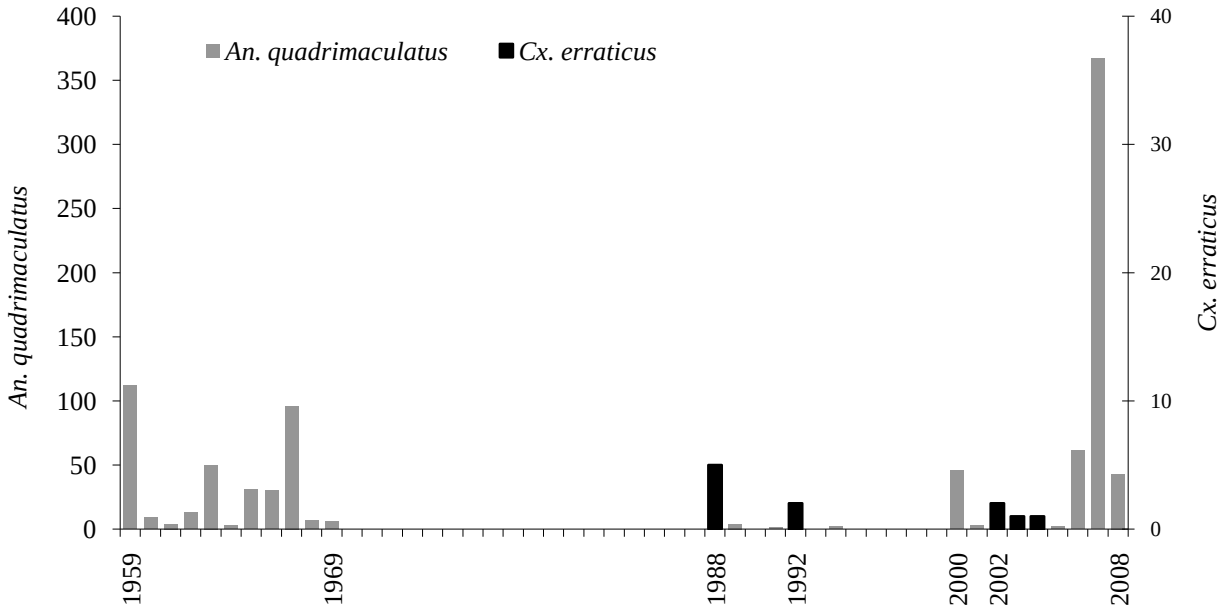


Figure 1.14 Yearly totals of *Anopheles quadrimaculatus* and *Culex erraticus* in New Jersey light traps, 1958-2008.

Vector Mosquito Surveillance

Aedes triseriatus Aspirator surveillance for the La Crosse encephalitis vector, *Ae. triseriatus,* began during the week of May 18. The peak rate of capture of just over 1.3 *Ae. triseriatus* per sample occurred during the week of July 6 (Figure 1.15). Surveillance results indicate that adult emergence was delayed by approximately two weeks early in the season, but the observed trend was similar to that expected for a year with normal precipitation until early July. Dry conditions during June and July severely impacted *Ae. triseriatus* populations for much of the remainder of the season.

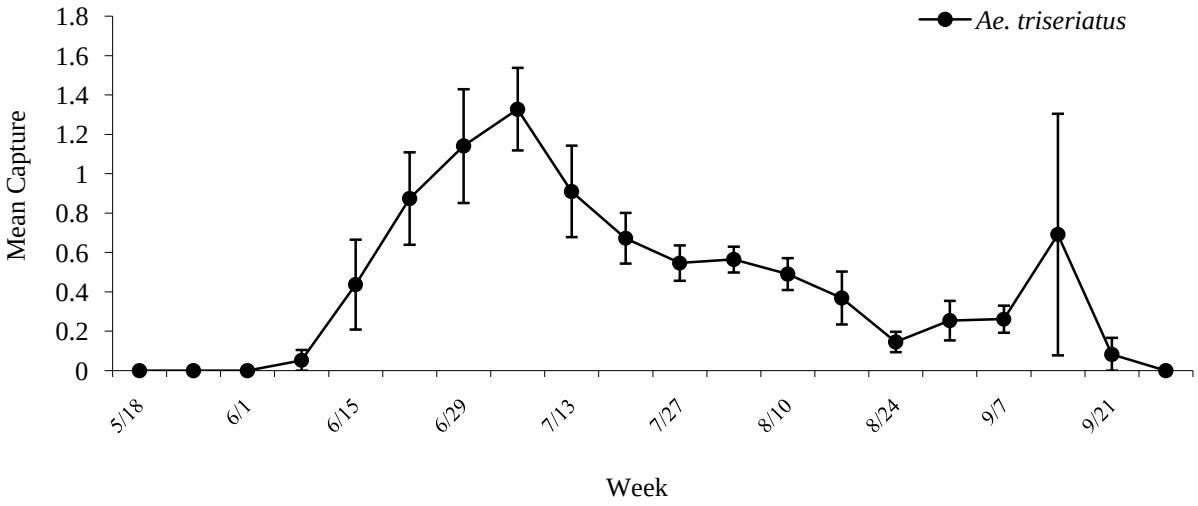


Figure 1.15 Mean number of *Ae. triseriatus* adults in aspirator samples, plotted by week, 2008. Dates listed are the first sampling day of each week. Error bars equal ± 1 standard error of the mean.

Culiseta melanura District staff monitored six locations for the eastern equine encephalitis (EEE) vector *Cs. melanura* using seven CO_2 traps. Three of the sites are located in Anoka County, two in Washington County and one site in Hennepin County. The Hennepin County location has a ground level trap and a canopy level trap. *Culiseta melanura* have been collected from each of the locations in the past. In addition, 66 aspirator samples were collected from wooded habitats surrounding potential *Cs. melanura* larval habitat (i.e., tamarack bogs).

Culiseta melanura adults were collected in CO_2 traps at all of the Anoka County and Washington County sites. No specimens were collected in the Hennepin County traps. Three aspirator samples contained *Cs. melanura* in 2008, two from Washington County and one from Anoka County.

Culiseta melanura were collected consistently from the first week of June through the end of surveillance (Figure 1.16); however, the rate of capture by CO_2 traps was low in 2008. One trap in Washington County collected elevated numbers of the species during the first two weeks of August. No other collection exceeded single digits during the entire season.

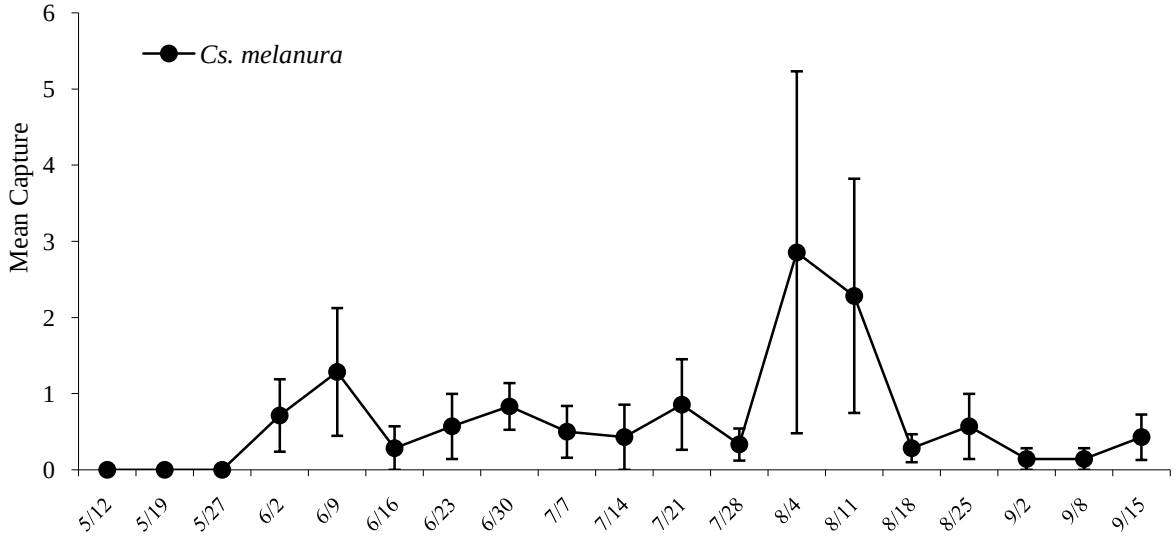


Figure 1.16 Mean number of *Cs. melanura* adults in CO_2 trap samples, plotted by week, 2008. Error bars equal ± 1 standard error of the mean.

***Culex* Surveillance** *Culex* species are important for the amplification and transmission of West Nile virus (WNV) and western equine encephalitis virus (WEE) in our area. In addition to CO_2 traps, gravid traps are used to monitor *Culex* adults. The gravid trap is designed to attract female mosquitoes that are seeking oviposition sites while the CO_2 trap is used for collecting female mosquitoes in their host-seeking phase. The District operated 133 CO_2 traps and 36 gravid traps in 2008.

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 and gravid traps were tested for WNV and WEE (see Chapter 2, Table 2.2). As is typical, very few *Cx. tarsalis* were collected by gravid trap in 2008. Capture rates in CO_2 traps were in the low part of what might be considered the normal range for our area. The season peak of 4.7 *Cx. tarsalis* per CO_2 trap occurred on July 14; a late season peak of 3.8 occurred on August 25 (Figure 1.17).

Culex restuans is another important vector of WNV in Minnesota. This species is largely responsible for the early season amplification of the virus and likely responsible for the season-long maintenance of the WNV cycle. *Culex restuans* were consistently present in CO_2 traps in low numbers from the beginning of June through the middle of August (Figure 1.18). Gravid trap collections of *Cx. restuans* increased steadily from the end of May through the end of June then declined steadily in July. The collections of 33.4 per gravid trap during the week of June 30 and 29.9 the following week are the two highest weekly mean captures on record in the District.

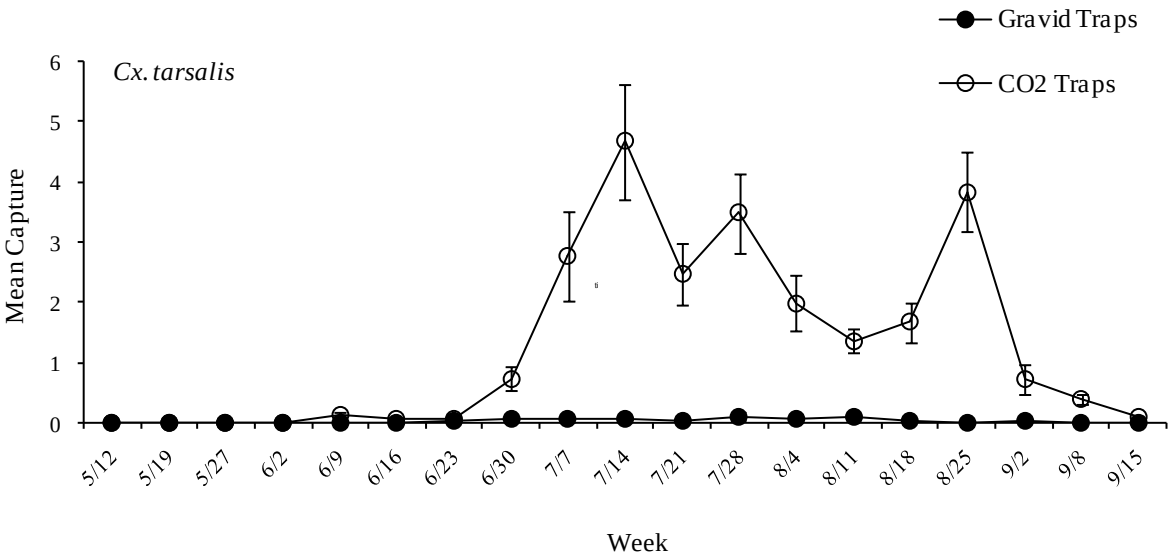


Figure 1.17 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2008. Error bars equal ± 1 standard error of the mean.

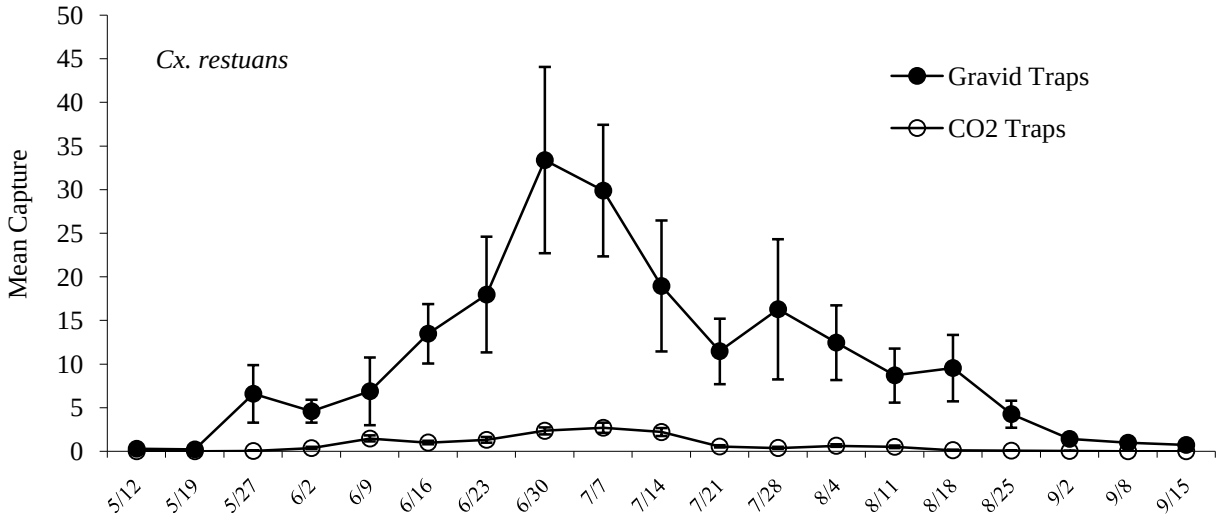


Figure 1.18 Average number of *Cx. restuans* in CO_2 traps and gravid traps, 2008. Error bars equal ± 1 standard error of the mean.

Culex pipiens has been an important vector of WNV in much of the United States. This species prefers warmer temperatures than *Cx. restuans*; therefore, populations of *Cx. pipiens* in the District tend to peak late in the summer when temperatures are typically warmer. Collections of *Cx. pipiens* were low in both CO_2 traps and gravid traps in 2008 (Figure 1.19).

The peak gravid trap capture of 1.2 occurred during the week of June 30; however, all of the *Cx. pipiens* collected that week came from a single trap in Hennepin County. Trap surveillance seems to indicate that the adult population was at its height across the District during mid to late July.

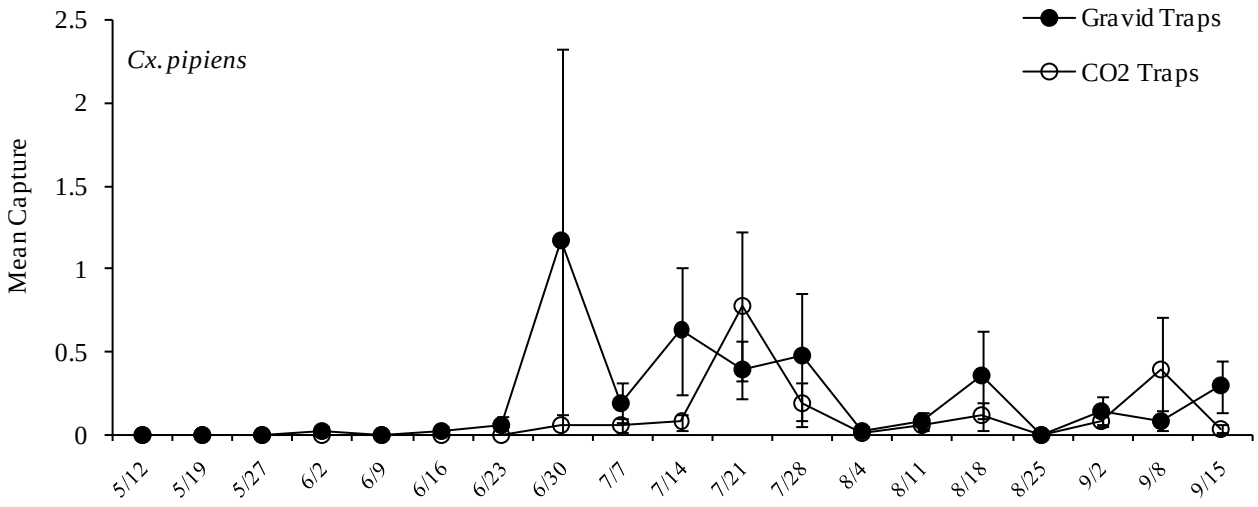


Figure 1.19 Average number of *Cx. pipiens* in weekly CO_2 traps and gravid traps, 2008. Error bars equal ± 1 standard error of the mean.

It is difficult to separate *Cx. restuans* and *Cx. pipiens* and often these species are combined. When *Culex* specimens are combined, they are grouped as either *Cx. pipiens/restuans* or as *Culex* species. Both groups usually consisted largely of *Cx. restuans*. In 2008, the numbers of *Cx. pipiens/restuans* and *Culex* species were elevated during two periods (Figure 1.20). The first period in late June and early July resembles the *Cx. restuans* pattern. The captures increased again from late July through mid-August. These may have included more *Cx. pipiens*.

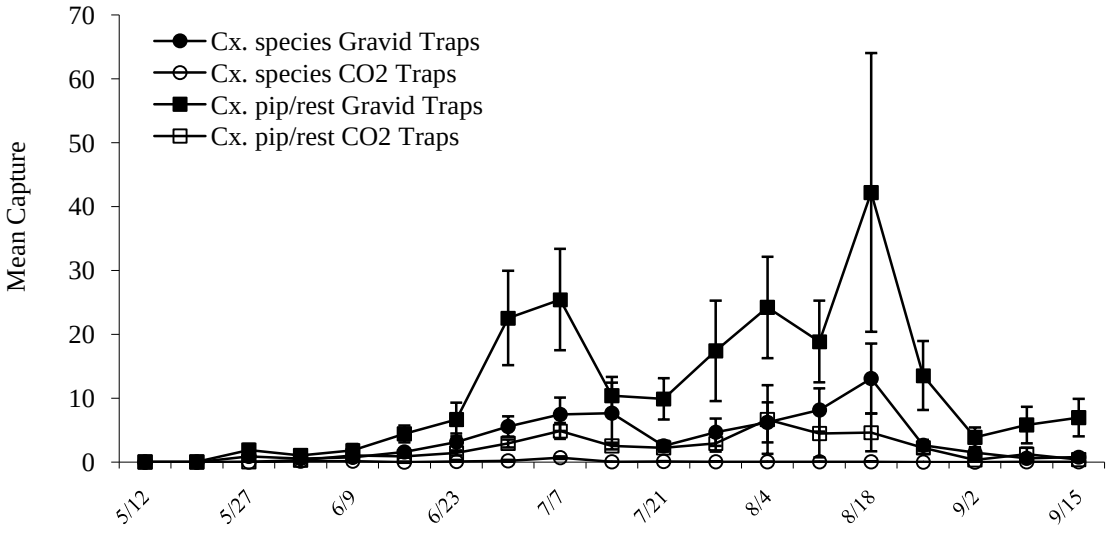


Figure 1.20 Average number of *Cx. pipiens/restuans* and *Culex* species in CO_2 traps and gravid traps, 2008. Error bars equal ± 1 standard error of the mean.

Exotic Species Each season, MMCD staff watches for exotic or introduced mosquito species. MMCD laboratory technicians are trained to recognize exotic species in their adult and larval stage so that the mosquitoes can be spotted in any of the thousands of samples processed each year. In addition, field staff place ovitraps and conduct aspirator surveillance in areas with elevated potential for introduction.

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 the use of tires and other artificial containers as oviposition sites and larval habitat. This allows them to be transported over great distances. Both of these species have the potential to transmit several viruses; West Nile virus and La Crosse encephalitis virus are the two of primary concern in our area. *Aedes albopictus* has been established in the continental US since 1985 and is now common in the southeastern states, along the East Coast, as well as in southern portions of the Midwest. *Aedes japonicus* was first identified in the US in 1999 in New Jersey and has now advanced westward beyond the Mississippi River in several locations. Another *Ae. japonicus* introduction occurred in the Seattle area in 2001.

Although *Ae. albopictus* were collected the past three years, none were collected in the District in 2008. *Aedes albopictus* have been found in Scott County during six previous seasons (1991, 1996, 1999, 2005, 2006, and 2007) and in Wright County once, in 1997.

Aedes japonicus was first confirmed in Minnesota in 2007 in Scott County. Extensive surveillance around the Scott County site of introduction failed to produce another specimen in 2008, suggesting *Ae. japonicus* were eradicated from the area by MMCD efforts in 2007.

Aedes japonicus was found in four Minnesota counties in 2008 including several Dakota County locations. They were also collected in Goodhue, Houston, and Wabasha counties. The first two samples containing *Ae. japonicus* in 2008 were collected during the course of routine larval surveillance in May from Castle Rock Township and from Eagan, both in Dakota County. The Castle Rock sample was collected on May 20 from an ornamental pond. The Eagan sample was collected on May 27 from a tire. In both cases, it is reasonable to suspect that the larvae hatched from eggs deposited in 2007. Property owners confirmed that both of the larval habitats had been in place for several years and not recently introduced. Furthermore, unusually cool spring temperatures prior to the collection of the larvae were inhospitable for adult mosquito activity including host seeking and oviposition.

One additional sample from Eagan, a gravid trap collection from July 7, contained *Ae. japonicus*. Seven more larval samples from Castle Rock also contained *Ae. japonicus*. One was collected on July 8; the others were collected in mid-September.

On September 2, an aspirator sample collected in Ravenna Township contained *Ae. japonicus*. Follow-up surveillance indicated that the extent of the infestation was greater than those we observed previously. Several samples containing *Ae. japonicus* larvae were collected in the days immediately following the aspirator collection. By the end of October, *Ae. japonicus* were detected on 29 properties in Ravenna, as well as in the neighboring communities of Marshan Township and Vermillion Township in Dakota County and Welch Township and Redwing Township in Goodhue County. Table 1.6 shows the results of *Ae. japonicus* surveillance done in 2008 in Dakota County.

A single detection of *Ae. japonicus* was made this year by the MDH while investigating a La Crosse encephalitis case in Wabasha County. Larvae were found at one site visited. Additionally, *Ae. japonicus* were collected by the La Crosse County Wisconsin Department of Health in Houston County, Minnesota and in both La Crosse County and neighboring Monroe County in Wisconsin.

Table 1.6 Results of surveillance following *Ae. japonicus* detections in Dakota County, 2008

	Properties* Inspected	Properties with *Ae. japonicus*	Larval Habitats Eliminated	Larval Samples Collected	Larval Samples with *Ae. japonicus*	Adult Samples Collected	Adult Samples with *Ae. japonicus*	Ovitrap Samples Collected	Ovitrap Samples with *Ae. japonicus*
Castle Rock	36	5	513	127	8	104	0	72	0
Eagan	104	2	112	81	1	105	1	56	0
Ravenna	136	29	513	236	62	43	4	6	1
Marshan	8	1	74	15	1	0	-	0	-
Vermillion	5	1	20	14	1	0	-	0	-

* MMCD also inspected properties in Goodhue County, three in Welch Township and a trailer court in Redwing. Five larval samples from two Welch properties and nine larval samples from Redwing contained *Ae. japonicus.*

We have long anticipated that *Ae. japonicus* would become established in the District given its ability to survive at and above our latitude in Asia. It appears now that the species has permanently infested parts of southeastern Minnesota (Figure 1.21).

Until they are fully established throughout the District, our efforts will be focused on containing and eliminating small, isolated populations of the species. Once *Ae. japonicus* is established in an area, our goal will be to maintain an effective population control program to minimize the risk of disease transmission.

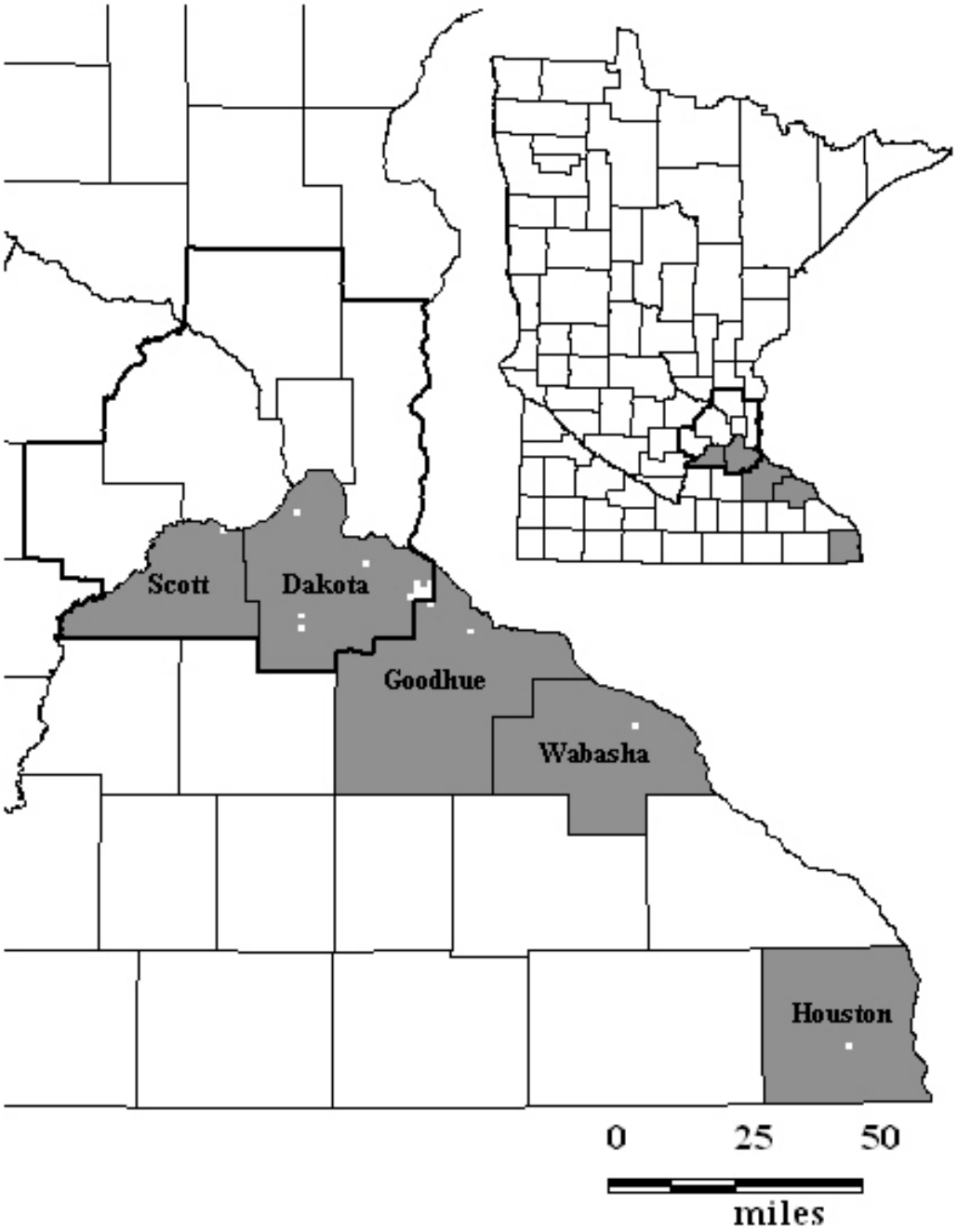


Figure 1.21 Locations of *Ae. japonicus* collections 2007, 2008. *Aedes japonicus* have been collected from the shaded counties; the white square mile sections in the shaded areas indicate where the species has been collected.

