2003 Operational Review & Plans for 2004

Annual Report to the Technical Advisory Board

Metropolitan Mosquito Control District
2099 University Avenue West
ul, MN 55104-3431

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 2004

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Janice Rettman	Ramsey County
Jerry Hennen	Scott County
Barbara Marschall	Scott County
Dennis Hegberg	Washington Co.
Myra Peterson	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.

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Metropolitan Mosquito Control District Contributing Staff

Joe Sanzone	Director
Stephen Manweiler	Technical Services Coordinator
Sandy Brogren	Entomologist
Diann Crane	Asst. Entomologist
Janet Jarnefeld	Technical Services/Tick
Kirk Johnson	Vector Ecologist
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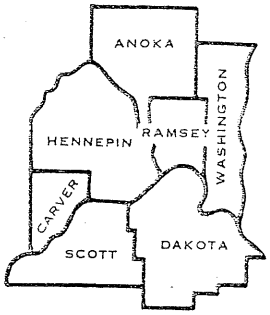

METROPOLITAN MOSQUITO CONTROL DISTRICT
METRO COUNTIES GOVERNMENT CENTER
2099 UNIVERSITY AVENUE WEST ■ ST. PAUL, MINNESOTA 55104-3431
651-645-9149 ■ FAX 651-645-3246 TTY use Minnesota Relay Service

JOSEPH F. SANZONE, BCE
Director

W.J. CAESAR
Business Admin.

Dear Reader:

The following report is the Metropolitan Mosquito Control District's (MMCD) 2003 Operational Review and Plans for 2004. It outlines program operations based on the policies set forth by the Metropolitan Mosquito Control Commission, 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 2004 are included in this report.

TAB's recommendations and report were accepted by the Commission at their April 2004 meeting. The Commission approved the MMCD 2003 Operational Review and Plans for 2004 and thanked the TAB for their work.

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

Sincerely,

Joseph Sanzone

Joseph F. Sanzone, BCE
Director

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1 April, 2004

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

Dear Commissioner Bennett,

The Technical Advisory Board (TAB) met on February 18, 2004 to discuss MMCD operations in 2003 and plans for 2004.

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 exchange of information and questions between the TAB and MMCD staff, the TAB approved the following motion:

> "The TAB encourages MMCD to continue research on all aspects of WNV, including biology of vectors, disease risk, and options for and consequences of control, recognizing that only through such research will there be effective control."

Sincerely,

Roger D. Moon

Roger Moon
Professor, University of Minnesota, and
Chair, Technical Advisory Board

cc: J. Sanzone, S. Manweiler

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Executive Summary

In 2003 MMCD was challenged to meet its commitment to protect human health, while maintaining a high level of other services.

West Nile virus (WNV) was first found in the District in 2002, and nearby states such as Illinois and Michigan had high rates of human disease. Preparations began early in 2003 should any increase in WNV be experienced here. As hosts of the American Mosquito Control Association annual meeting we were able to meet with experts from throughout North America and learn from their experience. Based on this and other research, we devoted a major effort to finding and controlling mosquitoes in stormwater catch basins, increasing surveillance of likely vector species and testing for virus, and testing control methods.

The 2003 season began with high rainfall that resulted in six District-wide broods of floodwater mosquitoes (May - early July) and provided potential habitat for later development of *Culex* species most likely to vector WNV. Very low rainfall after July made it easier to direct resources to control of vector species in catch basins. In June, July and August, MMCD treated a total of 135,978 catch basins to control vectors of WNV. Additional aggressive larvicide and adulticide treatments continued well into September in response to WNV.

In cooperation with other agencies, MMCD collected dead birds in the metropolitan area to help detect virus circulation, and 194 of 366 birds were WNV positive. In addition, four chickens in a sentinel flock located in Scott County tested positive for WNV between August 25 and September 22. MMCD submitted 3,369 pooled mosquito samples for testing to help determine likely vector species. West Nile virus was detected in 15 of these mosquito pools, most of which were from one location in St. Louis Park. Samples testing positive included three *Culex tarsalis*, six *Culex restuans*, three mixed *Culex pipiens/restuans,* and three *Culex* species pools.

The Minnesota Department of Health reported WNV activity throughout Minnesota, with 148 human cases statewide. In the metropolitan area there were 25 cases, with only 11 determined by MDH to be likely exposed within the District and another 6 that may have been exposed in the District. The number of horse cases was greatly reduced compared to 2002, probably due to widespread use of the equine WNV vaccine.

MMCD tests of elevated trap locations found that in areas with *Culex* mosquitoes many were present at heights of 25' in tree canopy; this will be examined further in 2004. Tests of larval controls showed Altosid® pellets (methoprene) effectively controlled *Culex* and other mosquitoes breeding in catch basins and these treatments are planned to continue in 2004. Vectolex® CG (*Bacillus sphaericus*) effectively controlled *Culex* and other mosquitoes breeding in wetlands for at least 12 days, and will provide another option for control of these species.

MMCD responded to one case of La Crosse encephalitis in 2003. Two additional cases occurred outside of the District. Both proactively and in response to La Crosse encephalitis cases, MMCD collected and recycled 14,763 waste tires, inspected 1,458 properties, eliminated 1,493 containers, and filled 507 tree holes, all of which are potential breeding sources of *Ochlerotatus triseriatus*, the vector of La Crosse encephalitis.

Although Eastern equine encephalitis caused 2 horse deaths in Wisconsin in 2003, no cases were detected in Minnesota. However, MMCD continued efforts to be prepared by surveying for potential larval habitats of the vector *Culiseta melanura*, primarily tamarack bogs.

Control of floodwater mosquitoes (*Aedes* and *Ochlerotatus*) and cattail mosquitoes (*Coquillettidia perturbans*) continues to be a major part of MMCD's work. Reducing these populations not only reduces citizen annoyance, but CDC has recommended continuing control of these species as possible additional vectors of WNV. Low rainfall levels after mid-July resulted in an overall reduction for the year in larval controls. Adult control increased slightly due to high mosquito counts early in the year and local WNV response later in the year.

MMCD continued black fly (biting gnat) control with small stream and large river treatments at levels similar to 2002. Adult black fly abundance was also similar to levels observed between 1999 and 2001. A study of human response to adult black fly annoyance was continued in 2003 with an additional 120 surveys completed. The data are currently being analyzed.

From 2000 – 2002, the abundance of *Ixodes scapularis*, the tick vector of Lyme disease, and the number of human tick-borne disease cases recorded by MDH have been at higher than typical levels. Total 2002 *I. scapularis* collections and the total number of sites where at least one *I. scapularis* was found were the highest since surveillance began in 1990, but the overall results are comparable to both our 2000 and 2001 results. Preliminary 2003 tick abundance and human disease case data appear slightly lower than 2000 – 2002.

Human Lyme disease and ehrlichiosis 2002 statewide case totals (Lyme 867 and ehrlichiosis 152) are the highest recorded by MDH and represent an 84% increase over 2001. Almost half (401) of the Lyme disease cases were contracted by metropolitan area residents; 69 of these 401 people were thought to have contracted Lyme disease within the seven county metropolitan area. Two people contracted ehrlichiosis within the metropolitan area in 2002 (Anoka and Washington counties). MMCD continues to provide surveillance, identification and homeowner consultations, and public information to try to minimize the impact of these tick-borne diseases.

MMCD staff completed digitizing of wetlands and wooded areas and updated areas previously digitized. Digital wetland files have been provided on request to other units of government, including the Ramsey Soil and Water Conservation District, City of Coon Rapids, MN DOT Metro Region, and MN DNR Metro Region. MMCD has also used data from the Metro GIS and metropolitan-area counties to determine property boundaries and ownership and to maintain current road information.

In 2003 the State Legislature approved legislation that formally included western Carver County within the District, defined notification requirements and methodologies, and clarified language authorizing MMCD to enter private property for disease surveillance and control. Legislation to secure additional funds to fight WNV did not pass. Several new notification options were made available to citizens to provide easier access to information about when and where adulticide treatments were scheduled. Citizens continued to submit a submit number of requests for service.

Chapter 1 Vector-borne Disease

2003 Highlights

- The District responded to one case of La Crosse encephalitis
- WNV illness confirmed in 148 Minnesotans, 25 are District residents
- WNV detected in 15 District mosquito samples and 44 samples statewide
- WN antibodies detected in four sentinel chickens
- Surveyed storm water catch-basins and applied larvicides to those suitable for mosquito habitat
- Identified and surveyed larval habitats for *Cs. melanura*, the EEE vector
- Collected and recycled 14,763 waste tires
- The 2002 *I. scapularis* distribution study seems to indicate a continued pattern of elevated populations of black-legged ticks
- In 2002, human Lyme disease cases were the highest ever recorded--an 84% increase over high levels of 2000 and 2001
- Preliminary 2003 tick abundance and human disease case data appear slightly lower than 2000-2002
- The HGE agent was renamed *Anaplasma phagocytophilum*

Background

District staff provide 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, western equine encephalitis, eastern equine encephalitis, and West Nile encephalitis and tick-borne illnesses such as Lyme disease and ehrlichiosis. 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 *Ochlerotatus triseriatus* (eastern tree-hole mosquito) and a history of La Crosse encephalitis cases. These areas are targeted for intensive control efforts including public education, mosquito breeding site removal, and limited adult mosquito treatments. Additionally, routine surveillance and control activities are conducted at past La Crosse encephalitis case sites. Surveillance for the exotic species *Aedes albopictus* (Asian tiger mosquito) and *Ochlerotatus japonicus* routinely occurs to detect infestations of these potential disease vectors.

Sentinel chicken flocks are used by MMCD to detect enzootic transmission of western equine encephalitis virus. In 2003, for the first time, the District's sentinel chickens were used to monitor for West Nile virus as well. Flocks are located at three sites in the District and blood is sampled weekly for submission to the Minnesota Department of Health (MDH) for antibody analysis.

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,* and will continue to do so in 2004. The District will continue to

2004 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Review and revise surveillance and control strategies of adult *Culex* mosquitoes
- Survey larval habitats for *Culex* mosquitoes to use to design control strategies
- Continue catch basin larvicide treatments
- Communicate treatment strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Continue surveillance of *Cs. melanura* larval habitats with emphasis in Anoka and Washington counties
- Be watchful for *Ae. albopictus* and *Oc. japonicus*
- Continue *I. scapularis* surveillance, but operational specifics depend on amount of staff time used for WNV activities
- Maintain tick-borne disease education, tick identifications and home-owner consultations

survey wetlands and wooded areas to inventory habitats that are used by this species.

MMCD is continuing to refine surveillance and response plans in anticipation of yearly detections of West Nile virus (WNV). Since its introduction to North America, WNV has caused illness in humans, domestic animals, and wildlife each transmission season. MMCD is involved in a national effort to identify the mosquitoes responsible for transmitting WNV. Additionally, MMCD is investigating a variety of mosquito control procedures to be used in enhancing a comprehensive integrated mosquito management system for the prevention of West Nile illness.

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 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 ehrlichiosis studies with the University of Minnesota. All data collected are summarized and given to the MDH for their risk analysis. Because wide-scale tick control is neither ecologically nor economically feasible, tick control is limited to public education activities which emphasize tick-borne disease awareness and prevention. 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).

2003 Mosquito-borne Disease Services

Breeding Source Reduction

Small water-holding containers provide developmental habitat for many mosquito species including *Oc. triseriatus*, the exotic species *Ae. albopictus* and *Oc. japonicus*, and other probable vectors of West Nile virus. In 2003, MMCD recycled 14,654 tires that were collected from the field. Since 1988 the District has recycled 403,487 tires. District staff eliminated another 1,542 container breeding sources and filled 518 tree holes. This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities including the 1,458 property inspections performed by MMCD staff in 2003.

La Crosse Encephalitis (LAC)

***Ochlerotatus triseriatus* Surveillance and Control** As in the past, intensive surveillance of adult *Oc. triseriatus* populations occurred throughout the District. MMCD samples wooded mosquito habitats by vacuum aspirator to monitor adult *Oc. triseriatus* populations and to direct adult and larval control efforts.

In 2003, MMCD staff collected 2,676 aspirator samples for the purpose of monitoring *Oc. triseriatus*. The District's threshold of at least two adult *Oc. triseriatus* was met in 460 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when samples reached threshold. Additionally, 342 adulticide applications to wooded areas were prompted by collections of *Oc. triseriatus* in aspirator samples.

Adult *Oc. triseriatus* were captured in 470 of 1,558 individual wooded areas sampled. This ratio is low compared to recent years (Table 1.1) and was likely an effect of dry conditions in July, August and September.

Table 1.1 Individual wooded areas sampled by aspirator and the number of those where *Oc. triseriatus* were captured 1998 – 2003.

Year	Total areas surveyed	Total areas with *Oc. triseriatus*	Percent of areas with *Oc. triseriatus*	Avg number per aspirator sample
1998	713	343	48.1	Not tallied
1999	895	397	44.4	Not tallied
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

Surveillance for *Oc. triseriatus* adults was initiated during the week of May 26 with the first specimens collected during the week of June 2. MMCD surveillance indicated an increase in *Oc.*

triseriatus adult emergence through June (Figure 1.1). The season's peak rate of capture occurred during the week of June 23, but that week was influenced by one sample's high count. A second, lesser peak occurred during the week of July 21, after which the population appears to have declined steadily through the end of the mosquito season. This decline is also likely due to the dry conditions experienced during the summer.

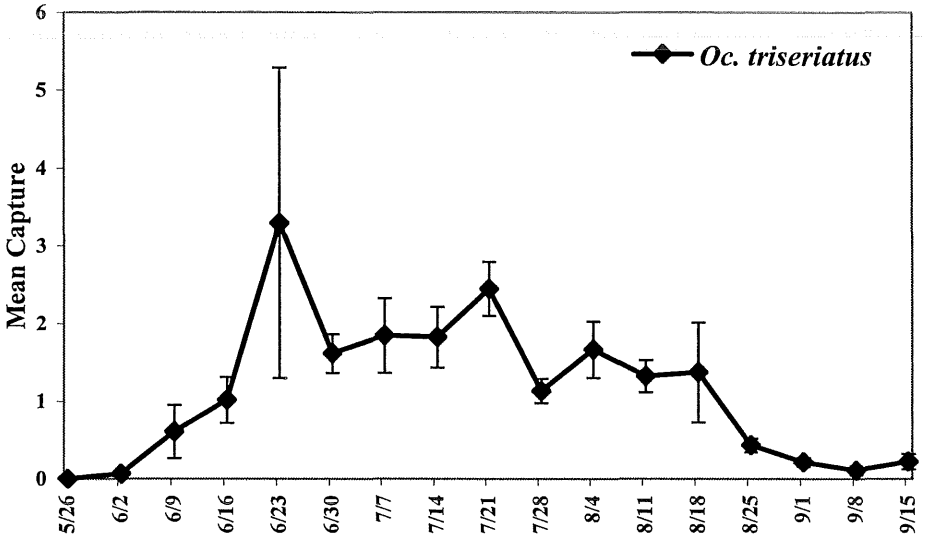

Figure 1.1 Mean number of *Oc. triseriatus* adults in aspirator samples, plotted by week. Dates listed are the first sampling day of each week. Sites sampled varied by week, although several locations were monitored repeatedly during the season. Heights of bars represent one standard error.

La Crosse Encephalitis Case Response Three cases of La Crosse encephalitis were reported to MDH in 2003, one of which occurred in the District. A two year-old girl from Scott County was diagnosed in early August. The onset of symptoms was August 8; however, the case was not reported to MDH until September 8. MDH promptly contacted the child's family and reported the case to MMCD the same day.

Upon the initial interview with the child's parents, it was determined there were two potential exposure locations, the family farm and a daycare, both located within the District. MMCD investigations of both areas were initiated on September 9.

In the area of the family farm, MMCD employees removed 21 tires and eliminated 26 container breeding sources and four tree hole breeding sources. Ten additional tree holes and one container were found in the area. In the area of the daycare, MMCD employees removed two tires and eliminated 19 container breeding sources. Of 52 breeding sources inspected for mosquitoes, only one contained larvae, a tree hole found in the area of the family farm. Most of the breeding

sources were dry due to a lengthy period without rain. The larval sample that was collected contained only one *Oc. triseriatus* larva which died prior to pupation. Consequently no mosquitoes were tested for the La Crosse virus from this case investigation.

Aspirator samples for adult mosquito surveillance were collected in both areas investigated, five from woodlots near the family farm and four from woodlots near the daycare. None of the samples contained adult *Oc. triseriatus* specimens.

West Nile Virus (WNV)

Progression of WNV in North America Forty-five states documented WNV activity in 2003. The only U. S. states not reporting WNV activity were Alaska, Hawaii, Idaho, Oregon, and Washington. Nationally there were 8,912 human WN illnesses and 211 fatalities reported to the Centers for Disease Control (CDC). Colorado, Nebraska, North Dakota, and South Dakota accounted for 5,828 of the cases. In addition, screening of the American blood supply detected WNV in 737 donors. West Nile illness was documented in 4,146 horses in the United States, as well—far fewer than the nearly 15,000 cases reported in horses in 2002, even though many western states experienced severe WN epidemics in 2003. Widespread use of the equine vaccine against WNV was probably responsible for the reduction in horse cases.

In Canada, WNV was detected in six of the 10 provinces with the Prairie Provinces experiencing the greatest impact. Alberta reported 272 human WN illnesses, Manitoba 141, and Saskatchewan 774. In Mexico, WNV was detected in 21 of 31 states as well as in the Federal District of Mexico. West Nile illness was reported in only six Mexican residents from three states; however, WN illness was reported in 2,046 horses in Mexico.

WNV in Minnesota Minnesota recorded the first U. S. WN illness in a horse in 2003. The Crow Wing County horse was diagnosed on April 22. In total, there were 75 cases of WN illness in Minnesota horses from 33 counties. In 2002, the state recorded 992 horse cases from 84 counties. Human WN cases increased in Minnesota in 2003. The state reported 148 cases in residents of 56 Minnesota counties. The earliest onset of a WN illness in the state was June 18. Over 70 percent of the Minnesota human cases had dates of onset between August 15 and September 15. Eighteen Minnesota blood donors from 15 counties screened positive for WNV, as well. Additional WNV detections in Minnesota included 433 wild birds, 59 mosquito samples, 8 non-equine mammals, 7 sentinel horses, and 4 sentinel chickens. Identifications of the 59 WNV positive mosquito samples were: *Culex tarsalis* (42 samples), *Culex pipiens/restuans* (7 samples), *Culex restuans* (6 samples), *Culex* species (3 samples), and *Aedes vexans* (1 sample).

West Nile Illness in the District Twenty-five residents of the District were diagnosed with WN illnesses. The MDH has determined that eight of these were travel related and exposed outside of Minnesota. Of the remaining 17 cases, 11 were likely exposed within the District and six may have been exposed either inside or outside of the District. Numbers of possible or probable local county exposures to WNV are: Anoka-1, Carver-0, Dakota-2, Hennepin-8, Ramsey-4, Scott-1, and Washington-1.

WNV Surveillance and Prevention in the District The emergence of WNV in Minnesota in 2002, along with the occurrences in near-by Midwestern states, prompted several surveillance and response activities within the MMCD service area in 2003. MMCD concerns following Minnesota's first WNV transmission season included mosquito development in catch basins, all aspects of *Culex* species production and methods for surveillance and control, and the likely involvement by *Cx. tarsalis* in the bridging of WNV to humans and horses in the region.

Plans for 2003 included documenting storm water catch basins in the seven counties serviced by our agency, a project initiated late in 2002. Prior to 2003, MMCD had no program for control of mosquito larvae in catch basins. We also continued evaluating *Culex* species production in many of the 70,000 wetlands located within the District. In addition, MMCD surveillance plans for WNV in mosquitoes and birds were coordinated with those of the MDH.

Mosquitoes in catch basins The design of a mosquito larval control program in MMCD catch basins required an extensive catch basin mapping project that was completed in 2003. Many cities provided MMCD with paper or electronic maps of their storm water systems which were used as a base for inspections.

Field staff inspected over 200,000 catch basins to identify those that might provide suitable habitat for mosquito development. The highest density of catch basins that hold water is in St. Paul (Figure 1.2), where many catch basins with sumps were routinely installed in an effort to remove sediment from storm water. In areas such as Minneapolis and many suburbs, most individual catch basins do not have sumps, but use other methods to clean storm water such as limited sumps or grit chambers. In some areas, catch basins were not designed to hold water, but maintenance or construction issues have led to them retaining water for sufficient time to support mosquito larvae.

During the course of the mapping project, MMCD staff made larvicide applications in June, July, and August to approximately 37,000, 45,000, and 50,000 catch basins respectively. MMCD staff have now identified over 58,000 catch basins that will require future larvicide treatments. In addition, 263 larval samples were collected from catch basins in 2003. Table 1.2 displays the seasonal occurrence of *Culex* larvae in catch basin samples.

Larval *Culex* surveillance In addition to mosquito development in catch basins, *Culex* species development in MMCD wetlands received increased attention. In 2003, MMCD staff conducted 5,892 wetland inspections with the intent of identifying *Culex* breeding habitat. *Culex* larvae were collected during 927 of the breeding site inspections (Table 1.3). From the fourth week of June through the end of surveillance, at least 75 percent of samples with *Culex* contained *Culex territans*. *Culex restuans* was the second most prevalent species collected from the first week of June through the last week of July. *Culex tarsalis* was the second most prevalent species collected from the first week of August through the first week of September.

With the emergence of *Culex tarsalis* as a likely vector of West Nile virus to humans and other mammals, MMCD is planning to devote additional attention to the design and enhancement of surveillance and control programs for both larvae and adults of the species. Plans for 2004 include intensified surveillance for *Cx. tarsalis* larvae and sources of larval habitat.

