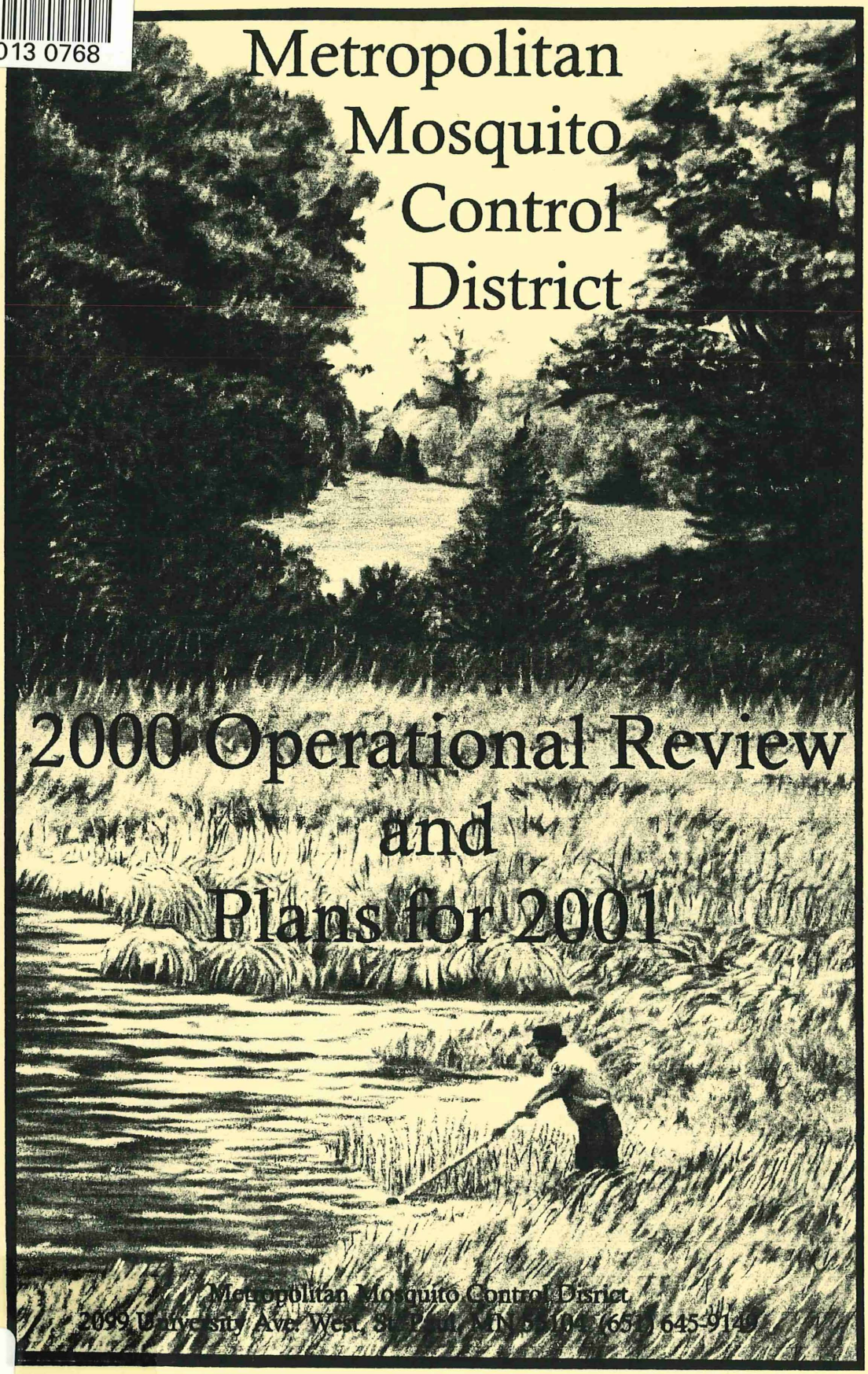
Metropolitan Mosquito Control District



2000 Operational Review and Plans for 2001

Metropolitan Mosquito Control District
2099 University Ave. West, St. Paul, MN 55104 (651) 645-9145

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, eastern Carver, Dakota, Hennepin, Ramsey, Scott, and Washington. The District operates under the seventeen 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 2001

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TECHNICAL ADVISORY BOARD

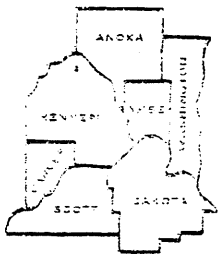
The TAB was formed in 1981 by the MMCC to provide annual independent review of the field control programs, to enhance inter-agency cooperation, and to facilitate compliance with Minnesota State Statute 473.716.