2009 Plans for Mosquito Surveillance

Surveillance strategies for *Aedes* mosquitoes will continue as in 2008. We will continue to evaluate the placement of CO_2 and gravid traps. Our goal is to operate a CO_2 trap in each township in the District to monitor mosquito population levels. Locations include: areas where adult treatments are performed on a regular basis and threshold determination is needed, near cattail sites to monitor *Cq. perturbans* populations, areas of potential disease vector mosquito activity, and employee's homes.

With the addition of more field crews in 2009, lab staff will be prepared for the increase in mosquito samples. Lab staff will continue to improve the relay of surveillance results to field staff to facilitate timely and accurate treatments.

We plan to search for the presence of *Ae. cataphylla* to determine whether or not it is established in the District. Additionally, we will monitor the spread of *Ae. japonicus* across the District and investigate which surveillance methods can best detect its presence.

Chapter 2 Vector-borne Disease

2008 Highlights

- There were no La Crosse encephalitis cases in the District
- WNV illness confirmed in 10 Minnesotans, 1 a District resident
- WNV detected in 23 District mosquito samples
- Conducted product efficacy tests against *Culex* vectors in catch basins and stormwater structures
- Made 195,833 catch basin treatments
- Collected and recycled 16,229 waste tires
- Most recent study results from tick monitoring are from 2007
- 2007 was the first time *I. scapularis* was collected from at least one site in all 7 metropolitan counties
- The 2007 season mean was 0.8976 *I. scapularis* per mammal and preliminary 2008 season mean was 0.644
- 2007 human case totals of tick-borne disease were at an all-time high: 1,239 cases of Lyme disease and 322 cases of human granulocytic anaplasmosis (source MDH)
- 2008 distribution study report will be on the web by June 2009

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 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* routinely occurs to detect infestations of these potential disease vectors.

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

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

Since the arrival of WNV in Minnesota in 2002, MMCD has investigated a variety of mosquito control procedures to be used to enhance our comprehensive integrated mosquito management strategy for the prevention of West Nile illness. MMCD monitors birds and mosquitoes for WNV and uses that information along with other mosquito sampling data to

2009 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Evaluate control materials in stormwater structures providing *Culex* larval habitat
- Continue catch basin larvicide treatments to manage WNV vectors
- Communicate treatment strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Be alert for introductions and spread of exotic species; maintain surveillance near points of discovery in 2008
- Surveillance at 100 sampling locations for *I. scapularis* will continue
- Continue with tick-borne disease education, tick identifications, and homeowner consultations
- Target education activities to specific metro townships based on higher human case totals and/or numbers of *I. scapularis* collected

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 with spirochete and anaplasmosis studies with the University of Minnesota. 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).

2008 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 La Crosse virus vector *Ae. triseriatus*, the exotic species *Ae. albopictus* and *Ae. japonicus*, and the WNV vectors *Culex restuans* and *Culex pipiens*.

Container habitat elimination is an effective strategy for preventing mosquito-borne illnesses. District staff recycled 16,229 tires that were collected from the field in 2008. Since 1988, the District has recycled 471,093 tires. In addition, MMCD eliminated 1,615 containers and filled 93 tree holes in 2008.

This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities, including the 1,385 property inspections by MMCD staff in 2008.

La Crosse Encephalitis

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

In 2008, MMCD staff collected 2,429 aspirator samples to monitor *Ae. triseriatus* populations. The District's treatment threshold of ≥2 adult *Ae. triseriatus*/aspirator collection was met in 249 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when samples reached threshold. Additionally, 123 adulticide applications to wooded areas were prompted by collections of *Ae. triseriatus* in aspirator samples.

Adult *Ae. triseriatus* were captured in 495 of 1,685 individual wooded areas sampled. This ratio was similar to the previous two dry seasons. The mean number of *Ae. triseriatus* captured per sample was low, but comparable to previous seasons which lacked ideal weather conditions for the species (Table 2.1).

Table 2.1 Individual wooded areas sampled by aspirator and the number of those where *Ae. triseriatus* were captured, 2000 – 2008

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

La Crosse Encephalitis in Minnesota One case of La Crosse illness was reported in Minnesota in 2008. A child from Wabasha County was diagnosed with La Crosse encephalitis after a September 21 onset of illness. There were no LAC illnesses in District residents in 2008.

Eastern Equine Encephalitis

In 2008, eastern equine encephalitis (EEE) virus was detected in 21 states, primarily on the East Coast and along the Gulf of Mexico. There were two human illnesses diagnosed, one in Alabama and one in Florida. One hundred seventy-three horses from 13 states were diagnosed with EEE. The nearest cases were found in Michigan and southeast 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 last record of EEE in Minnesota was in 2001 when three horses were infected with the virus including one from Anoka County.

***Culiseta melanura* Surveillance** *Culiseta melanura* are relatively rare in the District and are restricted to a few bog-type larval habitats. The greatest concentration of this type of habitat is in the northeast part of MMCD in Anoka and Washington counties. Still, *Cs. melanura* are occasionally collected in other areas of the District. Surveillance results are found in Chapter 1.

Western Equine Encephalitis

Western equine encephalitis (WEE) circulates among mosquitoes and birds in Minnesota, although normally below detectable levels. Occasionally, the virus causes illness in horses and less frequently in people. *Culex tarsalis* is the species most likely to transmit the virus to people and horses. In both 2004 and 2005, the virus was detected in *Cx. tarsalis* specimens collected in southern Minnesota. The virus has not been detected in Minnesota since then.

In 2008, *Cx. tarsalis* adults collected in the District during weekly CO_2 trap and gravid trap sampling were submitted to MDH for West Nile and WEE virus analysis. Two hundred eighteen *Cx. tarsalis* pools were tested for WEE, none of which were positive. The last record of WEE in the District was from a sentinel chicken sample collected in September 2001.

West Nile Virus

WNV in the United States West Nile virus (WNV) transmission was documented in 46 states in 2008. There were no WNV findings in Alaska, Hawaii, Maine, or North Carolina. The US Centers for Disease Control and Prevention received reports of 1,370 West Nile illnesses from 42 states. Fatalities occurred in 27 of the cases. California reported the greatest number of WNV illnesses with 411. Screening of the American blood supply detected WNV in 151 donors from 23 states. Additionally, West Nile illness was diagnosed in 138 equines from 30 states.

WNV in Minnesota The MDH reported 10 WNV illnesses in residents of 10 Minnesota counties. There were no WNV related fatalities. The earliest onset of a WNV illness in the state was July 18. Two blood donors from two counties screened positive for WNV in 2008. Additional WNV detections included 23 mosquito samples and seven birds. There were no WNV illnesses recorded from Minnesota horses in 2008.

West Nile Infections in the District One resident of the District, from Anoka County, was diagnosed with West Nile fever. There were no WNV fatalities in the District in 2008. One

blood donor from Dakota County had been infected with WNV as well. That infection was likely acquired in South Dakota and did not result in an illness.

Surveillance for WNV MMCD conducted surveillance for WNV in mosquitoes and wild birds. Several mosquito species from 33 CO_2 traps (13 elevated into the tree canopy) and 36 gravid traps were processed for viral analysis weekly. In addition, *Cx. tarsalis* collected in Monday night CO_2 traps were processed for viral analysis. MMCD tested 680 mosquito pools using Response Biomedical Corporation's RAMP® method and submitted 233 mosquito pools to MDH for viral analysis by PCR. Twenty-three pools were positive for WNV. Table 2.2 is a complete list of mosquitoes MMCD processed for viral analysis.

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

Species	Number of mosquitoes	Number of pools	WNV+ pools	MIR per 1000
Aedes japonicus	14	5	0	0.00
Culex pipiens	113	5	0	0.00
Culex restuans	5,748	168	3	0.52
Culex tarsalis	2,525	229	2	0.79
Culex species	4,604	221	8	1.74
Culex pipiens/restuans	7,424	285	10	1.35
Total	20,428	913	23	1.13

Bird mortality, especially among corvids, is often 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. Reports of 393 dead birds were received by telephone, internet or from employees. RAMP® tests were done on 25 birds, seven were positive for WNV. Results of testing are displayed by the week of bird deaths in Figure 2.1.

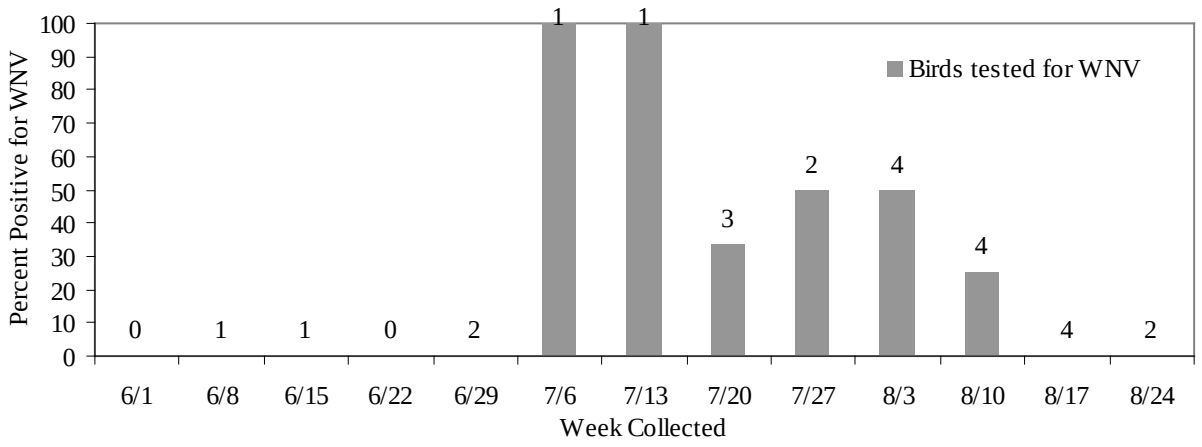


Figure 2.1 Percentage of birds collected by MMCD for WNV analysis that returned positive results by week of bird death. Labels indicate the number of birds tested.

Surveillance results for WNV in both birds and mosquitoes indicated that amplification of the virus occurred later in the 2008 season than in recent years. The first bird to test positive for WNV was collected on July 12. The first WNV positive birds of 2006 and 2007 were collected over one month earlier.

The first pool of mosquitoes to return a WNV positive result was collected on July 8. Infection rates in mosquitoes (Figure 2.2) remained low throughout the season, generally two orders of magnitude lower than the weekly rates experienced in 2007.

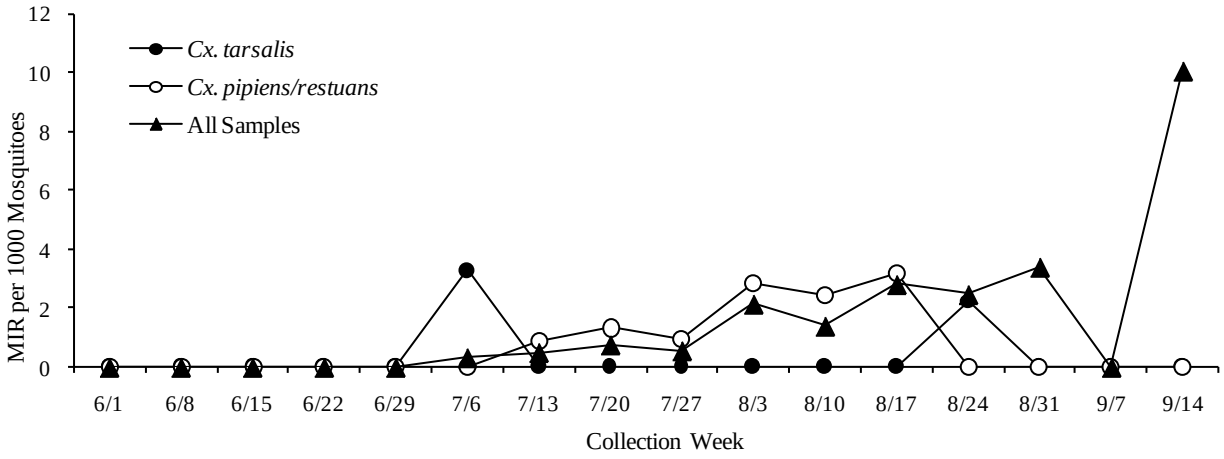


Figure 2.2 Weekly minimum WNV infection rates for all mosquito samples collected, *Cx. tarsalis*, and the *Cx. pipiens/restuans* group which includes pools of *Cx. pipiens*, *Cx. restuans*, and combined pools with both species.

Spring weather conditions, particularly cool temperatures during May and June, are the most plausible explanation for the late start to the 2008 WNV transmission season. Cool temperatures can impact WNV by suppressing vector populations and activity, as well as by slowing virus replication in infected mosquitoes.

Larval *Culex* Surveillance

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

Stormwater Management Structures and Other Man Made Habitats Since 2006, MMCD field staff have been working to locate undocumented stormwater structures, evaluate habitat, and provide larval control. A classification system was devised to categorize potential

habitats. Types of structures included culverts, washouts, rip/rap, risers (pond level regulators), underground structures, swimming pools, ornamental ponds and intermittent streams. In 2008, crews concentrated on documenting habitats that were previously undiscovered, applying larvicides to confirmed *Culex* habitats and testing larval control products.

Staff documented 23,763 visits to 12,235 structures in 2008. Two thousand eighty-two of the 9,389 wet structures inspected were inhabited by mosquitoes on the day visited. Inspectors collected 1,720 larval samples from stormwater structures and other man made habitats. West Nile virus vector *Culex* species were found in 85.1 % of the samples (Table 2.3). Other species commonly collected in 2008 were *Ae. vexans, Cx. territans*, and *Cs. inornata.*

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

Samples collected (N=1,720)	% occurrence
With *Cx. pipiens*	8.1
With *Cx. restuans*	77.8
With *Cx. salinarius*	0.2
With *Cx. tarsalis*	4.1
With ≥ 1 *Culex* species	85.1

For 2008, field studies were conducted to test VectoMax® CG (*B. sphaericus*) granules in stormwater structures. Culverts and washouts were selected as habitats suitable to test VectoMax® CG granules as *Culex* species often inhabit those that remain wet. Results of these material tests are located in Chapter 5.

Community Cooperation Treating Underground Stormwater Structures Many stormwater management systems include large underground chambers to trap sediments and other pollutants. There are several designs in use that vary in dimension and name, but collectively, they are often referred to as BMPs from *Best Management Practices for Stormwater* under the US Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES). MMCD has worked with city crews to survey underground BMPs since 2005. In 2006, we initiated a pilot project for cooperative larval control where MMCD provided larvicides and city staff made control applications. The cities of Bloomington and Maplewood participated in 2006. We expanded the project in 2007 when we worked with 23 municipalities to apply larvicides in underground BMPs (Table 2.4).

In 2008, we continued the cooperative mosquito control plan for underground habitats. Twenty-four communities volunteered their staff to assist with material applications (Table 2.4). Altosid® XR briquets were used at the label rate of one briquet per 1,500 gallons of water retained. Briquets were placed in 1,075 underground habitats.

Table 2.4 Cities that assisted in treating underground stormwater habitats; 1,075 structures were treated and a total of 1,364 briquets were applied

City	Structures treated	Briquets used	City	Structures treated	Briquets used
Arden Hills	6	6	Lino Lakes	10	10
Blaine	6	19	Maplewood	90	90
Bloomington	60	74	Mendota Heights	19	25
Brooklyn Center	4	15	Minneapolis	164	164
Crystal	2	6	New Brighton	3	6
Eagan	20	20	New Hope	6	12
Eden Prairie	12	20	Plymouth	150	335
Edina	17	17	Prior Lake	286	306
Fridley	10	23	Roseville	11	14
Golden Valley	100	100	Shoreview	22	25
Hastings	2	2	Spring Lake Park	2	2
Lauderdale	13	13	White Bear Lake	60	60

Staff were able to collect six bioassays from five underground structures in late July (Table 2.5). Five of the six bioassays were from treated sites. One was from an untreated structure. Even though the sample size was small, results indicate that the treated sites had unacceptable levels of adult emergence, similar to our experience in 2007.

Table 2.5 Underground structure bioassay results

Date collected	Treatment	Sitecode	% emergence
7/29/2008	Altosid XR	270306-730	69.0
7/29/2008	Altosid XR	270319-736	53.5
7/29/2008	Altosid XR	270319-736	51.0
7/29/2008	Altosid XR	270318-729	48.0
7/29/2008	Altosid XR	270330-728	54.5
7/29/2008	Untreated	274834-710	87.0

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. For 2009 we are planning on testing at least one alternative to Altosid® XR briquets in underground habitats. Work in 2008 to evaluate new larvicides for use in catch basins provided promising results for two extended release larvicides that might be applicable to underground habitats.

Larval *Culex* Control in Catch Basins Four extended efficacy larvicides were evaluated for use in catch basins in 2008. Two formulations (14 g, 28 g) of the FourStar™ briquet which includes both *Bti* and *B. sphaericus* were evaluated. Additionally, two formulations (30-day tablet, 150-day tablet) of a new product called Natular® containing the active ingredient Spinosad were tested. A review of this research is in Chapter 5.

Although the summer of 2008 was not as warm as the previous two summers, we did experience drought conditions for the third consecutive year. Mosquitoes that inhabit catch basins are generally aided by extended periods of dry weather as larvae are not swept away by flushing rainfall. We observed high rates of larval presence in catch basins from mid-June through August. Larvae were found during 669 of 1,038 catch basin inspections (64.5%) in 2008. Fifty sites were inspected weekly from June 1 through September during material efficacy trials. Field staff inspected additional catch basins for other purposes such as training, locating sources of mosquitoes in adult traps as well as to collect supplemental material efficacy data. Rates of larval presence by week are displayed in Figure 2.3.

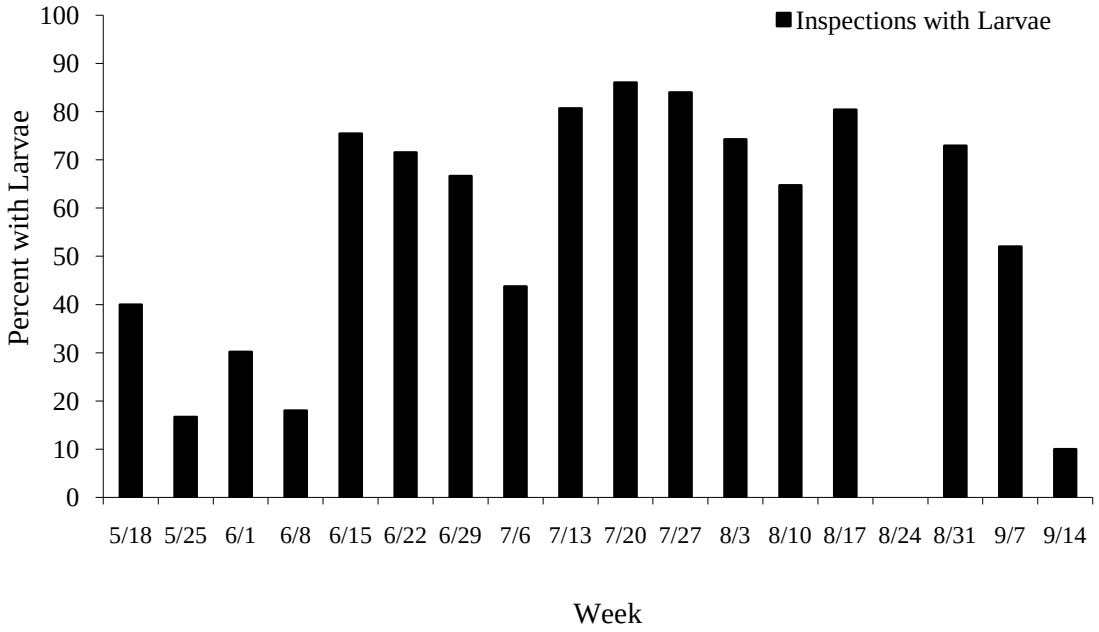


Figure 2.3 Weekly ratios of catch basins inhabited by mosquitoes (n=10 to 102). No samples were collected the week of August 24.

Mosquito larvae were identified from 661 catch basin samples (Figure 2.4). The predominant species was *Cx. restuans*, as is usually the case in our area. *Culex restuans* were found in 67.6% of catch basin larval samples. *Culex pipiens* were identified from a large number of catch basin samples, 46.3% which is similar to our 2007 observations. *Culex tarsalis* were collected infrequently and *Cx. salinarius* were not found in catch basins in 2008.

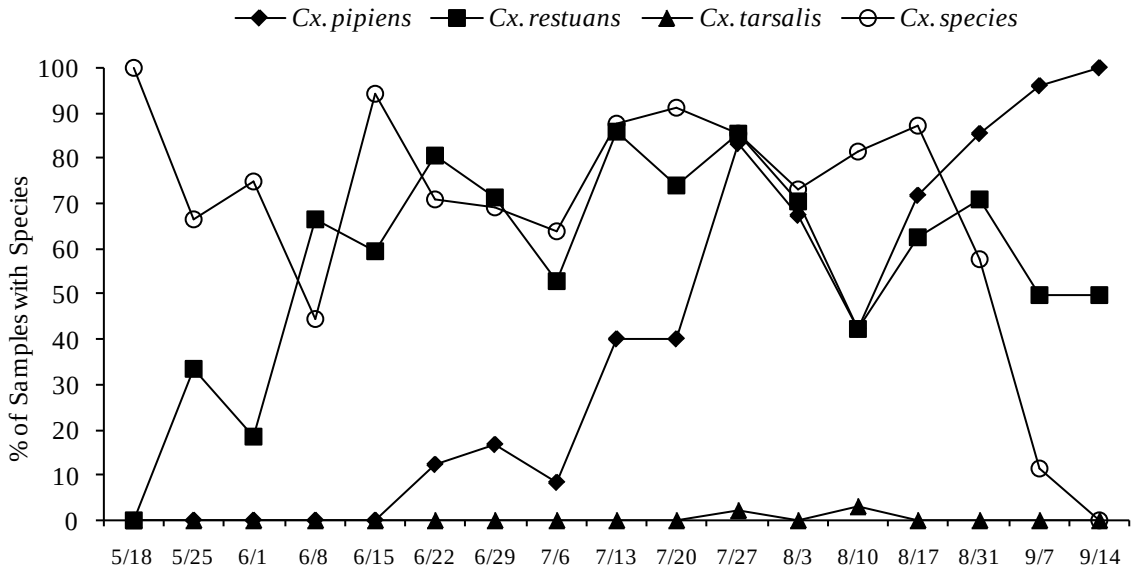


Figure 2.4 Composition of *Culex* mosquito species in catch basin larval samples by week (n= 4 to 73). No samples were collected the week of August 24.

Plans for 2009 – Mosquito-borne Disease

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

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. District staff 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. Finally, MMCD staff will intensely monitor the spread of *Ae. japonicus* and will remain watchful for the introduction of other exotic mosquito vectors, especially *Ae. albopictus*.

2008 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. The 2008 report will be available on our website (www.mmcd.org) in June. Following are the latest data compilations available including 2007 results and preliminary 2008 results.

The 2007 distribution study results seemed to provide continued evidence of an elevated *I. scapularis* population. For the first time in a single sampling season we collected *I. scapularis* from at least one site in all seven counties that comprise our service area. Further, our overall average of 0.876 ticks per mammal was comparable to our elevated averages (all $\geq$ .806) of 2000 – 2002, 2004 and 2005 and we collected many *I. scapularis* nymphs (Table 2.6). Finally, the number of positive sites, where at least one *I. scapularis* was collected, was tabulated in the 50s for only the fifth time (all since 2000) since the inception of this study.

Similarly, the MDH has been tabulating record-setting human tick-borne disease case totals since 2000. The 2007 human case totals for Lyme disease (1,239) and human granulocytic anaplasmosis (HGA) (322) were both new all-time high records. Their previous all-time high, statewide Lyme disease case total had occurred in 2004 (1,023 cases) while the previous HGA case total (186) record had been set in 2005. Other than for 2007 and 2004, the Lyme case totals since 2000 have ranged from 463 to 918 cases. Human granulocytic anaplasmosis (HGA) cases have also risen since 2000. The total case numbers from 2000 - 2006 ranged from 78 to 186 compared with an average of roughly 15 cases per year through 1999. Human disease case data for 2008 is not yet available.

In preliminary 2008 distribution study results, the overall 2008 *I. scapularis* per mammal season mean is currently calculated at 0.644; a decrease from 2007 (0.876), more similar to 2006 (0.637) and still higher than any season mean tabulated from 1990 - 1999. Although historically it has been typical for *Dermacentor variabilis* to comprise the majority of our tick collections (Table 2.6), in 2002, 2004, 2005, and 2006 *I. scapularis* comprised the majority ($\geq$ 50%) of our tick collections. However, in 2008, for the second consecutive year, we again collected a higher percentage of *D. variabilis* than *I. scapularis*. We have not fully evaluated the 2008 data just yet but did collect the fewest number of small mammals (702) since study inception.