Figure 1.2

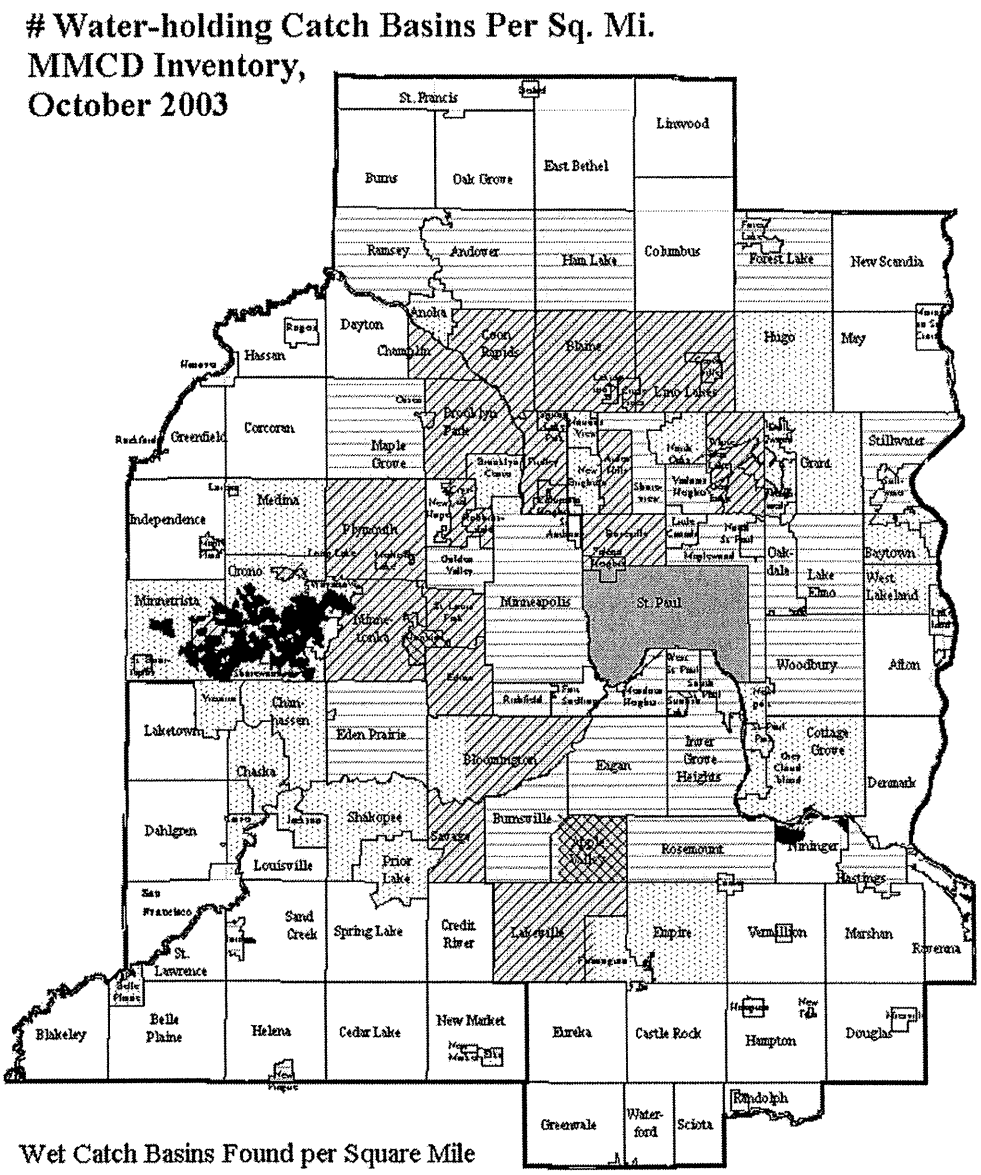
Water-holding Catch Basins Per Sq. Mi.
MMCD Inventory,
October 2003
St. Francis
Linwood
Burns
Oak Grove
East Bethel
Ramsey
Andover
Ham Lake
Columbus
Forest Lake
New Scandia
Anoka
Dayton
Coon Rapids
Blaine
Hugo
May
Hassan
Champlin
Corcoran
Greenfield
Brooklyn Park
Maple Grove
Stillwater
Medina
Independence
Plymouth
Grant
Crono
Oakdale
Baytown
Minnetrista
Minneapolis
St. Paul
Lake Elmo
West Lakeland
Woodbury
Afton
Laketown
Eden Prairie
Bloomington
Inver Grove Heights
Cottage Grove
Denmark
Chaska
Dahlgren
Shakopee
Savage
Burnsville
Rosemount
Vermillion
Louisville
Prior Lake
Hastings
Sand Creek
Spring Lake
Credit River
Lakeville
Empire
Marshan
Riverena
St. Lawrence
Blakeley
Bella Plaine
Helena
Cedar Lake
New Market
Eureka
Castle Rock
Hampton
Douglas
Randolph
Greenvale
Water-ford
Sciota
Wet Catch Basins Found per Square Mile
200 to 254
100 to 199
40 to 99
20 to 39
1 to 19
0 (some rural areas not surveyed)
Metropolitan Mosquito
Control District
St. Paul, MN www.mmcd.org

Table 1.2 Collections of mosquito larvae from catch basins*.

	June					July				August					September			
	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	Total
No. catch basin samples collected	8	21	13	2	4	21	7	19	6	41	38	8	24	6	2	42	1	263
Samples with:																		
Cx. pipiens	0	0	2	0	0	2	0	2	0	12	12	3	7	2	2	27	1	72
Cx. restuans	6	13	7	2	2	15	0	18	5	32	33	3	22	3	2	32	1	196
Cx. tarsalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Cx. territans	0	0	4	0	0	9	5	3	0	3	4	3	3	0	0	1	0	35
Culex species	4	9	1	0	1	7	0	11	2	25	15	3	7	1	0	15	0	101

*Other species collected: *Ae. cinereus, Ae. vexans, An. punctipennis, Cs. inornata, Cs. minnesotae, Ur. sapphirina*

Table 1.3 Collections of *Culex* species larvae from wetlands by week.

	May		June					July				August					Sept.		
	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	Total
No. site inspections	8	33	286	418	142	126	81	170	232	86	823	976	713	166	1020	403	182	27	5892
No. samples with *Culex*	1	1	24	53	18	27	14	42	51	35	130	200	124	16	111	63	16	1	927
Samples with:																			
Cx. pipiens	0	0	4	1	0	0	0	2	0	0	6	2	9	0	3	0	2	0	29
Cx. restuans	0	0	16	23	8	3	2	8	8	1	25	15	8	0	7	3	2	0	129
Cx. salinarius	0	0	0	0	0	0	0	2	1	0	1	2	3	0	3	1	1	0	14
Cx. tarsalis	0	0	0	2	0	0	1	6	2	0	7	34	22	1	30	11	2	0	118
Cx. territans	1	1	9	29	11	25	12	33	45	35	109	178	112	14	97	54	12	1	778
Culex species	0	0	1	10	2	0	2	0	3	1	15	26	9	1	11	4	2	0	87

Adult *Culex* surveillance Data from standard MMCD adult mosquito surveillance were examined for insight on *Culex* species seasonality and abundance, and an estimate of population change over time (Chapter 2, p. 25). Observations of CO_2-baited light trap captures of *Cx. tarsalis* indicated that adult populations remained relatively low in the District throughout 2003 (Chapter 2, Fig. 2.5). Minnesota experienced a moderately severe drought from early July through the end of the mosquito breeding season leading to an overall attrition of available larval habitat. *Culex tarsalis* tends to thrive in unusually wet years in our area. Populations in southwestern Minnesota were much higher, with mean counts of 10-60 per trap night (Moon and Bender 2003, unpublished report), compared with 1-4 in MMCD traps. *Culex restuans* were caught throughout the season in CO_2-baited light traps. In contrast, *Culex pipiens* had very low capture rates, increasing somewhat near the end of the year but not as much as in past years. Human-baited sweeps caught very few *Culex*.

Because of the low *Culex* capture rates in standard MMCD surveillance, we have been testing additional sampling strategies. Researchers in both Massachusetts (Reiter 2002) and Michigan (Crisp and Knepper 2002) compared CO_2 trap captures at different heights and found some *Culex* species may be feeding more in the tree canopy than at ground level. If this is the case in Minnesota, MMCD may need to make changes in surveillance and control of these species. In 2003 we included in our Monday night CO_2 trap network five locations with pairs of traps, one near ground level and one in the tree canopy 20 to 30 feet high. *Culex* species were attracted to CO_2 traps both near ground level and in the tree canopy although captures were often low at both elevations, as were mean rates of capture for the season.

Two-way analysis of variance (ANOVA) revealed no significant differences in the number of *Cx. tarsalis* or *Cx. restuans* caught by ground level and elevated traps. The number of mosquitoes captured on different dates did differ significantly (Table 1.4, Figures 1.3 and 1.4). Too few *Cx. pipiens* were captured on too few dates to permit ANOVA. Significantly more *Ae. vexans* and *Cq. perturbans* were captured in ground-level traps. Again, the number of mosquitoes captured on different dates did differ significantly (Table 1.4, Figures 1.5 and 1.6).

Table 1.4 Results of two-way ANOVA comparing mosquitoes captured by ground-level and elevated traps.

	ANOVA p-values		
Species	Trap height	Sample date	Height * Date
Cx. tarsalis	0.132	0.022	0.559
Cx. restuans	0.070	0.031	0.342
Ae. vexans	<0.001	<0.001	0.204
Cq. perturbans	0.009	<0.001	0.766

Note: All data were log(n+1) transformed, data from traps for dates when neither the elevated nor the ground-level trap caught mosquitoes were excluded.

These results suggest that a considerable portion of *Cx. tarsalis* and *Cx. restuans* populations may be found in the tree canopy that could be missed by our standard sampling methods. As expected, these results also show that the majority of *Ae. vexans* and *Cq. perturbans* remain close

to the ground. More detailed sampling to examine potential movement of *Cx. tarsalis* and *Cx. restuans* between ground-level and higher elevations during specific time periods should be conducted to determine if modifications to adulticide techniques are required to effectively control these species. The relatively low captures of *Cx. tarsalis*, *Cx. pipiens* and *Cx. restuans* indicates the more intensive surveillance may be required to detect WNV-positive mosquitoes when the WNV-infection rates are low. Additional sampling might reveal more about *Cx. pipiens* populations.

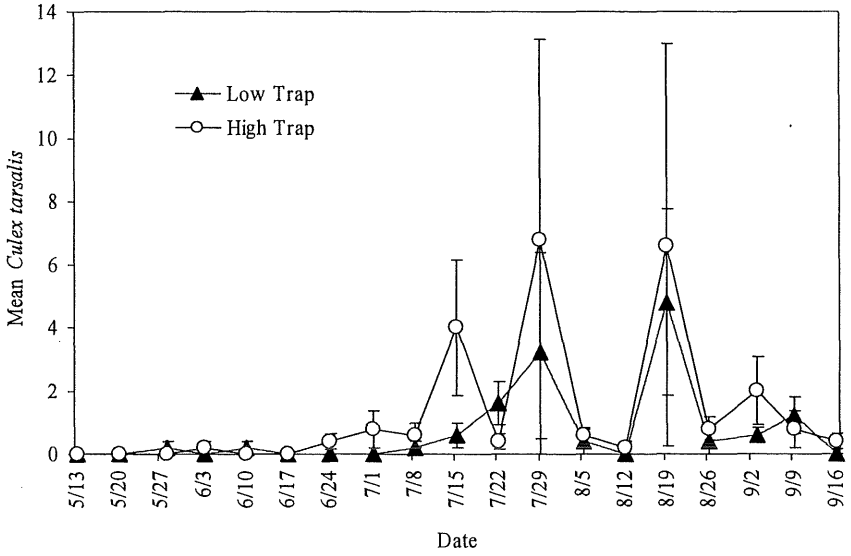

Figure 1.3 Mean number of *Cx. tarsalis* captured by ground-level (low) and elevated (high) traps. Error bars equal one standard error above and below the mean.

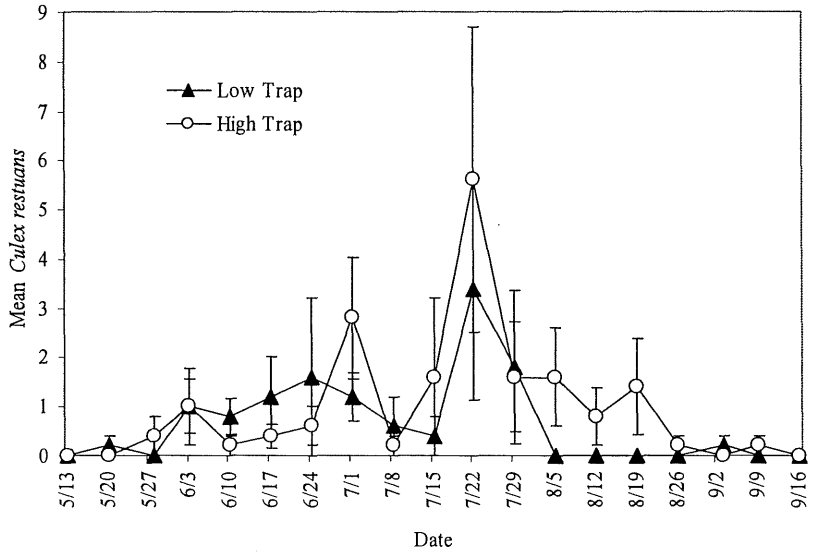

Figure 1.4 Mean number of *Cx. restuans* captured by ground-level (low) and elevated (high) traps. Error bars equal one standard error above and below the mean.

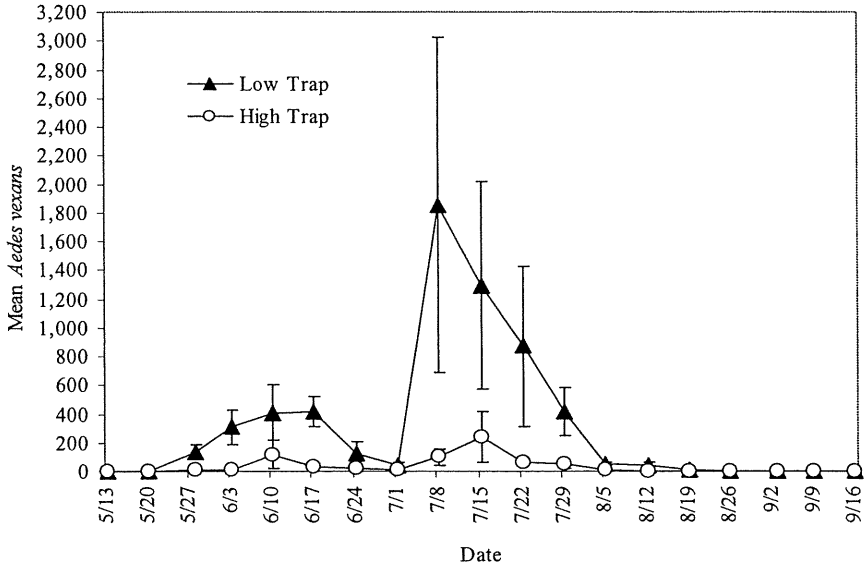

Figure 1.5 Mean number of *Ae. vexans* captured by ground-level (low) and elevated (high) traps. Error bars equal one standard error above and below the mean.

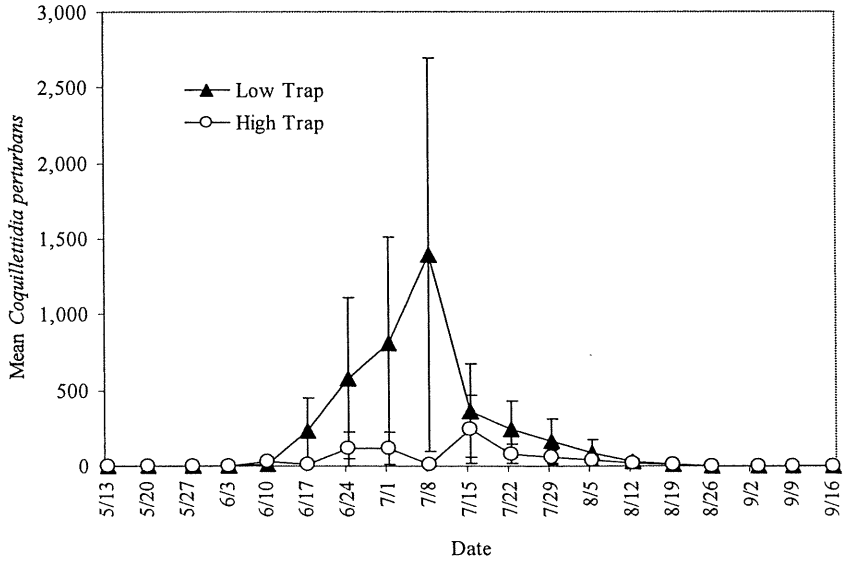

Figure 1.6 Mean number of *Cq. perturbans* captured by ground-level (low) and elevated (high) traps. Error bars equal one standard error above and below the mean.

Gravid traps were also used by MMCD to collect *Culex* species (Figure 1.7, the more frequently captured *Culex* and Figure 1.8, the less frequently captured *Culex*). These traps use a fermenting hay infusion to attract ovipositing females. In 2003, we sampled 11 locations weekly by gravid trap. Mean capture rates for *Cx. restuans* were higher in gravid traps than in CO_2 traps, but the pattern of activity through the year was similar in that this was the most frequently collected

Culex species by both sampling methods throughout the season. Other species of *Culex* were present in gravid trap collections, but at low levels.

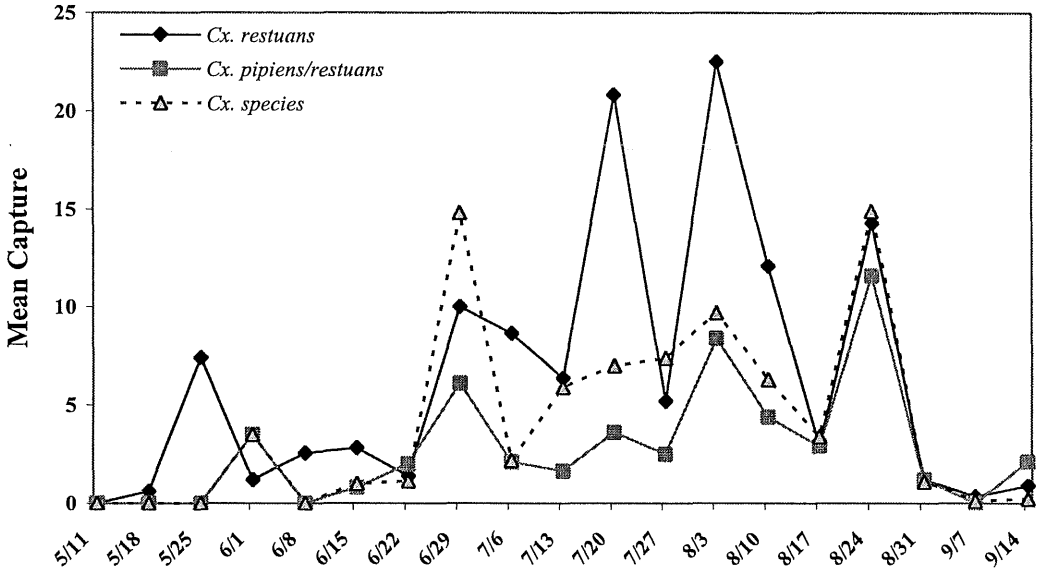

Figure 1.7 Gravid trap captures of *Culex restuans* and *Culex* not identified to species (n=11).

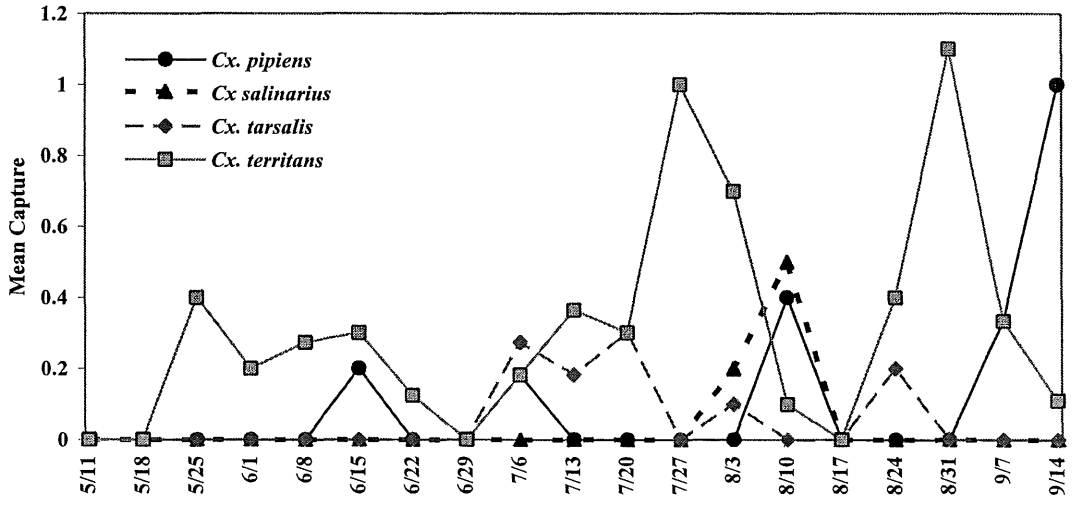

Figure 1.8 Gravid trap captures of selected *Culex* species (n=11).

Surveillance for WNV All gravid trap mosquito samples, as well as samples from 20 CO_2 traps (15 near ground level and 5 elevated into the tree canopy) were submitted to MDH for viral analysis. Additional samples for viral analysis were collected by various methods from areas where WNV had been detected during the season. Samples were sorted by species and divided into pools of up to 50 mosquitoes. The District submitted a total of 3,369 mosquito pools comprising the full spectrum of species commonly found in our area. Positive results for WNV were returned on 15 pools (Table 1.5), 12 of which were from a single gravid trap location. No other viruses were detected in MMCD mosquito samples in 2003.

Table 1.5 MMCD mosquito pools positive for WNV in 2003

Location	Collection date	Trap type	Species	No. mosquitoes
Minnetrista	7/15	Elevated CO_2	*Cx. tarsalis*	11
St. Louis Park	7/16	Gravid	*Cx. restuans*	48
St. Louis Park	7/23	Gravid	*Cx. restuans*	50
St. Louis Park	7/23	Gravid	*Cx.* species	50
St. Louis Park	8/13	Gravid	*Cx. pipiens/restuans*	40
St. Louis Park	8/20	Gravid	*Cx. restuans*	29
St. Louis Park	8/27	Gravid	*Cx. species*	25
St. Louis Park	8/27	Gravid	*Cx. species*	21
St. Louis Park	8/27	Gravid	*Cx. restuans*	25
St. Louis Park	8/27	Gravid	*Cx. pipiens/restuans*	25
St. Louis Park	8/27	Gravid	*Cx. pipiens/restuans*	25
St. Louis Park	8/27	Gravid	*Cx. restuans*	25
St. Louis Park	9/4	Gravid	*Cx. restuans*	8
St. Paul Park	9/9	CO_2	*Cx. tarsalis*	2
Plymouth	9/9	CO_2	*Cx. tarsalis*	4

In addition to mosquito surveillance, MMCD assisted with Minnesota's surveillance for WNV in wild birds. In 2003, acting on reports of sick and dead birds to MMCD and MDH, staff collected 366 birds for viral analysis. Positive results for WNV were returned on 194 of the birds (Figure 1.9). Collections by MMCD of most bird species ended after September 13.