TAB MEMBERS 2000-2001

Richard Anderson	US EPA
Greg Busacker, Chair	MDOT
Laurence Gillette	Hennepin Parks
Steve Hennes	MPCA
Geir Friisoe	MDA
Gary Montz	MDNR
Roger Moon	U of MN
Karen Oberhauser	U of MN
David Neitzel	MDH
Susan Palchick	Henn. Co. Comm. Health
Robert Sherman	Independent Statistician
Terry Schreiner	USFWS

METROPOLITAN MOSQUITO CONTROL DISTRICT CONTRIBUTING STAFF

Joe Sanzone	Director
Stephen Manweiler	Technical Services Coordinator
Sandy Brogren	Entomologist
Diann Crane	Asst. Entomologist
Cara Hansmann	Technical Services
Janet Jarnefeld	Tick Ecologist
Kirk Johnson	Vector Ecologist
Mike McLean	Public Affairs
Nancy Read	Supporting Research
Mark Smith	Control Materials
Jim Stark	Public Affairs Coordinator
John Walz	Black Fly



METROPOLITAN MOSQUITO CONTROL DISTRICT
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JOSEPH F. SANZONE, BCE
Director

W.J. CAESAR
Business Admin.

Dear Reader:

The following report is the Metropolitan Mosquito Control District's (MMCD) 2000 Operational Review and Plans for 2001. It outlines program operations based on the policies set forth by the Metropolitan Mosquito Control Commission, MMCD's governing board of elected county commissioners.

This 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 TAB's winter meeting are included in this report.

TAB's recommendations and report were accepted by the Commission at their August 22, 2001 meeting. The Commission approved the MMCD 2000 Operational Review and Plans for 2001 and thanked the TAB and District staff for their work.

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

Sincerely,

Joseph F. Sanzone
Director

EXECUTIVE SUMMARY

MMCD'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." The District provides a number of services to accomplish this mission including: surveillance and control of black flies and mosquitoes, elimination of disease vector mosquito breeding sites (including tires), monitoring the incidence and activity of mosquito (LaCrosse and Western Equine Encephalitis virus) and tick-borne pathogens (Lyme disease and Human Granulocytic Ehrlichiosis [HGE]), tick identification, non-target monitoring, and testing current and alternative control materials. Here are some highlights of 2000.

Six probable cases of LaCrosse encephalitis occurred within the metropolitan area during 2000. Four of these cases occurred adjacent to the District border in Carver County. MMCD staff extensively inspected each probable exposure location associated with these cases. During each inspection staff eliminated all breeding sources they detected and collected larval and adult mosquitoes samples to determine how many vector mosquitoes (*Ochlerotatus triseriatus*) were present. All adult *Oc. triseriatus* reared from larvae collected at each probable exposure location were tested by the Minnesota Department of Health for LaCrosse encephalitis virus infection. None of those mosquitoes was infected. Sentinel chicken flocks detected no Western Equine Encephalitis activity in the District.

Continued surveillance of the Greenman Technologies tire recycling facility in Scott County, where the Asian tiger mosquito (*Aedes albopictus*) was captured in 1999, detected no surviving *Ae. albopictus* in 2000. Preventing the establishment of this non-native species is important because it is capable of transmitting several mosquito-borne diseases including LaCrosse encephalitis.

A review of tick-borne disease data collected between 1997 and 1999 as part of the University of Minnesota/ MMCD cooperative study did not reveal major infection rate changes since 1997. Metro area HGE infection rates in small mammals remained low while *Borrelia burgdorferi* (Lyme disease agent) rates were somewhat higher. Preliminary results from the collaborative study including Camp Ripley, the Department of Health, the University of Minnesota and MMCD, suggest that the HGE infection rate of small mammals is higher in the Brainerd area than in the District. *B. burgdorferi* infection rates are more similar in the two areas.

District rainfall in 2000 was below average, the lowest in the last four years. Summer *Aedes* peaked in late July following heavy rains at the beginning of the month. Adult cattail mosquito (*Coquillettidia perturbans*) populations were lower in 2000 with their usual peak in early July. About 40,000 fewer acres were treated with larvicides in 2000 than in 1999. The number of acres treated with adulticides in 2000 decreased by around 9,000 acres from 1999 levels.

Planned comparisons of Altosid® and *Lagenidium*, a fungal parasite of mosquitoes marketed under the trade name Laginex®, to determine how Laginex® best fits into the cattail mosquito control program could not be performed because Laginex® was not commercially available in 2000. Laginex® is environmentally friendly because it only infects mosquitoes.