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services were maintained in 2008 using previously described methods and tools.

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

Year	No. sites	Total ticks collected	*Dermacentor variabilis* % larvae	*Dermacentor variabilis* % nymphs	*Ixodes scapularis* % larvae	*Ixodes scapularis* % nymphs	% other species[b]
1990 [a]	250	9,957	83	10	6	1	0
1991	270	8,452	81	13	5	1	0
1992	200	4,130	79	17	3	1	0
1993	100	1,785	64	12	22	1	1
1994	100	1,514	53	11	31	4	1
1995	100	1,196	54	19	22	4	1
1996	100	724	64	20	11	3	1
1997	100	693	73	10	14	3	0
1998	100	1,389	56	7	32	5	0
1999	100	1,594	51	8	36	4	1
2000	100	2,207	47	10	31	12	0
2001	100	1,957	54	8	36	2	0
2002	100	2,185	36	13	42	8	1
2003	100	1,293	52	11	26	11	0
2004	100	1,773	37	8	51	4	0
2005	100	1,974	36	6	53	4	1
2006	100	1,353	30	10	54	4	1
2007	100	1,700	47	8	33	10	1
2008	100	1,005	48	6	34	11	1

[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

2009 Plans for Tick-borne Services

The metro-based *I. scapularis* distribution study that began in 1990 is planned to continue unchanged. We also plan to 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 offer an encompassing slide presentation.

Chapter 3 Mosquito Control

2008 Highlights

- 8,053 more acres worth of larvicides were applied to wetlands in 2008 than in 2007
- Large scale applications of Altosid® XR-G sand significantly increased acres we can treat to control Cq. *perturbans* with current budget resources
- 77,054 more acres worth of adulticides were applied in 2008 than in 2007
- A cumulative total of 195,833 catch basin treatments were made in three rounds to control vectors of WNV

2009 Plans

- Concentrate on the stormwater management structure treatment program to maintain efficacy and reduce workload to enable staff to provide additional mosquito control services
- Review MMCD's integrated mosquito management program to maximize service we can provide to citizens with current resources
- Continue to increase vector surveillance and control in response to the expected geographic expansion of *Ae. japonicus* within the District

Background

The mosquito control program targets the principal summer pest mosquito *Aedes vexans*, several species of spring *Aedes*, the cattail mosquito *Coquillettidia perturbans*, the eastern treehole mosquito *Aedes triseriatus* (La Crosse encephalitis vector), and the vector of western equine encephalitis *Culex tarsalis*. The arrival of West Nile virus (WNV) in Minnesota in 2002 elevated the importance of controlling *Cx. tarsalis* and three other *Culex* species (*Cx. pipiens, Cx. restuans,* and *Cx. salinarius*) which are potential vectors of WNV. Detections of *Aedes japonicus*, another vector species, in 2007 and 2008 increased control needs. Larval control is the main focus of the program but is supplemented by adult mosquito control when necessary.

Aedes larvae hatch in response to snow melt or rain with adults emerging at various times during the spring and summer. Cattail mosquito larvae develop in cattail marshes over twelve months and emerge as adult mosquitoes in June and July. *Culex* populations increase during periods of greater precipitation but inhabit more permanent waters and therefore are not as dependent upon rainfall. Stormwater catch basins can also provide habitat for *Cx. pipiens* and *Cx. restuans.* This type of mosquito habitat can be the primary source of WNV vectors in heavily urbanized areas. Such was the case in the WNV epidemics in Chicago in 2002 and 2005. *Aedes triseriatus* and *Ae. japonicus* both use many kinds of natural and artificial containers for larval habitat.

MMCD uses "Priority Zones" to focus service in areas where it will benefit the highest number of citizens. Priority Zone 1 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 includes sparsely populated and rural parts of the District. Small towns or population centers in rural areas are considered satellite communities and receive services similar to Priority Zone 1.

Adult mosquito control supplements 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. Two formulations of natural pyrethrins, Pyrenone® and Pyrocide®, are also used, mainly in agricultural areas. A description of the control materials is found in Appendix C. Appendix D indicates the dosages of control materials used by MMCD, both in terms of amount of formulated (and in some cases diluted) product applied per acre and the amount of active ingredient (AI) applied per acre. Appendix E contains a historical summary of the number of acres treated with each control material. Pesticide labels are located in Appendix F.

2008 Mosquito Control

Larval Mosquito Control

The District primarily used *Bacillus thuringiensis israelensis* (*Bti*) to control populations of spring *Aedes* and summer floodwater *Aedes*. The threshold for treatment with *Bti* before mid-May was 0.1 larvae per dip in Priority Zone 1. A higher threshold of 0.5 larvae per dip was used in Priority Zone 2 to target limited control materials to sites with the most intense breeding. During this time the primary species found are spring *Aedes* which tend to be long lived aggressive biters.

After mid-May, the threshold is increased to control the summer floodwater mosquitoes and *Culex*. For sites with only *Culex* (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*), the threshold is 1 per dip in all priority zones. For sites with both *Culex* and floodwater mosquitoes, the threshold was 2 per dip in Priority Zone 1 and 5 per dip in Priority Zone 2.

In 2008, below average precipitation, a long cold spring, and a cooler summer resulted in three District-wide broods (one spring *Aedes* followed by two *Ae. vexans* broods) early in the season followed by nine small-medium broods. Eighty-three percent of the 2008 total aerial *Bti* treatments were completed between April and the end of June (98,562 acres); treatments decreased as the dry summer passed (Figure 3.1). Products containing *B. sphaericus* (VectoLex®, VectoMax®) were applied to more permanently wet sites to control *Culex* later in the summer.

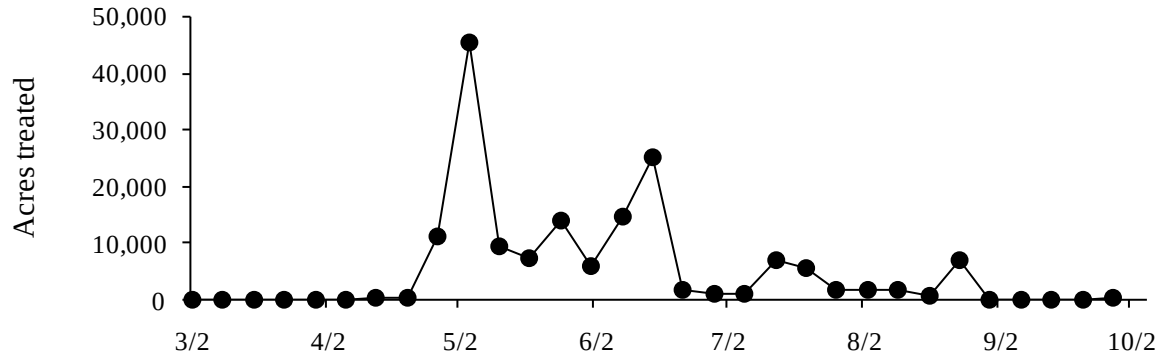


Figure 3.1 Acres of larvicide treatments each week (March-September 2008).

In 2008, we applied large scale treatments of Altosid® XR-G sand to control the cattail mosquito (4,803 more acres than in 2007, Table 3.1). The per acre material cost of XR-G sand is lower than Altosid® pellets meaning that the same funds spent on XR-G sand as pellets can purchase enough material to treat about 25% more acres with XR-G sand. We treated 70 acres of cattail sites with VectoLex® in late summer 2008; effectiveness will be evaluated with emergence cages in June-August 2009. The goal is to add a late summer window to our spring treatment period to provide more time for aerial treatments.

Stormwater catch basin treatments began in early June and ended in early September. Most catch basins were treated three times with Altosid® pellets (3.5 grams per catch basin) to control *Culex* mosquitoes from June through mid-September (Table 3.1). The primary goal of control material tests in 2008 was to find a longer lasting material and decrease the number of times per season catch basins required treatment to control WNV vectors (see Chapter 5).

Table 3.1 Comparison of larval control material usage in wetlands (includes pond level regulators) and stormwater catch basins for 2007 and 2008

	2007		2008	
Material	Amount used	Area treated	Amount used	Area treated
Wetlands				
Altosid® briquets	464.93 cases	290 acres	478.54 cases	294 acres
Altosid® pellets	125,721.97 lb	36,818 acres	119,538.12 lb	35,780 acres
Altosid® XR-G	17,760.00 lb	1,776 acres	65,787.20 lb	6,579 acres
VectoLex® CG	216.73 lb	27 acres	45.30 lb	6 acres
VectoMax® CG	0.00 lb	0 acres	1,459.02 lb	182 acres
VectoBac® G	945,104.87 lb	118,128 acres	978,056.76 lb	122,251 acres
Larvicide subtotals		157,039 acres		165,092 acres
Catch basins				
Altosid® briquets	29.26 cases	6,438 CB[1]	0.18 cases	40 CB[1]
Altosid® pellets	1,339.16 lb	161,876 CB	1,563.85 lb	195,793 CB
Larvicide subtotals		168,314 CB		195,833 CB

[1]CB=catch basin treatments

We continued to study how to reduce the amount of time and personnel required for effective season-long control of WNV vectors breeding in other stormwater management structures. In 2008, we expanded our program to control vectors breeding in stormwater management structures by testing larvicides in washouts and culverts, the third and fourth most common stormwater management structures; catch basins and pond level regulators are the most common and second most common, respectively.

Adult Mosquito Control

Adult mosquito control operations are considered when mosquito levels rise above established thresholds of 2 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 four *Culex* species: *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, and *Cx. tarsalis*. The thresholds are 1 of

any of these *Culex* species in a 2-minute sweep, 5 in an overnight CO_2 trap, 5 in a 2-day gravid trap, and 1 *Cx. tarsalis* in a vacuum aspirator sample. Adulticide treatments were also considered when 2 or more *Ae. triseriatus* were captured in a vacuum aspirator sample. One *Ae. japonicus* captured using any adult surveillance method will be the threshold in 2009. We may modify this threshold as we learn more about how *Ae. japonicus* spreads in the District.

As discussed in Chapter 1, spring *Aedes* mosquitoes remained abundant longer in 2008 than in previous years, possibly due in part to the long, cold spring and cool summer in 2008. *Aedes* mosquito abundance was highest in June and decreased thereafter. Populations of the permanent water species *Cq. perturbans* were more typical during June and July. *Culex restuans* and *Cx. pipiens* levels were significantly elevated in June through August. Accordingly, adulticide treatments began in early June, peaked in July, and continued at lower levels until mid-August. Figure 3.2 shows weekly adulticide acres treated and weekly larvicide-treated acreage.

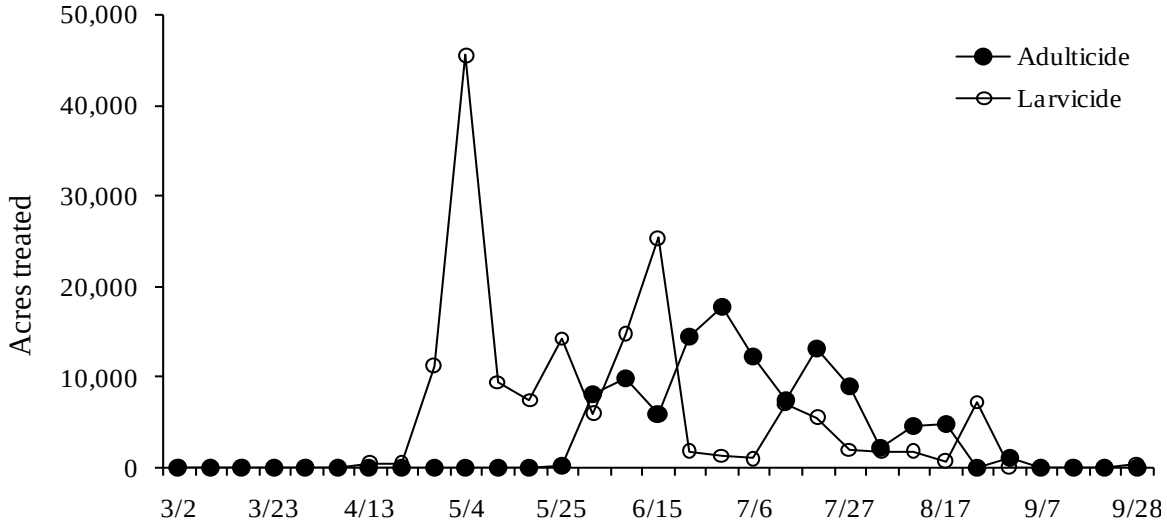


Figure 3.2 Acres of adulticide and larvicide treatments each week (March-September 2008).

In 2008, MMCD applied adulticides to 77,054 more acres than in 2007 (Table 3.2). The proportion of adulticide treatment in response to vectors (*Cx. restuans*, *Cx. pipiens*, *Cx. tarsalis*, *Ae. triseriatus* and *Ae. japonicus*) was high throughout the summer and increased each month (Table 3.3).

Table 3.2 Comparison of adult control material usage in 2007 and 2008

	2007		2008	
Material	Gallons used	Acres treated	Gallons used	Acres treated
Permethrin	761.16	3,897	1,615.69	8,272
Resmethrin	299.19	24,102	758.66	64,142
Sumithrin	131.43	5,608	513.27	35,734
Pyrocide*	0.00	0	3.50	299
Pyrenone*	0.00	0	25.95	2,214
Total		33,607		110,661

* Products containing natural pyrethrins for adulticide treatments in agricultural areas

Table 3.3 Percentage of adulticide treatments in response to nuisance and vector thresholds in 2008

	ULV treatments**			Permethrin barrier		
Month	>nuisance	>vector	>both*	>nuisance	>vector	>both*
June	81.3%	39.6%	20.8%	74.1%	27.1%	1.2%
July	81.3%	40.7%	22.0%	80.6%	43.9%	24.5%
August	71.4%	78.6%	50.0%	37.3%	66.7%	3.9%

* Both nuisance and vector thresholds exceeded in same surveillance sample (CO_2 traps)
** Materials included resmethrin, sumithrin, Pryocide, and Pyrenone)

2009 Plans for Mosquito Control Services

Integrated Mosquito Management Program

In 2009, MMCD will review all aspects of its integrated mosquito management program to ensure that budgetary resources are being used as effectively as possible with the goal of maximizing mosquito control services per budget dollar.

Larval Control

Cattail Mosquitoes In 2009, control of *Cq. perturbans* will use a strategy similar to that employed in 2008. 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 lbs/acre and Altosid® XR-G sand at 10 lb/acre. Additionally, staff will be evaluating the success of fall VectoLex® applications.

Floodwater Mosquitoes The primary control material will again be *Bti* corn cob granules. Budgeted *Bti* (VectoBac® G) and Altosid® pellet needs in 2009 are similar to 2008 requirements. As in previous years, to minimize shortfalls, control material use may be more strictly rationed during the second half of the season, depending upon the amount of the season remaining and control material supplies. Regardless of annoyance levels, MMCD will maintain sufficient resources to protect the public from potential disease risk.

Staff will treat ground sites (<3 acres) with methoprene products (Altosid® pellets, Altosid® briquets) or *Bti* corn cob granules. Breeding sites in highly populated areas will receive treatments first during a wide-scale mosquito brood. The District will then expand treatments into less populated areas where treatment thresholds are higher. Larval treatment thresholds will be the same as in 2008.

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

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

MMCD has expanded control of 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. Catch basins will be treated with Altosid® pellets. A few may be treated with *Bti/B. sphaericus* briquets. Catch basins selected for treatment include those found holding water, those that potentially could hold water based on their design, and those for which we have insufficient information to determine whether they will hold water. Treatments could begin as early as the end of May and no later than the third week of June. We have tentatively planned to complete a first round of pellet treatments by June 25 with subsequent Altosid® pellet treatments every 30 days. Catch basins treated with *Bti/ B. sphaericus* briquets will be treated by June 25 and retreated if larval surveillance indicates a cessation of control. We will continue tests of longer lasting larvicides with the goal of decreasing the number of treatments required per season to control WNV vectors.

We intend to continue working cooperatively with cities to treat underground stormwater management structures (see Chapter 2) and slowly expand the kinds of structures we treat with larvicides beyond pond level regulators as we determine which larvicides effectively control vector larvae in these structures (see Chapter 5).

Adult Mosquito Control

Staff will continue to review MMCD's adulticide program to ensure that resources are used most effectively to provide services and minimize possible non-target effects. The budget for adulticides in 2009 is the same as 2008. 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 continue to use natural pyrethrins as needed to control WNV vectors in agricultural areas that are off-label for other materials. We will also be evaluating possible adulticide use in response to *Ae. japonicus* spread.

Chapter 4 Black Fly Control

2008 Highlights

- Larval mortality following *Bti* treatment on the large rivers averaged 96%
- Completed statistical review of multiplate data collected from the Mississippi River between 1995 and 2005 to design more cost-effective protocols
- Monitored adult populations weekly using overhead net sweeps and CO_2 traps

2009 Plans

- Threshold for treatment will be the same as previous years
- Monitor adult populations by the overhead net sweep and CO_2 trap methods
- Complete report for the non-target monitoring samples collected in 2007
- Collect non-target monitoring samples on the Mississippi River
- Develop a five year operational framework for the black fly program

Background

The goal of the black fly program is to reduce pest populations of adult black flies within the MMCD to tolerable levels. Black flies develop in rivers and streams in clean flowing water. Larval populations are monitored at about 140 small stream and 27 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.

2008 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, 141 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 71 sites on 15 streams met the threshold and were treated once with VectoBac® 12AS formulation of *Bti*. A total of 62.1 gal of *Bti* was used (Table 4.1).

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.

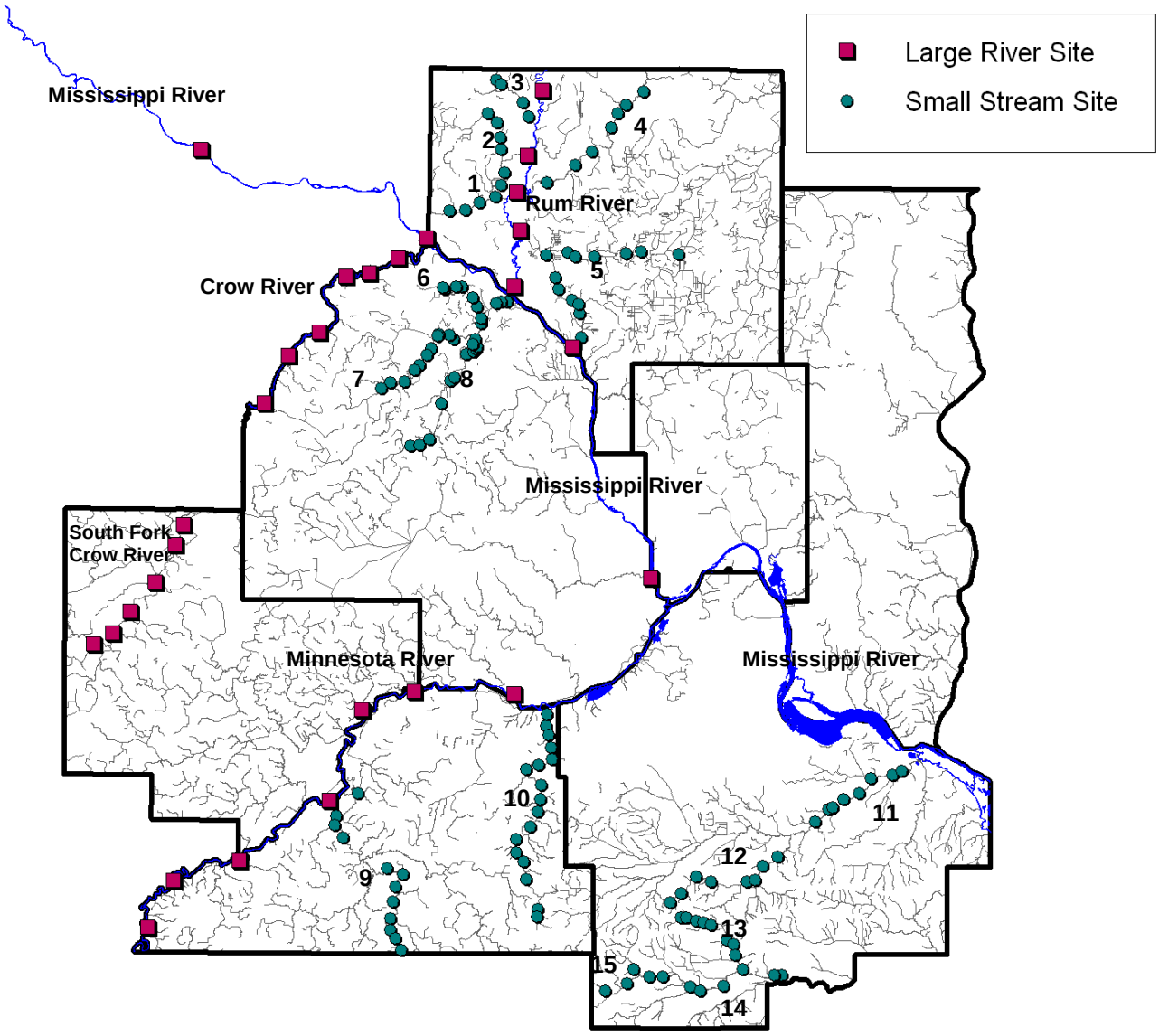


Figure 4.1 Large river and small stream black fly larval monitoring/treatment locations, 2008. Note: the large river site located outside the District on the Mississippi River is for monitoring only. The numbers on the map refer to the small stream names listed below:

1=Trott	9=Sand
2=Ford	10=Credit
3=Seelye	11=Vermillion
4=Cedar	12=Vermillion So. Branch
5=Coon	13=Chub No. Branch
6=Diamond	14=Chub
7=Rush	15=Dutch
8=Elm	

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 27 sites permitted by the Minnesota Department of Natural Resources (MnDNR) on the Rum, Mississippi, Crow, South Fork Crow and Minnesota rivers. A total of 452 samples were collected to determine if the treatment threshold was met. The treatment thresholds were the same as those used since 1990. Fifty-seven *Bti* treatments totaling 2001.7 gal of VectoBac® 12AS were used to control large river-breeding black fly larvae in 2008 (Table 4.1). The amount of *Bti* used in 2007 and 2008 was below the yearly average of approximately 3,000 gal.

Bti treatment effectiveness was excellent in 2008. The average post-*Bti* treatment larval mortality (measured at least 250 m downstream of the point of the *Bti* application) was 98% on the Mississippi River, 94% on the Minnesota River, 95% on the Rum River, and 99% on the South Fork Crow River. Overall, the average post-treatment mortality recorded on the large rivers in 2008 was 96%.

Table 4.1 Summary of *Bti* treatments for black fly control by the MMCD in 2007 and 2008

	2007			2008		
Water body	No. treatment sites	No. treatments	Gallons of *Bti* used	No. treatment sites	No. treatments	Gallons of *Bti* used
Small Stream Total	68	68	46.7	71	71	62.1
Large River						
Mississippi	2	8	570.1	2	17	1166.7
Crow	2	3	32.0	2	3	55.0
South Fork Crow	5	12	59.1	6	10	89.5
Minnesota	5	7	628.2	3	5	625.0
Rum	4	27	58.9	4	22	65.5
Large River Total	18	57	1348.3	17	57	2001.7
Grand Total	86	125	1395.0	88	128	2063.8

Adult Population Sampling

Daytime Sweep Net Collections The adult black fly population was monitored at 53 standard stations throughout the MMCD using the District's standard black fly over-head net sweep technique that was established in 1984. Samples were taken once weekly from early May to mid-September, generally between 8:00 AM and 10:00 AM. The average number of all species of adult black flies captured in 2008 was 1.07 (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 1.42 (1996-2008).

The most abundant black fly collected in the overhead net-sweep samples in 2008 was *S. luggeri*, comprising 82% of the total black flies captured. The overall average number of *S. luggeri* captured per net-sweep sample in 2008 was 0.88 (Table 4.2). *Simulium luggeri* was most abundant in Anoka County in 2008, as it has been since the program began. The average number of *S. luggeri* captured in Anoka County was 3.71 in 2008. 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 2008 was *S. meridionale*, averaging 0.08 per sample (Table 4.2) and comprising 7.8% of the total black flies collected. *Simulium meridionale* was most abundant in Dakota County in 2008 where an average of 0.28 were captured per net-sweep sample.

Black Fly Specific CO_2 Trap Collections Adult black fly populations were also monitored in 2008 between mid-May and mid-June with CO_2 traps at 4 sites in Scott County, 4 sites in Anoka County, and 5 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 later 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 2008 was 13.8 in Anoka County, 228.9 in Scott County and 169.6 in Carver County. The average number of *S. venustum* captured per trap between 1998 and 2007 was 11.5 in Anoka County, 6.6 in Scott County and 19.6 in Carver County. The reason for the higher numbers of *S. venustum* captured in the CO_2 traps in 2007 and 2008, particularly in Scott and Carver counties, is not known. In 2009, *S. venustum* larval surveillance efforts will be increased in order to better under the distribution of this species within the region.

The average number of *S. johannseni* captured per trap in 2008 was 0.13 in Anoka County, 20.2 in Scott County and 95.6 in Carver County. The average number of *S. johannseni* captured per trap between 1998 and 2007 was 1.1 in Anoka County, 10.1 in Scott County and 85.9 in Carver County.

The average number of *S. meridionale* captured per CO_2 trap in 2008 was 0.68 in Anoka County, 75.0 in Scott County and 359.02 in Carver County. The average number of *S. meridionale* captured per trap between 1998 and 2007 was 2.13 in Anoka County, 103.06 in Scott County, and 252.9 in Carver County.

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

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

[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
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
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

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 2008. 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 late May and early 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. In eastern Dakota County, a second, localized increase was observed in late June and early July (Figure 4.2). The cause of this increase is unknown and further study is needed. As mentioned previously, larval surveillance efforts will be increased in 2009 in Scott and Carver counties in order to better under the distribution of black flies in these areas.