Sentinel Chicken Surveillance

Sentinel chickens are monitored by MMCD at three locations, one each in Anoka, Hennepin, and Scott counties. The flocks were originally placed at their current locations to monitor for western equine encephalitis virus. Each flock consists of 20 birds that are sampled weekly. This was the first year that blood from these flocks was tested for WNV. Four chickens, all from the Scott County flock, returned positive results for WNV antibodies. The sample dates when the birds returned positive results were August 25, September 2, September 8, and September 22. There were no positive results for antibodies of the western equine encephalitis virus.

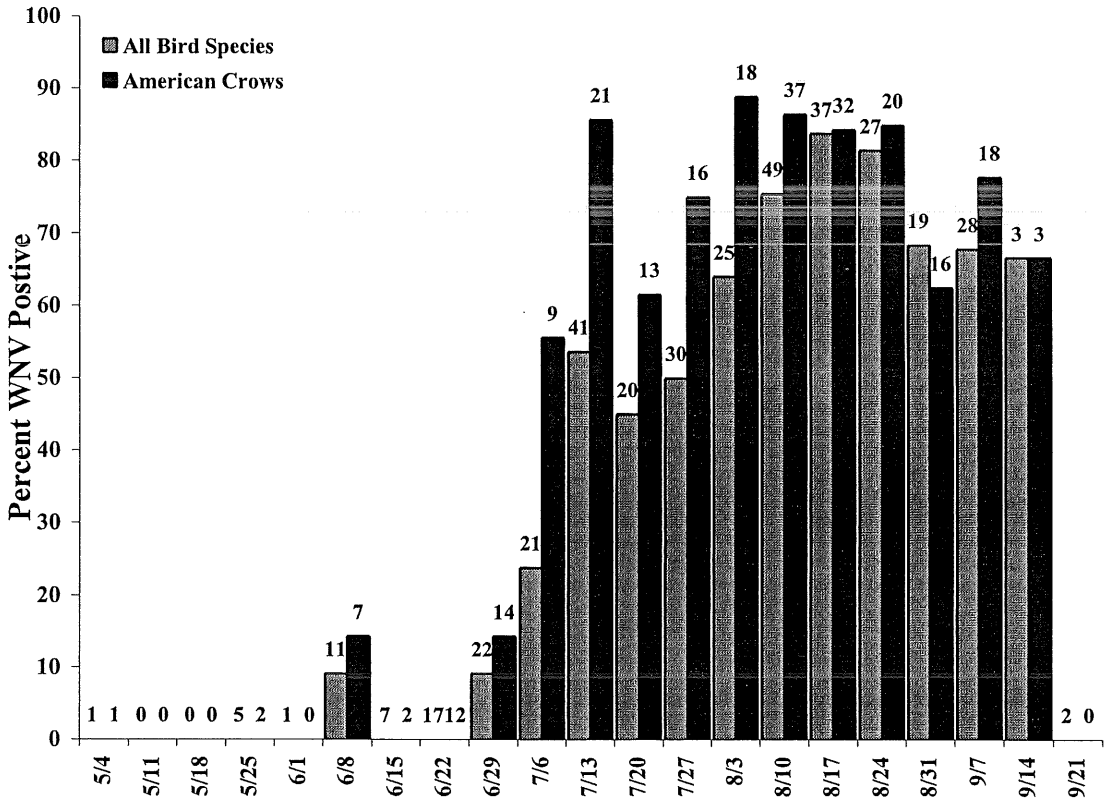

Figure 1.9 Percentage of birds collected by MMCD for WNV analysis returning positive results by week. Bars are labeled with the total number of birds collected by week.

Eastern Equine Encephalitis (EEE)

For the second time on record, EEE was detected in horses in western Wisconsin in 2003—two Polk County horses died of illnesses caused by the EEE virus. Polk County borders the northeastern most portion of MMCD. There were no observations of EEE in Minnesota or in any other Wisconsin counties in 2003. In 2001, an EEE epizootic was recorded in northwestern Wisconsin, including Polk County. Three equine cases were documented in Minnesota that year, as well, including one in Anoka County. Since that time MMCD has targeted the maintenance vector, *Culiseta melanura*, for surveillance.

***Culiseta melanura* Surveillance** Staff conducted a project in 2002 to compare and refine collection methods for both larvae and adults of *Cs. melanura*. In 2003, MMCD staff concentrated on larval surveillance to identify wetland habitats used by this species. While all of the *Cs. melanura* surveillance in 2002 was conducted in Anoka County, efforts were expanded to the entire District in 2003. The project was initiated by creating an inventory of tamarack bog

sites, the preferred breeding habitat of *Cs. melanura*. Using a variety of resources we were able to identify 119 tamarack bogs in the District by May of 2003. Staff continued to update the tamarack bog inventory as new sites were observed during the year. By November the inventory contained 329 wetlands to evaluate as habitat for *Cs. melanura*, including some wetlands dominated by a plant known commonly as leather leaf (*Chamaedaphne calyculata*).

MMCD staff performed 168 inspections for *Cs. melanura* larvae in 106 wetlands. *Culiseta melanura* larvae were found in ten samples collected from eight of the breeding sites. The species has now been collected from 15 wetlands in the District, all in Anoka County. Prior to September 2001, *Cs. melanura* larvae had never been collected within the District.

Plans for 2004 – 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, property inspections, and breeding source reduction.

MMCD staff will review and revise the District's surveillance and control strategies for adult *Culex* mosquitoes. We will continue to survey aquatic habitats for *Culex* larvae for use in design and improvement of larval control strategies.

District staff will continue to apply larvicides to catch basins. Catch basin treatment strategies will be communicated to other local government entities that might also provide services in the same catch basins.

MMCD will continue to conduct surveillance for WNV and other mosquito-borne viruses in coordination with MDH, MDA, the University of Minnesota, and other local authorities.

District staff will continue to survey *Cs. melanura* habitats in the District, with emphasis on Anoka and Washington counties.
MMCD staff will remain watchful for the introduction of exotic mosquito species, especially *Ae. albopictus* and *Oc. japonicus*.

References

Crisp, S. and Knepper, R. 2002. Mosquito Activity Related to Time of Day for Several Michigan Species. Wing Beats 13:4 pp. 10, 18, 30.

Reiter, P. 2002. *Culex* Biting Behavior and its Relationship to West Nile Virus. Oral Presentation at the 16th Annual Conference of the Michigan Mosquito Control Association.

2003 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 using this study methodology.

2002 results indicate a continuation in the pattern of an elevated *I. scapularis* population level that first became apparent in 2000. Our total 2002 *I. scapularis* collections and the total number of sites where at least one *I. scapularis* was found were the highest since the inception of this study in 1990, but these results are comparable to our 2000 and 2001 results. We now believe that we first began noticing a general upward trend in the *I. scapularis* population level in 1998 which then built into the elevated number of *I. scapularis* that we have collected since 2000 (Table 1.6). In 2003, tick abundance appears to have decreased slightly compared to levels observed in 2000 – 2002

The Minnesota Department of Health has also tabulated higher than typical numbers since 2000. Their 2002 human case totals (Lyme 867 and ehrlichiosis 152) were the highest recorded totals in their databases and represent an 84% increase over the previous high levels of 2001. Preliminary 2003 human disease case data are slightly lower than 2002

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services (including tick identifications and homeowner consultations) were maintained in 2003 using previously described methods and tools.

Table 1.6 Numbers and percentages of tick species collected by stage and year

Year	No. sites	Total ticks collected	*Dermacentor variabilis* Percent larvae (n)	*Dermacentor variabilis* Percent nymphs (n)	*Ixodes scapularis* Percent larvae (n)	*Ixodes scapularis* Percent nymphs (n)	Other species[b] percent (n)
1990[a]	250	9957	83 (8289)	10 (994)	6 (573)	1 (74)	0% (27)
1991	270	8452	81 (6807)	13 (1094)	5 (441)	1 (73)	0% (37)
1992	200	4130	79 (3259)	17 (703)	3 (114)	1 (34)	0% (20)
1993	100	1785	64 (1136)	12 (221)	22 (388)	1 (21)	1% (19)
1994	100	1514	53 (797)	11 (163)	31 (476)	4 (67)	1% (11)
1995	100	1196	54 (650)	19 (232)	22 (258)	4 (48)	1% (8)
1996	100	724	64 (466)	20 (146)	11 (82)	3 (20)	1% (10)
1997	100	693	73 (506)	10 (66)	14 (96)	3 (22)	0% (3)
1998	100	1389	56 (779)	7 100)	32 (439)	5 (67)	0% (4)
1999	100	1594	51 (820)	8 128)	36 (570)	4 (64)	1% (12)
2000	100	2207	47 (1030)	10 (228)	31 (688)	12 (257)	0% (4)
2001	100	1957	54 (1054)	8 (159)	36 (697)	2 (44)	0% (3)
2002	100	2185	36 (797)	13 (280)	42 (922)	8 (177)	0% (9)

[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

2004 Plans for Tick-borne Services

Metro surveillance

The metro-based *I. scapularis* distribution study that began in 1990 is planned to continue unchanged, but alternative sampling plans may be incorporated contingent on the volume of staff time used in performing 2004 West Nile mosquito activities.

Tick Identification Services/Outreach

We plan to maintain our tick-borne disease education activities and services, including tick identifications and homeowner consultations.

Chapter 2 Mosquito Surveillance

2003 Highlights

- Above average rainfall in May and June followed very low rainfall after July
- Rainstorms produced 8 broods of mosquitoes

2004 Plans

- Continue surveillance as in 2003
- Experiment with different trapping methods for *Culex* mosquitoes

2003 Mosquito Surveillance Results

Rainfall

Average rainfall per gauge in the District from May 1 through September 30, 2003 was 16.79 inches (Table 2.1). This is 12 inches below last year and almost three inches below the 45-year District average. The southern counties of Carver, Dakota and Scott received less rain than the northern counties.

Table 2.1 Average rainfall received in each county from May through September, 1999-2003 and 45-year District average.

	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
1999	22.12	20.12	22.66	22.55	22.95	22.43	21.60	22.41
2000	13.81	15.69	21.38	17.33	20.19	16.63	20.90	17.79
2001	17.40	15.38	16.23	18.98	18.94	15.01	17.78	17.73
2002	26.93	29.96	30.03	30.23	29.28	28.53	28.36	29.13
2003	17.30	14.15	14.72	17.59	18.07	13.34	18.00	16.79
45-Year Avg	19.00	NA	19.89	19.70	19.97	19.42	20.23	19.55

Typically a rain event $\geq$ 1 inch can produce a brood of floodwater mosquitoes. We experienced four District-wide broods in May and June (Fig. 2.1). The June 14 rain event was just under an inch and only produced a small brood of mosquitoes. A 3- to 6-inch storm at the end of June produced a large brood of mosquitoes, mostly in the northern half of the District. Rainfall for the remainder of the season was below average, resulting in only three more broods—two in July and one mid-September.

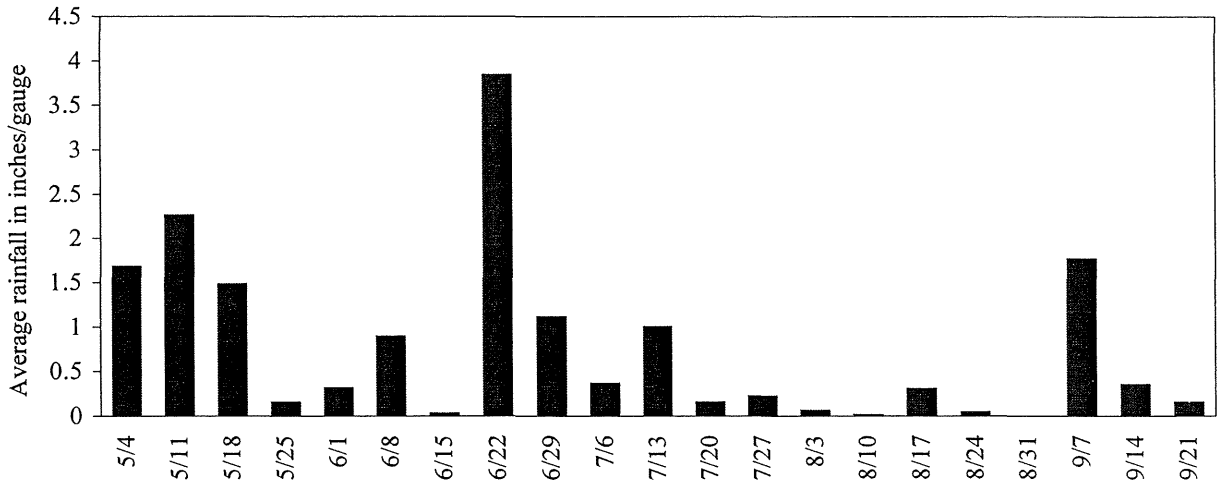

Fig. 2.1 Average rainfall per gauge per week, 2003

Larval Collections

In 2003, staff identified 16,789 larval collections. To accelerate the identification of samples from sites to be treated by air, larvae were identified to the genus level only. All other samples were identified to species. Table 2.2 shows the results of the 10,682 samples that were identified to species.

The most abundant species District-wide was *Aedes vexans*. *Culiseta inornata* and *Culex territans*, typically non-human biting species, were the second and third most abundant. The insidious ankle-biter, *Aedes cinereus*, which occurs in the spring and summer, had the fourth highest frequency of occurrence. The spring species *Ochlerotatus stimulans* and *Ochlerotatus excrucians* ranked 5th and 7th in frequency of occurrence, respectively. *Culex restuans* ranked 6th, *Uranotaenia sapphirina* ranked 8th, *Ochlerotatus trivittatus* ranked 9th, and *Culex tarsalis* ranked 10th.

Because *Culex* mosquitoes are the likely WNV vectors, staff sampled a greater variety of breeding sites to determine *Culex* site type preference. These samples were included in Table 2.2. However, the frequency of species occurrences did not reflect an increase in *Culex* presence, but was similar to last year.

Table 2.2 Frequency of occurrence (%) of larval species in standard dipper collections by county and District total, 2003.The total number of samples processed to species is in parentheses.

	Percent frequency of occurrence by facility						
Species	North (447)	South Jordan (1,156)	South Rosemount (1,943)	West Maple Grove (2,186)	West Plymouth (2,321)	East (2,629)	District (10,682)
Ochlerotatus abserratus	0.2	0.1	0.5	0.1	0.2	0.3	0.2
aurifer						0.1	0.02
canadensis	0.2	0.9	1.2	0.2	0.5	0.8	0.7
Aedes cinereus	21.7	11.7	7.7	11.6	13.7	14.4	12.5
Oc. dorsalis		0.1		0.1	0.04		0.05
excrucians	2.5	2.6	6.2	4.1	4.5	12.2	6.4
fitchii	0.2	0.4	0.6	0.3	0.1	3.0	1.0
flavescens					0.04		0.01
implicatus			0.1	0.1	0.1		0.2
intrudens						0.4	0.02
punctor	0.4		0.1	0.2	0.2	0.5	0.3
riparius		0.3	0.2	0.5	0.6	0.2	0.3
spencerii			0.1				0.01
sticticus	0.9	0.3	0.9	0.5	0.3	1.3	0.7
stimulans	1.1	7.5	12.2	8.3	8.9	18.5	11.3
provocans		0.2	0.2	0.1		1.3	0.4
trivittatus	1.3	2.1	3.8	3.7	2.5	2.3	2.9
Ae. vexans	38.7	29.3	49.2	55.9	44.5	26.7	41.4
Ae./Oc. species	31.1	20.4	31.0	32.7	25.5	27.3	28.1
Anopheles earlei		0.1			0.04	0.04	0.03
punctipennis	0.7	0.5	0.4	0.1	0.6	0.9	0.5
quadrimaculatus		0.1				0.04	0.02
walkeri				0.1			0.02
An. species	1.3	3.0	1.2	0.9	2.4	2.7	2.0
Culex pipiens	0.7	1.4	0.9	0.9	0.6	2.8	1.4
restuans	5.4	4.2	6.7	7.9	8.6	8.1	7.4
salinarius	0.2	1.0	0.1	0.1	0.2	0.1	0.2
tarsalis	2.0	6.5	0.7	0.9	0.8	2.7	1.9
territans	23.5	27.7	5.8	5.2	12.8	19.4	13.7
Cx. species	2.7	4.7	2.4	2.7	1.9	4.1	3.0
Culiseta inornata	8.5	17.7	21.2	10.1	19.0	14.1	15.8
minnesotae	4.5	3.4	1.0	1.3	3.5	1.1	2.0
morsitans				0.2	0.04		0.05
Cs. species	15.7	7.8	2.3	2.6	8.9	2.7	5.0
Psorophora ferox		0.1	0.1			0.1	0.05
horrida					0.04		0.01
Ps. species				0.1	0.2	0.3	0.1
Uranotaenia sapphirina	2.2	8.6	1.3	1.0	1.3	7.7	3.7
Unidentifiable	2.7	0.6	1.7	1.6	1.7	2.2	1.7

Adult Collections

Sweep net Collections Sweep net collections are used to monitor human annoyance during the peak mosquito activity period, which is 35-40 minutes after sunset for most mosquito species. Employees took two-minute collections in their yards once per week for 16 weeks. The number of collectors varied from 80-156 per evening. Summer species of *Aedes/Ochlerotatus* and *Coquillettidia perturbans* were predominant in the evening sweep net collections (Table 2.3).

Table 2.3 Average numbers of mosquitoes collected per evening sweep net collection within the District, 1999-2003.

Year	Summer *Ae./Oc.*	*Cq. perturbans*	Spring *Ae./Oc.*	*Cx. tarsalis*
1999	5.6	1.9	0.1	0.01
2000	2.4	0.5	0.01	0.01
2001	2.6	0.3	0.1	0.02
2002	4.2	0.5	0.1	0.01
2003	4.7	0.8	0.2	0.01

CO_2 trap collections CO_2 traps baited with dry ice are used to monitor mosquito population levels and to monitor the presence of disease vector species. Employees set traps in their yards on the same night as the sweep net collections are taken, once per week for 19 weeks. The number of traps operated varied from 5-88. As in the case of sweep netting, summer *Ae./Oc.* and *Cq. perturbans* were the predominant species captured in the traps, and were the highest in the past 5 years (Table 2.4). *Coquillettidia perturbans* populations increased due to snow melt and rain in 2002, and the heavy spring rains of 2003. Levels of spring *Ae./Oc.* were slightly lower than last year. Anoka County had the honor of collecting the most mosquitoes in a CO_2 trap ever; a record high of 44,096 mosquitoes was collected at a location in Priority Zone 2.

Table 2.4 Average number of mosquitoes collected in CO_2 traps within the District, 1999-2003.

Year	Summer *Ae./Oc.*	*Cq. perturbans*	Spring *Ae./Oc.*	*Cx. tarsalis*
1999	327.9	45.6	1.9	0.6
2000	245.0	34.6	0.3	1.3
2001	253.0	35.2	7.7	1.6
2002	426.3	58.6	7.7	0.6
2003	457.8	103.7	6.9	1.2

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 female mosquitoes are identified to species. The District operated seven traps in 2003. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap ML in Maple Grove, trap CA in Carlos Avery Wildlife Refuge, and trap AV at the Minnesota Zoo in Apple Valley (Fig. 2.2). Traps 1, 9 and 16 have operated each year since 1960.

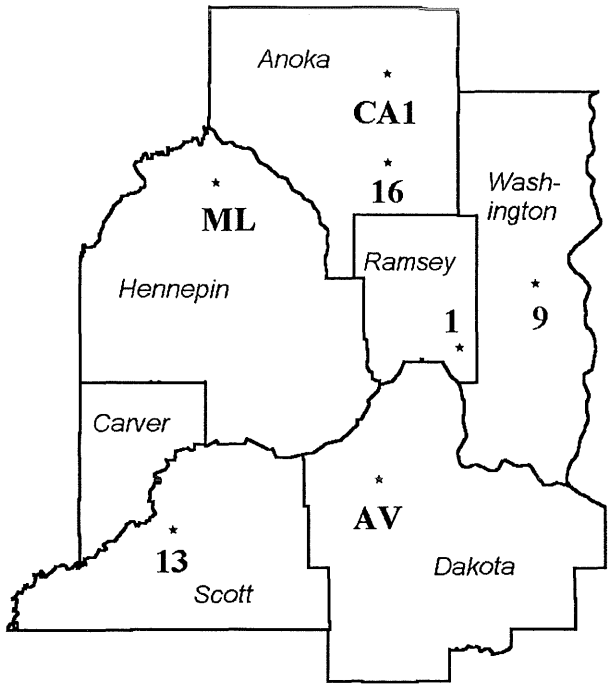

Fig. 2.2 New Jersey light trap locations – 2003

A total of 141,812 female mosquitoes were identified in 2003 (Table 2.5), with *Ae. vexans* being the most numerous species comprising 51% and *Cq. perturbans* second most numerous at 34%. The number of mosquitoes collected per night from 1965 to 2003 is displayed in Appendix A.

Table 2. 5. Total number and frequency of occurrence for each species collected in New Jersey light traps, May 10-Sept. 26, 2003.