An examination of loosestrife beetle release sites indicated that proximity to District adulticide treatments was not sufficient to explain beetle success or failure in the East metro area. Many locations with poor beetle success were not close to adult mosquito treatments.

Black fly treatments continued to result in significant reduction in black fly annoyance for metropolitan area residents in 2000. Material usage in 2000 was well below 1999 because of significantly lower flow rates in small streams and large rivers in 2000. MMCD's black fly program continues under a permit from the Minnesota Department of Natural Resources.

A poll of metro residents was completed in 2000, the fourth such biannual telephone survey since 1994. Most residents felt it was important to control mosquitoes and gnats in the metro area. Respondents reported effects of mosquitoes on their lives in terms of decreased enjoyment of the outdoors, someone in their household reacting strongly to bites, or repellent or control use. Most respondents were aware of mosquito control activities, felt that MMCD is a good value and were satisfied with MMCD's efforts. The poll showed that a growing number of residents are aware of the importance of dumping water out of containers to prevent mosquito-borne disease, however, awareness of black fly and tick services remains fairly low.

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- MMCD responded to six LaCrosse encephalitis cases.
- 18,022 tires were collected and recycled by the District.
- Western equine encephalitis virus (WEE) activity was not detected by sentinel chicken surveillance.
- MMCD initiated the use of the CDC gravid trap as a mosquito surveillance tool to help better define the distribution of *Culex* mosquitoes within the District.
- The District was contracted by the Minnesota Department of Health (MDH) to provide West Nile Virus (WNV) vector surveillance.

Tick Vectors

- 1999 study results detected no major changes to *Ixodes scapularis* distribution in the metropolitan area.
- The HGE agent appears to be more prevalent in small mammals from the Brainerd area than in the metro area.
- *Borrelia burgdorferi* appears to be prevalent in small mammals from both areas.
- Re-examination of several metro sampling sites did not detect any major infection rate changes since 1997.
- Minnesota human tick-borne disease cases doubled in 2000: Neither MDH nor the District has a solid explanation for this increase.

Plans for 2001

Mosquito Vectors

- Develop and refine sampling techniques for surveillance of possible WNV vectors.
- Continue collaboration with MDH in developing a WNV prevention program.
- Continue to monitor areas at risk for exotic mosquito introductions.
- Continue LaCrosse encephalitis prevention efforts as in the past with additional attention to areas near 2000 LaCrosse virus exposure locations.

Tick Vectors

- Collect questing *Ixodes scapularis* at several sites in collaboration with researchers from across the Midwest in an attempt to expand the Illinois and Wisconsin wide scale risk model and maps.
- Several tick-borne disease prevention public service announcements will be developed by the District.
- The Camp Ripley, University of MN (UM), and District collaborative study will begin its second year.
- The metro-based *I. scapularis* distribution study that began in 1990 will continue unchanged.
- Discontinue a three-year metro collaborative study: intensive sampling in Washington County has provided generally consistent results over the period.
- Discontinue re-examination of 1992-1997 study sites: intensive sampling in Ramsey County did not show any changes since 1997.

CHAPTER 1 VECTOR-BORNE DISEASE

BACKGROUND

District staff provide a variety of disease surveillance and control services, including public education, to reduce the risk of the mosquito-borne illnesses: LaCrosse encephalitis and western equine encephalitis and the tick-borne illnesses, 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).

LaCrosse 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 the Eastern treehole mosquito *Ochlerotatus triseriatus* (formerly *Aedes triseriatus*) and a history of LaCrosse 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. *Aedes albopictus* (Asian tiger mosquito) surveillance has also been initiated to detect infestations of this potential disease vector.

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, as well as undertaking cooperative spirochete and ehrlichiosis studies with the University of Minnesota. All data collected are summarized and given to the MDH for risk analysis. Because no ecologically or economically wide-scale tick control measures exist to date, tick control is limited to public education activities which emphasize tick-borne disease awareness and prevention. District staff 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).

2000 VECTOR-BORNE DISEASE SERVICES

***Ochlerotatus triseriatus* Surveillance and Control** Intensive surveillance of adult *Oc. triseriatus* populations continued in 2000 throughout the LaCrosse encephalitis endemic region of the District with efforts concentrated in areas at greater risk. In general, these are populated areas with adequate adult mosquito habitat. To monitor adult *Oc. triseriatus* populations and to direct adult and larval control efforts, mosquitoes resting in wooded areas are sampled by aspirator. In 2000, MMCD staff collected 1912 aspirator samples. *Ochlerotatus triseriatus* was captured in 943 samples with 576 samples exceeding the District threshold of two *Oc. triseriatus*. Follow-up

surveillance and control efforts were employed in most of the areas returning above-threshold samples. Adult *Oc. triseriatus* were captured in 575 of 1037 individual wooded areas sampled. This ratio is similar to those from recent years (Table 1.1).