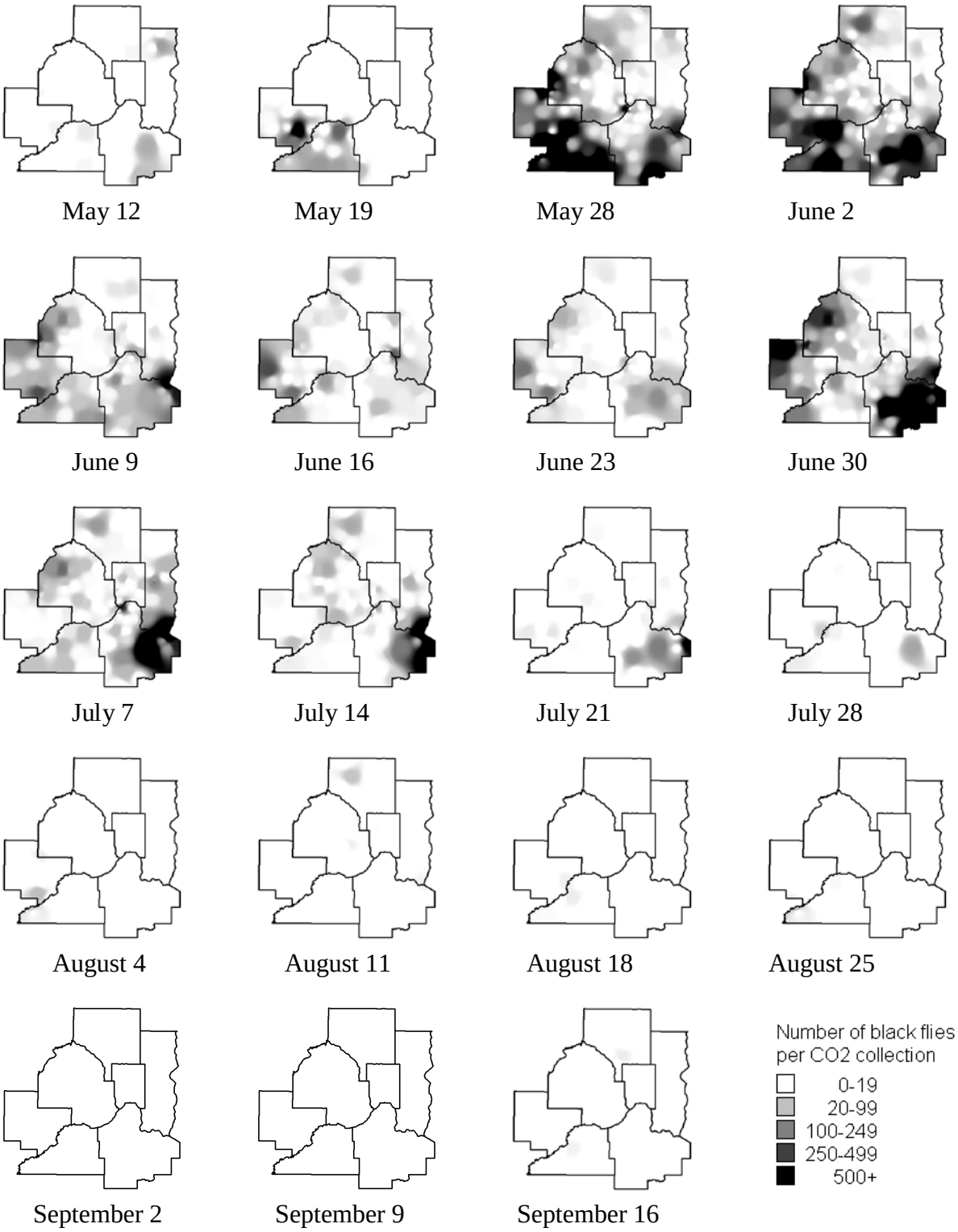


Figure 4.2 Number of black flies collected in mosquito surveillance District CO_2 traps, 2008. The number of traps operated per night varied from 114-123.

Non-target Monitoring

The District conducts biennial monitoring of the non-target invertebrate population in the Mississippi River as part of the permit requirements set by the MnDNR. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. Results from monitoring work done in 1995, 1997, 1999, 2001, 2003, and 2005 have not indicated that any large-scale changes have occurred within the invertebrate community in the *Bti*-treated reaches of the Mississippi River. Monitoring sampling will be repeated as scheduled on the Mississippi River in 2009. Sample processing and enumeration is underway for the monitoring samples collected in 2007. A report is scheduled for completion in spring 2009.

A statistical analysis of the non-target monitoring data collected between 1995 and 2005 was completed in 2008. The goal of this study was to determine if the non-target monitoring protocols could be revised in such a way as to reduce the District's labor cost while providing the same level of monitoring effectiveness. Based on the results of the study, the MnDNR agreed to revised protocols that allow the District to reduce the number of monitoring samples processed from each station and lower the level of taxonomic identification for some taxa.

2009 Plans

2009 marks the 25th year of black fly control in the District. Our goal in 2009 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 2009 black fly control permit application request has been submitted to the MnDNR. Non-target monitoring sampling will be repeated as scheduled on the Mississippi River in 2009. The non-target monitoring report for the samples collected in 2007 will be completed. Increased larval surveillance will take place in areas that had elevated adult black fly populations in 2008 according to our CO_2 trap collection data. Efforts will also be directed towards developing a five-year plan for the black fly program. Emphasis will be placed developing a framework for improving future program effectiveness, surveillance, and efficiency.

Chapter 5 *Product & Equipment Tests*

2008 Highlights

- VectoBac® G *Bti* achieved the same high level of control of *Ae. vexans* in air sites as in previous years
- Two controlled release formulations (Natular® 150-day tablets; FourStar™ 14-g briquets) controlled WNV vector larvae in catch basins for the entire season
- Two Natular® formulations controlled floodwater mosquitoes in ground sites.
- Permethrin controlled mosquitoes in woodlots for up to seven days after treatment
- Pyrocide® effectively controlled adult mosquito including *Culex* in croplands

2009 Plans

- Continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy
- Continue tests of Natular® formulations in stormwater management and natural ground sites to better determine how long they control mosquito larvae
- Continue tests of adulticides in different situations emphasizing control of *Culex*

Background

Quality assurance (QA) is an integral part of MMCD services. The QA process focuses on control material evaluations, label compliance, application analysis, calibration, and exploration of new technologies to improve our operations. The Technical Services team provides project management and technical support. The regional process teams coordinate field testing and data collection.

2008 Projects

Quality assurance processes focused on equipment, product evaluations, and waste reduction. Before being used operationally, all products must complete a certification process that consists of tests to demonstrate how to use the product to effectively control mosquitoes. The District continued certification testing of four larvicides and one new adulticide. All four larvicides have been tested in different control situations in the past. Three larvicides were tested to control *Culex* breeding in catch basins, two to control *Culex* developing in wetlands, and one to control the cattail mosquito. The adulticide was tested for use in croplands. These additional materials will provide MMCD with more tools to use in its operations.

Acceptance Testing of Altosid® (methoprene) Briquets and Pellets

Warehouse staff collected random Altosid® product samples from shipments received from Wellmark International for methoprene content analysis. 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 2008 samples were within acceptable values of the label claim of percent methoprene (Table 5.1).

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

Methoprene Product	No. Samples Analyzed	Methoprene Content: Label Claim	Methoprene Content: Analysis Average	SE
XR-Briquet	9	2.10%	2.12%	0.0147
Pellets	9	4.25%	3.85%	0.0242
XR-G Sand	9	1.50%	1.30%	0.0747

Evaluation of Active Ingredient Levels in Adult Mosquito Control Products

MMCD has requested the 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 2008 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 2008 adulticides

Product	No. Samples Analyzed	% AI Content: Label Claim	% AI Content: Analysis Average	SE
Permethrin 57% Concentrate	2	57.00	58.75	0.550
Permethrin 5.7% Mix	4	5.70	7.13	0.079
Resmethrin 4%	3	4.00	4.53	0.105
PBO 12%	3	12.00	12.77	0.328
Resmethrin	2	1.33	1.27	0.005
PBO	2	3.99	6.12	0.025
Sumithrin 2%	3	2.00	1.87	0.041
PBO 2%	3	2.00	2.16	0.056
Sumithrin	2	5.71	4.64	0.010
PBO	2	5.71	5.20	0.140

Improvement of Warehouse Inventory Management

Warehouse operations were enhanced by using an improved control material inventory tracking system in 2008. MMCD has used the handheld PDAs to record field facility inventories for multiple years and we recently incorporated the two control material warehouses in this electronic database. This system can now produce daily district-wide reports which allow the warehouse operations to be more proactive in forecasting needs and related control material deliveries. Previously, we have been dependent upon a weekly inventory counts, word of mouth and each facility's ability to provide accurate inventory figures. The earlier system often limited response time for re-supply and stressed the capacity of our warehouse operations. Since MMCD is continuing to expand air operations and using multiple helicopters in all areas, it is critical that

we have a responsive inventory system in place to easily track the multiple control materials being used to keep from inhibiting efficient field operations.

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 a new company, Consolidated Container Company, Minneapolis, MN, for disposal services of their plastic pesticide container-recycling program in 2008.

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 6,473 jugs for this recycling program. The control materials that use plastic 2.5 gal containers are sumithrin (136 jugs), *Bti* liquid (825 jugs), natural pyrethrins (14 jugs) and Altosid® pellets (5,498 jugs).

In addition, the warehouse recycled numerous plastic drums and steel containers this past season. These 55 or 30 gal drums are brought to a local company to be refurbished and reused.

Efficacy of Control Materials

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

Table 5.3 Efficacy of aerial VectoBac® G applications in 2008 and 2007 (SE=standard error)

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2007	300	92.0	100.0	1.4%	0.0	100.0
2008	247	87.5	100.0	1.9%	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 2008 was designed to evaluate how different segments of mosquito control programs can be modified to deliver more mosquito control services to a greater part of the District area using existing resources.

Control of WNV Vectors (*Culex*) in Catch Basins The primary goal of control material tests in 2008 was to find a longer lasting material and decrease the number of times per season catch basins required treatment to control WNV vectors. In 2008, we selected 50 catch basins in St. Paul that we sampled approximately weekly from mid-June through mid-September. Twenty catch basins were treated with FourStar™ briquets, 20 were treated with an experimental Clarke product (Natular®), and ten were not treated and served as untreated controls. All 50 catch basins were dipped weekly (3 dips per catch basin per inspection) beginning on May 22 and ending on September 12. We identified and tallied the developmental stage of immature mosquitoes (larvae and pupae) in all samples. Data from the same ten untreated catch basins were compared to catch basins treated with Natular® and Fourstar™ formulations.

Clarke Natular® tablets (30-day, 150-day) in catch basins Natular® contains a biological active called Spinosad that is isolated from the soil bacterium *Saccharopolyspora spinosa*. Spinosad has been used by organic growers for over ten years (WHO 2008). Only recently are Spinosad formulations being developed as mosquito larvicides.

Ten catch basins were treated with one 150-day Natular® tablet each on May 22 and ten with one 30-day Natular® tablet each on June 19, the date when larvae began to appear. Four weeks after the 30-day tablet treatment (July 17), significantly fewer larvae (cumulative) had been collected from both the 150-day tablet-treated and 30-day tablet-treated catch basins (Table 5.4, Figure 5.1). By the end of the season, significantly more larvae had been collected from untreated catch basins than from 150-day tablet-treated catch basins (Table 5.4). The total cumulative larvae collected from 30-day tablet-treated catch basins was intermediate between control and 150-day tablet-treated catch basins (Table 5.4). This strongly suggests that both larvicides effectively controlled immature mosquitoes for at least part of the season.

Table 5.4. Comparisons of cumulative mean larvae per catch basin (±SE) on three dates collected from catch basins treated with two Natular® tablet formulations and from untreated catch basins (Kruskal-Wallis ANOVA)

		Treatment Group		
Date	p-value	Control*	150-day*	30-day*
6/19	0.3996	18.19 ± 4.76[a]	16.69 ± 8.83[a]	27.18 ± 8.97[a]
7/17	0.0017	332.27 ± 73.77[b]	133.34 ± 86.39[a]	54.96 ± 11.02[a]
9/12	0.0013	757.94 ± 104.70[b]	204.25 ± 90.59[a]	427.34 ± 78.70[ab]

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

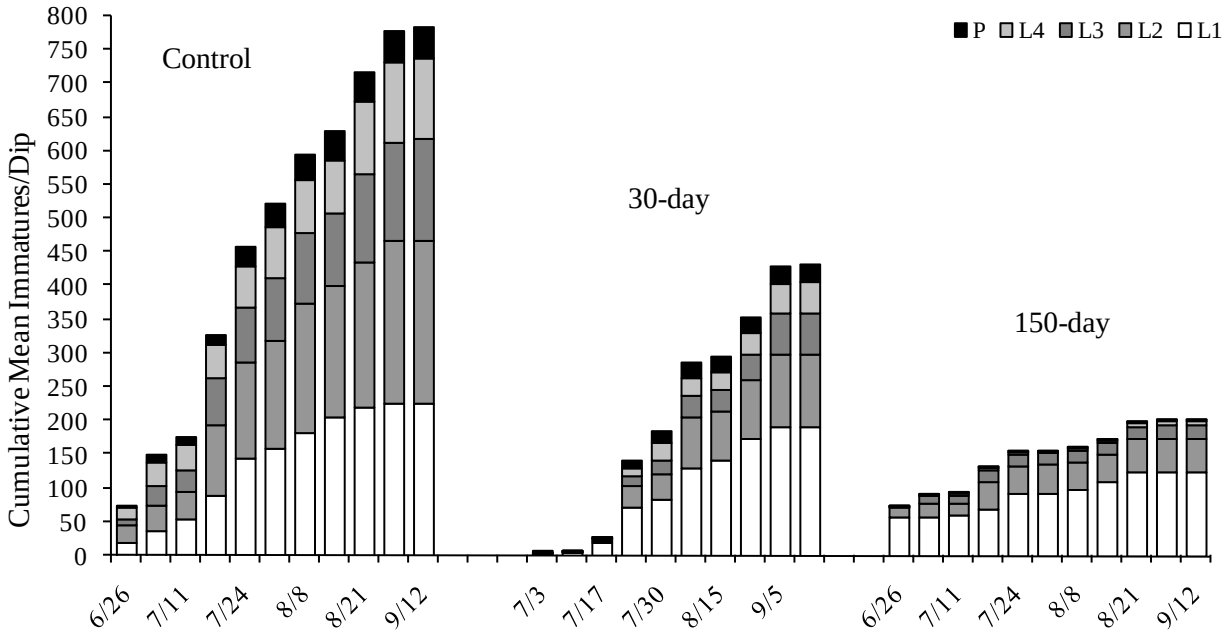


Figure 5.1 Cumulative immature mosquitoes per dip differentiated by instar from catch basins treated with Natular® tablets in 2008: 30-day and 150-day compared to untreated catch basins (Control) (L1=instar 1, L4=instar 4, P=pupa).

The cumulative number of pupae per untreated catch basin increased steadily throughout the season. Four weeks after treatment (July 17) cumulative mean pupae per catch basin collected from the 30-day Natular® tablet treatment was lower than the untreated control and similar to the 150-day Natular® tablet treatment (Figure 5.2). After July 17, cumulative pupae from 30-day Natular® tablet-treated catch basins increased at a rate similar to that of the untreated control (Figure 5.2).

In terms of pupal production, we conclude that the 150-day tablet larvicide effectively controlled mosquitoes (almost exclusively *Cx. restuans* and *Cx. pipiens*) for the entire season (May 22 through September 12) and the 30-day tablet larvicide effectively controlled mosquitoes for four weeks (June 19 - July 17) (Table 5.5, Figure 5.2). A mean percent control value can be calculated by comparing cumulative pupae per catch basin in the untreated control and the 150-day tablet and 30-day tablet treatments. The 150-day tablet larvicide achieved 99.3% control through the season. The 30-day tablet larvicide achieved 98.6% control through July 17 (four weeks of effective control). Control decreased to 46.5% by September 12, the end of the season (Table 5.5, Figure 5.2).

Table 5.5 Comparisons of cumulative mean pupae per catch basin (±SE) on three dates collected from catch basins treated with two Natular® tablet formulations and from untreated catch basins (Kruskal-Wallis ANOVA)

		Treatment Group					
Date	p-value	Control*	±SE	150-day*	±SE	30-day*	±SE
6/19	1.0000	0.00	0.00[a]	0.000	0.000[a]	0.00	0.00[a]
7/17	0.0001	15.97	6.12[b]	0.064	0.064[a]	0.22	0.16[a]
9/12	0.0005	46.80	13.99[b]	0.340	0.197[a]	24.98	0.40[b]

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

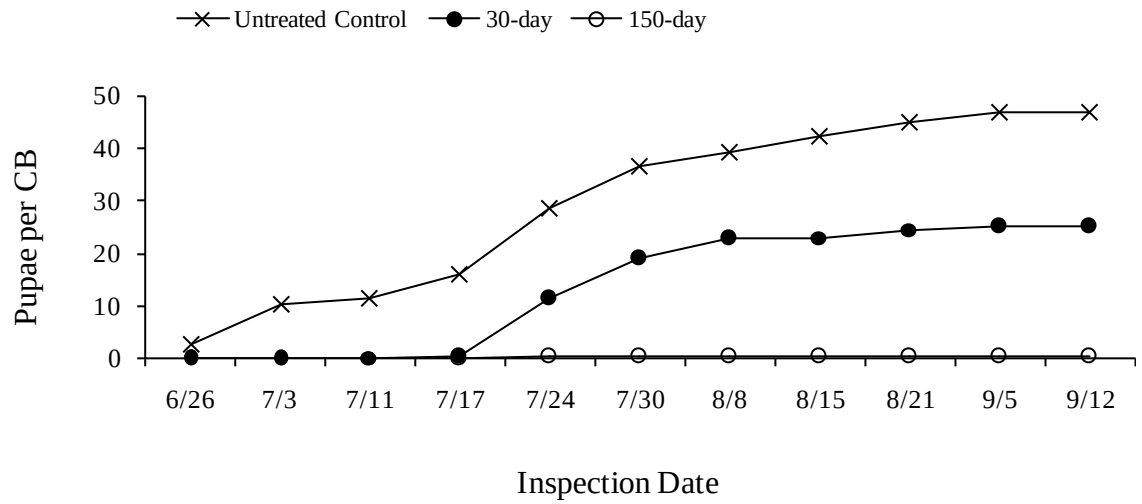


Figure 5.2 Cumulative pupae per dip from catch basins treated with Natular® tablets in 2008: 30-day and 150-day compared to untreated catch basins.

FourStar™ Bti/B. sphaericus briquets in catch basins Ten catch basins were treated with one 28 g FourStar™ briquet each and ten with two 14 g FourStar™ briquets on June 19, the date when larvae began to appear. Each FourStar™-treated and untreated control catch basin was dipped approximately weekly beginning on May 22 and ending on September 12.

Five weeks after both FourStar™ treatments (July 24), significantly more larvae (cumulative) had been collected from untreated catch basins than from 28 g-treated and 14 g-treated catch basins (Table 5.6, Figure 5.3). This pattern remained unchanged at the end of the season; significantly more larvae had been collected from untreated catch basins than from both FourStar™ treatments (Table 5.6). This strongly suggests that both FourStar™ treatments significantly suppressed mosquito larvae for the entire season.

Table 5.6 Comparisons of cumulative mean larvae per catch basin (±SE) on three dates collected from catch basins treated with two FourStar™ briquet formulations and from untreated catch basins (Kruskal-Wallis ANOVA)

		Treatment Group					
Date	p-value	Control*	±SE	28 g*	±SE	Two 14 g*	±SE
6/19	0.1478	18.19	4.76[a]	12.89	5.77[a]	34.39	11.30[a]
7/24	0.0020	448.65	89.02[b]	172.13	53.96[a]	150.95	27.46[a]
9/12	0.0107	757.94	104.70[b]	420.31	135.40[a]	332.86	65.29[a]

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

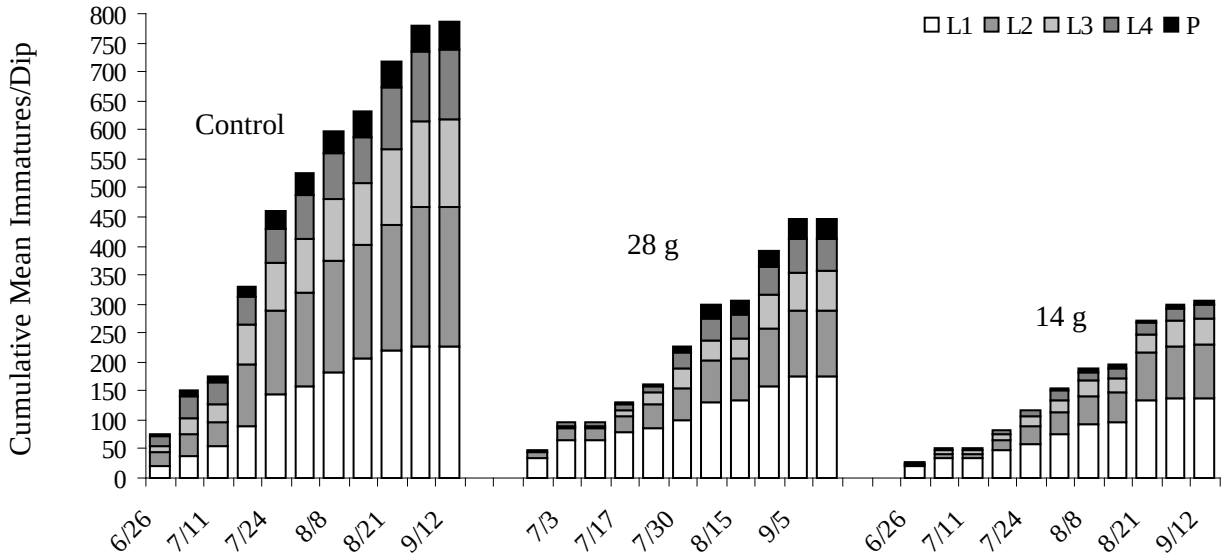


Figure 5.3 Cumulative immature mosquitoes per dip differentiated by instar from catch basins treated with FourStar™ briquets in 2008: 28 g and 14 g compared to untreated catch basins (Control) (L1=instar 1, L4=instar 4, P=pupa).

Compared to untreated catch basins, cumulative pupae collected from FourStar™-treated catch basins rose much more slowly until after July 30 when the pattern of increase for the 28 g FourStar™ treatment became similar to that of the untreated control (Figure 5.4). Cumulative pupae from the 14 g FourStar™ treatment remained lower for the remainder of the season (Table 5.7, Figure 5.4). We conclude that the 28 g FourStar™ treatment was effective for five weeks (same result as in 2007) and that the 14 g FourStar™ treatment was effective throughout the season. A comparison of cumulative pupae per catch basin gives an estimated season-long control of 85.3% for the 14 g FourStar™ treatment. The 28 g FourStar™ treatment achieved 90% control for five weeks. Control decreased to 32.2% control by the end of the season.

Table 5.7 Comparisons of cumulative mean pupae per catch basin (±SE) on three dates collected from catch basins treated with two FourStar™ briquet formulations and from untreated catch basins (Kruskal-Wallis ANOVA).

		Treatment Group					
Date	p-value	Control*	±SE	28 g *	±SE	Two 14 g*	±SE
6/19	0.3679	0.00	0.00[a]	0.00	0.00[a]	0.06	0.06[a]
7/24	0.0019	28.44	8.33[b]	2.91	1.32[a]	1.43	0.89[a]
9/12	0.0364	46.80	13.99[b]	30.66	15.83[ab]	6.94	2.51[a]

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

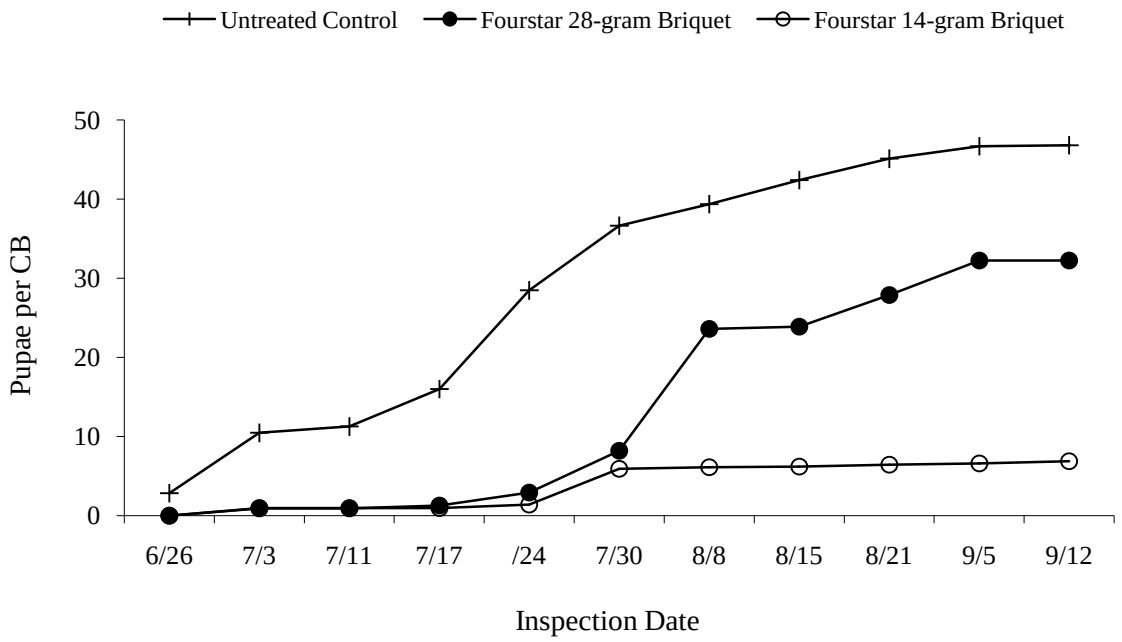


Figure 5.4 Cumulative pupae per dip from catch basins treated with FourStar™ briquets in 2008: 28 g and 14 g compared to untreated catch basins.