	Trap Code, Location, and Number of Collections							Summary Statistics		
	1	9	13	16	ML	CA1	AV	Season		
	St. Paul	Lk. Elmo	Jordan	Lino Lks.	N. Henn.	Carlos	Apple Valley	Total	% Female	Avg per
Species	135	135	139	139	139	135	125	947	Total	Night
1. Oc. abserratus	0	0	0	0	0	540	0	540	0.38%	0.57
3. aurifer	0	0	0	0	0	0	0	0	0.00%	0.00
6. canadensis	0	4	0	2	2	65	1	74	0.05%	0.08
7. Ae. cinereus	0	19	8	54	23	1,379	115	1,598	1.13%	1.69
10. Oc. dorsalis	2	2	9	8	2	4	0	27	0.02%	0.03
11. excrucians	0	7	0	0	2	37	0	46	0.03%	0.05
12. fitchii	0	1	0	0	1	6	1	9	0.01%	0.01
13. flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
16. nigromaculus	0	0	0	0	0	0	0	0	0.00%	0.00
18. punctor	0	0	0	0	1	290	0	291	0.21%	0.31
19. riparius	0	1	0	0	0	25	0	26	0.02%	0.03
20. spenceri	0	0	0	0	0	0	0	0	0.00%	0.00
21. sticticus	0	103	120	10	24	635	56	948	0.67%	1.00
22. stimulans	0	8	0	0	5	14	4	31	0.02%	0.03
23. provocans	0	0	0	0	1	21	0	22	0.02%	0.02
24. triseriatus	0	2	0	2	0	12	3	19	0.01%	0.02
25. trivittatus	2	1,023	59	14	654	278	162	2,192	1.55%	2.31
26. Ae. vexans	268	9,543	2,000	6,710	7,803	39,924	6,482	72,730	51.29%	76.80
118. Oc. abs/punct.	0	3	0	5	2	6,178	1	6,189	4.36%	6.54
261. Ae. species	43	8	1	6	11	162	2	233	0.16%	0.25
262. Spring Ae/Oc	1	6	1	1	2	98	6	115	0.08%	0.12
264. Summer Ae/Oc	0	22	2	2	7	74	7	114	0.08%	0.12
27. An. barberi	0	2	0	0	0	0	0	2	0.00%	0.00
28. earlei	0	1	1	1	2	19	0	24	0.02%	0.03
29. punctipennis	0	39	9	5	20	372	71	516	0.36%	0.54
30. quadrimac.	0	2	1	0	1	1	0	5	0.00%	0.01
31. walkeri	0	21	41	55	12	4,739	32	4,900	3.46%	5.17
311. An. species	0	0	1	1	0	105	2	109	0.08%	0.12
32. Cx. erraticus	0	0	0	0	0	0	1	1	0.00%	0.00
33. pipiens	0	0	1	0	0	0	1	2	0.00%	0.00
34. restuans	5	189	13	89	55	153	85	589	0.42%	0.62
35. salinarius	0	5	1	6	5	3	1	21	0.01%	0.02
36. tarsalis	1	14	14	40	45	44	7	165	0.12%	0.17
37. territans	1	46	7	35	4	92	73	258	0.18%	0.27
371. Cx. species	2	18	1	11	6	36	5	79	0.06%	0.08
372. Cx. pip/rest	2	17	2	21	6	21	12	81	0.06%	0.09
38. Cs. inornata	2	38	19	39	103	85	59	345	0.24%	0.36
39. melanura	0	0	0	0	0	0	0	0	0.00%	0.00
40. minnesotae	0	4	4	115	21	305	2	451	0.32%	0.48
41. morsitans	3	15	0	5	5	113	1	142	0.10%	0.15
411. Cs. species	0	1	1	10	0	26	0	38	0.03%	0.04
42. Cq. perturbans	6	95	80	690	213	47,088	249	48,421	34.14%	51.13
44. Ps. ciliata	0	0	0	0	0	0	0	0	0.00%	0.00
47. horrida	0	0	0	0	0	0	0	0	0.00%	0.00
471. Ps. species	0	0	0	0	0	0	0	0	0.00%	0.00
48. Ur. sapphirina	0	211	9	22	17	26	50	335	0.24%	0.35
501. Unident.	1	8	1	18	19	68	9	124	0.09%	0.13
Female Total	339	11,478	2,406	7,977	9,075	103,038	7,500	141,812	85.11%	149.75
Male Total	94	4,425	1,155	2,732	1,606	12,062	2,735	24,809	14.89%	26.20
Grand Total	433	15,903	3,561	10,709	10,681	115,100	10,235	166,621	100.00%	175.95

Seasonal and Geographic Distributions

Seasonal Distribution Sweep net and CO_2 trap collections detected two peaks of *Ae./Oc.* mosquitoes in 2003 (Figs. 2.3 and 2.4). Population levels began to increase in late May, reached their highest levels by mid-June, and declined thereafter. The second peak occurred approximately one week after the major rainfall event of June 25. Populations were high throughout July and began declining to tolerable levels in August. *Coquillettidia perturbans* began emerging in mid-June and reached elevated levels by the first week of July. This peak occurred simultaneously with the second peak of *Ae./Oc.* mosquitoes.

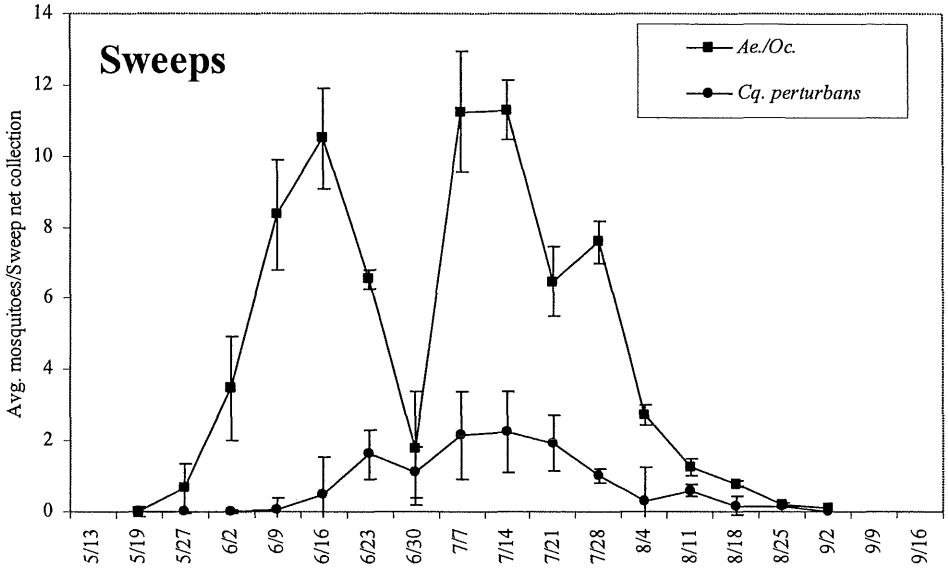

Fig. 2.3 Average number of Summer *Ae./Oc.* and *Cq. perturbans* per evening sweep net collection, 2003. Heights of bars indicate 1 standard error.

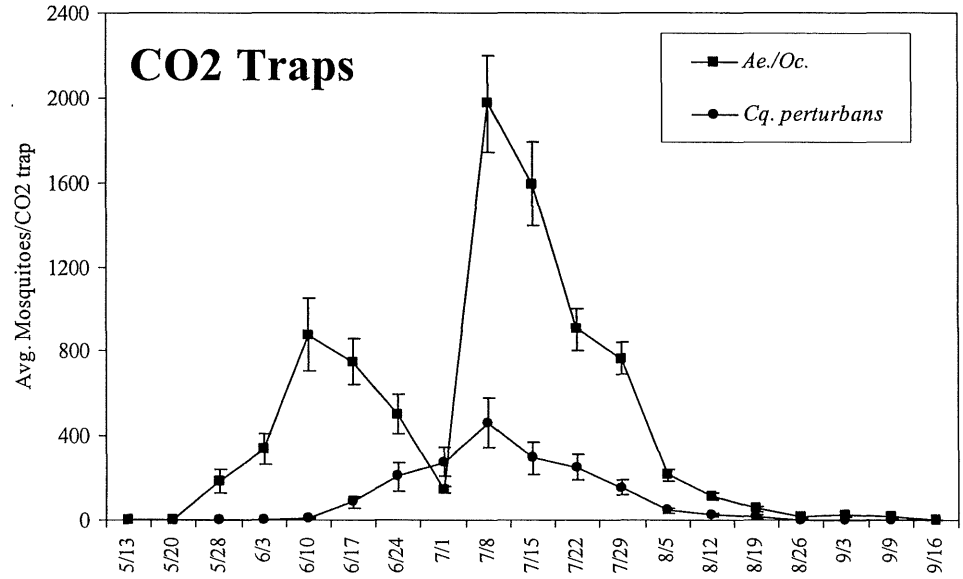

Fig. 2.4 Average number of Summer *Ae./Oc.* and *Cq. perturbans* per CO_2 trap, 2003. Heights of bars indicate 1 standard error.

Five species of *Culex* mosquitoes are found in the District: *Cx. pipiens*, *Cx. restuans*, *Cx. salinarius*, *Cx. tarsalis* and *Cx. territans*. *Culex territans* prefers to feed on reptiles and amphibians and is therefore not of interest to our control program. The remaining four species have been implicated in the transmission of WNV, especially *Cx. tarsalis*. The seasonal distribution of *Culex* species is different than floodwater mosquitoes because their hatching is not a direct response to rain events. Overwintered adults appear in the spring and populations build during the summer with peaks later in the season. *Culex tarsalis* populations reached their highest levels in July, albeit the high was only 3.5 mosquitoes per trap (Fig. 2.5). Levels rose slightly again in August and September, but still were only between 1.0-2.5 mosquitoes per trap.

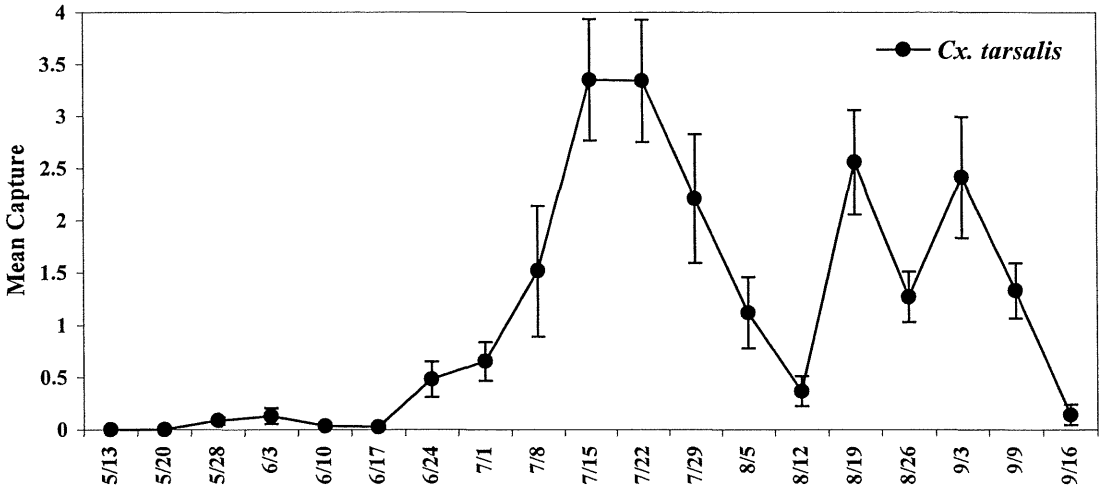

Fig. 2.5 Mean number of *Cx. tarsalis* per CO_2 trap, 2003. Heights of bars indicate 1 standard error.

Because it is difficult to identify *Cx. pipiens* versus *Cx. restuans*, they are often combined together into a *Cx. pip/rest* category. Unidentifiable *Culex* is labeled *Cx. spp*. Populations of *Cx. restuans* and *Cx. pip/rest* began to rise in June before any of the other species (Fig. 2.6). All species reached their highest levels in mid-July and *Cx. pipiens* had a second rise in levels in early September.

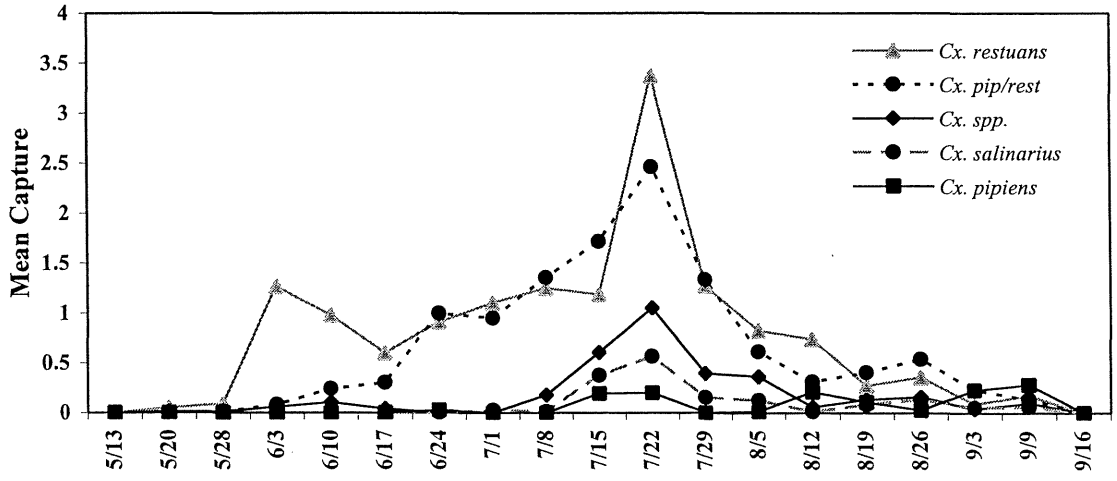

Fig. 2.6 Mean number of selected *Culex* species per CO_2 trap, 2003

Geographic Distribution Figure 2.7 displays the geographic distribution of mosquitoes collected in sweep net collections inside and outside the District. White areas are tolerable annoyance levels (0-4), lightest gray is moderate (5-9), darker gray is bad (10-14) and black is extremely bad (>15). There are some hot spots within the interior of the District, but overall mosquito levels are higher in outer areas. Figure 2.8 depicts the sweep net collection locations for 2003.

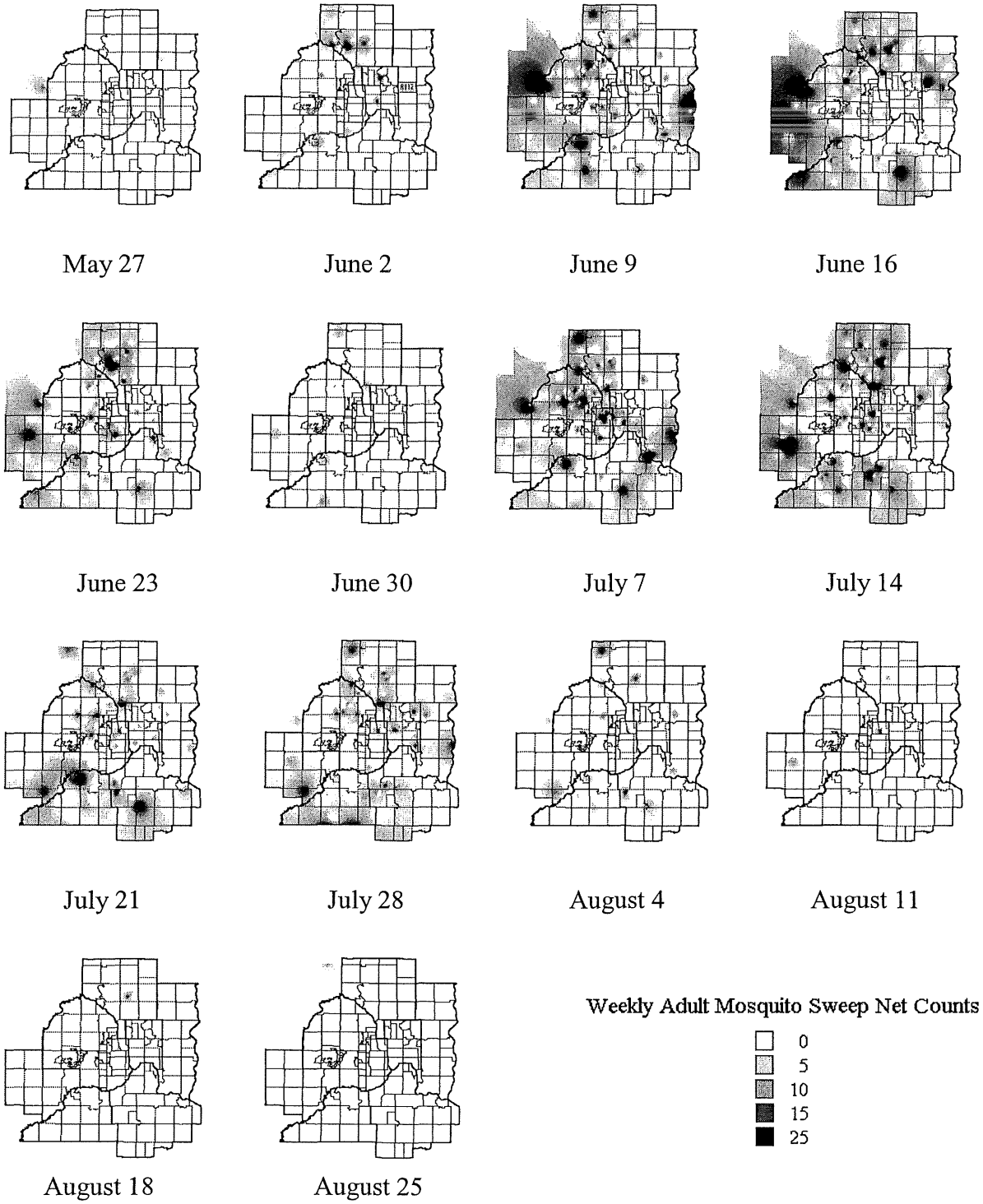

Fig. 2.7 Average number of *Ae./Oc.* mosquitoes in sweep net collections, 2003

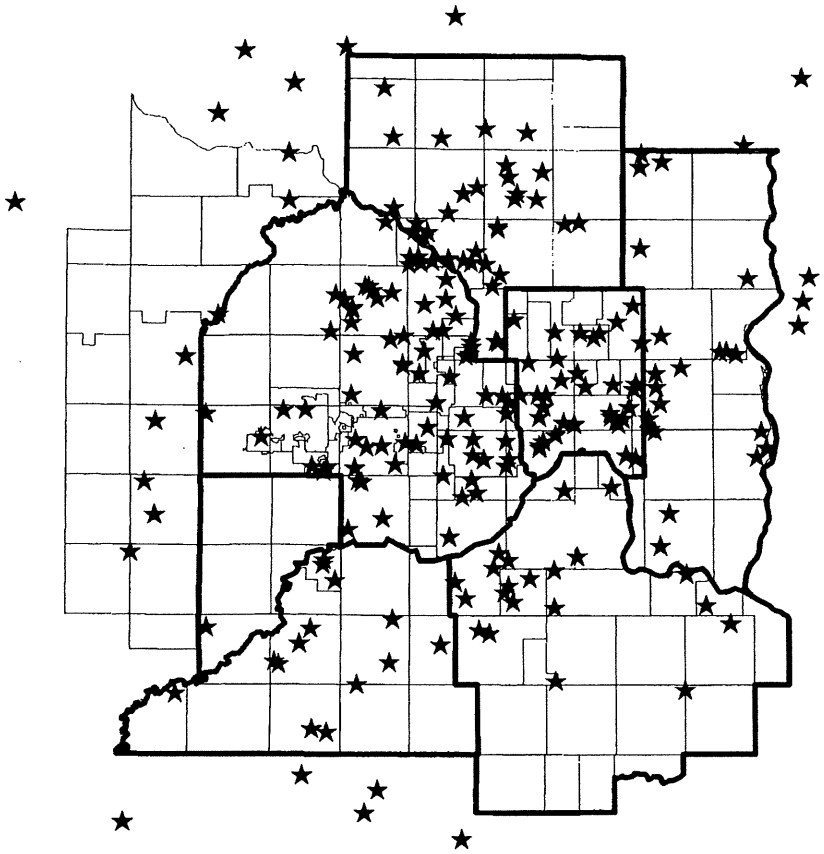

Figure 2.8 Locations of weekly evening sweep net collections, 2003

Plans for 2004

Surveillance strategies for *Ae./Oc.* mosquitoes will remain unchanged. Staff will be researching surveillance strategies and defining adult treatment thresholds for *Culex* mosquitoes. We will also review the placement of New Jersey light traps, especially in the expansion area of Carver County.

Chapter 3 Mosquito Control

2003 Highlights

- 89,885 fewer acres of wetlands were treated with larvicides than in 2002
- 7,649 more acres treated with adulticides than in 2002
- A cumulative total of 135,978 catch basins treated in three rounds to control vectors of WNV
- Larval treatment thresholds revised to include: *Culex restuans, Cx. pipiens, Cx. salinarius,& Cx. tarsalis*

2004 Plans

- All mosquito control programs undertaken in 2003 will continue
- Targeting WNV vectors, primarily *Culex*, will result mostly in increased larvicide applications
- Western Carver County joins the District resulting in increased larvicide and adulticide applications
- Adulticide applications may increase if there is an increase in mosquito-borne disease risk

Background Information

The mosquito control program targets the principal summer pest mosquito (*Ae. vexans)*, several species of spring *Aedes* and *Ochlerotatus*, the cattail mosquito-(*Cq. perturbans)*, the eastern treehole mosquito-(*Ochlerotatus triseriatus*-La Crosse encephalitis vector), and several *Culex* species that are potential vectors of West Nile virus (*Culex pipiens, Culex restuans, Cx. tarsalis,* and *Culex salinarius*). Larval control is the main focus of the program but is supplemented by adult mosquito control when necessary.

Aedes/Ochlerotatus 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* species also breed during periods of greater precipitation but inhabit more permanent waters and therefore are not as dependent upon rainfall. Catch basins also can support breeding of *Cx. pipiens* and *Cx. restuans* and were the primary source of WNV vectors in heavily urbanized areas during the 2002 WNV epidemic in Chicago. Chapter 1 provides detailed information about control of *Oc. triseriatus*. In-depth descriptions of the biology of the various mosquito species found in the District is in Appendix B.

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 metro area and has boundaries similar to the Metropolitan Urban Service Area (MUSA, Metropolitan Council). Priority Zone 2 includes sparsely populated areas. The remaining rural parts of the District are designated Priority Zone 3. 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, primarily in high use park and recreation areas, for public events and in response to citizen mosquito annoyance reports. Three synthetic pyrethroids are used: resmethrin, permethrin and sumithrin. 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 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.