Table 1.1 Individual wooded areas sampled by aspirator and the number of those with *Ochlerotatus triseriatus* captured 1996 - 2000. Data from 1997 are incomplete and have been excluded from comparison.

Year	Wooded Areas Surveyed	Wooded Areas Where *Oc. triseriatus* Were Captured	Frequency of *Oc. triseriatus* Capture
1996	476	238	50.0 %
1998	713	343	48.1%
1999	895	397	44.4%
2000	1037	575	55.4%

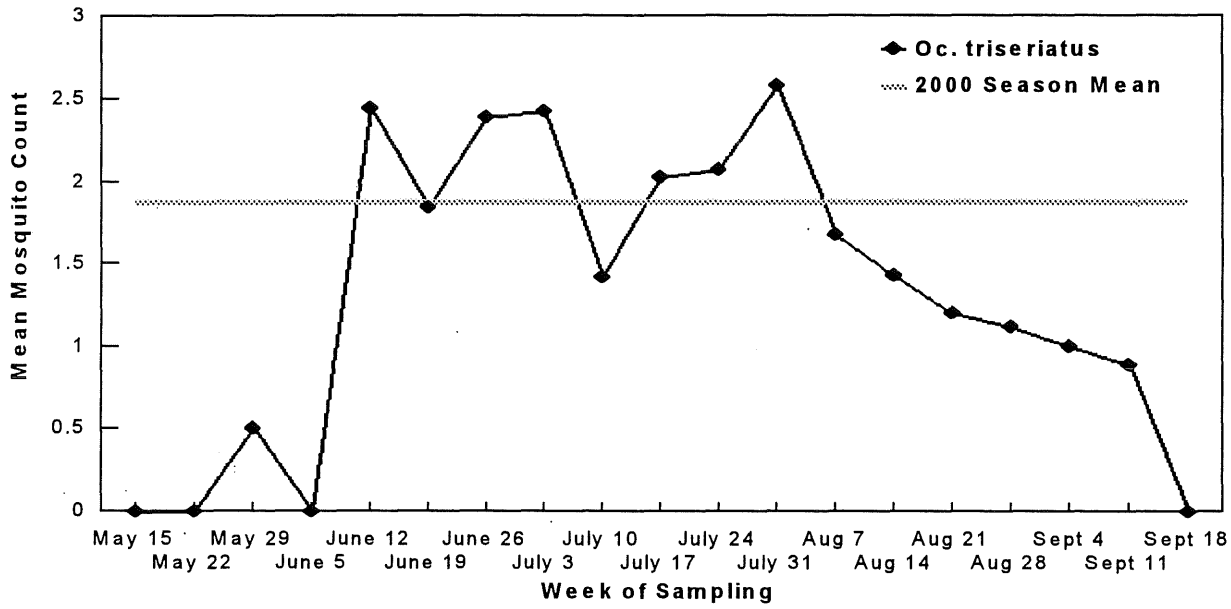


Figure 1.1 Mean number of *Ochlerotatus triseriatus* adults in aspirator samples, plotted by week. Dates listed are the first sampling day of each week. Sites sampled each week vary with many being repeatedly sampled during the season.

Surveillance for *Oc. triseriatus* adults was initiated during the week of May 15th with the first captures occurring during the week of May 29. Sampling indicated three peaks in the adult population during the 2000 season (Figure 1.1), with the final peak occurring during the first week of August.

In 2000 MMCD recycled 18,022 tires removed from the field by staff. Since 1988, the District has recycled 357,143 tires. Once again, waste tire abatement was assisted through cooperative arrangements with Carver County and Dakota County. During routine surveillance and in response to LaCrosse encephalitis cases, MMCD completed 3,445 site inspections including inspections of 415 individual wooded areas. In addition to the tires removed, these inspections resulted in the filling of 2,018 tree holes and the elimination of 2,545 container breeding sources. Three hundred seventy-one adulticide treatments were made against *Oc. triseriatus* populations found to be in excess of the MMCD threshold.

A cooperative effort was initiated among the Minnesota Pollution Control Agency (MPCA), the Washington County Department of Public Health and Environment, and MMCD to remove the equivalent (by weight) of 6,000 waste automobile tires from an auto salvage yard in St. Paul Park in addition to those collected by MMCD staff. Coordination of the tire removal effort was through the Washington County Department of Public Health and Environment. Tire recycling costs were shared between the property owner and Washington County using funds provided by MPCA. Labor was provided through the Washington County Sentenced to Serve Program. MMCD provided additional labor and equipment as well as technical advice.