In summary, 14 g FourStar™ briquets and 150-day Natular® tablets suppressed pupal development throughout the season. Thirty-day Natular® tablets were effective for four weeks and 28 g FourStar™ briquets were effective for at least five weeks. In 2009 we plan to focus upon tests of 14 g FourStar™ briquets and 150-day Natular® tablets in catch basins possibly including larger scale tests.

Control of *Culex* in Culverts and Washouts with VectoMax® CG (*Bti/Bs*) Culverts and washouts are some of the most common stormwater management structures in the District. Sampling conducted in 2006 detected significant levels of *Culex* vectors breeding in culverts and washouts. The primary goal of control material tests in 2008 was to determine the duration and consistency of control achieved by candidate products in these types of habitats. VectoMax® CG

is produced by Valent BioSciences and contains two active ingredients (*Bti* and *B. sphaericus*) formulated on corn cob granules similar to VectoBac® G. In these tests we selected culverts and washouts that tended to remain wet longer because previous attempts to test materials in these kinds of sites were limited when the sites dried up soon after treatment. Both untreated and treated culverts and washouts were dipped (5 dips per culvert or washout per inspection date) before and on several dates after treatment.

VectoMax® CG granules in culverts Eight culverts were treated with VectoMax® CG (8 lb/acre) between July 23 and July 30. Three more culverts were not treated. All were dipped for larvae before treatment and approximately weekly through August. Larval abundance in the treated culverts was high before treatment and remained low for at least 40 days after treatment (Figure 5.5). Untreated culverts dried up during the test, the same problem that hindered data collection in 2007.

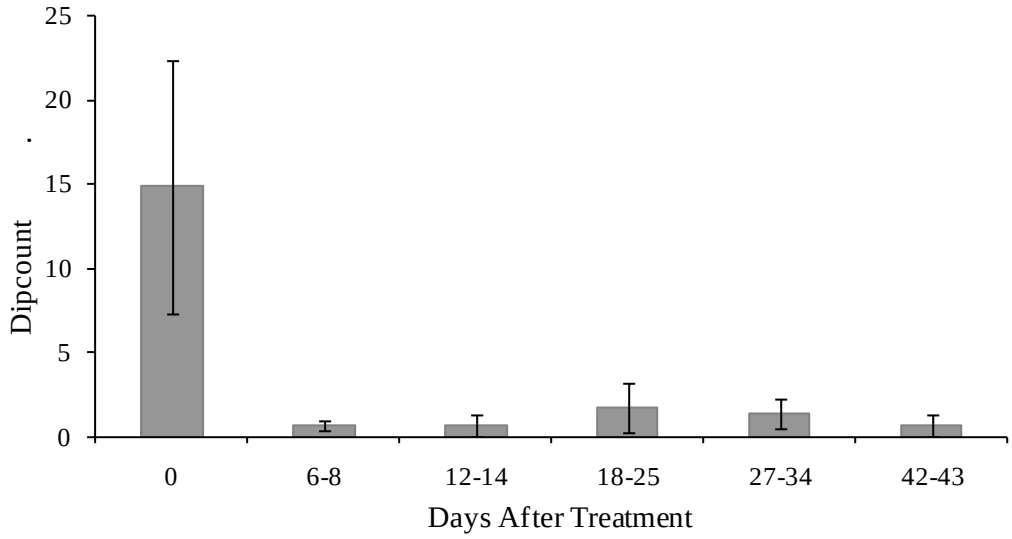


Figure 5.5 Mean dip counts from culverts treated with VectoMax® CG in 2008. Error bars equal ±one standard error of the mean (n=8).

Control of WNV vectors (Culex) in washouts Four washouts were treated with VectoMax® CG (8 lb/acre) between July 24 and July 30. Three more washouts were not treated. All were dipped for larvae before treatment and approximately weekly through August. Larval abundance in the treated washouts was high before treatment and remained low for at least 40 days after treatment (Figure 5.6). All but one untreated washout dried up during the test, the same problem that hindered data collection in 2007. Breeding in the single untreated washout that remained wet throughout the test was variable ranging from zero to 22.5 larvae per dip. It contained 22.5 larvae per dip in early August when the VectoMax®-treated washouts contained very few larvae.

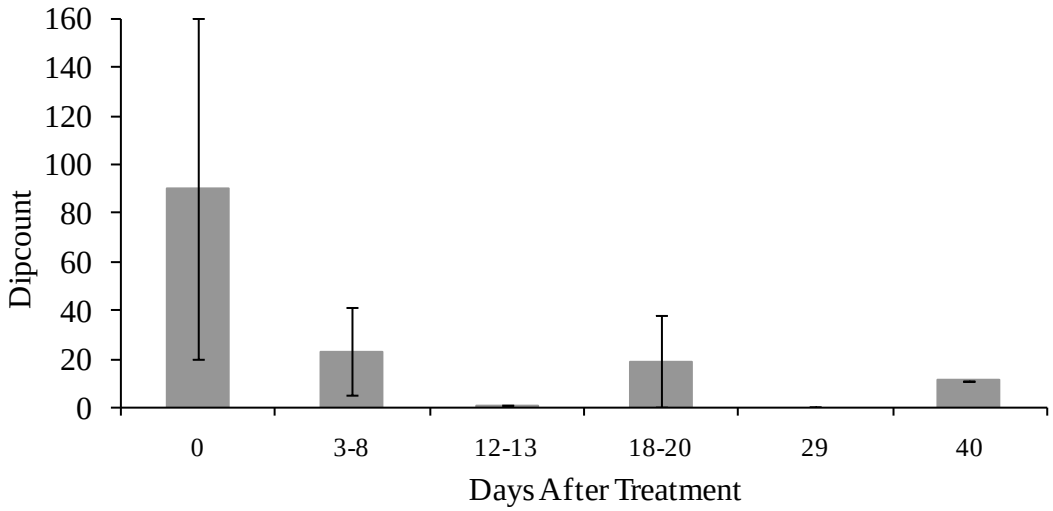


Figure 5.6 Mean dip counts from washouts treated with VectoMax® CG in 2008. Error bars equal ±one standard error of the mean (n=4).

Based upon a comparison of before and after treatment dip counts from culverts and washouts that were repeatedly dipped, VectoMax® CG effectively controlled WNV vectors breeding in culverts and washouts for at least 40 days after treatment (Figure 5.5, 5.6), slightly longer than the 4-week control achieved in pond level regulators in 2007 tests. This conclusion applies only to culverts and washouts that do not dry out which limits the usefulness of VectoMax® CG in culverts and washouts. Tests in 2009 will emphasize different larvicides that potentially are not as significantly impacted if the culvert dries up and is flooded again later.

Experimental Larval Control Materials & Strategies The District uses methoprene products (Altosid® pellets) to control floodwater mosquitoes breeding in ground sites (<3 acres) that have a history of repeatedly producing mosquitoes. In 2008, we tested two experimental Natular® formulations (30-day granules, 150-day tablets) in ground sites as possible alternatives to methoprene.

Clarke Natular® (30-day granules, 150-day tablets) ground sites Four small (<0.1 acre) ground sites were treated with Natular® 30-day granules (10 lb/acre) and four with Natular® 150-day tablets (400 tablets/acre) on May 29, 2008 when all sites were partially or completely dry. Precipitation significant enough to completely flood the treated and nearby untreated control sites occurred on May 30, June 2, and June 5. All treated and control sites were dipped on June 9, eleven days after treatment and ten or fewer days after a brood-inducing precipitation occurred.

Effectiveness was evaluated by comparing the mean number of larvae per dip collected on June 9 from the eight treated and seven untreated control sites (ten dips were collected from each site during each inspection). Both Natular® formulations suppressed larval development (Table 5.8). We had planned to inspect these sites repeatedly throughout the season after each brood-inducing rainfall but were unable to do so because no additional rain significant enough to flood the sites

occurred before the end of the mosquito season in September. These initial results suggest that both test materials can effectively control floodwater mosquitoes at least one week after treatment. We cannot say more about how long the test materials remained able to control floodwater mosquitoes.

Table 5.8 Efficacy of aerial Natular® 30-day granules and 150-day tablets in ground sites (SE=standard error; n= number of sites)

Treatment	Mean larvae/dip	SE	(n)	% control
150-day tablets	0.200	0.200	4	96.9
30-day granules	0.025	0.025	4	99.6
Control	6.357	2.580	7	N/A

Kruskall-Wallis test: p=0.0195; sample sizes too small for three pairwise posthoc comparisons.

Cognis Agnique MMF G® (30-day granules) MMCD received 80 lbs of a new pupacide granule for aerial swath pattern characterization evaluations. The distributor notified MMCD that the product was not meeting their standards due to the high small particle content (i.e. dust) in the current formulation. MMCD did not evaluate the product due to this concern. MMCD will evaluate the product when the formulation issues are resolved. This product has the potential to increase the number of days of aerial application during a brood because it can control larval mosquitoes in the non-feeding life stage (i.e. late 4th instar and pupae) prior to emergence. MMCD does not currently have a control material that could be used in our aerial application program during this period. The product could benefit the program in times when we cannot apply the other operational larvicides earlier due to poor or unsafe flying conditions.

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

In September 2008, six breeding sites were treated in Anoka and Washington counties while water temperatures were ca 50 °F and the larvae were still theoretically actively feeding. Pre-treatment samples from these sites contained high larval populations. In 2009, these sites will be evaluated by measuring the adult emergence and comparing the applications to untreated controls found in the same geographical region.

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

into treated foliage and remain toxic to some insects that eat the foliage up to a month after treatment.

Permethrin barrier We completed three tests in 2008. 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 changes in the control as well as the treatment) that compares mean mosquito captures before and at various times after treatment. The goal of all three tests was to collect more information to better evaluate how consistently and how long barrier permethrin treatments suppressed adult mosquitoes. We also attempted to collect sufficient vector species to evaluate vector-specific efficacy. Low numbers of vectors in CO_2 traps have hindered vector-specific evaluations in the past. We did not test barrier adulticides other than permethrin in 2008.

Sufficient WNV vectors (*Cx. tarsalis*, *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*) were captured during the first two tests to evaluate vector-specific efficacy. Effectiveness against vectors lasted at least 24 h. No vectors were captured during the third test (Table 5.9).

Permethrin effectively controlled mosquitoes for 24 h in all three tests (mainly *Ae. vexans* and *Cq. perturbans*). Test 1 ended 24 h after treatment. Effective control continued for seven days in Tests 2 and 3 (Table 5.9). Three previous tests (two in 2006 and one in 2007) achieved high levels of control 24-48 h after treatment. Control persisted seven days in the 2007 test. In summary, permethrin barrier treatments effectively controlled mosquitoes for 24-48 h in six of six tests in 2008. Effective control persisted for seven days in three of the five tests that were sampled seven days after treatment.

Natural pyrethrum (ULV) in agricultural areas Scourge® and Anvil® label requirements restrict their use to agricultural areas—areas where mosquito surveillance has detected large numbers of WNV vectors (*Culex*). Pyrocide® (a natural pyrethrum product) can be used in agricultural areas. Previous tests demonstrated that Pyrocide® controlled adult mosquitoes as well as Scourge® and consistently suppressed *Culex* vector mosquitoes.

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). CO_2 traps were placed three consecutive nights in both control and treated sites. Test materials were applied the evening of the second night of trapping; CO_2 traps were placed 30 min 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.

Table 5.9 Results of three tests of permethrin efficacy using Mulla's formula in 2008; 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		*Cx. tarsalis, Cx. restuans, Cx. pipiens, Cx. salinarius*	
Test	Collection	CO_2 trap catch	Efficacy	CO_2 trap catch	Efficacy
Test 1*	Pre-treat	563.5	---	8.0	---
June 17-19	Post-treat	175.0	72%	0.5	99%
(Oakdale)	Post-24 h	378.5	60%	5.0	88%
Untreated	Pre-treat	389.0	---	1.0	---
control	Post-treat	432.0	---	4.5	---
	Post-24 h	660.5	---	5.0	---
Test 2*	Pre-treat	671.0	---	4.0	---
July 15-23	Post-treat	167.5	74%	3.0	63%
(Oakdale)	Post-24 h	67.5	81%	0.5	50%
	Post-7 day	118.0	57%	8.0	0%
Untreated	Pre-treat	539.0	---	2.0	---
control	Post-treat	513.0	---	4.0	---
	Post-24 h	281.0	---	0.5	---
	Post-7 day	222.0	---	3.5	---
Test 3**	Pre-treat	1,128.0	---	---	---
July 15-23	Post-treat	36.0	98%	---	---
(Jordan)	Post-24 h	36.0	94%	---	---
	Post-5 day	110.0	73%	---	---
	Post-7 day	90.0	91%	---	---
Untreated	Pre-treat	369.0	---	---	---
control	Post-treat	999.0	---	---	---
	Post-24 h	354.0	---	---	---
	Post-5 day	228.0	---	---	---
	Post-7 day	547.0	---	---	---

* Two CO_2 traps per treated and untreated woodlot per sampling period.

** One CO_2 trap per treated and untreated woodlot per sampling period. Both woodlots were very small, about 0.25 mi apart, and surrounded by agricultural fields.

Vectors and other mosquitoes were effectively controlled in both tests completed in 2008 (Table 5.10). The first test was conducted in three campgrounds in Anoka County the location of numerous similar tests. The second test was conducted in a more isolated agricultural area in Scott County in the same treated and untreated woodlots a month after the third permethrin test.

In the first test, both Pyrocide® and Anvil® effectively suppressed adult mosquitoes of all species for 24 h. In the second test, Pyrocide® controlled vector and other mosquitoes for seven days. The clearest vector-specific data (highest initial vector captures) were collected during the second test. These results together with similar results from previous tests demonstrate that

Pyrocide® can effectively control vector and other mosquitoes for at least 24 h. Control may last longer in isolated areas.

Table 5.10 Results of two tests of ULV Pyrocide® (one test compared to Anvil®) in 2008; 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		*Cx. tarsalis, Cx. restuans, Cx. pipiens, Cx. salinarius*	
Test	Collection	CO_2 trap catch	Efficacy	CO_2 trap catch	Efficacy
Test 1*	Pre-treat	1,831.3	---	1.3	---
July 15-17	Post-treat	81.0	93%	1.7	63%
Pyrocide®	Post-24 h	395.7	49%	0.0	100%
Untreated	Pre-treat	430.7	---	2.0	---
control	Post-treat	276.3	---	6.7	---
	Post-24 h	183.0	---	3.3	---
Anvil®	Pre-treat	1,245.3	---	6.3	---
	Post-treat	92.3	88%	1.3	94%
	Post-24 h	139.3	74%	4.7	56%
Test 2**	Pre-treat	494.0	---	484.0	---
Aug 11-20	Post-treat	4.0	98%	4.0	98%
	Post-5 day	368.0	72%	366.0	75%
	Post-7 day	52.0	80%	44.0	84%
Untreated	Pre-treat	144.0	---	128.0	---
control	Post-treat	55.0	---	50.0	---
	Post-5 day	388.0	---	386.0	---
	Post-7 day	77.0	---	75.0	---

* Three CO_2 traps per treated and untreated site per sampling period.

** One CO_2 trap per treated and untreated woodlot per sampling period. Both woodlots were very small, about 0.25 mi apart, and surrounded by agricultural fields.

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services and field staff conducted seven aerial calibration sessions for dry granular materials during the 2008 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so each helicopter's dispersal characteristics are optimized. Seven sessions were held at the municipal airport in LeSueur, MN. Staff completed calibrations for seven different operational and experimental control materials. In total, eight helicopters were calibrated and each helicopter was configured to apply an average of three different control materials.

For Altosid® pellet applications, Technical Services has traditionally conducted a calibration session just prior to the application due to the high control material cost and the importance of

properly applying a 30-day control material within highly productive breeding sites. Since Altosid® pellets are an extruded material, the final manufactured product is not consistent in pellet length. These pellets, while traveling through gravity feed hoppers, can interlock, bind, and bridge with each other instead of flowing freely. This characteristic, along with a small gate size for low application rates on the helicopter hoppers, requires staff to recalibrate prior to using this material. Because pellet recalibrations are numerous and time consuming, MMCD field staff wanted to find out whether previous pellet settings could be used which may result in reduced frequency of recalibrations.

In June, Technical Services conducted an evaluation to analyze swath patterns and application rate calculations of two calibrated helicopters versus two un-calibrated helicopters. This trial was conducted at the Scott County fairgrounds in Jordan, MN. At these low application rates, pellets have the tendency to "pulse or burst" out of our application systems causing higher variability in the swath patterns. Therefore, it is critical to adjust the flow through these gate settings as accurately as possible to maximize flow but maintain the low application rate. The sensitivity of the manually-set gate size and these minute adjustments is important to the overall success of the application. The variability of swath patterns was shown to be higher in non-calibrated helicopters even though overall application rates might still be within acceptable limits. Technical Services emphasized the importance of uniform applications to the overall success of the aerial application program and recommended the continuance of our current calibration procedures. Therefore, equipment settings must be accurately readjusted just prior to application to apply the desired treatment rate.

Droplet Analysis of Ground-based Spray Equipment Technical Service staff optimized 59 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.

Development of an Indoor Spray Booth for Adulticide Equipment Calibration
Technical Services and the East Region staff developed a 20 ft x 40 ft indoor spray booth to evaluate adulticide application equipment. This booth eliminates some of the outdoor environmental variables which can adversely affect the testing results and can limit the days available for evaluations. This new system improves the accuracy of our evaluations by allowing us to focus on the spray variables we can control and improves the overall accuracy of our calibration procedures by evaluating all of our spray systems in a single location. The efficiency of our operations will be improved by eliminating adverse weather conditions which might shut down evaluations and will allow calibrations to be completed in the non-treatment season. Thus, reducing staff time and demand for resources in May when these evaluations are typically completed and staff can be focused on other aspects of our operations.

In addition, the self-contained booth also collects the adulticide spray particles so they are not unduly released into the environment during the calibration process.

Plans for 2009

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 2009 we plan to continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy. We will expand tests of Natular® formulations in stormwater management and natural ground sites to better determine how long they control mosquito larvae. We also plan to repeat tests of adulticides, emphasizing control of *Culex* in different situations.

References

Mulla's Formula:

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

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

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

2008 Highlights

- Developed web-based system for tracking and mapping customer calls, including Geocoder web service for metro
- Continued data support for AG-NAV® Guía GPS for aerial treatments
- Updated wetland and stormwater structure maps
- Continued education efforts on stormwater and mosquitoes
- Conducted biennial public opinion survey
- Worked with TPT on historical video project

2009 Plans

- Continue adding functionality to Call System and Web Map to improve access to data

2008 Projects

Call Tracking & Mapping System

Calls from citizens are an important source of information for MMCD, both for bringing attention to areas that may need service, aiding efforts such as removing tires, and for recording citizen complaints and requests for limited or no treatment.

MMCD receives up to 4,000 contacts from the public every year, mostly as phone calls, but also as e-mails from the MMCD web site. Requests for information can sometimes be handled by the reception staff, including inquiries where information is readily available on the MMCD Web Map site. Requests for service, however, are forwarded to the appropriate field office where foremen respond to the caller via telephone, e-mail, or door hanger, and by inspecting and providing treatment to the area if appropriate. Periodic checks are done to ensure all calls have been responded to. At the end of the year, staff prepares reports for county commissioners and city managers on what contacts have been received from their areas and what actions have been taken.

In late 2007 and 2008, we developed specifications and contracted with Houston Engineering to build a new web-based system to track and forward calls. This replaced an older system which would no longer run on newer PCs and could not be modified to meet changing needs. The new system includes two valuable new functionalities:

1. addresses are checked to make sure they are complete, valid, and interpretable, and
2. addresses are geocoded and displayed on a map (staff currently do this by hand as service requests are received, and in peak times it takes time away from providing the service itself).

At the end of the summer staff evaluated if geocoding and mapping calls had affected the amount of time required to handle calls. Estimates of time per call averaged 5 min (range 1 to 15) with the old system, vs. 1 min (range 0.25 to 1) with

the new system. This represents an 80% decrease in time spent handling call paperwork. To estimate how this affected operations, we examined daily call volumes. For example, at the North facility (Andover) in June, an average of 32 calls was received daily, with a peak of 73 calls on one day. Using the old and new average time per call this would mean a reduction from 2.7 hr per day spent on call paperwork to about ½ hr for average June days, and a reduction from about 5 hr to 1 hr at peak. Savings at other times or other locations were smaller, but these savings at peak call times are particularly useful as those also tend to be the busiest times for providing services. (See Fig. 6.10 and Table 6.2 later in this chapter for more information on total calls.)

The new system results include improvements from address verification (geocoder) as the call was received, as well as automatically assigning section, foreman and facility, and having a printable pre-mapped location. Locations of calls received in 2008 are shown in Fig. 6.1.

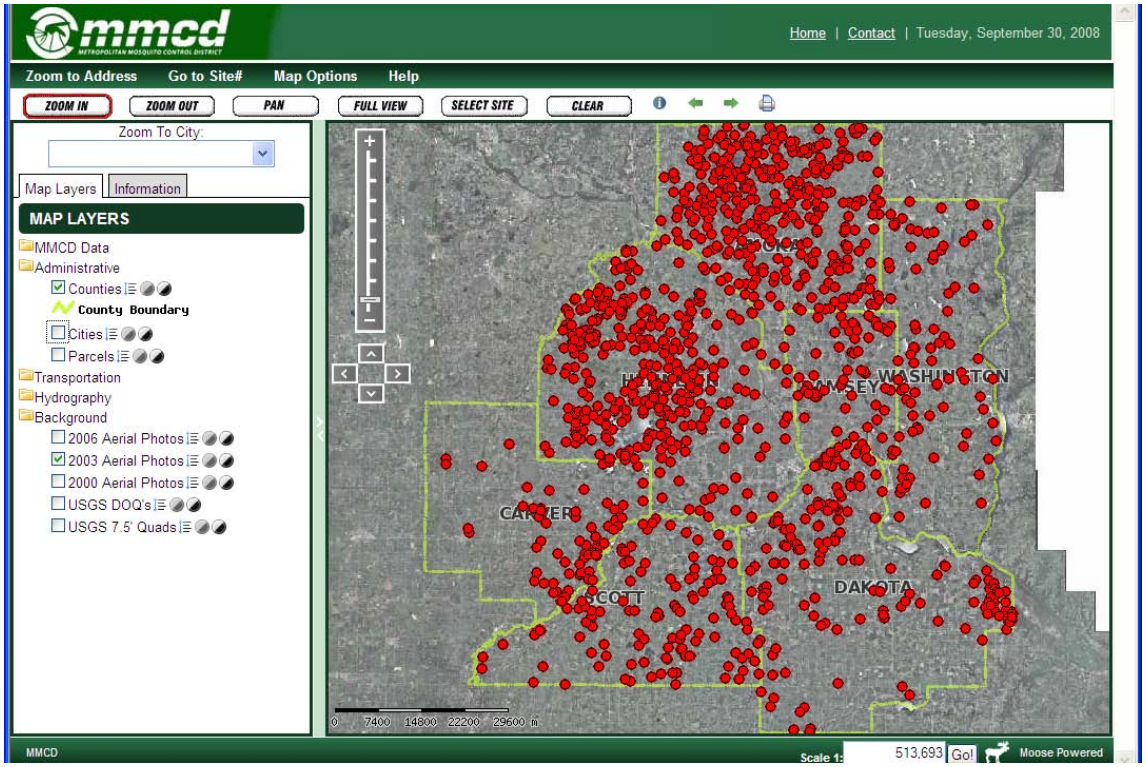


Figure 6.1 Example of screen shot in which the location of calls received are geocoded and mapped in 2008.

Web Map

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. The map and data interface was developed by Houston Engineering and uses open source GeoMoose software.

The public version of the Web Map site, available from MMCD's home page, www.mmcd.org, has been running since April 2007, and that year received an average of 35 visits per day. For 2008 average usage was up to 40 visits a day, but public usage was difficult to estimate because the Call System also access the Web Map, and reporting was not differentiated until late in the year. In December the Web Map site was hit from over 200 unique IP addresses (not including MMCD or Houston Engineering), and since its first release it has been visited from over 7,000 unique IPs. An internal version with greater detail is available from MMCD computers.

Geocoder

MMCD's Web Map site opens with a place for people to look up the location of a particular street address ("geocoding"), as do many other government or business web sites. In 2008 MMCD staff led a MetroGIS/Metropolitan Council funded project to develop a free high-quality geocoding web service for the metro area that any agency or web developer could use for address look-up in web applications. This new geocoder provides more accurate and robust address look-up capabilities, using both county parcel data and MetroGIS street data (from The Lawrence Group) as a base. By setting it up as a web service, users do not have to deal with keeping the underlying data or geocoder engine software up-to-date; users simply send a request to the service web location in a browser's url command, and receive the result in a form that can be displayed or used in their application.

Initial development of the geocoder (based on the open-source PAGC geocoder engine) was completed in mid-year and was set up as a service hosted at the Land Management Information Center (LMIC). MMCD's web site was switched to using the service as soon as it became available. The service accepts either street address or intersection requests. MMCD staff led an interagency effort to get additional funding from MetroGIS to add to the geocoder the ability to look up landmarks such as parks and schools by name, and that project will be undertaken in 2009.

The geocoder is also an integral part of MMCD's new Call Tracking System (above). For complete information on the MetroGIS Geocoder Project see www.metrogis.org/data/apps/geocoder/

Aerial Treatment Tracking and Guidance

The AG-NAV® Guía system, an aircraft-mounted GPS system provided by our helicopter contractor, Scott's Helicopter Service, continued to be used and improved in 2008. After discussions with the source company at the end of 2007 and early 2008, a technical representative from the company visited May 8-9, installed software updates, and worked with the pilots to improve system performance. These changes improved usability of the system, especially regarding in-flight display for pilots.

In general, MMCD's procedures to provide site boundary files to pilots and retrieve treatment tracks worked well this season, and staff continued to provide marked paper maps as well. However, early on MMCD staff discovered that efforts to improve mapping of some larger wetlands in the 2007-2008 winter off-season had made some of these site outlines too detailed to

use reliably in AG-NAV guidance files, and alternative simplified air site boundary files were made in some areas to accommodate this need.

MMCD staff organized a symposium at the American Mosquito Control Association (AMCA) annual meeting in February where representatives from various districts in North America described their experience with GPS guidance and tracking systems. For a more detailed description of AG-NAV capabilities, refer to the 2007-2008 TAB Report.