2003 Mosquito Control

Larval Mosquito Control

District-wide larvicide treatments for the cattail mosquito, *Cq. perturbans*, began in March while spring *Ae./Oc.* treatments began in mid-April. Floodwater mosquito treatment began in mid-May and continued though September. The majority of larvicide treatments occurred in May, June and July, which is when the District received much of the season's rainfall (Fig. 3.1). Drier conditions thereafter resulted in lower levels of mosquito production. Because of the lack of significant rainfall after mid-July 2003 compared to nearly weekly significant rains that supported mosquito breeding throughout the 2002 season, MMCD treated about 89,885 fewer acres with larvicides than in 2002 (Table 3.1). However, in June, July and August 2003, MMCD treated a total of 135,978 catch basins with larvicides to control vectors of WNV. MMCD did not treat catch basins in 2002.

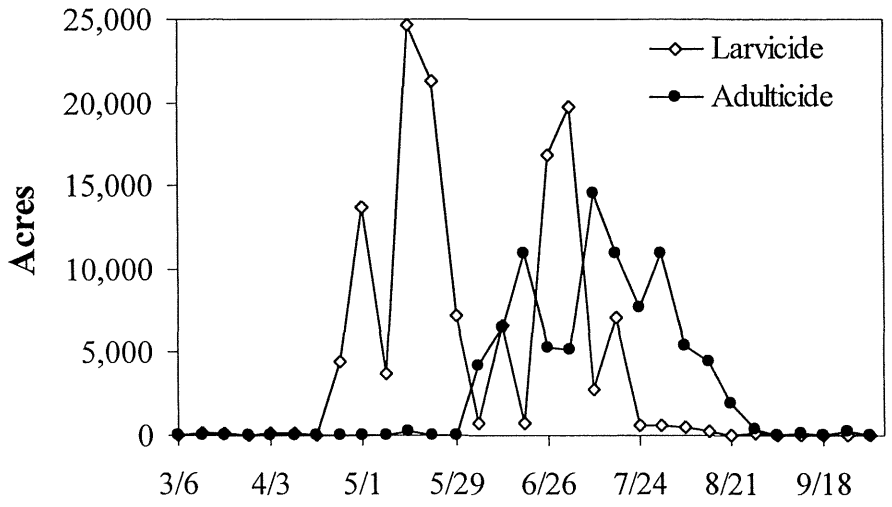

Figure 3.1 Acres of larvicide and adulticide treatments each week (March-October 2003).

In 2003 the number of acres treated with Altosid® pellets was slightly higher than in 2002. Altosid® SR-20 treatments were slightly lower in 2003 than in 2002. Significantly fewer acres were treated with Altosid® briquets and Altosand products in 2003 compared to 2002. Altosid® briquet treatments decreased primarily because cattail sites, which receive a significant proportion of Altosid® briquets, were drier in 2003 than in 2002. Altosand products have been essentially discontinued because only ground treatments have achieved consistent control. Significantly fewer acres were treated with *Bti* in 2003 than in 2002, primarily due to lower levels of breeding during the latter half of the 2003 season (Table 3.1).

Table 3.1 Comparison of larval control material usage in 2003 and 2002.

	2002		2003	
Material	Amount used	Area treated	Amount used	Area treated
Altosid® briquets	800 cases	628 acres	548 cases	323 acres
Altosid® pellets	49,860.68 lb	16,521 acres	57,607.59 lb	18,458 acres
Altosid® pellets	None		1,259.05 lb	135,978 CB[1]
Altosand products	12,606.01 lb	1,822 acres	2.36 lb	0.47 acres
Altosid® SR-20	1,015.30 ml	51 acres	654.57 ml	33 acres
Bti corncob	1,623,001.13 lb	202,875 acres	905,657.34 lb	113,198 acres
				132,012 acres
Larvicide totals		221,897 acres		135,978 CB[1]

[1]CB-catch basin treatments

Beginning in April 2003, the threshold for treatment with *Bti* was 0.1 larvae per dip for spring *Ae./Oc.* in Priority Zone 1. A higher threshold of 0.5 larvae per dip was used in Priority Zones 2 and 3 to target limited control materials to sites with the most intense breeding. After mid-May, the threshold was increased to control the summer floodwater mosquitoes. This year we included *Culex* in the threshold. For sites with only *Culex,* the threshold was 1 per dip in all priority zones. For sites with both *Culex* (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, and *Cx. tarsalis*) and floodwater mosquitoes, the threshold was 2 per dip in Priority Zone 1 and 5 per dip in Priority Zones 2 and 3.

Catch basin treatments were scheduled to begin during the third week of June or sooner if mosquito breeding was detected in at least one out of three catch basins targeted for inspection and treatment. Treatments of Altosid® pellets (3.5 grams per catch basin) occurred during three 10-day blocks, one each in June, July and August.

Adult Mosquito Control

Adulticide treatments began in early June, peaked in July and continued until late August (Fig. 3.1). Adult mosquito control operations were considered when mosquito levels rose above established thresholds of two mosquitoes in a 2-minute sweep or 2-minute slap count or 130 mosquitoes in an overnight CO_2 trap. Staff conducted treatments in areas identified by District surveillance and customer mosquito annoyance reports. In 2003, MMCD treated about 7,649 more acres with adulticides than in 2002 (Table 3.2), primarily in response to WNV surveillance.

Table 3.2 Comparison of adult control material usage in 2002 and 2003.

	2002		2003	
Material	Amount used	Area treated	Amount used	Area treated
Permethrin	1,137.89 gal	5,734 acres	1,251.55 gal	6,411 acres
Resmethrin	515.41 gal	43,302 acres	817.66 gal	68,057 acres
Sumithrin	768.28 gal	32,230 acres	347.77 gal	14,447 acres
Total		81,266 acres		88,915 acres

2004 Plans for Mosquito Control Services

Larval Control

Cattail Mosquitoes *Coquillettidia perturbans* has a limited flight range of five miles. Consequently, MMCD will focus control activities on the most productive cattail marshes near human population centers. Briquet applications will start in early March to frozen sites (floating bogs, deep water cattail sites, remotely located sites). Beginning in late May, staff will treat with pellets applied by helicopter at a rate of 4 lbs/acre.

Floodwater mosquitoes and *Culex* species The larval treatment strategy for 2004 will be similar to 2003. Staff will treat ground sites (<3 acres) with methoprene products or *Bti* corn cob granules. MMCD also plans to continue using six helicopters for the treatment of air sites. 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. In 2004, larval treatment thresholds will be the same as in 2003.

The primary control material will again be *Bti* corn cob granules. Forecasted material needs in 2004 are higher than in 2003, primarily due to vector control and the addition of western Carver County to the District. 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.

In 2004, methoprene pellets will be used in catch basins chosen for treatment. Catch basins selected for treatment include those found holding water, those that potentially could hold water based on their design, and those about which we have insufficient information to determine that they will not hold water. Treatments could begin as early as the end of May and no later than the third week of June. Surveillance in 2003 indicated that *Cx. restuans* was present in catch basins during the first week of June and *Cx. pipiens* during the third week of June. We have tentatively planned to complete a first round of pellet treatments by June 26 with subsequent treatments every 30 days.

Adult Mosquito Control

Forecasted permethrin, resmethrin and sumithrin requirements in 2004 are higher than in 2003 with the increase due primarily to WNV vector control and the addition of western Carver County to the District. MMCD will direct adult mosquito control treatments to provide the greatest customer benefit, generally higher risk disease areas and human populated areas that have high levels of mosquitoes. Also, MMCD will provide service in high-use park and

recreation areas and for public functions. Notification methods of adult mosquito applications are discussed in Chapter 6 Supporting Work.

Vector Mosquito Control

Employees will routinely monitor and control *Oc. triseriatus*, *Cs. melanura*, *Cx. tarsalis*, *Cx. pipiens*, *Cx. restuans*, *Cx. salinarius*, and *Ae. albopictus* populations. See Chapter 1 Vector-Borne Disease of this report for more details.

Chapter 4 Black Fly Control

2003 Highlights

- 2nd year of black fly public perception study completed
- 2001 multiplates processed
- 2003 nontarget samples collected
- Adult levels of black flies low

2004 Plans

- Threshold for treatments the same as previous years
- Non-target study from 2001 will be submitted in February
- Process and identify 2003 multiplate samples
- Analyze public perception annoyance study results

Background

The goal of the black fly program is to reduce pest populations of adult black flies within the MMCD to tolerable levels. Black fly larval populations are monitored at about 140 small stream and 21 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 went into effect in 1996.

2003 Program

Small Stream Program - *Simulium venustum* Control

The only human biting species that breeds in small streams is *Simulium venustum*. It has one early spring generation. Larvae are found in small streams throughout the District, although the largest populations generally are found in Anoka County.

Approximately 100 potential *S. venustum* breeding sites were sampled in mid-April to determine larval abundance using the standard grab sampling technique developed by the MMCD in 1990. The treatment threshold was 100 *S. venustum* per sample. A total of 23 sites on 10 streams met the threshold and were treated once with Vectobac® AS12 formulation of *Bti*. A total of 14.1 gallons of *Bti* was used (Table 4.1).

Table 4.1. Summary of *Bti* treatments for black fly control by the MMCD in 2003.

Water body	No. of application sites	No. of treatments	Gallons of *Bti* used
Small streams	23	23	14.1
Mississippi River	2	13	1,672.9
Crow River	3	7	170.0
Minnesota River	6	13	1,393.5
Rum River	3	16	157.1
Total	37	72	3,407.6

Large River Program

There are three large river-breeding black fly species that the MMCD targets for control. *Simulium luggeri* breeds mainly in the Rum and Mississippi rivers, although it also breeds in smaller numbers in the Minnesota and Crow rivers. *Simulium luggeri* is abundant from mid-May through August. *Simulium meridionale* and *Simulium johannseni* breed primarily in the 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 population size at each treatment location was measured weekly between May and early-September in 2003 using artificial substrates at the 21 sites permitted by the Minnesota Department of Natural Resources on the Rum, Mississippi, Crow and Minnesota rivers. The treatment thresholds were the same as those used since 1990. A total of 49 treatments using 3,393.5 gallons of Vectobac® AS12 (*Bti*) were made to control large river-breeding black fly larvae in 2003. Black fly large river treatment history is demonstrated in Table 4.2. Flows were above average during the black fly breeding season (April - September) on the Mississippi (+4% over the long term average for the treatment season), Rum (+60%), and Crow rivers (+44%), and 28% below average on the Minnesota River in 2003.

All treatments for black fly control in 2003 were made with Vectobac® 12AS. The average post-*Bti* treatment larval mortality (measured at least 250 m downstream of the point of the *Bti* application) was 88% on the Crow River, 96% on the Rum River, 97% on the Minnesota River, and 99% on the Mississippi River.

Table 4.2. Large River Treatment History

Year	No. of treatments	No. of gallons used	Discharge (cu ft/sec)
1999	50	4,299.0	6,857
2000	18	808.6	809
2001	45	4,045.0	11,243
2002	55	3,145.0	6,490
2003	49	3,393.5	4,862

Adult Population Sampling

The adult black fly population was monitored in 2003 at 48 standard locations throughout the MMCD using the District's standard black fly over-head net sweep monitoring technique that was established in 1984. Samples were taken twice weekly from early May to mid-September, generally between 8 AM and 10 AM. The average number of all species of adult black flies captured per sample in 2003 was 1.96. Between 1998 and 2002, the overall average number of adults captured was 2.85, 1.63, 2.38, 1.30 and 0.61, respectively (Table 4.3). In 1984 and 1985, before any large river treatments were done, the average number of black flies captured per sample was 17.95 and 14.56, respectively (Table 4.3).

The most abundant black fly collected in the overhead net-sweep samples in 2003 was *S. luggeri,* comprising 84% of the black flies collected. The overall average number of *S. luggeri* captured in the net-sweep samples in 2003 was 1.65. Population peaks of adult *S. luggeri* were observed in late May, late July and late August. *Simulium luggeri* was most abundant in Anoka County in 2003, as it has been in all previous years of the program. The average number of *S. luggeri* captured in Anoka County between 1998 and 2002 ranged between 1.65 and 16. The high number *of S. luggeri* captured in Anoka County is most likely due to its close proximity to the Rum and Mississippi rivers (especially untreated portions of the rivers that are outside the MMCD), which have abundant *S. luggeri* larval habitat.

Adult black fly populations were also monitored twice weekly from May 12 until June 26 by CO_2-baited light traps at 4 sites in Scott/Carver counties, at 4 sites in Anoka County and at 3 sites outside the MMCD in Monticello. The sampling sites in Anoka and Scott/Carver counties were located near *S. venustum* breeding sites on small streams. The traps were placed at the edges of woodlots and open areas, which is the optimal host-seeking habitat for black flies and *S. venustum* in particular. The three sampling sites in Monticello were located near the Mississippi River and were selected to serve as general reference sites outside the MMCD black fly treatment area. Sampling has been conducted at these sites with CO_2 traps since 1998.

The average number of *S. venustum* captured per CO_2 trap was 7.46 in 2003. Between 1998 and 2002, the average number of *S. venustum* captured per trap has ranged between 1.95 and 10.5. The average number of *S. luggeri* captured per trap in 2003 at the three reference sites in Monticello was 3.77 versus 2.97 per trap at the seven sites within the MMCD. In 2002, the average number of *S. luggeri* captured per trap in Monticello was 32.60 versus 0.79 per trap at the trap sites within the MMCD. The average number of *S. meridionale* captured in the 7 traps within the MMCD in 2003 was 53.3. In 2002, the average number of *S. meridionale* captured within the MMCD was 27.35. The highest population of black flies observed since the CO_2 trapping program began occurred in 2001 when *S. meridionale* averaged 611 per trap, which was attributed to flooding of the Minnesota River during May and June and subsequent cancellation of *Bti* treatments.

Table 4.3 Annual mean number of black fly adults captured in over-head net sweeps in bi-weekly samples taken at 48 standard sampling locations throughout the MMCD between mid-May and mid-September. The first operational treatments of the Mississippi River began in 1990 at the Coon Rapids Dam. 1988 was a severe drought year and limited black fly production occurred.

Year	All species[1]	*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	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

[1]All species includes *S. luggeri, S. meridionale, S. johannseni, S. vittatum* and *S. venustum*

Non-target Monitoring

The District conducts biennial monitoring of the non-target invertebrate population in the Mississippi River as a requirement of its permit from the Minnesota Department of Natural Resources. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. Sampling was conducted in 2001. A final report on these data is past due, but will be completed in February 2004. The results from the monitoring work conducted in 1995, 1997 and 1999 do not indicate that any large-scale changes have occurred within the invertebrate community (collected on Hester-Dendy multiplates) in the *Bti* treated reaches of the Mississippi River. Sampling was repeated as scheduled on the Mississippi River in 2003. Samples are in the process of being identified and enumerated with a report due in February 2005.

Public Perception of Annoyance from Black Flies

In 2001, the Black Fly team developed plans for a study designed to estimate public annoyance relative to black fly numbers, establish what level of annoyance is tolerable, and estimate the value the public places on reducing black fly annoyance. Data were collected from 141 randomly selected households in 2002 and 120 randomly selected households in 2003. Data are currently being analyzed.

2004 Plans

Our goal is to continue to effectively control black flies in the large rivers and small streams. The larval population monitoring program and thresholds for treatment will remain the same as in previous years. Taxonomic identification and enumeration of the non-target samples collected in 2001 have been completed and a report will be submitted to MDNR in February 2004. The non-target monitoring samples collected on the Mississippi River in 2003 are in the process of being identified and enumerated.

Chapter 5 Product & Equipment Tests

2003 Highlights

- Vectobac® G *Bti* achieved 88.2 % control of *Ae. vexans* in air sites
- Altosid® pellets effectively controlled *Culex* and other mosquitoes in catch basins
- Altosid® briquets and Vectolex® CG (*B. sphaericus*) failed to effectively control mosquitoes in catch basins
- Vectolex® CG effectively controlled *Culex* in wetlands for 12 days
- Altosid® XR-G sand controlled *Cq. perturbans* as effectively as Altosid® pellets in cage tests
- ULV applications of Pyrenone® controlled adult mosquitoes as effectively as Scourge®. Pyrenone has no crop restriction while Scourge® and Anvil® do.

2004 Plans

- Continue testing Vectolex® CG, Altosid® briquets, and Altosid® pellets to control *Culex* mosquitoes
- Continue testing Altosid® XR-G sand against *Cq. perturbans*
- Further test Pyrenone® for adult mosquito control in croplands
- Test aerial adulticide equipment to prepare for possible aerial adulticiding to combat WNV or other mosquito-borne diseases

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.

2003 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 utilize in its operations.

Acceptance Testing of Altosid® (methoprene) Briquets, Pellets and XR-G Sand

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, "Determination of

Methoprene in Altosid Sand Granules". All 2003 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 XR-G sand.

Methoprene Product	Samples Analyzed	Methoprene Content: Label Claim	Methoprene Content: Analysis Average	SE
150-day XR Briquets	10	2.10%	2.09%	4.35%
30-day Pellets	27	4.25%	4.23%	1.09%
20-day XR-G Sand	5	1.50%	1.55%	4.50%

In 2004, MMCD will resubmit the 2003 samples for independent analysis of their active ingredient levels. This evaluation will build our product carryover database to help determine whether methoprene products can be stored over the winter. By evaluating these samples at their expiration dates, we will gain further insight into the shelf-life of these products allowing MMCD to make better treatment and purchasing decisions in the latter part of the mosquito season.

Evaluation of Active Ingredient Levels in Adult Mosquito Control Products

MMCD has requested the certificates of Active Ingredient (AI) analysis from the manufacturers to verify product AI levels at the time of manufacture. All of the products received by MMCD in 2003 were guaranteed by the manufacturer to contain label required AI levels. MMCD has incorporated AI analysis as part of our product evaluation procedures and will submit samples of all adulticide control materials (purchased and stored) to an independent laboratory for AI analysis in 2004. These independent results will be compared to manufacturer's Certificates of Analysis to assure quality of purchased products and MMCD storage parameters.

Recycling of Pesticide Containers

MMCD continued to use the Minnesota Department of Agriculture's (MDA) pesticide container recycling program which focuses on properly disposing of agricultural pesticide waste containers thereby protecting the environment from the related pesticide contamination of ground and water. MDA again used Tri-Rinse, Inc., St. Louis, MO for disposal services of their plastic pesticide container-recycling program.

Warehouse personnel arranged for all of MMCD's plastic containers to be collected and properly stored until they could be processed. MMCD staff collected over 4,117 jugs for this recycling program. The control materials that use plastic 2.5-gallon containers are sumithrin (141 jugs), *Bti* liquid (1,363 jugs) and Altosid® pellets (2,613 jugs).

Twelve MMCD staff members (two employees from each regional facility) assisted in the jug grinding process which was completed in one day and resulted in approximately 3,600 lbs of recycled shredded plastic.

Reduced Production of Hazardous Waste

To properly handle and dispose of pesticide containers, each oil-based adulticide container had to be triple-rinsed with mineral spirits. This rinsing process creates a rinsate that MMCD manages as hazardous waste.

This year MMCD centralized the triple-rinsing process and used our warehouse personnel expertise to lower the amount of hazardous waste created by our operations. By rinsing all the containers at the same time, warehouse staff was able to significantly reduce the quantity of mineral spirits used in the recycling process. MMCD only produced 2.25 gallons of mineral spirit rinsate in 2003.

In addition, warehouse staff recovered 0.75 gal of Anvil® by drawing off each of the 141 containers before starting the triple-rinsing process. This recovery saved the District approximately $40.00 in material costs.

Efficacy of Control Materials

***Bti* Corncob Applications** Vectobac® G brand *Bti* (5/8 inch mesh size corncob granules) from Valent BioSciences was the primary *Bti* product applied by helicopter in 2003. Efficacy as calculated in terms of pre-treatment and post-treatment larval counts was similar in 2003 and 2002 (Table 5.2).

Table 5.2 Efficacy of aerial *Bti* (Vectobac® G) applications in 2002 and 2003. SE=standard error.

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2002	837	93.3	100.0	0.7%	0.0	100.0
2003	687	88.2	100.0	1.1 %	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. It is the District's policy to attempt to use the most environmentally friendly products possible while achieving acceptable control rates. As part of this process, MMCD certifies materials as acceptable with District-run evaluations before using the products operationally.

Altosid® Treatments in Catch Basins In 2003 MMCD treated catch basins to control potential mosquito vectors of WNV. Both Altosid® briquets and pellets were effective in Michigan (McCarry 1996, Knepper et al. 1992). This year staff concentrated on bioassays of Altosid® briquets and pellets in catch basins because these products had never been tested in this breeding habitat in Minnesota. Untreated control emergence was similar to results of untreated control bioassays collected in 2002 from floodwater mosquito breeding sites (Table 5.3).

Table 5.3 Bioassay results for untreated control catch basins in 2003 compared to floodwater mosquito sites in 2002.

Year	n	Mean % emergence	Median % emergence	SE	Min % emergence	Max % emergence
2002	18	91.2	95.5	2.8%	55.0	100.0
2003	11	83.8	82.0	2.7%	72.9	100.0

We tested a new Altosid® briquet shape called the "ingot" designed to better fit through catch basin grates. The ingot has the same label, amount of active ingredients and field life (150 days) as standard Altosid® briquets. The ingots were not effective in catch basins treated in 2003 (Table 5.4). The lack of efficacy did not seem to be related to briquets being flushed out of catch basins by a 5-inch rain on June 25 because bioassays collected before this rain and bioassays of catch basins treated after this rain also indicated low efficacy (Table 5.5). Altosid® ingot briquets must deliver consistent long lasting high efficacy to be cost effective. More data are required to determine the cause of low ingot efficacy because their potential long field-life makes them attractive for treating catch basins located in hard-to-reach or unsafe places.

Table 5.4 Results of bioassays from catch basins treated with Altosid® ingot briquets and Altosid® pellets in 2003. Emergence inhibition (EI) is corrected for untreated control mortality.

Material	n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
Altosid® ingot	33	36.1	16.5	6.2%	0.0	100.0
Altosid® pellet	56	84.3	99.0	4.2%	0.0	100.0

Altosid® pellets, however, were very effective in catch basins in 2003 (Table 5.4). Control measured by bioassays collected after the 5-inch rain from catch basins treated before the rain appears significantly lower than control in catch basins both treated and evaluated via bioassay before or after the 5-inch rain (Table 5.5). This might be a chance result because the vast majority of bioassays were collected from catch basins treated after the 5-inch rain. It also could indicate that pellets were flushed out of catch basins by the rain thereby nullifying control. These data indicate that pellets effectively control mosquitoes breeding in catch basins in the absence of large rain events.