Field & Lab Data Entry and Reporting

We continued to use our electronic field and lab data entry system, "DataGate", for all mosquito and black fly larval and adult inspection, treatment, and sample data, and much of the physical inventory entry and reporting. The importance of rapid and accurate data access increased as we started to use electronic data for helicopter treatment plans (see Ag-Nav, above), as well as making it available on the public Web Map site. Field data continue to be entered using Palm OS-based Personal Digital Assistants (PDAs), and data records are uploaded into the network when field staff return to their base.

Wetland and Stormwater Mapping

Staff updated wet area boundary changes in winter of 2007-2008 and will do so again in winter of 2008-2009. Statewide aerial photography flown in 2008 by the Natural Resources Conservation Service (NRCS) was made available in the latter part of 2008 by LMIC. We use these photos by accessing them as a web service directly through the web, which eliminates the need for storing this very large set of photos locally.

A District-wide effort launched in fall 2007 to map stormwater control structures such as pond regulators and culverts which often provide productive habitat for *Culex* species was continued in 2008. A total of 22,800 such structures were entered as of January 2009, and updates based on 2008 field notes are still underway. Many of these sites now receive routine treatment (see earlier chapters). Staff are participating in an Minnesota Pollution Control Agency (MPCA)-led effort to standardize mapping of stormwater structures.

Digital wetland files were provided on request to other units of government, including:

- Rice Creek Watershed District
- MnDNR National Wetlands Inventory (NWI) update project

Staff are serving on the Technical Advisory Committee of the NWI update project, which is funded by Legislative-Citizen Commission on Minnesota Resources (LCCMR) and the Governer’s GIS Council Hydrography Committee.

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

Stormwater Management, Wetland Design, and Mosquitoes

MMCD staff continues to try to maintain awareness of mosquito issues within the stormwater design and regulatory community.

- The "Stormwater and Mosquitoes" page on the MMCD web site received 891 visits in 2008. A general fact sheet recorded 70 downloads, and a new fact sheet on rain barrels recorded 201 downloads.
- Bruce Wilson from MPCA visited MMCD for discussion and a tour of catch basin and stormwater structure mosquito control issues
- Staff participated in the MN Water Resources Conference (civil engineers, city & watershed dist. staff, U of M researchers).

We also stay in contact with MPCA Stormwater Steering Committee regarding current activities and updates to the *Minnesota Stormwater Manual* which includes a section on mosquitoes and stormwater in Chapter 6. (http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html)

On July 15 Kirk Johnson, MMCD Vector Ecologist, spoke to the Lakeland City Council about rain gardens and other concerns about stormwater management, mosquito production and West Nile virus. We continue to seek ways to communicate with designers and engineers on this issue and appreciate any suggestions from TAB members.

MMCD staff contributed to efforts by the Society of Wetland Scientists (SWS) to develop an SWS Position Statement on West Nile virus, mosquitoes, and wetlands. Due to irreconcilable differences among the original authors and among SWS Board members regarding the work, it was downgraded from a position statement to a "White Paper" (synthesis of current understanding), re-revised and a draft released in April 2008 for review by the SWS membership (http://www.sws.org/documents/wnv_draft_v2.pdf). While on the whole, the paper represents a good summary of current understanding of wetland management and mosquito issues, a few statements were inserted in the revision that many mosquito researchers consider unsupported by facts, and discussion continues with SWS leadership.

Public Opinion Survey

MMCD has conducted a series of public opinion surveys to help assess customer awareness, satisfaction and concerns, and track changes over time. From 1994-2000 surveys were done every two years. Since yearly changes were small at that time, no survey was done in 2002. However, 2004 showed marked changes, probably relating to the arrival of West Nile virus, and we returned to a two-year schedule. The 2008 telephone survey of 406 metro-area residents was done July 8 - August 13 by The Research Edge, LLC. The survey used standard polling techniques (random-digit sample, participant chosen by most recent birthday), plus a quota system was used to keep the male/female ratio of respondents near that of the metro population. The sample included cell phone numbers if people had transferred their home phone number to a cell phone (note that a January 2008 - Pew Research Center study found that "while different demographically, Americans who mostly or exclusively rely on cell phones are not substantially different from the landline population in their basic political attitudes and preferences" … but

may differ on some questions). We found a higher number of answering machines in this year than previous and used techniques such as leaving a callback message and multiple redials at different times to try to convert these to respondents. Results can be generalized to the population of the seven-county metro area with a margin of error of ± 5%.

Most residents continued to express that it is important to control the mosquito populations in the metro area.

- 83% of respondents rated the importance of controlling mosquitoes 5, 6, or 7 on a 7-point scale (1 = not important, 4 = neutral, 7 = very important), lower than in 2004-2006 and about the same as earlier years (Fig. 6.2).

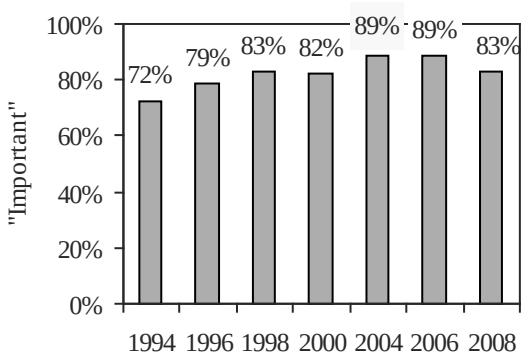


Figure 6.2 "How important do you feel it is to control the mosquito population in the metro area?"

However, given the low numbers of mosquitoes most of the year, relatively few respondents reported major effects of mosquitoes on their lives.

- 39% said mosquitoes in their neighborhood this year decreased their enjoyment of the outdoors very often or somewhat often. This is the same as 2006 and a large decrease from the spike in 2004 (Fig. 6.3) that may have reflected both West Nile virus concerns and high mosquito populations that year.

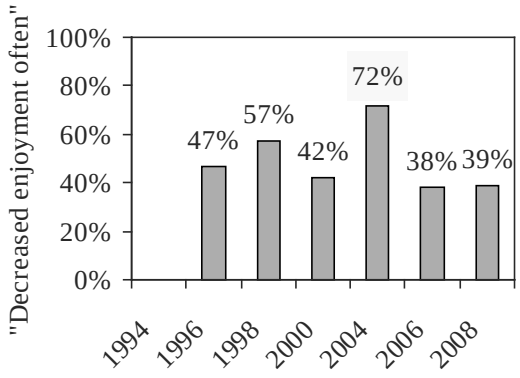


Figure 6.3 "In your neighborhood this year, how often have mosquitoes decreased your enjoyment of the outdoors? Would you say very often, somewhat often, a few times, or never?" Proportion of respondents replying somewhat or very often.

- Repellent use reached a new low, at 63% (Fig. 6.4).

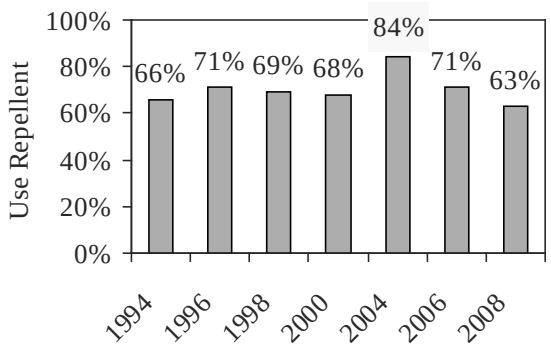


Figure 6.4 "Please indicate which of the following methods or products you use to repel or control mosquitoes or gnats. Do you use . . . Repellent?"

Median amount of money spent on control or repellent continued to hold at $10, as it has been every year except 2004, when it went up to $15.

Most respondents were aware that mosquitoes can transmit disease. Those aware that metro-area mosquitoes can transmit disease (95%) was about the same as 2004 and remained up significantly from 1994 (80%), the previous time that question was asked. Those reporting checking their yard weekly to clean out containers was down to 53%, much lower than 2004 (Fig. 6.5)

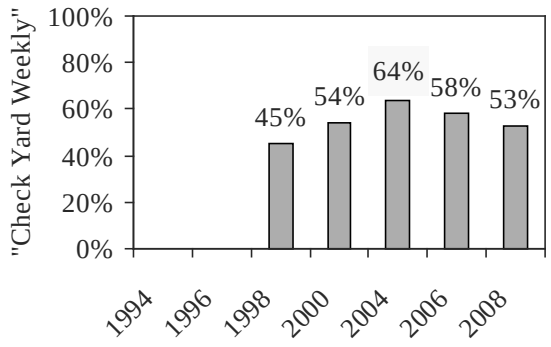


Figure 6.5 "About how often do you check your yard and remove or clean out water-holding containers that might breed mosquitoes that carry disease? Would you say weekly, monthly, once a year, or never?"

Most respondents were aware of mosquito control activities.

- 73% reported being aware of "a local government agency called the Metropolitan Mosquito Control District", a record high.

Sources of information included TV, major newspapers, radio, contact with employees or seeing trucks, local newspapers, presentations and fairs, and MMCD's web site/e-mail. Those aware of MMCD who listed TV news as a source of information continued declining from 77% in 2004 and 72% in 2006 down to 63%. Both those who listed radio or got information from local papers remained steady (vs. 2006) at 22%. Respondents reporting seeing trucks or employees increased again, to 39%, up from 30% in 2004, and much higher than the original 19% in 1996. The increase in trucks on the streets for catch basin treatments may be contributing to this rise. Those

seeing presentations or attending a fair booth were up slightly to 11%. Those listing e-mail or web site as a source of information increased very slightly, to 3%.

- Unlike past surveys, men and women were equally likely to agree they had heard of MMCD. Those over 50 were more likely to be aware.
- Households with children were more likely to be aware of MMCD than in the past (64%), but still less likely to be aware overall.
- An additional 11% were aware of larval or adult control, although not of MMCD. The total aware that some control was being done was 84% (same as 2006).

Most felt the MMCD was an important service, and many would like increased control.

- 83% agreed "MMCD provides an important service to the community", similar to 2006 and significantly higher than 2004 or previous years (Fig. 6.6).

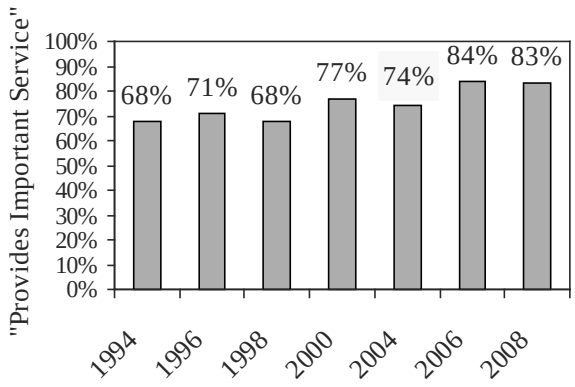


Figure 6.6 "MMCD provides an important service to the community." Respondents indicating 5, 6 or 7 on agreement scale.

- 71% agreed "MMCD is a good buy for the money", about the same as 2006 and still up from previous years, despite the difference in amount paid ("$12 of property taxes on a $250,000 house", up from "$5.40 per $120,000 house" in 2000) (Fig. 6.7).

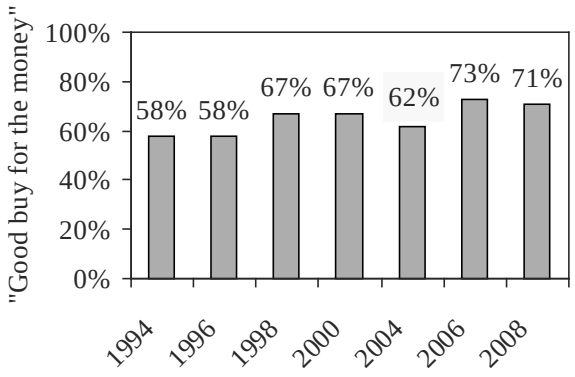


Figure 6.7 "Less than $12 of property taxes on a $250,000 house goes to fund MMCD. Considering the task and relative cost of the MMCD, …MMCD is a good buy for the money." Respondents indicating 5, 6 or 7 on agreement scale.

- 47% agreed “Mosquito and gnat control should be increased”, significantly lower than any previous years (Fig. 6.8), and 20% disagreed with the statement. Lack of mosquitoes probably affected this result; usually those reporting frequent problems with mosquitoes are more likely to support increased control.

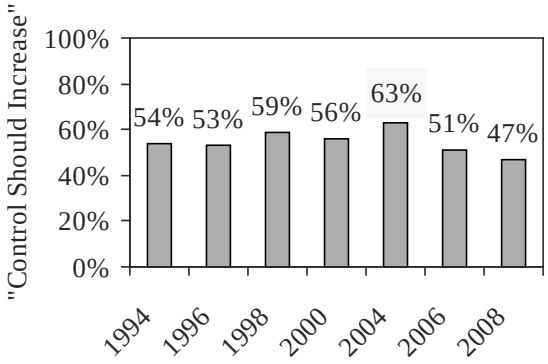


Figure 6.8 “The level of mosquito and gnat control should be increased.” Respondents indicating 5, 6 or 7 on agreement scale.

- 40% agreed “MMCD funding should be increased,” slightly lower than previous years (42% to 46%), but 24% disagree, up significantly from 17% in 2006.

Few respondents showed concerns about environmental or health effects of controls.

- 16% agreed with a statement suggesting adult control harms environment or health, up somewhat from 2004 but still lower than previous years (Fig. 6.9); 44% disagreed, 40% replied neutral or don’t know. Similar concern levels were seen for larval control in wetlands and possible effects of those on human health.

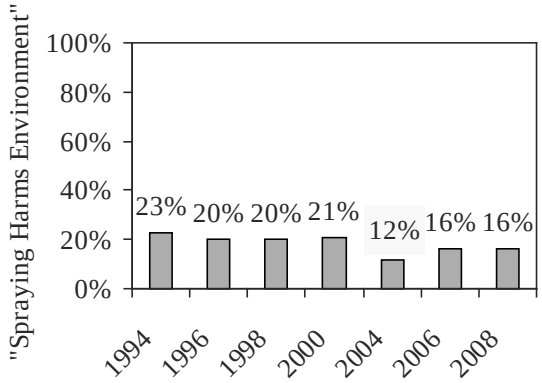


Figure 6.9 “If 1 is strongly disagree, 4 is neutral, and 7 is strongly agree, please indicate the extent to which you agree with the following statement: Spraying to control adult mosquitoes at parks, events, and wooded areas is harmful to the environment.” Respondents indicating 5, 6 or 7 on agreement scale

- 65% agreed "Spraying has some risk, but the benefit of a professionally-done spray program outweighs the risk," up slightly from previous years; 10% disagreed with that statement.

In general, respondents aware of MMCD, of larval control, or of adult control were more likely to feel that controls do not cause harm.

Two questions were added to measure progress with notification efforts:

- 12% were aware "spray treatment schedules are available by phone or internet"
- 10% were aware they can "go to MMCD web site to request service or check for wetland treatments done in your area"

This is similar to estimates of awareness of notices run in the major metro newspapers, which was 11.4% (1998 survey).

A 2006 question to assess pressures facing decision-makers as the metropolitan area expands was repeated:

> "As new homes are built in areas that once were farms or woods, people expect to add services such as streets and sewers in these new developments. Should mosquito control be another service that people in new growth areas should expect, or not?"

A large majority, 73%, responded "Yes" to this question, similar to the result in 2006 (76%).

MMCD has been trying to increase awareness of both tick-borne disease and of MMCD's services in this area, and added more questions relating to ticks and disease.

- 94% were aware that "ticks in the metro-area can transmit disease to people or animals", compared with 96% in 2006.
- 56% were aware ticks "may transmit other human diseases in addition to Lyme disease" (new question)

A question about actions to prevent tick-borne disease were modified after discussion with MDH staff in order to help support other research efforts in this area. In 2006 the question read:

> "When you spend time in woods or on shaded trails, about how often do you take actions to avoid tick bites, such as choosing clothing, using tick repellents, or washing or checking after walking in brush? Would you say: Every time you go out, Usually, Seldom, or Never?"

Results showed 52% said "Every time", 28% said "Usually", 18% were Seldom or Never.
For the 2008 survey the question was reworded as:

> "Now I'm going to list several actions people might take to avoid ticks when they are outside in woods, brush, or on shaded trails. I'd like to know how often <u>you</u> do each of these, Every Time, Often, Seldom, or Never. When you are spending time in woods, brush, or on shaded trails, how often do you -
>
> a. choose clothing such as long pants, or long sleeves?
> b. use some kind of repellent to deter ticks?
> c. wash off and check for ticks after being outside?"

Most people reported they wash off and check for ticks after being out (Table 6.1). Many never use repellent for ticks.

Table 6.1 Results of question regarding personal actions taken to avoid tick-borne disease

Personal actions taken	Every time or often	Never
Choose clothing such as long pants or long sleeves	69%	12%
Use some kind of repellent to deter ticks	46%	36%
Wash off and check for ticks after being outside	78%	9%

Despite a marked increase in reported Lyme disease cases in 2007 (now more than twice those reported in 2003) only 27% thought "the annual number of cases in Minnesota in recent years is increasing;" 40% thought it was about the same, 10% thought it was decreasing and 23% didn't know.

Awareness of MMCD's activities to prevent Lyme disease was at 36% in 2008, slightly higher than 2006 (33%) and 2004 (30%) and significantly higher than 2000 (24%).

Notification

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 get the latest information on scheduled treatments. The District also publishes a three-column by nine-inch ad in local daily and weekly newspapers, just prior to Memorial Day weekend, advising citizens how to find out where and when District adulticiding will take place throughout the season. This ad also describes the process for opting out of treatment.

Calls Requesting Service

Calls requesting treatment early in the season generally followed the seasonal pattern shown by sweep net counts for human-biting mosquitoes (Fig. 6.10). Calls requesting service from early through mid-June continue to reflect a high demand for treatment. People planning outdoor activities, such as picnics, outdoor weddings and graduation open houses are responsible for many early season calls, as are actual mosquito numbers.

Yearly comparisons of citizen calls are listed in Table 6.2. Total call volume declined from 1,929 calls in 2006 to 1,441 calls in 2007, continuing a downward trend from the high of 4,185 calls recorded during 2003 when mosquito numbers were high. Call volume increased in 2008 to a total of 2,843. Calls requesting adult treatment and calls to treat prior to events – both public and private – were up considerably, possibly due to increased sophistication on the part of citizens who know MMCD will respond to multiple requests from the same area for service. Calls requesting a dead bird pick-up for WNV testing were not included in this table. There were 393 total reports of dead birds, including 77 reports sent to MMCD via its web-based reporting form.

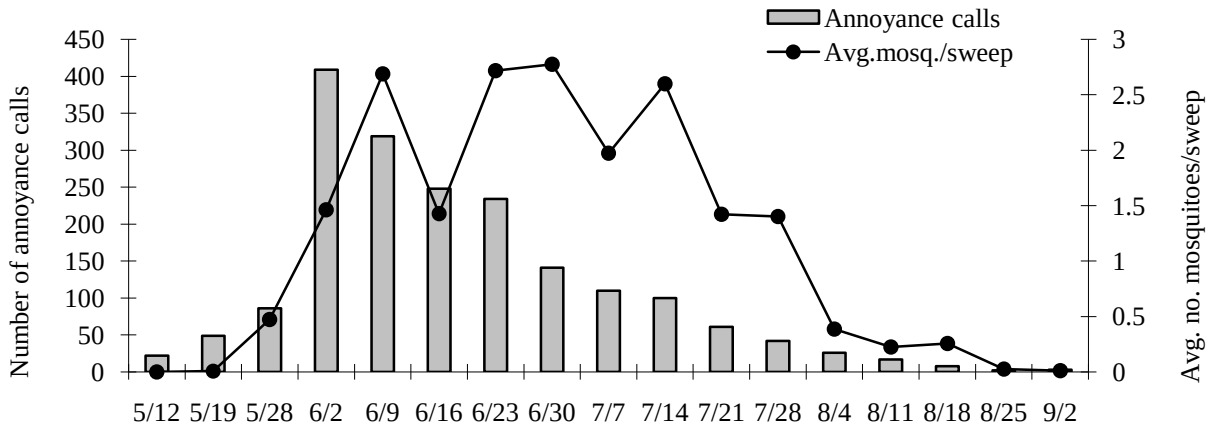


Figure 6.10 Calls requesting treatment and sweep net counts by week, 2008.

Table 6.2 Yearly comparisons of citizen calls tallied by service request from 2002 to 2008

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

* - years where confirmation postcards sent

Curriculum in Schools

MMCD continued to deliver “Mosquito Mania,” a three-day curriculum for upper elementary and middle school students. This curriculum was introduced to metro-area schools during the 2005-2006 school-year. “Mosquito Mania” builds on MMCD’s relationship with schools by offering a standards-based approach to the subject of mosquitoes and their relationship to the environment. Regional facilities together with Main Office staff reached a total 3,499 students in 42 schools during 2008.

Outreach

May 16, 2008 MMCD sponsored an open house commemorating 50 years of serving metro citizens. Staff provided building tours which included informational displays and exhibits of

control materials and equipment. Our helicopter contractor, Scott Churchill, landed a helicopter at the Main Office for viewing. Approximately 100 people attended including many former employees.

Jim Stark, Stephen Manweiler, Kirk Johnson and Nancy Read met with Charlie Blair, the new Manager for the Minnesota Valley National Wildlife Refuge, and Vicky Sherry, Refuge Biologist, to discuss the ongoing development of a plan to manage vector mosquitoes within the refuge. We were near completion of this plan when the United States Fish and Wildlife Service released a draft mosquito and mosquito-borne disease management policy in October 2007. Mr. Blair indicated that he did not feel comfortable establishing an agreement with MMCD until this policy is finalized. We will continue working with Mr. Blair and Refuge staff to ensure our agreement meets all the requirements of this draft policy.

The History of Minnesota Mosquito Control, a half-hour documentary MMCD produced with Twin Cities Public Television, premiered on Saturday June 14 at 8:00 pm on Channel 17/The Minnesota Channel. This documentary focused on the technology used in current mosquito control practices and the important public health implications of mosquito control. In addition, there was information presented on what citizens can do to reduce risk of mosquito and tick transmitted diseases and to minimize mosquito production in their neighborhoods. The documentary also aired throughout July and has been rebroadcast more than a dozen times on TPT's Minnesota Channel.

Jim Stark and John Kahl, MMCD's Legislative Affairs advisor, met with Mathew Norton, Forestry Advocate and Staff Attorney, and Samuel Yamin, Public Health Scientist for the Minnesota Center for Environmental Advocacy. They discussed MMCD's program, notification efforts, and what measures are being taken to ensure that treatments do not have a significant impact on human health or non-target insects. We have forwarded copies of the risk assessment MDH conducted on our adult control materials, information pertaining to the SPRP long-term studies conducted in Wright County, and the work Karen Oberhauser has led on monarch butterflies.

Also at this meeting was Mark Martell, Director of Bird Conservation for Audubon Minnesota. Mr. Martell is interested in the effects our control efforts have on overall biomass as it relates to feeding birds. Stephen Manweiler forwarded three references that report various aspects of evaluations of the impacts of mosquito larvicide treatments on birds breeding in wetlands. These papers describe data collected during extensive non-target impact studies conducted in the late 1980s through the 1990s.

Nontarget Studies

Publication of results of previous adulticide nontarget studies organized by the TAB subgroup (Karen Oberhauser, Roger Moon, Nancy Read, and Stephen Manweiler), reported in 2004 and 2005 TAB reports, continued. Dr. Oberhauser compiled a paper summarizing studies on resmethrin on monarch (*Danaus plexippus* (L.)) larvae, which was accepted by the Journal of the American Mosquito Control Association and is expected to appear in an upcoming issue (in

press). Results of the study of milkweed distribution relative to MMCD adulticide treatments are being prepared for publication.

Previous Larvicide Nontarget Impact 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 2006-2008 are given in Table 6.3.

Table 6.3 Larvicide nontarget impact study report downloads from www.mmcd.org

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

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 2008 and talks that will be presented in 2009. Also included are publications that have MMCD staff as authors or co-authors.

2008 Presentations & Posters

Brogren, S., D. Crane, and C. LaMere. 2008. You've come a long way *Aedes*: A historical review of surveillance methods and the mosquito fauna in the metropolitan area of Minnesota. Presentation at the Michigan Mosquito Control Association, Kalamazoo, MI.

Crane, D., S. Brogren, and C. LaMere. 2008. You've come a long way *Aedes*: A 50-year review of surveillance methods and the mosquito fauna in the metropolitan area of Minnesota. Presentation at the American Mosquito Control Association Annual Meeting, Sparks, NV.

Dirkswager, D. and C. Herrmann. 2008. Using GPS and GIS to map helicopter treatments for mosquitoes. Poster at the MN GIS-LIS Annual Conference, Rochester, MN.

Johnson, K. 2008. West Nile virus, mosquitoes and stormwater management. Presentation at the Minnesota Structural Pest Management Conference, Minneapolis, MN.

Johnson, K. The status of *Aedes japonicus* in the Metropolitan Mosquito Control District. Poster presentation at the Society of Vector Ecologists Annual Meeting in Ft. Collins, CO.

Johnson, K. and D. Neitzel. 2008. Asian mosquitoes in Minnesota: An approach to monitoring and control. Presentation at the Minnesota Invasive Species Conference, Duluth, MN.

Pennuto, K. and N. Read. 2008. Geocoding customer calls – field results. Poster at the MN GIS-LIS Annual Conference, Rochester, MN.

Peterson, J., K. Beadle, and N. Read. 2008. Surveillance and control of *Culex* vectors in stormwater structures. Poster at the American Mosquito Control Association Annual Meeting, Sparks, NV.

Prather, B. and K. Johnson. 2008. Managing WNV vectors: Larval and adult control in urban environments. Michigan Mosquito Control Association, Kalamazoo, MI.

Manweiler, S., D. Stith, and M. Kirkman. 2008. Incorporation of Altosid XR-G sand into MMCD's *Coquillettidia perturbans* control program. Michigan Mosquito Control Association, Kalamazoo, MI.

Read, N., B. Fischer, M. McLean, and J. Peterson. 2008. Web Map connects citizens, staff, and data. Presentation at the American Mosquito Control Association Annual Meeting, Sparks, NV.

Read, N. 2008. Larviciding in Minneapolis/St. Paul, MN. In symposium: Aerial treatment guidance/tracking GPS - experience from the field. Presentation at the American Mosquito Control Association Annual Meeting, Sparks, NV.

Read, N., and B. Fischer. 2008. The metro geocoding web service at work – locating customer calls. Presentation at the MN GIS-LIS Annual Conference, Rochester, MN.

Read, N., and B. Fischer. 2008. Wetland Web Map connects citizens, staff, data. Poster at the MN Water Resources Annual Conference, St. Paul, MN.

Smith, M. and S. Manweiler. 2008. Evaluation of Altosid XR-G sand for expansion of control of *Coquillettidia perturbans* mosquitoes in MN. Presentation at the American Mosquito Control Association Annual Meeting, Sparks, NV.

Walz, J. and C. LaMere. 2008. Black fly larval control with *Bti* and long-term non-target monitoring in the Mississippi River. Presentation at the Annual North American Black Fly Meeting in Laughlin, Nevada.

2009 Presentations & Posters

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

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

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

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

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

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

2009 Publications

Oberhauser, K., S. A. Manweiler, R. Lelich, M. Blank, R. V. Batalden and Alma de Anda. 2009. Impacts of ULV resmethrin applications on nontarget insects. J. Amer. Mosq. Cont. Assn. 25(1):83-93.

APPENDICES

APPENDIX A Mosquito Biology

There are 51 species of mosquitoes in Minnesota. Forty-five species are found within the MMCD. Species can be grouped according to their habits and habitat preferences. For example, the District uses the following categories when describing the various species: Disease vectors, spring snow melt species, summer 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 use permanent and semipermanent sites for larval habitat and *Cx. pipiens* and *Cx. restuans* use storm sewers and catch basins as well. Gravid traps and CO_2 traps are used to monitor these mosquitoes.

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. MMCD monitors *Cs. melanura* abundance with CO_2 traps and vacuum aspirators. Adults are tested for eastern equine encephalitis virus (EEE).

Floodwater Mosquitoes

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

Summer Floodwater *Aedes* Summer floodwater eggs hatch in late April and early May. Eggs are laid at the margins of grassy depressions, marshes, and along river flood plains. There are multiple generations per year resulting from rainfalls greater than one inch. Overwintering is in the egg stage. Adult females live about three weeks. Most species can fly great distances and are highly attracted to light. Peak biting activity is as at dusk.

The floodwater mosquito, *Ae. vexans*, is our most numerous pest. Other summer species are *Ae. cinereus, Ae. sticticus* and *Ae. trivittatus*. New Jersey light traps, CO_2 traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans This summer species develops 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

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 also bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. The District targets four *Culex* species and one *Culiseta* species for surveillance and/or control.

Exotic or Rare Species

Aedes albopictus This exotic species is called the Asian tiger mosquito. It breeds in tree holes and containers. This mosquito is a very efficient vector of several diseases, including La Crosse encephalitis. *Aedes albopictus* has been found in Minnesota, but it is not known to overwinter here. It was brought into the country in recycled tires from Asia and has established itself in areas as far north as Chicago. 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 is an exotic species that was first detected in Minnesota in 2007. In 2008, we determined *Ae. japonicus* was established in the District, and also in southeastern Minnesota. Larvae occur in a wide variety of natural and artificial containers, including rock holes and used tires. Preferred sites contain organic-rich water and are usually shaded. 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 in Minnesota 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 New Jersey Light Traps and Average Yearly Rainfall - 1965-2008

Year	*Aedes abs/punct*	*Aedes cinereus*	*Aedes sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Cq. perturbans*	All species	Avg. Rainfall
1965	1.03	0.77	0.19	0.08	89.00	4.70	1.43	111.74	27.97
1966	1.29	0.13	0.00	0.02	33.70	0.69	17.66	61.78	14.41
1967	0.64	0.24	0.65	0.12	75.40	1.61	14.37	101.55	15.60
1968	0.14	1.60	0.04	0.77	119.30	1.25	2.43	136.54	22.62
1969	0.70	0.19	0.02	0.17	19.90	0.65	4.27	30.82	9.75
1970	0.17	0.57	0.06	0.33	73.10	0.76	2.78	83.16	17.55
1971	0.69	0.55	0.15	0.33	52.10	0.28	3.51	62.93	17.82
1972	0.98	2.13	0.41	0.35	124.50	0.39	8.12	142.35	18.06
1973	1.29	0.70	0.11	0.06	62.20	0.41	25.86	95.14	17.95
1974	0.17	0.32	0.14	0.12	30.30	0.15	7.15	40.09	14.32
1975	0.28	0.63	0.44	0.17	40.10	6.94	4.93	60.64	21.47
1976	0.10	0.05	0.04	0.00	2.30	0.23	4.42	9.02	9.48
1977	0.20	0.16	0.01	0.02	17.50	2.44	1.16	25.17	20.90
1978	0.17	0.74	0.33	0.24	51.40	1.35	1.04	62.63	24.93
1979	0.07	0.24	0.10	0.21	18.30	0.13	4.39	25.59	19.98
1980	0.02	0.26	0.33	0.77	47.40	0.25	13.87	65.28	19.92
1981	0.01	0.10	0.25	1.03	57.00	0.44	3.98	65.30	19.08
1982	0.01	0.21	0.08	0.03	23.10	0.15	8.63	34.60	15.59
1983	0.03	0.24	0.08	0.14	55.60	0.58	8.72	69.71	20.31
1984	0.08	0.16	0.14	0.35	65.40	1.82	1.60	92.42	21.45
1985	0.05	0.17	0.05	0.02	21.20	0.21	5.07	28.51	20.73
1986	0.40	0.23	0.12	0.03	25.80	0.92	2.61	34.30	23.39
1987	0.00	0.11	0.01	0.15	29.10	0.96	3.37	37.77	19.48
1988	0.01	0.51	0.00	0.00	21.00	0.72	1.40	27.28	12.31
1989	0.66	1.60	0.01	0.12	14.40	1.01	0.12	26.35	16.64
1990	0.83	11.37	1.22	0.34	125.80	2.65	0.99	159.45	23.95
1991	1.17	2.67	1.55	0.51	90.80	1.37	6.03	14.44	26.88
1992	0.09	0.09	0.02	0.24	36.00	0.49	38.31	79.81	19.10
1993	0.54	0.50	1.01	1.50	71.20	1.20	34.10	120.45	27.84
1994	0.70	0.47	0.46	0.33	29.70	0.15	68.45	104.52	17.72
1995	2.13	1.62	0.25	0.40	129.01	0.37	48.28	193.26	21.00
1996	0.82	0.62	0.58	0.47	25.82	0.09	40.65	72.05	13.27
1997	1.53	1.91	0.19	4.46	72.66	0.10	48.47	132.48	21.33
1998	1.86	0.66	0.08	0.54	53.93	0.05	36.16	89.89	19.43
1999	2.48	0.93	0.31	0.37	60.73	0.04	28.71	82.6	22.41
2000	0.38	0.30	0.00	1.33	56.61	0.15	20.61	89.85	17.79
2001	1.20	2.65	1.38	6.05	76.77	0.23	10.93	114.23	17.73
2002	0.30	1.07	0.07	2.18	92.77	0.39	5.07	108.35	29.13
2003	6.54	1.69	1.00	2.31	76.80	0.17	51.13	149.75	16.79
2004	0.49	1.79	0.53	0.72	29.91	0.14	11.39	48.34	21.65
2005	1.42	2.03	0.11	0.37	29.04	0.18	12.16	49.21	23.60
2006	6.29	1.16	0.14	0.01	12.63	0.08	20.61	44.41	18.65
2007	4.23	2.15	0.01	0.01	12.69	0.25	32.04	59.48	17.83
2008	5.99	2.14	0.13	0.03	10.51	0.08	12.52	38.12	14.15

APPENDIX C Description of Control Materials

The following is an explanation of the control materials currently used by MMCD in 2008, including specific product names. The generic products will not change in 2009, although the specific formulator may change.

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

Altosid briquets are typically applied to larval mosquito habitats 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 which may flood and then dry up (Types 1 & 2) are treated completely. Sites which are somewhat permanent (Types 3, 4, 5) are treated with briquets to the perimeter of the site in the grassy areas. Pockety ground sites (i.e., sites without a dish type bottom) may not be treated with briquets due to spotty control achieved in the uneven drawdown of the site.

Cattail mosquito (*Cq. perturbans*) larval habitats 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 (Altosid® Pellets) Zoecon/Central Life Sciences

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

Altosid (methoprene) XR-G sand (Altosid® XR-G Sand) Zoecon/Central Life Sciences

Altosid XR-G sand consists of methoprene formulated in a sand-sized granule designed to provide up to 20 days control. Applications will be made to ground sites (less than three acres in size) at a rate of five lb per acre for *Aedes* control. Experimental applications for control of *Cq. perturbans* are being evaluated at 10 lb per acre.

***Bacillus thuringiensis israelensis* corn cob** (VectoBac® G) Valent BioSciences Corporation

Bacillus thuringiensis israelensis (*Bti*) corn cob may be applied in all types of sites where mosquitoes develop. *Bti* can be effectively applied during the first 3 instars of the mosquito breeding cycle. Typical applications are by helicopter in sites which are greater than three acres in size at a rate of 5-10 lb per acre. In sites less than three acres, *Bti* is applied to pockety sites with cyclone seeders or power back packs.

***Bacillus thuringiensis israelensis* liquid** (VectoBac® 12AS) Valent BioSciences Corporation

Bacillus thuringiensis israelensis 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 (VectoLex® CG) Valent BioSciences Corporation

Bacillus sphaericus (*Bs*) corn cob may be experimentally applied in all types of *Culex* mosquito breeding. *Bacillus sphaericus* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical experimental applications are by helicopter in sites which are greater than three acres in size at a rate of 5-10 lbs 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 lbs per acre. This product is also being evaluated as a control material for catch basin applications.

Bti*/*B. sphaericus (VectoMax® CG) Valent BioSciences Corporation

VectoMax CG contains two active ingredients, *Bti* and *Bs*, and is formulated on corn cob granules similar to VectoBac G. VectoMax CG is being tested in pond level regulators and culverts at a rate of 8 lb per acre. In sites less than three acres, *Bti*/*Bs* is applied to pockety sites with cyclone seeders or power back packs at rates of 8 lbs per acre. This product is also being evaluated as a control material for catch basins and other small stormwater management structures.

Bti*/*B. sphaericus (FourStar™ *Bti*/*B. sphaericus* Briquets 150) Meridian LLC

FourStar™ briquets are designed to work by releasing *Bti* and *B. sphaericus* that is ingested by mosquito larvae which are then killed sometime afterward. FourStar™ briquets are being tested in catch basins at a rate of 1 briquet per catch basin.

Spinosad (Natular®XRG, T30, XRT) Clarke Mosquito Control

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

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

Agnique® 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 gals 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 (Permethrin 57% OS) Clarke Mosquito Control Products

Permethrin is used by the District to treat adult mosquitoes in known daytime resting or harborage areas. Adult control is initiated when MMCD surveillance (sweep net and CO_2 trap collections) indicates nuisance populations of mosquitoes, when employee conducted landing rate collections document high numbers of mosquitoes, or when a large number of 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 (Scourge® 4+12) Bayer Environmental Science

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 AI per acre). Resmethrin is a restricted use compound and is applied only by Minnesota Department of Agriculture licensed applicators.

Sumithrin (Anvil® 2+2) Clarke Mosquito Control Products

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 AI per acre). Sumithrin is a non-restricted use compound.

Natural Pyrethrin (Pyrenone® 25-5) Bayer Environmental Science

Pyrenone is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrenone is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand held cold fog machines that enables the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrenone is applied

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

Natural Pyrethrin [Pyrocide® 7396 (5+25)] Mc Laughlin Gormley King Co.

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 AI per acre). Pyrocide is a non-restricted use compound.

APPENDIX D 2008 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 2000-2008; the actual geographic area treated is smaller because some sites are treated more than once

Control Material	2000	2001	2002	2003	2004	2005	2006	2007	2008
Altosid® XR Briquet 150-day	533	589	628	323	398	635	352	290	294
Altosid® Sand-Products	786	1,889	1,822	0.5	0	0	0	1,776	6,579
Altosid® SR-20 liquid	29	91	51	33	0	0	0	0	0
Altosid® Pellets 30-day	11,121	14,791	16,521	18,458	19,139	29,965	31,827	36,818	35,780
Altosid® Pellets Catch Basins	0	0	0	135,978	148,023	145,386	167,797	161,876	195,973
Altosid® XR Briquet Catch Basins	0	0	0	0	0	0	5,210	6,438	40
VectoLex® CG granules	0	0	0	0	0	810	540	27	6
VectoMax® CG granules	0	0	0	0	0	0	0	0	182
Bti Corn Cob granules	84,521	90,527	202,875	113,198	166,299	176,947	160,780	118,128	122,251
Bti Liquid Black Fly (gallons used)	821	4,047	3,169	3,408	2,813	3,230	1,035	1,348	2,063
Permethrin Adulticide	4,066	3,444	5,734	6,411	8,292	7,982	5,114	3,897	8,272
Resmethrin Adulticide	42,986	41,311	43,302	68,057	71,847	40,343	29,876	24,102	64,142
Sumithrin Adulticide	0	8,423	32,230	14,447	15,508	25,067	5,350	5,608	35,734
Pyrenone® Adulticide	0	0	0	0	0	0	0	0	2,214
Pyrocide® Adulticide	0	0	0	0	0	0	0	0	299

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®

Altosid® XR
EXTENDED RESIDUAL BRIQUETS

A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

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

EPA Reg No. 2724-421

KEEP OUT OF REACH OF CHILDREN
CAUTION

INTRODUCTION

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

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

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

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

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

APPLICATION TIME

Placement of **ALTOSID XR BRIQUETS** should be at or before the beginning of the mosquito season. **ALTOSID XR BRIQUETS** can be applied prior to flooding when sites are dry, or on snow and ice in breeding sites prior to spring thaw. Under normal conditions, 1 application should last the entire mosquito season, or up to 150 days, whichever is shorter. Alternate wetting and drying will not reduce their effectiveness.

APPLICATION RATES

Aedes and *Psorophora* spp.: For control in non-(or low-) flow shallow depressions (≤ 2 feet in depth), treat on the basis of surface area, placing 1 briquet per 200 ft^2. Briquets should be placed in the lowest areas of mosquito breeding sites to maintain continuous control as the site alternately floods and dries up.

Culex, Culiseta, and *Anopheles* spp.: Place one **ALTOSID XR BRIQUET** per 100 ft^2.

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

Culex sp. in storm water drainage areas, sewers, and catch basins: For catch basins, place 1 briquet into each basin. In cases of large catch basins, follow the chart below to determine the number of briquets to use. For storm water drainage areas, place 1 briquet per 100 feet square of surface area up to 2 ft deep. In areas that are deeper than 2 feet, use 1 additional briquet per 2 feet of water depth.

Large water flows may increase the dissolution of the briquet thus reducing the residual life of the briquet. Regular inspections (visual or biological) in areas of heavy water flow may be necessary to determine if the briquet is still present. The retreatment interval may be adjusted based on the results of an inspection.

Altosid XR Briquets Application Chart

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

APPLICATION SITES

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

STORAGE AND DISPOSAL

STORAGE

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

DISPOSAL

Dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Wellmark

ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

22 - 24 - 001

Made in the U.S.A.

January 2002
Schaumburg, IL

Altosid® Pellets
MOSQUITO GROWTH REGULATOR

A GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

EPA Reg No. 2724-448
EPA EST. NO. 39578-TX-1

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIROMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midge) larvae. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

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

INTRODUCTION

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

GENERAL DIRECTIONS

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

APPLICATION SITES AND RATES

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

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

APPLICATION METHODS

Apply ALTOSID Pellets up to 15 days prior to flooding, or at any stage of larval development after flooding, or in permanent water sites. Fixed wing aircraft or helicopters equipped with granular spreaders capable of applying rates from 2.5 to 10.0 lb/acre may be used to apply ALTOSID Pellets. The pellets may also be applied using ground equipment which will achieve good even coverage at the above rates. ALTOSID Pellets may be applied to artificial containers, such as tires and catch basins, etc.

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

STORAGE

Store closed containers of ALTOSID Pellets in a cool dry place.

PESTICIDE DISPOSAL

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

CONTAINER DISPOSAL

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

For information call 1-800-248-7763 or visit our web site: www.altosid.com.

Wellmark

ZOECON

Wellmark International
Schaumburg, Illinois U.S.A.

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

20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Altosid® Liquid Larvicide CONCENTRATE

PREVENTS EMERGENCE OF ADULT FLOODWATER MOSQUITOES

SPECIMEN LABEL

ACTIVE INGREDIENT:

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

* CAS # 65733-16-6

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

EPA Reg No. 2724-446

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE ADDITIONAL PRECAUTIONARY STATEMENTS

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

CAUTION

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

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

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

CHEMIGATION

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

MIXING AND HANDLING INSTRUCTIONS

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

RECOMMENDED APPLICATIONS

INTRODUCTION

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

METHODS OF APPLICATION

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

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

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

APPLICATION SITES

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

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

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

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

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

STORAGE AND DISPOSAL

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

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

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

CONTAINER DISPOSAL
Triple rinse or equivalent. Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

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

For information call 1-800-248-7763

Always read the label before using the product.

Wellmark

ZOËCON Professional Products

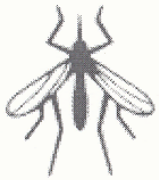
Wellmark International
Schaumburg, Illinois U.S.A.

21-24-004

Made in the U.S.A.

October 2000
Schaumburg, IL

Altosid® XR-G



AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

EPA Reg No. 2724-451

EPA Est. No. 2724-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

FIRST AID

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

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midges). Using it in a manner other than that described by the label could result in harm to aquatic dipteran (mosquitoes) and chironomid (midges). Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

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

GENERAL DIRECTIONS

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

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

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

APPLICATION TIME

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

APPLICATION RATES

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

APPLICATION SITES

NON-CROP AREAS

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

CROP AREAS

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

NOTE

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

STORAGE AND DISPOSAL

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

STORAGE

Store closed containers of ALTOSID XR-G in a cool dry place.

PESTICIDE DISPOSAL

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

CONTAINER DISPOSAL

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

For information call 1-800-248-7763 or visit our web site: www.altosid.com.

Wellmark

ZOECON Professional Products

Wellmark International
Bensenville, Illinois U.S.A.

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

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

1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

As a general precaution when exposed to potentially high concentrations of living microbial products such as this, all mixer/loaders and applicators not in enclosed cabs or aircraft must wear a dust/mist filtering respirator meeting NIOSH standards of at least N-95, R-95, or P-95.

2.2 ENVIRONMENTAL HAZARDS

Do not apply directly to treated finished drinking water reservoirs or drinking water receptacles when water is intended for human consumption.

3.0 DIRECTIONS FOR USE

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

3.1 Chemigation

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

4.0 STORAGE AND DISPOSAL

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

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

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

Container Disposal: Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

5.0 APPLICATION DIRECTIONS

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

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

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

When applying this product to standing water containing mosquito larvae in fields growing crops, do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Polluted water (such as sewage lagoons, animal waste lagoons)	7.0 - 14.0 oz/acre (200 - 400 g/acre) (0.5 - 1.0 kg/ha)

[redacted]

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

6.0 SMALL QUANTITY DILUTION RATES

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

VectoBac WDG

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

7.0 GROUND AND AERIAL APPLICATION

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

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

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

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

7.1 AERIAL APPLICATION

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

Rinse and flush spray equipment thoroughly following each use.

8.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

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

Valent BioSciences Corporation

VectoLex® CG

Biological Larvicide
Granules

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

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

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

INDEX:

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

1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

2.2 Environmental Hazards

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

3.0 DIRECTIONS FOR USE

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

4.0 STORAGE AND DISPOSAL

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

Pesticide Storage: Store in a cool, dry place.

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

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

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

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

Habitat	Rate Range
Wastewater: Sewage effluent, sewage lagoons, oxidation ponds, septic ditches, animal waste lagoons, impounded wastewater associated with fruit and vegetable processing	5-20 lbs/acre**
Stormwater/Drainage Systems: Storm sewers, catch basins, drainage ditches, retention, detention and seepage ponds	5-20 lbs/acre**
Marine/Coastal Areas: Salt marshes, mangroves, estuaries	5-20 lbs/acre**
Water Bodies: Natural and manmade aquatic sites such as lakes, ponds, rivers, canals and streams	5-20 lbs/acre**
Dormant Rice Fields: Impounded water in dormant rice fields. (For application only during the interval between harvest and preparation of the field for the next cropping cycle.)	5-20 lbs/acre**
Waste Tires: Tires stockpiled in dumps, landfills, recycling plants, and other similar sites.	20-80 lbs/acre(1)

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

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

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

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

* Mosquito species effectively controlled by VectoLex CG:

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

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

CONTINUED

[redacted]

6.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING THE USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-8397

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: Soft marshes, mangroves, estuaries.	5-20 lbs/acre**
Water Bodies: Natural and manmade aquatic sites such as lakes, ponds, rivers, canals, streams, and livestock watering ponds and troughs.	5-20 lbs/acre**
Dormant Rice Fields: Impounded water in dormant rice fields. (For application only during the interval between harvest and preparation of the field for the next cropping cycle.)	5-20 lbs/acre**
Waste Tires: Tires stockpiled in dumps, landfills, recycling plants, and other similar sites.	20-80 lbs/acre(1)

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

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

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

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

*Mosquito species effectively controlled by VectoMax CG:

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

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

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

NOTICE TO USER

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

FourStar™ Bti Briquets 150

A Sustained Release 150 day Bti Mosquito Larvicide Briquet

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

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

See attached booklet for additional precautionary statements

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

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

APPLICATION TIME

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

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

APPLICATION RATES

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

STORAGE AND DISPOSAL

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

PESTICIDE STORAGE: Store in a cool, dry place.

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

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

NOTICE TO USER

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Meridian LLC, Sherwood, OR USA

U.S. Patent Pending

FS1031006 RCV050806

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

ENVIRONMENTAL HAZARDS

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

FIRST AID	
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth to mouth if possible. • Call poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call poison control center or doctor for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, and then continue rinsing eyes. • Call poison control center or doctor for treatment advice.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

DIRECTIONS FOR USE

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

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

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

APPLICATION SITES

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

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PRP 011609/ 8329-84

Natular XRT

An insecticide for the control of mosquito larvae.

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

Group	5	INSECTICIDE

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

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

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

Keep Out of Reach of Children
CAUTION

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

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

Precautionary Statements

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

First Aid	
If swallowed:	• Call a poison control center of doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything to an unconscious person.
If in eyes:	• Hold eye open and rinse slowly and gently with warm water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. • Call a poison control center or doctor for treatment advice.
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.	

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

Directions for Use

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

Read all Directions for Use carefully before applying.

General Information
Natular XRT is a Naturalyte® insect product for killing mosquito and midge larvae. This product's active ingredient, spinosad, is biologically derived from the fermentation of Saccharopolyspora spinosa, a naturally occurring soil organism. Natular XRT tablets release effective levels of spinosad over a period up to 180 days in mosquito breeding sites. The tablet is designed for easy application to catch basins.

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

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

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

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

- Base insecticide use on comprehensive IPM and IRM programs.
- Do not use less than the labeled rates.
- Routinely evaluate applications for loss of effectiveness.
- Rotate with other labeled effective mosquito larvicides that have a different mode of action.
- In dormant rice fields, standing water within agricultural/crop sites, and permanent marine and freshwater sites, do not make more than 3 applications per year.
- Use insecticides with a different mode of action (different insecticide group) on adult mosquitoes so that both larvae and adults are not exposed to products with the same mode of action.
- Contact your local extension specialist, technical advisor, and/or Clarke Mosquito Control representative for insecticide resistance management and/or IPM recommendations for the specific site and resistant pest problems.
- For further information or to report suspected resistance, you may contact your local Clarke Mosquito Control representative by calling 800-323-5727.

Application
Proper application techniques help ensure adequate coverage and correct dosage necessary to obtain optimum kill of mosquito and midge larvae. Natular XRT tablets can be applied prior to flooding, on snow and ice in breeding sites prior to spring thaw, or at any time after flooding in listed sites. Under normal conditions, one application

P1/2

PRP 011609/ 8329-84

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

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

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

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

Stream eddies, creek edges, detention ponds.

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

Brackish water swamps and marshes, intertidal areas.

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

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

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

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

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

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

STORAGE AND DISPOSAL

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

Pesticide Storage: Store in a cool dry place in original container only.
Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.
Container Handling: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Warranty

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

Lot:_____ **Net Weight:**_____

® Trademark of Dow AgroSciences LLC

P2/2

AGNIQUE® MMF

MOSQUITO LARVICIDE & PUPICIDE

MONOMOLECULAR SURFACE FILM FOR CONTROL OF IMMATURE MOSQUITOES AND MIDGES

ACTIVE INGREDIENT

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

CAUTION

KEEP OUT OF THE REACH OF CHILDREN

FIRST AID TREATMENT

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

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

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

DIRECTIONS FOR USE

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

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

STORAGE AND DISPOSAL

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

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

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

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

APPLICATION DIRECTIONS

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

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

APPLICATION NOTES

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

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

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

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

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

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

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

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

NOTICE

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

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

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

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

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

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

cognis agrosolutions

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

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

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

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

CLARKE

PERMETHRIN 57% OS

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.

IN 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

CLARKE

Contains An Oil Soluble Synergized Synthetic Pyrethroid For Control of Adult Mosquitoes (Including Organophosphate-Resistant Species) Midges, and Black Flies in Outdoor Residential and Recreational Areas.

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

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

ENVIRONMENTAL HAZARDS

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

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

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

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

IN CALIFORNIA: This product is to be applied by County Health Department, State Department of Health Services, Mosquito and Vector Control or Mosquito Abatement District personnel only.

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

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

NET CONTENTS

LOT NO.

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

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

** Contains a petroleum distillate

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

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta haya sido explicado ampliamente.

STATEMENT OF PRACTICAL TREATMENT

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

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

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

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

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

DISTRIBUTED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.