Table 5.5 Results of bioassays from catch basins treated with Altosid® ingot briquets and Altosid® pellets in 2003 categorized by whether the treatment and bioassay occurred before or after a 5-inch rain on June 25, 2003. Emergence inhibition (EI) is corrected for untreated control mortality.

Material	Treatment Before Rain?	Bioassay Before Rain?	n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
Altosid® ingot	Before	Before	1	10.5	10.5	N/A	10.5	10.5
	Before	After	27	42.6	29.6	7.0%	0.0	100.0
	After	After	5	6.5	2.1	3.2%	0.0	16.5
Altosid® pellet	Before	Before	3	57.9	76.1	29.6%	0.0	97.6
	Before	After	3	28.4	4.5	25.7%	1.0	79.7
	After	After	50	89.2	100.0	3.6%	0.0	100.0

Vectolex® CG Granules in Catch Basins We also tested Vectolex® CG in catch basins. Vectolex® CG granules contain *Bacillus sphaericus* (*Bs*), a bacterium that is related to *Bti*. *Bacillus sphaericus* is of interest because it has achieved control of mosquito larvae for up to four weeks, retains effectiveness against mosquitoes in water of high organic content (potential *Culex* breeding sites), has a mode of action similar to but not identical to that of *Bti*, and is as specific to mosquitoes as *Bti* which minimizes non-target impacts.

Vectolex® CG granules were only moderately effective against mosquito larvae breeding in catch basins in preliminary tests, although high median efficacy values suggest that Vectolex® CG has the potential to achieve effective control for at least 8 days after treatment (Table 5.6). These tests will be repeated in 2004.

Table 5.6 Efficacy of Vectolex® CG granules in catch basins in 2003.

Days after treatment	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2 days	8	59.0	73.1	16.0%	0.0	100.0
8 days	7	67.1	90.0	17.6%	0.0	100.0
10 days	7	53.3	66.7	1.1 %	0.0	100.0

Cattail Mosquito Control (Altosid® XR-G sand) In 2003 MMCD treated about 200 acres of cattail mosquito (*Cq. perturbans*) breeding sites with Altosid® XR-G sand to try to find a less expensive product than Altosid® pellets for controlling cattail mosquitoes. Emergence cages were used to evaluate the efficacy of Altosid® XR-G sand and Altosid® pellets. Altosid® XR-G sand performed very well compared to pellets (Table 5.7). These tests will be repeated in 2004 to confirm results for Altosid® XR-G sand.

Table 5.7 Emergence cage test results of Altosid® XR-G sand and Altosid® pellets against *Cq. perturbans.*

Treatment	Total emerged from all 15 cages	Mean emerged per cage	Percent reduction	No. of cages with *Cq. perturbans*
Control	203	13.5	N/A	12 of 15
XR-G	10	0.7	95.1	3 of 15
Pellets	61	4.1	70.0	7 of 15

***Culex* control in wetlands** Vectolex® CG effectively controlled both *Culex* and other mosquito larvae for at least twelve days (Table 5.8). At a few sites, repeat sampling occurred through 23 days after treatment. These results suggest that Vectolex® CG was effective at least for 23 days. These tests will be repeated in 2004 to better understand how consistently Vectolex® CG can control *Culex* and other mosquito larvae. Consistent effective control would make Vectolex® CG potentially more cost effective compared to Vectobac® G in sites with more permanent water because fewer applications would be required.

Table 5.8 Efficacy of Vectolex® CG Granules against *Culex* and all mosquito larvae in wetlands in 2003.

Species	Days after treatment	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
Culex	2 days	29	99.9	100.0	0.1%	96.2	100.0
	5 days	23	99.6	100.0	0.4%	90.0	100.0
	8-9 days	11	99.8	100.0	0.2%	98.2	100.0
	12 days	7	97.3	100.0	1.6%	88.9	100.0
	23 days	3	100.0	100.0	0.0%	100.0	100.0
All species*	2 days	44	96.7	100.0	1.8%	47.0	100.0
	5 days	42	88.3	100.0	3.9%	0.0	100.0
	8-9 days	13	76.7	100.0	9.7%	0.0	100.0
	12 days	9	80.5	100.0	11.3%	0.0	100.0
	16 days	4	57.5	65.0	25.3%	0.0	100.0
	23 days	4	94.0	95.5	3.7 %	85.0	100.0

* All species includes *Culex*, *Aedes*, *Ochlerotatus*, and *Anopheles*

Agnique® MMF This monomolecular surface film is being evaluated as a pupal control material. The last larval instar and pupa are non-feeding stages of mosquitoes that are not affected by current *Bti*-based larval control materials. This control material was applied to a few sites, mainly to evaluate operational feasibility. Insufficient results were collected to evaluate efficacy of Agnique.

Pyrenone® 5+25 MMCD tested Pyrenone® 5+25 because, according to the label, there are no crop restrictions so Pyrenone® can be used to control WNV vectors in croplands. Pyrenone® contains natural pyrethrins synergized with piperonyl butoxide. ULV applications (1.5 oz/acre; 0.00172 lb ai/acre) of Pyrenone® 5+25 controlled adult mosquitoes as effectively as Scourge® (1.5 oz/acre; 0.0035 lb ai/acre) in two separate tests (Table 5.9, Fig. 5.1). Efficacy was evaluated using the District's standard protocol that compares mean mosquito captures the first night of trapping (pre-treatment counts) with mean mosquito captures the second and third nights of trapping (post-treatment counts). Test materials were applied the evening of the second night of trapping; CO_2-traps were placed 30 minutes after the treatments were completed at both treated locations and the untreated control location.

Table 5.9 Efficacy of Scourge® and Pyrenone® against adult mosquitoes in two tests in July 2003. Test locations were Ajawah, Guy Robinson, and Rum campgrounds.

Date	Treatment	Average % decrease	Average mosquitoes per trap	Median mosquitoes per trap	SE	Minimum mosquitoes per trap	Maximum mosquitoes per trap
July 8	Scourge®	Ajawah	2,879	3,544	1,014.9	886	4,208
July 9	Scourge®	93.0	200	208	44.9	119	274
July 10	Scourge®	29.0	2,043	2,392	393.5	1,258	2,480
July 8	Control	Guy R.	7,827	7,520	339.2	7,456	8,504
July 9	Control	-245.1	27,013	22,992	8,931.1	13,952	44,096
July 10	Control	24.6	5,901	5,904	150.1	5,640	6,160
July 8	Pyrenone®	Rum	5,256	6,280	1,276.1	2,719	6,768
July9	Pyrenone®	96.7	173	153	34.4	126	240
July 10	Pyrenone®	50.2	2,615	1,978	734.4	1,788	4,080
July 23	Scourge®	Guy R.	2,493	2,594	163.9	2,172	2,712
July 24	Scourge®	12.1	2,191	501	1,808.8	266	5,806
July 25	Scourge®	50.0	1,246	1,424	354.9	562	1,752
July 23	Control	Rum	785	779	211.1	423	1,154
July 24	Control	-103.4	1,597	1,528	217.6	1,260	2,004
July 25	Control	-147.8	1,946	1,838	327.2	1,441	2,559
July 23	Pyrenone®	Ajawah	2,320	2,348	287.9	1,808	2,804
July 24	Pyrenone®	97.2	65	72	24.8	19	104
July 25	Pyrenone®	91.6	194	231	58.9	79	273

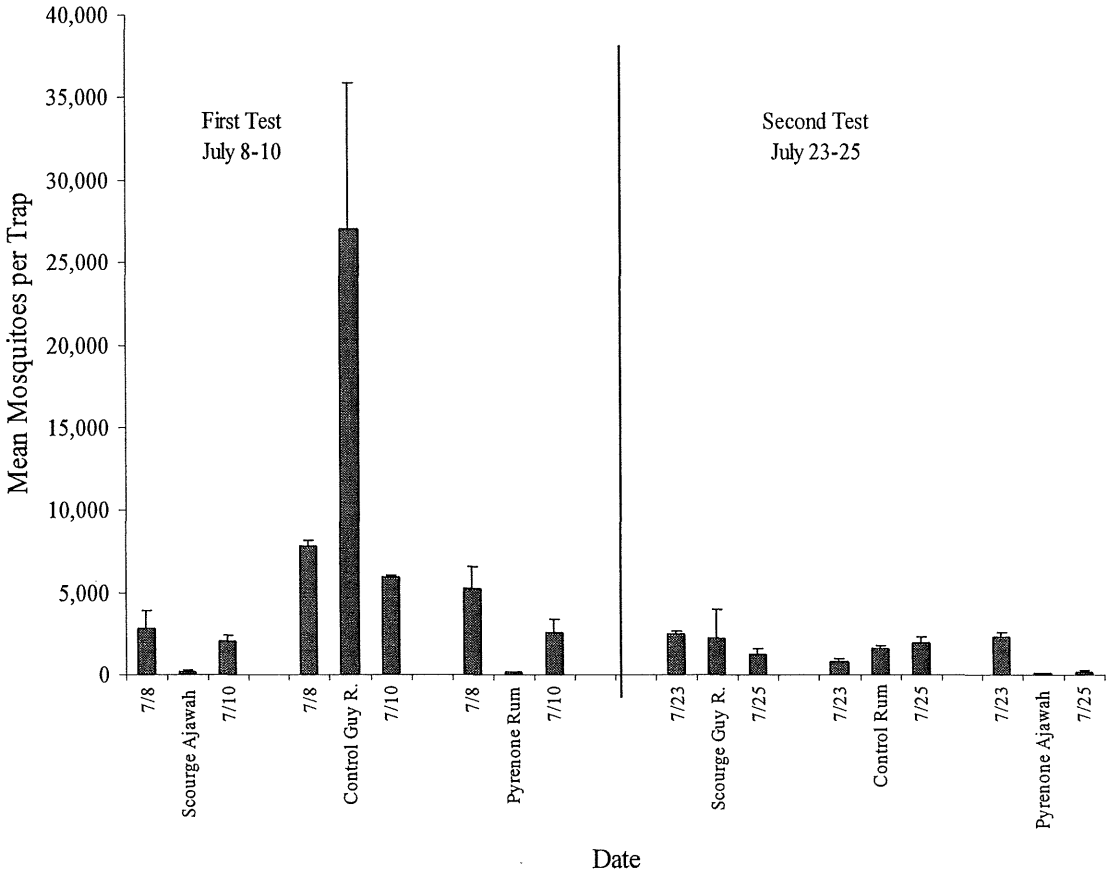

Fig. 5.1 Efficacy of Scourge® and Pyrenone® against adult mosquitoes in two tests in July 2003. Heights of bars indicate 1 standard error.

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services and field staff conducted four aerial calibration sessions for dry granular materials during the 2003 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so MMCD can optimize each helicopter's dispersal characteristics. Two sessions were held at the municipal airport in LeSueur, MN and two sessions were located in Lino Lakes, MN. Staff completed calibrations for six different operational and experimental control materials. In total, six helicopters were calibrated and each helicopter was configured to apply an average of three different control materials.

Aerial Adulticide Applications MMCD continues to evaluate various spray systems for their applicability in our adult mosquito control program. Technical Services has worked directly with our helicopter contractor, manufacturers and other mosquito control professionals to develop an appropriate application system for our control materials.

Observation of a Sioux Falls, South Dakota Aerial Adulticide Application Technical Services continued to acquire experience with aerial application methodologies and observed a large scale city-wide spray operation in Sioux Falls, SD on 15 September 2003. The South Dakota Department of Health authorized this fixed-wing spray application of Anvil® 10-10 (Sumithrin) in response to multiple cases of WNV occurring throughout the state. Clarke Mosquito Control (Roselle, IL) and Dynamic Aviation (Bridgewater, VA) conducted the aerial operations and allowed MMCD staff to observe the overall spray operations. As part of this observation, Clarke/Dynamic permitted MMCD Technical Services staff to collect physical data on swath patterns and droplet characteristics. Within the treatment area, MMCD placed two 200-foot lines of rotating impingers complete with Teflon-coated slides to collect insecticide droplets and observed uniform dispersal of droplets of approximately 12-22 microns (median micron diameter). This droplet size range is consistent with label recommendations, literature research, and MMCD data for optimum adult mosquito control.

Helicopter Aerial Adulticide Trials (Scott's Helicopter Service, LeSueur, MN
Technical Service staff conducted two aerial spray trials in 2003 using MMCD's rotary atomizers (Beecomist 360A Electric) mounted on a Bell 47 helicopter. The first trial physically examined the overall spray system and calculated the necessary flow rates to perform an experimental trial application. Using blank material (i.e. mineral oil), a flight test was conducted to investigate the best methods to evaluate the overall swath patterns and droplet spectrums.

A second trial was conducted to examine the basic flight operation of the spray system. During simulated applications using blank material, MMCD staff measured the atomizer's performance by placing a single 200-foot line of rotating impingers in the target area (LeSueur Airport) to collect spray droplets and evaluate the overall performance of the spray system. Additional variables were monitored including environmental conditions, swath offsets and application parameters. The rotary atomizers performed adequately producing a droplet spectrum that was within the recommended range for optimum adult mosquito control (8-20 microns) and a consistent swath pattern. In comparing the microscopic analysis of our helicopter spray system with the fixed-wing application completed in South Dakota, the helicopter system produced noticeably fewer droplets per slide but this was expected due to the different flight and application parameters.

To complete preparations for aerial applications, Technical Services is recommending a small-scale aerial adulticide test (using active materials - Anvil® 10-10 or Pyrenone® 5-25) in an outlying area to test the effectiveness of our control materials against adult mosquitoes using our helicopter system. This evaluation would be used as a basis for an emergency aerial application to assist in the control of a wide-scale disease outbreak or exotic species infestation that was deemed necessary according to the Centers for Disease Control (CDC), Metropolitan Mosquito Control Commission (MMCC) and MMCD guidelines.

Droplet Analysis of Ground-based Spray Equipment Technical Service staff optimized all fifty 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 our 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.

Technical Services recorded additional data on each piece of equipment to better understand all of the physical parameters that affect droplet production. MMCD continues to gain expertise in adjusting equipment attributes by utilizing new techniques and measuring devices (i.e. meters, gauges) to gain more control of the many variables which contribute to the spray quality. By further standardizing these variables, we have the ability to adjust and regulate equipment to produce the proper droplet range. Further equipment analysis has facilitated the replacement of worn or missing parts to advance additional MMCD equipment improvements.

All of the District's backpacks (112 units) were evaluated in 2003. A new database was developed as part of this evaluation. Due to the variability of the backpack brands and various ages of the equipment, testing further demonstrated a need for a standardized maintenance program to be established to better optimize our barrier spray systems. Technical Services is recommending development of a training program in which we utilize the small engine skills of specific employees to educate other members of our equipment team to improve backpack operations. All of the backpacks tested were adjusted to apply the correct droplet range for barrier treatments or removed from service. Removed units were eventually adjusted to proper working order or designated for replacement. Technical Services will continue use this technology to improve the consistency of the output of the District's adult mosquito treatment program.

Database for Evaluating Equipment Performance A new equipment database was developed to combine spray equipment performance with other fixed asset equipment databases. This expanded database will allow field staff to more easily access data about individual equipment (e.g. dates of evaluation, calibration data, equipment settings, evaluations of performance) as needed. It is intended to assist staff to evaluate their facility's purchasing needs, facilitate repairs/calibration requirements and increase staff access to their equipment's historical records. It is anticipated that MMCD can maintain a real-time equipment log book in this database and eliminate paper records.

American Mosquito Control Association (AMCA) Field Demonstration Day This demonstration day was held as part of the AMCA's 2003 Annual Meeting in Minneapolis, MN. Twenty-three organizations participated by demonstrating new equipment, techniques, and field methodologies used in mosquito abatement operations throughout the United States. This forum allowed MMCD staff to exchange ideas with other mosquito control professionals and to incorporate this acquired knowledge to improve our operations.

Plans for 2004

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 2004 MMCD plans to repeat tests of Vectolex® CG (*B. sphaericus*), Altosid® briquets and Altosid® pellets to control *Culex* mosquitoes breeding in catch basins and other sites. Tests of Altosid® XR-G sand against the cattail mosquito (*Cq. perturbans*) will be repeated as will tests of Pyrenone® for adult mosquito control. Finally, tests of aerial adulticide equipment will be conducted so we are prepared if aerial adulticiding is necessary to combat WNV or other mosquito-borne diseases.

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Chapter 6 Supporting Work

2003 Highlights

- Completed successful trial of field data entry using Palm PDAs
- Mapped locations of catch basins for WNV control. Wetland maps updated as needed
- Began developing storm water management education materials and made presentations to professional groups
- Dr. Karen Oberhauser conducted a test of permethrin toxicity to monarch butterfly larvae
- Work ongoing to publish 1997-1998 Wright County *Bti* and methoprene nontarget study
- New methods of public notification included direct e-mail messages and daily public meetings

2004 Plans

- Implement field data entry with PDAs in all field offices.
- Develop and disseminate storm water information on how management designs affect mosquito production
- Continue to develop adulticide nontarget impact studies
- Finalize publication of 1997-1998 Wright County *Bti* and methoprene nontarget study
- Conduct public opinion survey

2003 Projects

PDA Field Data Entry

Staff expanded on a successful small-scale test in 2002 of Palm OS-based Personal Digital Assistants (PDAs) for field data entry. Two field offices were equipped with PDAs for all inspectors. Custom data entry software was developed for two common MMCD forms: the FF2 (wetland inspections and ground treatments, catch basin treatments, and cattail larval inspections) and the C-form (container and tire inspections and removal). Data were entered for the latter part of the year using these forms on the PDAs and uploaded to local server databases daily. Most staff found the PDAs easy to use.

Using PDAs for daily data entry has several benefits for MMCD. Results of a time study showed foremen spent less time correcting errors when their staff used PDAs. Eliminating the cost of the current data entry service used for paper forms will pay for the PDA hardware in about 3 years. Having data available immediately will enable staff to use the information to improve inventory checking and tracking of lab samples. We also hope to develop tools for improving real-time fieldwork planning during periods of intense activity after a major rainfall.

Based on the success of the 2003 study, PDAs have been purchased for inspectors at all six field offices. There are also plans to develop additional software for entry of adult mosquito surveillance and other routine tasks.

Mapping

A major effort this year was mapping locations of storm water catch basins for WNV control. This used many of the map layers MMCD uses for other maps, including digital aerial orthorectified photos and metro area streets, both obtained through the MetroGIS project at the Metropolitan Council. Tests of MMCD's current low-end GPS units early in the year

showed that their accuracy was inadequate for catch basin mapping so the project was done using ¼ section paper maps augmented by information from the cities when available. The results are topologically accurate (e.g., 3rd catch basin from the SW corner of an intersection on the west side of street can be identified) and observations suggest their location accuracy to be +/- about 15 feet parallel to the street.

Staff continued to update digitized wetlands and wooded areas, and have begun mapping wetlands in the western Carver County area recently added to the District. Map updates in areas with new construction have been aided by the acquisition of new aerial photography in the fall of 2003 made available by the USDA Farm Service Administration through an agreement with the MN Land Management Info Center and MnDOT, MnDNR, and MPCA.

In early 2003 map and data files on citizen requests for restricted access or limited treatments on their property were updated and restructured to facilitate future data updates. Property boundaries were verified with parcel data obtained from the counties and MetroGIS.

Digital wetland or catch basin files have been provided on request to other units of government, including the U of M Department of Forest Resources, MN DNR Waters, Metro Council Environmental Services, and the city of St. Louis Park. Ramsey Soil and Water Conservation District has started a project making wetland maps including our data available on the internet as PDF files. MMCD continues to participate in MetroGIS, including serving on the Coordinating Committee. We shared information about our mapping process with Cass County, ND mosquito control employees who are working on setting up a similar system. We are beginning talks with USFWS representatives on how our data might be useful in an update of the National Wetlands Inventory in the metro area.

Storm water Management and Mosquitoes

The spread of West Nile virus has brought national attention to problems with constructed storm water structures Best Management Practices (BMPs) that provide larval habitat for mosquitoes (see "The Dark Side Of Storm water Management" by Metzger et al., Stormwater magazine, March/April 2002, http://www.stormh20.com). Locally, MMCD staff members have been assembling information on how storm water designs can promote or hinder mosquito production here. Staff participated in a workshop by the U of M Stormwater Laboratory and made presentations to organizations including the Board of Soil and Water Resources, SW Minnesota Public Works Association, MPCA/MECA "Plants and Stormwater Design" workshop, and Wetland Delineators Association, as well as to groups of city and private engineers.

Nontarget Studies

2003 Monarch Toxicity pilot study At the request of the Technical Advisory Board, MMCD has continued to evaluate nontarget effects of adulticides. Work reported in previous MMCD Operational Reviews has included:

- Literature review of ULV aerosol resmethrin and sumithrin (2002). ULV aerosol treatments result in little surface deposit, and resmethrin does not persist long in water or soil. Although fish and some aquatic invertebrates are susceptible to acute exposure to resmethrin, aquatic

habitats do not appear to receive sufficient exposure from ULV aerosol treatments to trigger mortality.

- Acute toxicity of Scourge® (ULV resmethrin) to caged loosestrife beetles (2002). Mortality of beetles downwind of fog path was 80% within 25 feet downwind, dropping to 20% or less at 75-110 ft.
- Loosestrife beetle exposure to MMCD adulticides (2000 and 2001). Data on the success of beetle releases vs. proximity to MMCD treatments showed that, although treatments might have affected a few sites, overall success of beetle populations was not related to adulticide treatments. MMCD currently keeps spray paths 150 ft from recent beetle release sites to allow establishment of beetle populations.
- Scourge® (ULV resmethrin) or Anvil® (ULV sumithrin) effect on nontarget flying insects (2000). Nontarget insect numbers in traps baited with ultraviolet light sources did not appear to be related to treatments in two field tests.

2003 Planning session—Staff members Stephen Manweiler and Nancy Read met with TAB members Dr. Karen Oberhauser, U of M Department of Fisheries, Wildlife and Conservation Biology, and Dr. Roger Moon, U of M Department of Entomology, to outline steps toward ecological risk assessment. We discussed possible species of concern, determining risk of exposure to toxic doses, mechanisms of exposure, mobile vs. sedentary insects, and possible methods including post-hoc surveys, direct mortality, and laboratory and field bioassays.

For 2003, we chose to study permethrin barrier treatments because of their long residual, and examine effects on monarch butterflies (*Danaus plexippus* (L.)) as an example of a charismatic sedentary herbivore. We decided to begin with a simple screening-level test (as defined by Wolt et al. 2003) to determine whether permethrin on milkweed had an effect on monarch larvae that fed on the leaves. If the material affected larval mortality or growth, additional work could evaluate larval population exposure to treated food sources. A brief review of relevant literature on permethrin was also done.

Permethrin background information—Permethrin, like other synthetic pyrethroids, is known for its low toxicity on mammals and birds (WHO 1990) and is unlikely to present a hazard to humans. Fish and many aquatic invertebrates are susceptible to permethrin but rarely exposed due to use patterns and the characteristics of the material (WHO 1990, NRCC1986). However, it is a broad-spectrum insecticide affecting Lepidoptera as well as Hemiptera, Diptera, and Coleoptera, especially when eaten by larvae, and has significant repellent action (WHO 1990). It has been used extensively on cotton (WHO 1990) and is labeled for use on vegetables, field corn and soybeans as Ambush® or Pounce®. The label dose for these crops ranges from 0.05 to 0.4 lbs AI/acre; label dose for barrier spray for mosquitoes and other flies is 0.1 lbs AI/acre (see Permethrin 57% OS label, Appendix F). Aerial applications of permethrin have been used for spruce budworm control in forests (NRCC 1986) at doses of 0.008 to 0.125 lb AI/acre. It is labeled as a ULV aerosol for mosquito control at doses of 0.0035 to 0.021 lbs AI/acre, but this application method is not used by MMCD for this material. Agricultural use of permethrin is complicated by development of resistance (Shelton 2000, Mascarenhas 2000), and potential for disruption of predatory mites (Zalom et al 2001) or parasitoids (e.g. Hill and Foster 2000).

Screening Tests –Initial studies were designed and carried out in July-September, 2003. MMCD staff examined areas where permethrin treatments were planned and found some areas with milkweed present. Staff collected milkweed from these areas and untreated areas at intervals after treatment. Individually packaged leaves were relabeled by staff from Dr. Moon's lab for a randomized double-blind design. Leaves were then delivered to Dr. Oberhauser's lab and set up in individual containers each with a single monarch larva from Dr. Oberhauser's colony. Additional leaves were collected by Dr. Oberhauser from treated areas listed on the MMCD web site and compared with leaves from untreated areas. A test of sublethal effects using serial dilutions of permethrin was also done. Dr. Oberhauser and student Sara Brinda scored and recorded results.

Results showed mortality of most monarch larvae on field treated leaves in all trials. First instar larvae appeared to be more susceptible. Leaves collected up to 15 days after treatment still caused mortality, but there was less than 0.5 in rainfall during this period so material was unlikely to have been washed off. Larvae exposed to the leaves for a shorter time had lower mortality, and the material may have had a repellent effect on some larvae. In the sublethal effects test, a dose of 0.1% of field rate (approx. 0.0001 lb AI/acre) appeared to extend normal development, usually about 26 days, by about 3 days. Details of the methods and results will be made available in a separate report.

Given these results, it appears that further work is warranted to evaluate risk. Most MMCD permethrin treatments are done at woodland edges, to keep mosquitoes from moving out of shaded resting areas into open areas with human activities. Field staff working on this study observed that, while milkweed may be found at woodland edges, it prefers more open locations if these are not mowed or otherwise managed. An ecological risk assessment would need to evaluate milkweed distributions relative to permethrin exposure, similar to the approach used by Oberhauser et al. 2001 to evaluate exposure of larvae to Bt corn pollen, and previous work on loosestrife beetle exposure to MMCD adulticide treatments (MMCD 2000 Operational Review, August 2001).

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Product labels for Ambush® 25W and Pounce® 3.2 EC from www.greenbook.net (CRC Press).

Wright County Non-target Impact Study Publication Interest remains high in the nontarget studies on *Bti* and methoprene done under the direction of the Scientific Peer Review Panel assembled by MMCD. Reports were sent as requested to the following:

Bureau of Land Mgmt./Fish and Wildlife Service Interagency Library, Sacramento, CA
Presidio Trust, San Francisco, CA
American Mosquito Control Association Technical Advisor, Orange Park, FL
Pesticides Section, Ministry of the Environment, Toronto, ON, Canada
Toronto Public Health, Health Promotion and Environmental Protection, Toronto, ON

In addition, access to the reports and related work has been expanded on the MMCD web site, www.mmcd.org.

Some progress has been made on assembling a report suitable for peer-reviewed journal publication from the 1997-1998 results of the Wright County *Bti* and methoprene non-target study. Dr. Richard Anderson (EPA, now retired, Continuation Panel member) assembled an initial draft. Work is progressing on assembling tables and figures and refining the draft, which will then be reviewed by the original researchers (Drs. Mary Balcer and Kurt Schmude, LSRI, and Lyle Shannon, UMD) and members of the Continuation Review Panel.

Public Information

During its 2003 session, the Minnesota State Legislature mandated changes in the way the District must notify citizens of adulticiding activities. In addition to notification methods already

in place, changes in MMCD's statutes now call for notification at least 24 hours in advance and direct notification of interested citizens.

Notification The District continues to post daily adulticide information on its website (www.mmcd.org) and on its "Bite Line" (651-643-8383), a pre-recorded telephone message interested citizens can call to get the latest information on scheduled treatments. The District also publishes a three column by nine-inch ad in local newspapers each spring advising citizens how they can find out where and when adulticiding will take place throughout the season.

Direct email notification In 2003, in response to legislation, the District began direct email notification of citizens who requested advance notification. A local company, GovDocs, was chosen to house and maintain lists of subscribers to this service. GovDocs was chosen for its experience in managing direct email notification of snow emergencies in the city of St. Paul. Citizens can subscribe by visiting MMCD's website and are offered a choice from among eight lists published daily by the District – North Hennepin, South Hennepin, Anoka, Dakota, Carver, Scott, Ramsey, and Washington facilities. Email notices are identical to notices posted each day on the District's website. Subscriptions to this service reached a peak of 440 in mid-July.

Daily public meetings Also new in 2003, public meetings about scheduled adulticide treatments were held each day at 3:00 PM at each regional office. Information available at these meetings was identical to information available through direct email notification, on the District's Bite Line, and on the District's website.

West Nile Virus in the News MDH was the lead agency for basic West Nile virus human case information. Information about horse cases was disseminated by the Minnesota Board of Animal Health. MMCD continued to be a sought-after source of accurate information about West Nile virus mosquitoes, prevention tips, and current treatment practices.

Throughout 2003, WNV-related press releases were issued by the Minnesota Department of Health (see: http://www.health.state.mn.us/divs/idepc/diseases/westnile/index.html for a list of MDH press releases). MMCD issued a single press release in late August advising citizens to continue taking precautions against mosquito bites – even though mosquito numbers appeared to be dropping due to dry weather.

WNV continues to be an important local, regional, and national story. While MMCD does not actively solicit media coverage of West Nile virus related activities, staff continue to be available to offer easily accessible and accurate information through brochures, community events, media interviews, and direct communication with city, county and state officials.

Calls Requesting Service Citizens of the metropolitan area can call MMCD to report high numbers of adult mosquitoes and request service. After increasing for several years, total call numbers in 2003 were similar to 2002. Calls reporting annoyance generally followed the seasonal pattern shown by sweep net counts for human-biting mosquitoes (Fig. 6.1 and Chapter 2). Increases in calls followed major floodwater mosquito broods, indicated by larvicide activity, and were in turn followed by adulticide activity (Fig. 6.2).

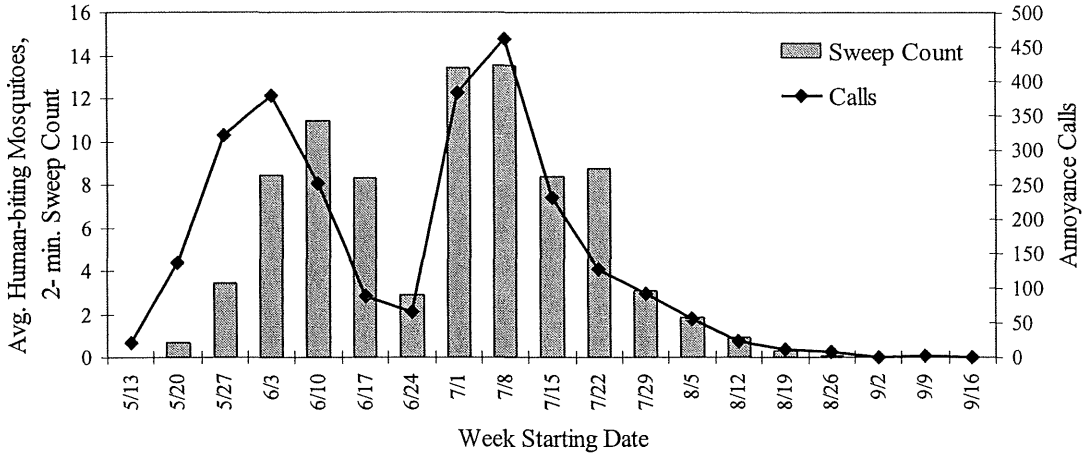


Figure 6.1 Calls requesting annoyance service and average sweep counts of human-biting mosquitoes by week, 2003.

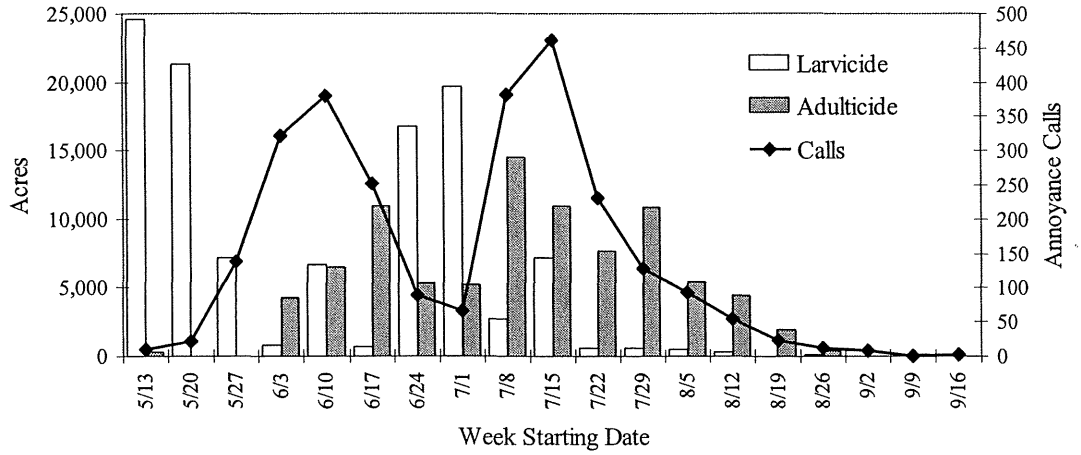


Figure 6.2 Calls requesting annoyance service and acres treated with larvicides or adulticides by week, 2003.

Other calls received are listed in Table 6.1. A total of 4,185 calls were recorded during the year. Lower than average mosquito levels during late summer precipitated fewer calls, but this appeared to be offset by increased numbers of callers concerned about West Nile virus and potential mosquito breeding sites. Calls requesting a dead bird pick-up for WNV testing were not included in this table; most of these were directed to the Minnesota Department of Health in 2003 and referred back to MMCD if action was needed (see Chapter 1). Requests for limited or no treatment dropped significantly in 2003.

Table 6.1 Calls received by MMCD front desk, by type of concern and year. Some calls may have included more than one concern.

	# Calls		
Caller Concern	2003	2002	2001
Check a breeding site	1516	1307	1050
Request adult treatment	2714	3062	2598
Public event, request treatment	132	171	115
Request tire removal	236	321	252
Request limited or no treatment	60	190	199

2004 Plans

All field offices will implement field data entry using PDAs. This will enable rapid access to data by lab staff and allow a similar streamlining of lab data entry practices.

Staff will continue to provide wetland map data through Metro GIS for distribution to any users through a web interface. We will also provide catch basin map data to the city or county entities contacted last year, as well as any other agencies that might find it helpful.

Staff will continue to develop and disseminate information on how storm water management designs affect mosquito production for target audiences such as engineers and watershed managers.

Nontarget impact studies of adulticides with small scale tests to be designed in conjunction with TAB members will also continue to be developed. Staff will work with Dr. Richard Anderson to finalize publication of the paper describing the 1997-1998 results of the Wright County *Bti* and methoprene non-target study.

A public opinion survey, similar to that done in 2000 and in previous years, will be conducted.

APPENDICES

Appendix A Average Number of Common Mosquito Species Collected per Night in New Jersey Light Traps 1965-2003

Year	*Ochlerotatus abs/punc*	*Aedes cinereus*	*Ochlerotatus sticticus*	*Ochlerotatus trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Coquillettidia perturbans*	All species	Average 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	82.64	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

APPENDIX B Mosquito Biology

There are 50 species of mosquitoes in Minnesota. Thirty-nine species are found within the MMCD. Species can be grouped according to their habits and habitat preferences. For example, the District uses the following categories when describing the various species: disease vectors, spring snow melt species, summer flood water species, permanent water species, and the cattail mosquito.

Disease Vectors

Ochlerotatus triseriatus Also known as the eastern treehole mosquito, *Oc. 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. WEE and WN viral activity is monitored by testing blood from sentinel chicken flocks.

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

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

Floodwater Mosquitoes

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

Summer Flood Water Mosquitoes Summer flood water 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*, *Oc. sticticus* and *Oc. trivittatus*. New Jersey light traps, CO_2-baited traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans This summer species breeds in cattail marshes and is called the cattail mosquito. A unique characteristic of this mosquito is that it 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 breed in permanent and semipermanent sites. These mosquitoes comprise the remaining *Anopheles*, *Culex*, and *Culiseta* species. These mosquitoes are multi-brooded and lay their eggs in rafts on the surface of the water. The adults prefer to feed on birds or livestock but will bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. The District targets four *Culex* and one *Culiseta* species for surveillance and/or control.

APPENDIX C Description of Control Materials

The following is an explanation of the control materials currently in use by MMCD. The specific names of products used in 2003 are given. The generic products will not change in 2004, although the specific formulator may change.

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

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

Cattail mosquito (*Cq. perturbans*) breeding sites are treated at 330 briquets per acre in rooted sites or 440 briquets per acre in floating cattail stands. Applications are made in the winter and early spring.

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

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

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

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

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

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

***Bacillus thuringiensis israelensis* (*Bti*) corn cob** Valent Biosciences-Vectobac® G

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

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

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

Bacillus sphaericus Valent Biosciences-VectoLex® CG

Bs corn cob may be experimentally applied in all types of *Culex* mosquito breeding. *Bs* 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 7 lbs per acre. This product is also being evaluated as a control material for catch basin applications..

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

Agnique liquid is applied directly to small mosquito breeding sites to control pupae. Experimental treatments are applied when mosquito larvae are no longer actively feeding or affected by other larvicides. Application rates are 0.2-0.3 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 Clarke Mosquito Control Products-Permethrin 57% OS

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

Adult control is initiated when MMCD surveillance (sweep net and light trap collections) indicates nuisance populations of mosquitoes, when employee conducted landing rate collections document high numbers of mosquitoes, or when a large number of citizen complaints of mosquito annoyance are received from an area. In the case of citizen complaints, MMCD staff evaluates mosquito levels to determine if treatment is warranted. MMCD also treats functions

open to the public, and public owned park and recreation areas upon request and at no charge if the event is not-for-profit.

The District mixes permethrin with soybean and food grade mineral oil and applies it to wooded areas with a power backpack mister at a rate of 25 ounces of mixed material per acre (0.0977 lb active ingredient per acre).

Resmethrin Bayer-Scourge® 4+12

Resmethrin is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Resmethrin is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enable the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Resmethrin is applied at a rate of 1.5 ounces of mixed material per acre (0.0035 lb active ingredient per acre). Resmethrin is a restricted used compound and is applied only by Minnesota Department of Agriculture licensed applicators.

Sumithrin Clarke-Anvil® 2+2

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

Natural Pyrethrin Bayer-Pyrenone® 25-5

Pyrenone is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrenone is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand held cold fog machines that enables the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrenone is applied at a rate of 1.5 ounces of mixed material per acre (0.00172 lb active ingredient per acre). Pyrenone is a non-restricted used compound.

APPENDIX D 2003 Control Materials: AI Identity, Percent Active Ingredient (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	5 lb	0.0750	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
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

[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)
* 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 1995-2003. The actual geographic area treated is smaller because some sites are treated more than once.

Control Material	1995	1996	1997	1998	1999	2000	2001	2002	2003
Altosid® XR Briquet 150-day	7,303	422	501	371	533	533	589	628	323
Altosid® XR Briquet 90-day	0	0	0	961	0	0	0	0	0
Altosid® Sand-Products	871	712	1,096	1,868	3,968	786	1,889	1,822	0.5
Altosid® Pellets 30-day	8,212	10,654	8,851	10,432	13,775	11,121	14,791	16,521	18,458
Altosid® SR-20 liquid	668	565	1,645	529*	355	29	91	51	33
Bti Corn Cob granules	131,589	68,355	106,755	113,539*	118,733	84,521	90,527	202,875	113,198
Bti Liquid Black Fly (gallons used)	3,606	3,025	5,445	4,233	4,343	821	4,047	3,169	3,408
Permethrin Adulticide	6,305	5,914	6,340	6,164	4,865	4,066	3,444	5,734	6,411
Resmethrin Adulticide	61,858	120,472	106,065	65,356	51,582	42,986	41,311	43,302	68,057
Sumithrin Adulticide	0	0	0	0	0	0	8,423	32,230	14,447

* These values are updated; therefore, some values may differ from similar values in earlier publications.

Appendix F Control Material Labels

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 ft². 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 ft².

Coquillettidia and *Mansonia* spp.: For application to cattail marshes and water hyacinth beds. For control of these mosquitoes, place 1 briquet per 100 ft².

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

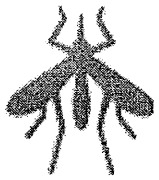
Wellmark International
Schaumburg, Illinois U.S.A.

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

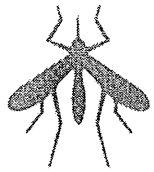
Wellmark International
Schaumburg, Illinois U.S.A.

20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Altosid® Liquid Larvicide CONCENTRATE



PREVENTS EMERGENCE OF ADULT FLOODWATER MOSQUITOES

SPECIMEN LABEL

ACTIVE INGREDIENT:

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

* CAS # 65733-16-6

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

EPA Reg No. 2724-446

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE ADDITIONAL PRECAUTIONARY STATEMENTS

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

CAUTION

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

ENVIRONMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

CHEMIGATION

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

MIXING AND HANDLING INSTRUCTIONS

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

RECOMMENDED APPLICATIONS

INTRODUCTION

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

METHODS OF APPLICATION

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

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

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

APPLICATION SITES

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

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

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

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

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

STORAGE AND DISPOSAL

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

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

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

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

For information call 1-800-248-7763

Always read the label before using the product.

Wellmark

ZOËCON Professional Products

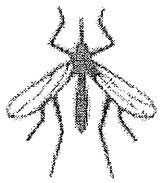
Wellmark International
Schaumburg, Illinois U.S.A.

21-24-004

Made in the U.S.A.

October 2000
Schaumburg, IL

Altosid® XR-G



AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

EPA Reg No. 2724-451

EPA Est. No. 2724-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION

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

FIRST AID

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

ENVIRONMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

GENERAL DIRECTIONS

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

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

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

APPLICATION TIME

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

APPLICATION RATES

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

APPLICATION SITES

NON-CROP AREAS

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

CROP AREAS

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

NOTE

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

STORAGE AND DISPOSAL

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

STORAGE

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

PESTICIDE DISPOSAL

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

CONTAINER DISPOSAL

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Wellmark

ZOECON Professional Products

Wellmark International
Bensenville, Illinois U.S.A.

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

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 · 800-323-2537

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
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
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1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

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

2.2 ENVIRONMENTAL HAZARDS

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

3.0 DIRECTIONS FOR USE

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

3.1 Chemigation

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

4.0 STORAGE AND DISPOSAL

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

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

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

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

5.0 APPLICATION DIRECTIONS

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

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

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

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

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

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

6.0 SMALL QUANTITY DILUTION RATES

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

VectoBac WDG

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

7.0 GROUND AND AERIAL APPLICATION

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

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

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

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

7.1 AERIAL APPLICATION

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

Rinse and flush spray equipment thoroughly following each use.

8.0 NOTICE TO USER

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

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

Valent BioSciences Corporation

VectoLex® CG

Biological Larvicide
Granules

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

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

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

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1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

2.2 Environmental Hazards

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

3.0 DIRECTIONS FOR USE

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

4.0 STORAGE AND DISPOSAL

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

Pesticide Storage: Store in a cool, dry place.

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

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

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

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

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

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

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

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

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

* Mosquito species effectively controlled by VectoLex CG:

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

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

CONTINUED

[redacted]

6.0 NOTICE TO USER

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

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

AGNIQUE® MMF MOSQUITO LARVICIDE & PUPICIDE

MONOMOLECULAR SURFACE FILM FOR CONTROL OF IMMATURE MOSQUITOES AND MIDGES

ACTIVE INGREDIENT

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

CAUTION

KEEP OUT OF THE REACH OF CHILDREN

FIRST AID TREATMENT

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

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

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

DIRECTIONS FOR USE

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

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

STORAGE AND DISPOSAL

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

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

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

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

APPLICATION DIRECTIONS

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

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

APPLICATION NOTES

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

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

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

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

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

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

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

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

NOTICE

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

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

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

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

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

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

cognis agrosolutions

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

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

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

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

PERMETHRIN 57% OS

CLARKE

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

Precautionary Statements

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

STATEMENT OF PRACTICAL TREATMENT

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

ENVIRONMENTAL HAZARDS

This product is highly toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated area may be hazardous to aquatic organisms in neighboring areas. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges or water supplies. Do not contaminate water when disposing of equipment washwaters.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

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

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

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

Normal use pattern of product requires a residual application on plant and other surfaces where mosquitoes may rest. Product commonly provides sustained control in wooded areas lasting up to 14 days in shaded areas. Secondary activity of product is through repellency. Apply product by ground application equipment such as mist blower, ULV equipment, power backpack or pressure sprayer. Not to be used within 100 feet (30 meters) of lakes and streams. To kill or repel mosquitoes, midges, deer flies, and other biting flies, mix with enough oil mixture so as to easily apply 0.1 pounds of Permethrin per acre. The oil-mixture is obtained by mixing one part of soybean oil to two parts of mineral oil. Non-phytotoxic oils must be used. The following chart represents some possible dilutions based on a 2 MPH walking speed with a fifty (50) foot swath. If a different dilution rate 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	35.8	5.6
1 Part	5.8 Parts	17.5	2.5
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. 8329ILO1
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 outdoor 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 application 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 solvent such as mineral oil and applied by aerial ULV equipment so long as 0.6 fluid ounces per acre of PERMETHRIN 57% is not exceeded. Both aerial and ground applications should be made when wind is less than 10 MPH.