159 N. GARDEN AVENUE • ROSELLE, ILLINOIS 60172

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

GROUND ULV APPLICATION

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

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

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

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

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

AERIAL APPLICATION

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

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

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

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

STORAGE & DISPOSAL

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

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

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

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

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

12/11/00

PYRENONE® 25-5

PUBLIC HEALTH INSECTICIDE

Specimen Label

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

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

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

See Rear Panel For Additional Precautions

EPA REG. NO. 432-1050

EPA EST. NO.

NET CONTENTS:

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

FIRST AID

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

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

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

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

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

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

PRECAUTIONARY STATEMENTS
Hazards To Humans & Domestic Animals

CAUTION

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

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

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

Environmental Hazards

This product is toxic to fish. For terrestrial uses, do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources. Apply this product only as specified on this label.

DIRECTIONS FOR USE

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

STORAGE AND DISPOSAL

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

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

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

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

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

SPACE AND/OR CONTACT USE AREAS:

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

OUTDOOR USE AREAS:

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

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

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

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

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

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

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

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

FOR USE ON ANIMALS: To protect beef and dairy cattle and horses from ***Horn Flies, House Flies, Mosquitoes and Gnats,*** dilute 1 part of Pyrenone 25-5 plus 49 parts oil or suitable solvent, mix well and apply a light mist sufficient to wet the tips of the hair. To control ***Stable Flies, Horse Flies and Deer Flies*** on beef and dairy cattle and horses, apply 2 oz. per adult animal, sufficient to wet the hair but not to soak the hide. Repeat treatment once or twice daily or at intervals to give continued protection.

USE IN MOSQUITO CONTROL

Pyrenone 25-5 Public Health Insecticide may be used for mosquito control programs involving residential, industrial, recreational and agricultural areas as well as swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur. Pyrenone 25-5 Public Health Insecticide may be used over agricultural crops because the ingredients are exempt from tolerance when applied to growing crops. For best results, apply when meteorological conditions create a temperature inversion and wind speed does not exceed 10 miles per hour. The application should be made so the wind will carry the insecticidal fog into the area being treated. Treatment may be repeated as necessary to achieve the desired level of control.

When used in cold aerosol generators that produce a fog with the majority of droplets in the 10-25 micron VMD range, Pyrenone 25-5 Public Health Insecticide should be diluted with light mineral oil or suitable solvent (specific gravity of approximately 0.8 at 60°F; boiling point: 500-840°F). An N.F. grade oil is prefered.

GROUND APPLICATION: To control adult mosquitoes and all common diptera, apply up to 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Truck-Mounted ULV Application: The delivery rate and truck speed may be varied as long as the application rate does not exceed 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Backpack Spray Application: Dilute 1 part Pyrenone 25-5 Public Health Insecticide with 10 parts oil or suitable solvent and apply at the rate of 7 ounces per acre (based on a 50 foot swath, 7 ounces should be applied while walking 870 feet).

AERIAL APPLICATION (FIXED WING AND HELICOPTER): To control adult mosquitoes and biting flies, apply up to 0.0025 pounds of pyrethrins per acre with equipment designed and operated to produce a ULV spray application.

IMPORTANT: READ BEFORE USE

By using this product, user or buyer accepts the following conditions, disclaimer of warranties and limitations of liability.

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

DISCLAIMER OF WARRANTIES: THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WHICH EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for incidental or consequential damages, including, but not limited to, liability arising out of breach of contract, express or implied warranty (including warranties of merchantability and fitness for a particular purpose), tort, negligence, strict liability or otherwise.

LIMITATIONS OF LIABILITY: THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT BAYER ENVIRONMENTAL SCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

Bayer Environmental Science
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road
Montvale, NJ 07645

Py 25-5 PH-SL-9/02 Bayer

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

Appendix G Technical Advisory Board Meeting Notes February 11, 2009

TAB Members present:
Roger Moon, Meeting Chair, University of Minnesota
Robert Koch, Minnesota Department of Agriculture
Bob Sherman, Independent Statistician
Susan Palchick, Hennepin County Public Health
Dave Neitzel, MN Department of Health
Sarma Straumanis, MN Department of Transportation
Steve Hennes, MN Pollution Control Agency
Larry Gillette, Three Rivers Park District
Gary Montz, Ecological Services, MN Department of Natural Resources
Jeanne Holler and Gerry Shimek, Minnesota Valley NWR, US Fish and Wildlife Service

TAB Members absent (received materials for review):
Karen Oberhauser, University of Minnesota,
Rick Bennett, US Environmental Protection Agency

MMCD staff in attendance:
Jim Stark, Stephen Manweiler, Nancy Read, Sandy Brogren, Kirk Johnson, Mark Smith, Michael McLean, Janet Jarnefeld, Diann Crane, John Walz, Carey LaMere

Welcome and Call to Order – 12:30 pm
Roger Moon introduced himself. He noted that the Technical Advisory Board (TAB) meeting is a time when agency and University staff with the responsibility of providing consultation review MMCD's program. He started a round of introductions for participants and MMCD staff, and reminded TAB members to consider possible recommendations and resolutions as the meeting continued. He then introduced MMCD Executive Director Jim Stark and designated Gary Montz and Dave Neitzel to monitor any recommendations for resolutions during the meeting.

MMCD Strategic Overview
Jim Stark welcomed attendees and gave a presentation on the District's service to the Twin Cities metro area and continued support for services and training to citizens in greater Minnesota. He noted the District's 50th anniversary (1958-2008) emphasizing a District-sponsored production of a documentary by Twin Cities Public Television, and thanked Roger Moon for his participation in the documentary. The District also sponsored an open house for former employees, Commissioners, and others associated with MMCD over the years. MMCD's mission has remained fairly constant: to protect public health, and control mosquitoes and biting gnats with as little impact on the environment as possible.

MMCD uses a team structure, relying on all staff to review processes strategically. These strategic objectives include expanding larval control, improving efficiency, testing materials, and expanding outreach. For example, MMCD's call system has been upgraded to better handle the flow between citizens requesting information or service and MMCD field staff, and has increased our efficiency in handling calls. The District continues to monitor citizen expectations by conducting public opinion surveys every two years. The 2008 survey reported 83% of respondents feel controlling mosquitoes is important; 16% are concerned about control efforts

harming environment or health. Jim Stark has met with representatives of the Minnesota Audubon Society and the Minnesota Center for Environmental Advocacy to discuss these kinds of concerns.

Plans for 2009 include managing MMCD's budget and growth plan with sensitivity to current economic trends. Plans focus on refining service delivery processes and continued staff training. Outreach efforts are designed to improve awareness of the program. There will be continued emphasis on expanding larval control to lessen MMCD's reliance on adult control.

Susan Palchick thanked Jim Stark for sending out monthly Director's Reports. These reports help TAB members keep abreast of District activities between annual reviews. Dave Neitzel and Roger Moon echoed her sentiments.

2008 Season Review and Recent Trends

Janet Jarnefeld, MMCD staff, gave updates on climate, tick surveillance, and mosquito-borne disease during the 2008 season (see TAB Report, Chapter 2).

2008 weather data from the State climatology office showed precipitation and temperature were considerably below average in April and May.

The District's annual tick distribution study data showed that the first ticks on small mammals were collected later in the year compared to other years. After 2000, surveillance shows elevated tick numbers coinciding with greater numbers of human Lyme disease cases. Tick numbers, while lower in 2008, have remained high relative to pre-year 2000 numbers.

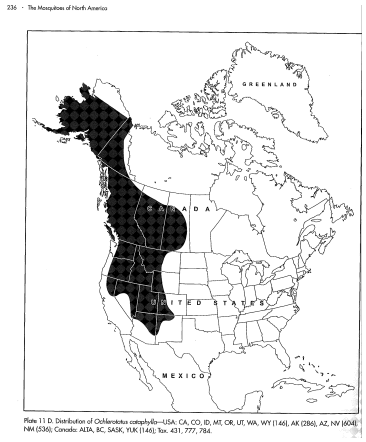
La Crosse encephalitis cases remained very low (no cases in the District, one case state-wide) for the third year. Surveillance showed that *Aedes triseriatus* got off to a slow start due to the cool early-season conditions. The first collection of *Ae. triseriatus* adults was about 2 weeks later than usual and overall collections remained low. West Nile virus case numbers were also very low relative to past years. Only 10 human cases were confirmed in Minnesota in 2008. There were 101 cases in 2007. The human case numbers coincided with fewer positive mosquito pools and only seven positive birds reported. This drop in West Nile virus indicators may be due to such factors a cool spring, low *Culex tarsalis* numbers, built up "herd immunity" in some bird populations, and less dead bird reporting by public.

Susan Palchick noted that the MDH is no longer accepting birds for WNV testing and MMCD still is. She asked if there was a need to get that message out to the public.
Gary Montz asked if mosquito pools were being tested state-wide, or just in the metro area. Dave Neitzel responded that outside the metro there is very little mosquito sampling although a contractor collects samples at four locations in greater Minnesota. This year all out-state samples were negative.
Roger Moon asked about the species makeup of the WNV-positive mosquito pools. Kirk Johnson responded that two contained *Cx. tarsalis* and others a mix of *Cx. pipiens* and *Cx. restuans*.

Sandy Brogren gave a detailed report on the mosquito season (see TAB Report, Chapter 1). The climate backdrop of the 2008 season was a long cool spring with snow showers in April. Three

major rains produced broods early in the season, and elevated populations of mosquitoes lasted through midsummer. A dry summer meant that heavy rains at the end of the season did not flood breeding sites long enough produce mosquitoes. The most unusual characteristic of the mosquito season was that spring *Aedes* numbers, as revealed in sweep net samples, outnumbered the summer *Aedes* species. Because these spring species do not all hatch all at once, treatments are difficult to time correctly.

Aedes cataphylla, a species native to the western part of North America, was found for the first time in the District. Sandy Brogren noted that staff is looking forward to getting out and looking for this species again in 2009. TAB members discussed the implications of this finding.



Ae. cataphylla range

Dave Neitzel asked about the site type in which *Ae. cataphylla* was found. Sandy Brogren said it was a small type-4 wetland site. This appears to be just another long-lived spring *Aedes* species, she added. Although not a major disease vector, it is an annoying mosquito in its native range.

Several TAB members commented on the *Ae. cataphylla* findings and the overall strength of this year's spring *Aedes* mosquito numbers: Roger Moon asked about the overall implications for the District if spring *Aedes* were to regularly become more abundant. Sandy Brogren noted that the District usually does a good job controlling spring species, but this year was different. If the District experiences conditions like these again, monitoring and treatment strategies would have to change. Spring *Aedes* typically do not fly far, so if adults are detected larval sites are likely nearby.

Roger Moon asked if the District will need to sort samples to species in order to zero in on specific spring species. Diann Crane, MMCD entomologist asked TAB members if there were any suggestions regarding how to identify the ways new species come to an area. Bob Koch suggested District staff look at specific pathways of introduction. Roger Moon asked if *Ae. cataphylla* over-winter as eggs. Sandy Brogren answered yes. After further discussion, Roger Moon suggested that the District first determine if this new species is truly established. Dave Neitzel suggested that there is perhaps more concern about exotic species with vector capacity, and container breeders. Even so, he added, some spring *Aedes* could be vectors of California-group viruses, Jamestown Canyon for example. Steve Hennes asked if there were any discoveries of *Ae. cataphylla* between its native western North American range and Minnesota. Sandy Brogren said that there is little surveillance done between here and there. Kirk Johnson noted that most monitoring focuses on exotics, not simply species range expansion. Roger Moon suggested District staff try to find it again, to continue to learn about its biology and habitats.

Jim Stark commented on the generally high numbers of spring mosquitoes. He has asked staff to look into more effective larval control procedures for these mosquito species. The challenge, he explained, is that cool temperatures can limit effectiveness of control materials, and an extended early spring provides unusually good conditions for these mosquitoes. Larry Gillette asked if the

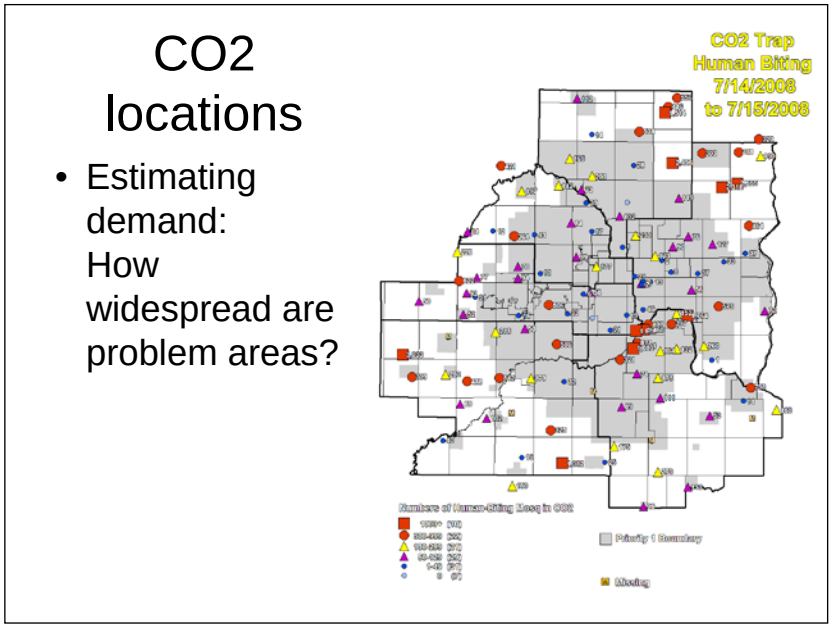
District discerns which areas were missed by treatment or if areas were treated and the treatment was simply not effective for these species. Bob Koch suggested the TAB should encourage follow up on *Ae. cataphylla* biology, without eradication. Bob Sherman said that he would encourage treatment as appropriate to be done thoroughly. Susan Palchick asked if the District will have resources next spring to do larval ID in real-time. Sandy Brogren answered yes. Steve Hennes said it is important not to overreact, and that some range contractions and expansions are inevitable with climate change. The District should, he added, consider a policy on how to react to these changes. General discussion on a resolution was deferred until later in the meeting.

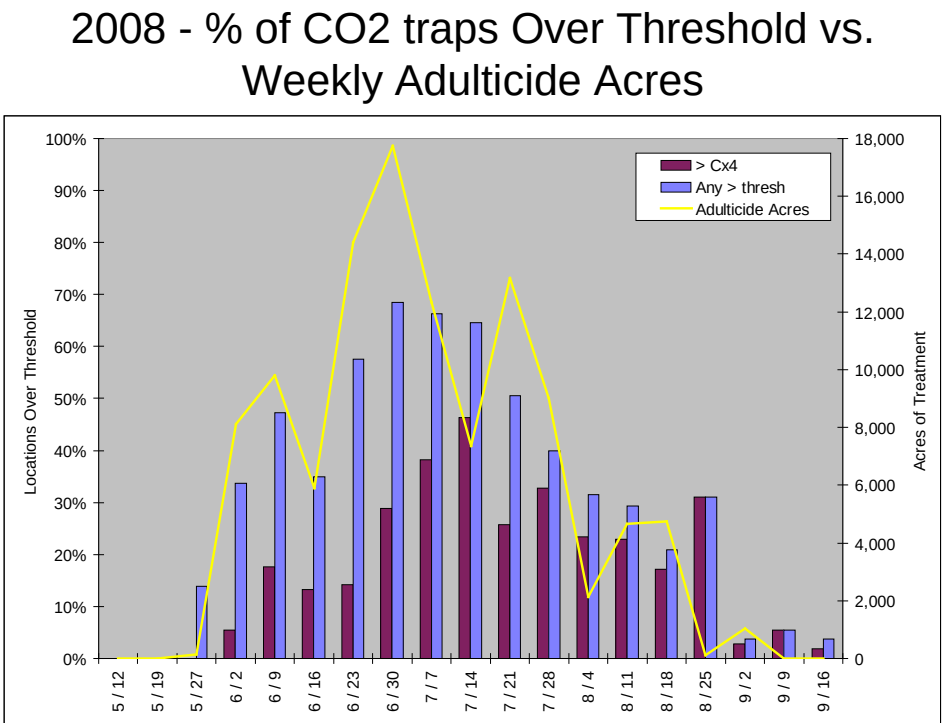
25 Years of Black Fly Monitoring and Control

John Walz, MMCD staff, introduced the District Black Fly program, celebrating 25 years of control. The program has been designed well and works well. John Walz reviewed the timeline of the Black Fly Program and noted that many of his brief statements just touch on aspects of the program that really were a huge undertaking. Examples include the perception study to establish tolerance levels, and the nontarget results report coming out soon. In 2008 stream flow was higher than in the past few years, resulting in more treatments (see TAB Report Chapter 4). John Walz noted that it is important to thank District Commissioners and a management team that fully supports the program. He also noted the solid working relationship with MnDNR, TAB and previous review boards. Roger Moon asked that maps of treatment locations be put in future TAB reports, and Steve Hennes asked that the TAB be notified when nontarget monitoring reports are available.

Adulticide Usage Discussion

Nancy Read, MMCD staff, lead a discussion of 2008 District adulticide usage. She described how adulticiding fits into MMCD's IPM program, the surveillance, thresholds, and notification processes involved, and how weather, personnel time, and equipment can limit treatments. She then showed a history of larvicide and adulticide annual acres of treatment as reported in TAB Reports since 1984. Although you might expect treatment acres to be higher in years when there are more mosquitoes, when treatment totals are compared with NJ trap or CO_2 trap annual averages, there is not always an obvious relationship. However, if you look at the % of the 120 CO_2 trap locations in the District that were over threshold per week in 2008 and compare that with adulticide acres for the same week, there appears to be a close relationship most weeks (see graph). The graph also shows the % of locations over threshold for *Culex* species that can vector WNV.





Susan Palchick asked why there was no adulticiding after the late August peak in *Culex*-over-threshold traps, and staff noted given the lack of disease cases there was a decision to not respond as aggressively around that time. Gary Montz noted that it looks as if adulticiding is not reducing specific CO_2 trap numbers. Nancy Read noted that adulticiding will have a local effect which is not necessarily going to be picked up by widely spaced adult traps. Nancy also discussed the data available for specific treatments and the current limitations on using that to determine how many treatments were in response to disease, events, calls, or other triggers. Larry Gillette asked that the District's survey of public attitudes phrase questions to give people a choice – do they think adulticiding is worthwhile if they only gain three to five days of mosquito reduction (for instance, adulticiding for summer species that die off anyway). Roger Moon suggested that if the TAB thought that the District was doing too much adulticiding, the group might want to consider looking at recommending raising certain treatment thresholds.

Aedes japonicus: Here There and Everywhere

Kirk Johnson, MMCD staff, reviewed the biology, habitat and behavior of *Ae. japonicus*, verified in 2008 as established in Minnesota (TAB Report Chapter 1). *Aedes japonicus* is very cold-hardy, more so than *Ae. albopictus*, the Asian tiger mosquito. *Aedes japonicus* is capable of transmitting a number of human disease viruses. It was found in several locations in Dakota County in 2008, and in several counties along the Mississippi River. Kirk Johnson described actual habitats where larvae were found in these locations. This may be an example of long-distance dispersal of container-breeding mosquitoes through human transport. The Ravenna Township, Welch, Red Wing area seems to be northern edge of general expansion of this species' range. The District response includes property inspections, informing property owners,

adult surveillance and ovitraps. Where there are isolated infestations, MMCD is attempting to eliminate them. However, MMCD does not expect to eliminate this species from the entire area. MMCD expects to do habitat elimination, backed up by larvicides and adult control. Next steps include monitoring, evaluating health implications and any ecological impacts.

Gary Montz asked if the treatment threshold was 1 in a trap, and if that threshold is the same as it is for *Ae. triseriatus.* Kirk Johnson answered that the District will use 1 for isolated instances, but may raise the threshold for treatment as *Ae. japonicus* becomes established. He stressed that elimination of larval habitat for this new mosquito is the highest priority. Roger Moon asked about the potential for virus transmission. Kirk Johnson answered that there appears to be potential for WNV transmission, but it isn't known if the effect will be noticeable. The District remains more concerned about the potential for LAC transmission. Dave Neitzel added that MDH agreed with that assessment. Kirk Johnson noted that *Ae. japonicus* may have a little wider habitat range than *Ae. triseriatus* which might raise risk for LAC in new areas. Roger Moon suggested that testing *Ae. japonicus* for LAC should be considered and Nancy Read noted that Japanese encephalitis was also a possibility.

Materials Testing

Stephen Manweiler, MMCD, discussed tests on Natular, , a new larvicide formulation of spinosad being developed by Clarke Mosquito Control (TAB Report, Chapter 5). He reviewed the source, structure and mode of action of this natural bacterial product. Spinosad has been used in crops since 1997 and is certified for use on organic crops. It has very low mammalian or avian toxicity, slight to moderate toxicity on aquatic invertebrates, and is rated as highly toxic to oysters and marine mollusks (EPA, 1997). It is toxic to bees until it dries on foliage, but has little effect on most predatory insects. Soil microbes break it down, as well as sunlight. A World Health Organization (WHO) report summarizes literature showing uses for mosquito control (WHOPES 2007). MMCD is involved in tests of new extended release material formulations in catch basins and a few ground-treated sites. The material is effective for the labeled number of days in both catch basins and small wetlands. Pricing of the product and potential nontarget effects are still issues. The District plans follow-up tests in some catch basins in 2009.

Sarma Straumanis asked if the product is available early enough for our purposes. Stephen Manweiler said that we should have some material available. Roger Moon asked about downstream effects on marine mollusks, Stephen Manweiler answered that the District will carefully review the literature, then also look at how the product breaks down in catch basins, and how much material might survive long enough to make it through the stormwater system into natural river settings. The District has asked Clarke to work to enable cooperative nontarget testing. Bob Koch asked about other organizations that might help work out the nontarget research. Gary Montz noted that if there is material discharge into the Mississippi there may be concerns raised about the Higgins eye, an endangered mollusk, and other species. He suggested that a lot more nontarget work would need to be done before the use of this product is significantly expanded. Stephen Manweiler agreed that nontarget research would have to go hand in hand with efficacy work. He added that he didn't believe that this product would eliminate other larvicides, but it would add a new tool.

Roger Moon asked if the District plans operational use of the product this year. Stephen Manweiler answered that only small-scale tests are being considered. Roger Moon commented

that fermented products tend to be very expensive, so cost, efficacy, nontarget effects should be considered – in that order. Gary Montz asked if there were limits to the size and scope of testing due to lack of complete product registration. Stephen Manweiler answered that there is a one acre limit. Bob Koch asked if Clarke is funding this effort around the country. Stephen Manweiler said that Clarke is providing product in return for data. Steve Hennes recommended that the issue of persistence in sediment be examined, especially if the product is protected from light; that route is not often looked at and has become an issue with pyrethroids where it becomes bound to sediment and sediments become toxic. At Roger Moon's suggestion, Steve Hennes and Gary Montz offered to give input to MMCD if it was needed in toxicity and nontarget review of the product. Bob Sherman noted the tendency of product costs to go down over time as production increases and the market expands.

General Discussion and Resolutions

Roger Moon asked for any proposed resolutions from the TAB to include in the TAB's report to the MMCD commissioners.

Bob Sherman moved to revise the 2007 TAB resolution as follows:
The TAB revises last year's resolution regarding adulticide testing to strike the words "on only those materials."
Second by Susan Palchick.
Bob Sherman led the discussion centered on the need to reflect more of the primary sentiment described in last year's notes, encouraging rigorous testing of specific materials. Further discussion confirmed that the TAB was revising last year's resolution.
Motion passed

Dave Neitzel recapped the TAB concerns regarding appropriate response to the apparent *Ae cataphylla* introduction. He noted questions about the site where this mosquito was found and the surrounding area. MMCD could spend some time looking at literature on this species, its preferred habitats, and how it fits in with current Spring *Aedes*, as a prelude to possibly gearing up for more aggressive, prompt control in that area.
Bob Sherman emphasized that this is and should be a matter of concern for the TAB. Roger Moon asked about how to express this issue to the Commission. Larry Gillette said he thinks MMCD is on top of the issue, and the TAB recommends they should continue.

Susan Palchick moved:
The TAB recognizes current District response to the discovery of Aedes cataphylla, and supports their continued surveillance efforts.
Second by Bob Sherman.
Motion passed

Larry Gillette commented that he would like to see species grouped separately in reports and charts. He said the issue is a suggestion, not a motion.
Larry Gillette also suggested that in the biennial survey MMCD consider phrasing questions to get at the extent adult control is needed for summer species. Jim Stark said that this may make a good focus group project, especially for areas where MMCD does not offer much larval control.

Larry Gillette moved:
MMCD should continue to look at ways adulticides are used for control of summer nuisance mosquitoes in an attempt to reduce applications where practical.
Second by Gary Montz

In discussion, Bob Sherman suggested that "where practical" is a vague statement. Control is done for the benefit of people and their personal enjoyment of the summer. Larry Gillette said that the motion gets back to the survey response – what do people want? Gary Montz indicated that he did not have a problem with the word "practical." While he believes adulticide use should be minimized "where practical" gives professional leeway. Roger Moon noted that the motion endorses what the District is already doing. Dave Neitzel said he was glad that distinction between annoyance and disease was being made. Jeanne Holler said the discussion is consistent with new USFW national policy which does not support nuisance control but is okay with treatment for disease outbreaks.
Motion passed with one opposed.

Gary Montz moved:
The TAB recognizes the efforts of the MMCD Black Fly program and their history of cooperation with the MnDNR.
Second by Susan Palchick
Motion passed

In further discussion, Jeanne Holler asked if the TAB wanted to recommend that MMCD develop a policy for dealing with new species as they are found. Gary Montz said that from his perspective we might want to wipe out certain non-native species such as aggressive vectors, but other non-natives might just end up in the pool of nuisance mosquitoes. If they can be easily removed, fine, but if the non-natives are here because of a simple range expansion, eradication efforts may not be a good use of resources. Susan Palchick added that good policy might capture Gary Montz' sentiments. Gary Montz noted that the MnDNR is struggling with these questions too. Once a species is in the system, he said, it's hard to get rid of. Jeanne Holler suggested that there are proactive ways to deal with these situations. Susan Palchick said that the sense of the TAB on this issue might be useful if MMCD needs to shift resources. TAB agreed to leave this as a suggestion recorded in the minutes, and no resolution was put forward.

The next TAB meeting chair will be Sarma Straumanis.

Adjourn – 3:50 pm

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