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

STORAGE & DISPOSAL

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

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

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

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

CONTAINERS ONE GALLON AND SMALLER: Do not reuse containers. 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 Applicator's Certification.

SCOURGE® INSECTICIDE

with SBP-1382*/PIPERONYL BUTOXIDE 4% + 12% ME FORMULA II

Specimen Label

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

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

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

PRECAUCION AL CONSUMIDOR: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.
(TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

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

See Side Panel For Additional Precautionary Statements

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

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

NET CONTENTS:

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

PRECAUTIONARY STATEMENTS

Hazards To Humans & Domestic Animals

CAUTION

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

Environmental Hazards

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

DIRECTIONS FOR USE

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

STORAGE AND DISPOSAL

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

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

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

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

READ ENTIRE LABEL FOR DIRECTIONS

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

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

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

NOTICE: This concentrate cannot be diluted in water. Mix well before using. Avoid storing excess formulation in spray equipment tank beyond the period needed for application.

ULTRA LOW VOLUME APPLICATIONS

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

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

Treatment lb ai/A of Scourge Wanted SBP-1382/PBO	Fl oz/A of Undiluted Spray to be Applied	Application Rate-Fl oz/Min	
		5 MPH	10 MPH
0.007/0.021	3.0(90 ml)	9.0(266.2ml)	18.0(532.3ml)
0.0035/0.0105	1.5(45 ml)	4.5(133.1 ml)	9.0(266.2 ml)
0.00175/0.00525	0.75(22.5 ml)	2.25(66.6 ml)	4.5(133.1 ml)
0.00117/0.00351	0.50(15 ml)	1.50(45 ml)	3.0(90 ml)

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

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

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

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

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

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

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

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

DIRECTIONS FOR AERIAL APPLICATIONS

FOR USE WITH FIXED-WING AND ROTARY AIRCRAFT

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

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

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

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

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

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

IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

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

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

DISCLAIMER OF WARRANTIES: BAYER ENVIRONMENTAL SCIENCE MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for special, incidental or consequential damages resulting from the use or handling of this product.

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

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

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.

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Appendix G Technical Advisory Board Meeting Minutes Wednesday, February 18, 2004

TAB Members Attending/*(Absent)*:

Greg Busacker	Minnesota Department of Transportation
Val Cervenka	Minnesota Department of Agriculture
Larry Gillette	Hennepin County Parks
Steven Hennes	Minnesota Pollution Control Agency
Gary Montz	Minnesota Department of Natural Resources
Roger Moon (chair)	University of Minnesota
Dave Neitzel	Minnesota Department of Health
Karen Oberhauser	University of Minnesota
Susan Palchick	*Hennepin County Community Health*
Robert Sherman	Statistician
Terry Schreiner	US Fish and Wildlife Service
Danny Tanner	US Environmental Protection Agency

MMCD Staff Attending:

Sandy Brogren
Diann Crane
Janet Jarnefeld
Kirk Johnson
Carey LaMere
Michael McLean
Nancy Read
Joseph Sanzone, Director
Mark Smith
Jim Stark
John Walz

1. Call to Order

Chair Roger Moon (RM) called the meeting to order at 12:30 p.m., and asked members to introduce themselves. RM stated the purpose of the meeting was to review MMCD's program, and he will present results to the Metropolitan Mosquito Control Commission.

2. 2003 Legislative Issues

MMCD Director Joseph Sanzone (JS) updated the TAB on recent legislation that has affected District operations:

1. Western Carver County is now included in District, and will receive disease control and other services.
2. Mosquito Control Commission requested authority for a county levy increase to address West Nile Virus (WNV), but this did not pass.
3. Statute regarding entering private property was clarified, at Commission request.
4. Notification issue – Senate committee asked us to increase public notification efforts, we have done so, including meetings, web access, in addition to other methods.

Questions:
Gary Montz (GM) – Any initiatives for this year? Jim Stark (JSt) – No.

Comment:
RM – Increase in geographic scope in Western Carver is important for TAB to consider as we review programs.

3. 2003 TAB resolutions

JS reviewed the resolutions made by the TAB last year. The Board of Animal Health has decided to maintain West Nile virus (WNV) as a reportable disease. MMCD has continued surveillance and control for WNV and is working to establish best practices.
RM asked that members help note possible resolutions during the meeting, so TAB can review and present wording after break.

4. Mosquitoes

4a. Surveillance

Sandy Brogren (SB) briefly described the 2003 season and referred to the surveillance section of the report. The first half of 2003 was wet and second half was dry, which affected many activities. There were 8 broods of floodwater mosquitoes, 3 large. See report for summary of adult collections from sweep nets, CO2 traps. Counts reflect rainfall for floodwater species. Culex species lay eggs on standing water, overwinter as adults, so populations are low early, peak later. The District is especially interested in *Cx. tarsalis* as potential WNV vector. *Cx. restuans* peak earlier, also potential enzootic vector of West Nile virus. Note that we have very low populations of *Culex*.

Questions:
RM – Can you tell *Cx. restuans* and *Cx. pipiens* apart? SB – Sometimes; if they have been rubbed together in the trap we can't tell. Graph suggests many "*pipiens/restuans*" may be *Cx. restuans*. RM - If you combine "*pipiens/restuans*" with other *Culex* is the count higher, like other species? SB – Numbers would be close to *Cq. perturbans* in sweep samples, otherwise still low.

Dan Tanner (DT) – Maps show more mosquitoes at edge of District. Is that the only area with water [habitat]? SB – Not the only area.
Bob Sherman (BS) – Are new developments, catch basins etc. adding sites? Are areas such as those around Lake of the Isles, Cedar Lake being treated? SB – New sites are added to maps. If they are built right, they don't produce many mosquitoes. They are checked and treated as needed.

Larry Gillette (LG) – What are plans for 2004 regarding thresholds for *Culex*? SB – With low numbers in current traps we are testing other surveillance methods, including gravid traps, where females attracted to water for oviposition, to see if we can collect more, or if trapping really reflects populations. LG – If thresholds change for adult treatments, given different emergence time and widespread distribution, this may greatly expand need for adult mosquito control; concerned that this would greatly increase treatments. RM asked Dave Neitzel (DN) if there has been any discussion at CDC meetings regarding thresholds; DN said in areas with high transmission (west of MN and western MN), they have had no trouble finding *Cx. tarsalis* in high numbers, much higher counts than here, no discussion of thresholds there.

LG – Regarding sweep collection maps, do you not have as many sweep collection samples as you would like? Near my house on July 7 doesn't look like a problem on the maps, but it was.
SB – That's an inherent problem with this collection system and map display.
RM – Would help to give a base map of sweep collection sites.
Karen Oberhauser (KO) – Asked for clarification of the meaning of black dots, white areas on maps that were being discussed.

Susan Palchick (Q submitted by e-mail) – Are we missing daytime biters? If not active at dusk, don't list in table. SB – We have other surveillance methods that we use on species like *Oc. triseriatus*.

4b. *Culex* trapping at high and low elevations

Nancy Read (NR) (in absence of Stephen Manweiler) presented results of a study of adult mosquito captures at 5 locations with paired CO_2 traps at ground level (ca. 5 ft.) and in or near the tree canopy (20 to 30 ft.). For *Aedes vexans* and *Cq. perturbans*, which tend to feed on large mammals, counts were much higher at ground level than in the canopy. For *Culex* species, counts were similar at high or low elevations, and at some locations tended to be somewhat greater in the canopy, although this varied by week and location. This spread of adults may have implications for control efforts for *Culex*. [Analysis will be included in final TAB report.]

BS – Do *Culex* move up and down during night? Would they hit control material eventually? NR – Not known; fog is present only for short time. DT – You could do a vertical movement study, with traps checked every hour, at various heights.
Steve Hennes (SH) – Do you fog at night or during day? NR – generally in early evening, after sunset. Diann Crane (DC) – We have a workgroup doing a literature review on spatial distribution, bird hosts.

4c. West Nile Virus

Kirk Johnson (KJ) reviewed current information. WNV may be similar to St. Louis encephalitis in having cyclical outbreaks. We are examining different mosquito species as potential vectors, and evaluating surveillance and control. We hope to improve control for WNV prevention.

Overall in Minnesota this year human cases occurred in most counties, especially south and west. Disease rates (number of cases per 100,000 residents) were much higher in western Minnesota. (DN – When you remove cases that may have been exposed out of state, most of the remaining cases were exposed in southwestern, western, and central Minnesota. The District was on the edge of activity, but we did see a few locally-acquired cases in Hennepin, Ramsey, Washington, Scott and Dakota counties.) Horse cases dramatically decreased with use of vaccine. There were probably thousands of bird deaths. Testing showed 59 mosquito pools positive in MN, which is low compared to states farther west; 15 positive in metro. Most positive mosquitoes statewide were *Cx. tarsalis*. MDH onset of illness data fits pattern expected for mosquito-borne virus. Delay between case onset and when District learns of case presents challenge for response; late in season, couldn't find mosquitoes.

Catch basins (storm water street drains) can be habitat for vectors, so we did a major mapping project starting with information from cities, counties, and MnDOT. Employees inspected 210,000 catch basins and by end of year found 58,000 wet. Treatments began in June with Altosid pellets, repeated July and August. We are contacting cities regarding maintenance, treatment timing, and working together.

RM – What proportion of catch basins are producing C*ulex*? Can you target by design?
KJ – Density varies by community. Often cities don't have listing by type.

Larval surveillance was added targeting *Culex*, based on timing relative to rain and choice of wetlands or parts of wetlands. Of about 6000 inspections we found *Culex* larvae in about 1 in 4, most were *Cx. territans*, probably not a significant vector, hard to find larvae of vector species (see Table 1.3).

DN – Was *Cx. tarsalis* larval control done? KJ – Yes, when *Cx.* vector species found in air treatment sites, count was included toward threshold, also some ground treatments done in areas where virus was active. Working on targeting larval control for these species.

When WNV activity is identified, we plan to focus control on *Cx. tarsalis, Cx. restuans,* and *Cx. pipiens*, primarily as larvae. Until we have a better understanding of how to do that, we are following CDC "risk level" guidelines (see 2002 report, appendix J). Last two seasons "moderate" risk, with sporadic transmission to humans in District. Some areas of state "high" risk last year, with clusters of cases in horses or humans. Our response is primarily local surveillance and control relative to risk indicated in a local area. Public education is important to help prevent mosquito production and human exposure, especially if virus activity is greater than MMCD's capacity to respond.

Risk reduction from control is hard to assess. A Michigan study showed minimum infection rates lower in areas with control than those without. In MN in 2003, minimum infection rate was as high inside as outside the District. Case incidence was lower: 0.63 per 100,000 compared with 2-4 per 100,000 outside metro in MN. We were on NE edge of 2003 epidemic.
KO – Is that a statistically significant difference? KJ – Don't know.
DT – Is anyone doing control in ND, SD? DN – Some areas doing something, not as much infrastructure. KJ – Infection rates there 2-5%, extremely high, similar to *Cx. pipiens* levels in Michigan area last year. Cass County does some mosquito control.

DT – Is there an indicator of what is good habitat for *Cx.* species other than *Cx. territans*? Do catch basins freeze in winter? Could you introduce fish? MS – Problems for fish in catch basins, pollutants from roads, also fill with silt. KJ – Also flush after rain events.
RM – Doing right thing by looking at specific vectors. Tough to try to show effect.

LG – Is virus less virulent? Seems to have moved through areas. KJ – Bird immunity may have an influence on transmission, not as much evidence of change in virus itself. Also note Pennsylvania had worst year ever this year. DN – Media impact means more of the milder cases end up being reported. New York still had a number of cases.

DN – You have developed good catch basin program, along eastern model of transmission, encourage you to increase efforts on *Cx. tarsalis* habitats. KJ – Plan to focus on *Cx. tarsalis* next year. NR – Also have *Cx. restuans* in catchbasins. DN – Enzootic vector, but may not be transmitting to humans.

KO – Would like to contest RMs statement that we shouldn't look at effectiveness; if it's not effective, important to know. Would like to have more statistics.
RM – More important to go after foci of virus and vector, efficacy too hard to measure. If not getting control of vectors, there's no efficacy to measure.

4d. Mosquito Control

Mark Smith (MS) gave an overview. Larvicide use less than previous years; was ahead of average early but down with dry time at end of year. Larval control continues to be main activity. Adulticides supplement larviciding, done based on thresholds. We are working with national experts to make sure we are up-to-date on adulticide operations. In 2003 more adulticiding was done than 2002, probably due to WNV concerns, and with dry conditions staff available to do surveillance and treatments.

LG – How long do citizens wait before they call, and how long will they wait for response? Mosquitoes will die eventually anyway. JSt – In 2002, received calls within a week of major brood. NR – Graph of calls vs. sweep counts in report shows close link with little delay.

RM – Table 3.2, "Comparison of adult control material usage", did resmethrin acres increase due to WNV protection? Why did sumithrin go down? Sum of sumithrin and resmethrin seems to be the same. MS – some MMCD field divisions use sumithrin, some use resmethrin, may be a difference between areas.

Plans for 2004 – continue as in the past, plus targeting WNV vectors, with emphasis on larval control. Addition of western Carver will increase larvicide and adulticide use. Adulticide use might increase in response to WNV

LG – In report, p. 31 next to last sentence, "direct control treatments to . . . areas with high levels of mosquitoes," should that be populated areas, as opposed to park reserves? MS – Assume that, yes; we could clarify.

4e. Product efficacy

MS highlighted results from report.
Vectobac® BTI – 88% control of *Ae. vexans* in air by helicopter, lower than last year, within range of last 10 years. May be result of 5" rain. No major problems.
Altosid® (methoprene) - Pellets gave 84% emergence inhibition when in place at proper times in wetlands and catch basins.
Vectolex® BS – Tried in catch basins, 50-60% efficacy, surprising low. Note BS recycles, can give longer control, tends to be more effective on *Culex* than *Aedes*. Looking at advantages of smaller particle size.
Pyrenone® adulticide (natural pyrethroid) - as effective as synthetic, no crop restrictions, would be useful in rural areas.
For 2004 continue testing on *Culex* in particular. May look at aerial adulticiding for small areas, especially if tree canopy is important.
RM – what product would be used for aerial adulticiding? Short-lived pyrethroids? MS – Yes, sumithrin or Pyrenone®. Adulticide would be a last resort.

4f. Other mosquito-borne diseases

KJ reported there was only one human case of La Crosse encephalitis; we probably benefited from dry weather late in the year, vector population low. We tested sentinel chickens for western equine encephalitis and found no evidence of the disease. Surveillance continued for eastern equine encephalitis vectors, but no cases or virus found.

5. Black Fly

John Walz (JW) reported briefly. Multiplates samples of non-target insects in rivers show no real changes. Public opinion survey to compare people's reactions with number of black flies continued, still have many samples with low black fly numbers, will do analysis this year. With Carver Co. expansion we hope to expand black fly work in that area; will start by working on permits with DNR.

KO – What invertebrates collected in non-target studies? JW – will provide report.

6. Ticks

Janet Jarnefeld gave brief highlights. Regarding addition of western Carver County, this area is on edge of current tick distribution, and we have been doing sampling there since early 1990s. The disease agent for Human Granulocytic Ehrlichiosis (HGE) has been named. It is now *Anaplasma phagocytophyllum*. Note high case numbers of Lyme disease. Tick numbers were down in 2003.

7. Nontarget impact studies

Karen Oberhauser described work done last summer (see brief summary in report; a separate detailed report is also planned). TAB Working Group (Karen, Roger, Nancy and Stephen) met re: organisms of concern, chose a "charismatic" insect, monarch butterfly: had easy access to colony in Karen's lab and species is well known.

There are three aspects to defining and measuring risk: 1) overlap in time and space, 2) toxicity, 3) proportion of population exposed. Combination determines possibility of population-level effect. For monarch butterflies:

1. Overlap in time & space – Timing of oviposition and larval frequency available from Minnesota Monarch Larvae Monitoring Project data appears to overlap with mosquito adulticide use. Spatial overlap not yet quantified. Host plant prefers open areas, but since many open areas mowed, tend to be on edges, with potential overlap with barrier sprays. Some concern if adulticiding increases.

2. Toxicity – Working group ran trials in 2003:
   a. Lab bioassay of existing permethrin barrier spray treatments, find out if leaves were toxic to feeding larvae.
   b. Sublethal effects of permethrin at low doses.

Bioassays – High proportion of larvae on treated leaves died. Older instars or fewer days on leaf more likely to survive. Number of days since spraying (range 1-21 days) did not have an effect. Surprising that toxicity continued at 21 days, some question about whether rainfall would affect that (low rain last year)

Sublethal effects – Checked development time, mass of larvae. Calculated deposition, dilutions, needed 0.5% and 0.1% by volume to get any survival. Development time was significantly longer in 0.1% but weight was not detectibly different. Only two individuals survived in 0.5%, and they had a long development time and low weight.

Would like to hear from the board what studies should be considered for further work. Possible topics:

- Non-target behavior – Do adult females avoid plants for oviposition? Will larvae move to untreated leaves or plants?
- Residue longevity – what would affect it?
- Extent of monarch habitat (milkweed) in areas targeted for permethrin application.
- Other species at risk – permethrin is general insecticide.
- Look at ULV fog treatment instead of barrier.

Discussion began on the relative value of impacted species vs. benefits; Chair Roger Moon asked that group focus on specific research topics for the District.
Various TAB members voiced interest in the following:
BS - What is area of milkweed being affected by permethrin, is that impact large?
GM – Like the list, any would be fine
SH – Concerned at how long effect lasted, more potential for impact.
LG – What about other insects that just land on leaves?
KO – Female avoidance of treated leaves would be interesting.
JS – Are there more eggs on edge habitat, as in gypsy moth? KO – milkweed at edge
BS –Could aim permethrin at areas other than milkweed, fog on the other hand could go anywhere.

LG – Probably not a population effect on monarchs, want to get more of an idea of ecosystem effects – insects that land on plants, other species, would like broader sense of overall impact on non-target species. KO – Would be very complicated study. DT –Invertebrate community analysis of areas sprayed v non-sprayed would probably find other insects impacted, that's what these chemicals do. Would people care? A beekeeper would care on local impact. RM – As veteran of Wright Co. Study [larvicide nontarget effects], we discussed this lot, many things we can imagine but can't measure. On other hand, look at expanse of treatment, overlap for monarchs and other things as well. Give better evidence to public making decisions. JS – Only 6000 acres treated with permethrin.
LG – I'm more concerned about resmethrin.

Group agreed to continue "Working Group" consisting of Roger Moon, Karen Oberhauser, Nancy Read, Stephen Manweiler (plus other interested TAB members, possibly Steve Hennes?) to develop non-target studies. If TAB members have questions they would like to see addressed, send to Working Group for review, also copy to entire Board.

8. 2004 Resolutions
Concerns about adulticiding and WNV response; Research priorities
LG – WNV has not had a very big impact on human health, and we don't have good data to date that efforts to control *Culex* are reducing WNV. Also have trouble predicting if it will become a larger problem. Seems prudent to learn more about vectors for further control. Not sure I can support additional adulticide treatments to control *Culex* if you can't show efficacy. Key is learning more about it, identifying vector species, life history, where larvae are, flight patterns; all that will help develop effective control. I'm not comfortable with spraying for any high population of *Culex*.

Greg Busacker (GB) – If you discontinue treatment, you're doing experiment on people who live here, not politically popular. Could go to a western Minnesota county, apply control methods there, and see if it has an impact.
Roger Moon – Fundamental root is whether to take risk of disease or risk of impact.

LG – I support current research, but want more evidence of efficacy; WNV is not that serious a disease. Can you show that treatment is reducing incidence of WNV? Joe - Research is going on in Colorado right now on efficacy. Maybe a subgroup of TAB could look at research available.

DT – Would like research on what elevations *Culex* are at, find out habitats for *Culex* larvae for targeting, is it necessary to use permethrin.

GM – At last year's secondary TAB meeting one issue was whether the District was going to adulticide in response to dead birds, or whether a positive mosquito pool was needed, possibly using rapid test. Was increased adulticide use just from birds, or from what evidence? If not in response to mosquito pool, would like to see that.
KJ – There was additional adulticide work done in response to whatever information available; bird info was most quickly available, also mosquito numbers, plus we followed up positive pools with more mosquito surveillance.

** RESOLUTION **
Larry Gillette proposed the following resolution:
- That the TAB encourages MMCD to continue research on all aspects of WNV, including biology of vectors, disease risk, and options for and consequences of control, recognizing that only through such research will there be effective control.
** RESOLUTION PASSED **

Bob Sherman - Would like to have more time for drafting resolutions; also encourage JS and others to help TAB focus motions on what the Commission is concerned about.

(Note: Larry Gillette and Gary Montz left the meeting at this time, ca. 3:30 p.m.)

9. Report
Various TAB members expressed that they were pleased with quality of the report and the quality of work done by the organization. Bob Sherman suggested that 1-2 page updates be sent to the TAB more often to keep in touch throughout the year.

10. Next Chair
Chair position rotates among organizations listed in statute as being part of the review process. Next year's chair will be the representative from MnDOT, Greg Busacker.

Meeting adjourned 3:54.

Editorial Staff

Diann Crane, M. S., Assistant Entomologist

Acknowledgments

Thank you to the following people who wrote or reviewed major portions of this document: Sandra Brogren, Janet Jarnefeld, Kirk Johnson, Stephen Manweiler, Mike McLean, Nancy Read, Ken Simmons, Mark Smith, and John Walz.

May 6, 2004