As in past years, MMCD staff distributed LaCrosse encephalitis prevention brochures to residents of identified risk areas. MMCD also distributed brochures at public functions such as county fairs and the Minnesota State Fair. The goals of these forms of information were to educate the public on LaCrosse encephalitis and to stress residential mosquito control by eliminating sources of *Oc. triseriatus* larval habitat around an individual's home.

In addition to the District's standard methods of distributing information, MMCD investigated reaching residents of targeted neighborhoods by mail. An area surrounding a 1999 LaCrosse encephalitis case site in Shorewood was selected for a pilot project. The area selected included portions of Chanhassen in Carver County, and Excelsior and Shorewood in Hennepin County. Aspirator sampling was used to identify populations of *Oc. triseriatus* in the trial area. Following control efforts by MMCD staff in areas where the mosquito was located, residents living near the sample location received an informational letter describing La Crosse encephalitis and methods to reduce risk in the neighborhood. The mailings were generated by selecting properties from internally generated digital maps, then creating labels using county parcel maps and databases. Three hundred fifty-seven letters were sent to residents of the area, as well as non-resident property owners.

LaCrosse Encephalitis Case Responses MMCD responded to six probable cases of LaCrosse encephalitis in and near the District during 2000 (Table 1.2). There were eight cases of the illness reported in Minnesota residents. Two of the individuals who contracted LaCrosse encephalitis in 2000 were residents of the District.

MMCD identified and inspected eight locations in and near the District as possible LaCrosse virus exposure sites for the six cases investigated. Four of these areas are located within the District and four lie just beyond the western border of the District. Intensive inspections and mosquito

sampling occurred at each of the possible exposure locations resulting in the removal of potential breeding sources and reduction of adult *Oc. triseriatus* populations where necessary. All properties within ½ mile of three possible exposure locations within the District (Independence, Jordan, Victoria) received thorough inspections.

Table 1.2 LaCrosse encephalitis cases investigated by MMCD in 2000. Locations in bold type lie within the District. Locations in italics were not inspected by MMCD.

MMCD Case #	Age Gender	Community of Residence	Date of Onset of Symptoms	Date Reported to MMCD	Possible Exposure Areas Identified
A00	7 Years Male	rural Delano	July 27	August 10	Family farmstead
B00	7 Years Male	Waconia	August 25	September 8	Farmstead rural Waconia **Father's residence Jordan**
C00	7 Years Female	rural Watertown	August 30	September 8	Family farmstead
D00	9 Years Male	**Independence**	August 25	September 8	**Neighborhood of residence** *Forestville State Park* *Fillmore County* *Farmstead* *Fillmore County*
E00	3 Years Male	rural Watertown	August 30	September 12	Family farmstead *Rural residence* *Clear Lake WI*
F00	47 Years Female	**Victoria**	September 9	September 21	**Neighborhood of residence** **Family property Minnetrista**

Table 1.3 Breeding sources removed from properties inspected in response to six LaCrosse encephalitis cases in and near MMCD during 2000. Locations in bold type lie within the District.

MMCD Case # Location	Properties Inspected	Tires Removed	Treeholes Eliminated	Containers Eliminated
A00 Delano	4	28	0	0
B00 Waconia Farm	1	62	0	5
B00 Jordan	504	91	6	112
C00 Watertown Farm	1	15	0	0
D00 Independence	176	35	5	117
E00 Watertown Farm	2	94	0	2
F00 Victoria	95	4	0	37
F00 Minnetrista	3	0	2	11

Table 1.4 Adult and larval mosquito samples collected from possible LaCrosse virus exposure areas for six LaCrosse encephalitis cases in and near MMCD during 2000. Locations in bold type lie within the District.

MMCD Case # Location	Aspirator Samples Collected	Aspirator Samples Over Threshold	Live Larval Samples Collected (all species)	Adult *Oc. triseriatus* to MDH for Viral Analysis Pools (Total #)
A00 Delano	5	2	5	6 (164)
B00 Waconia Farm	1	1	4	3 (9)
B00 Jordan	10	3	46	11 (110)
C00 Watertown Farm	0	0	4	2 (50)
D00 Independence	13	2	32	13 (441)
E00 Watertown Farm	1	0	6	2 (52)
F00 Victoria	6	0	1	0
F00 Minnetrista	0	0	1	0

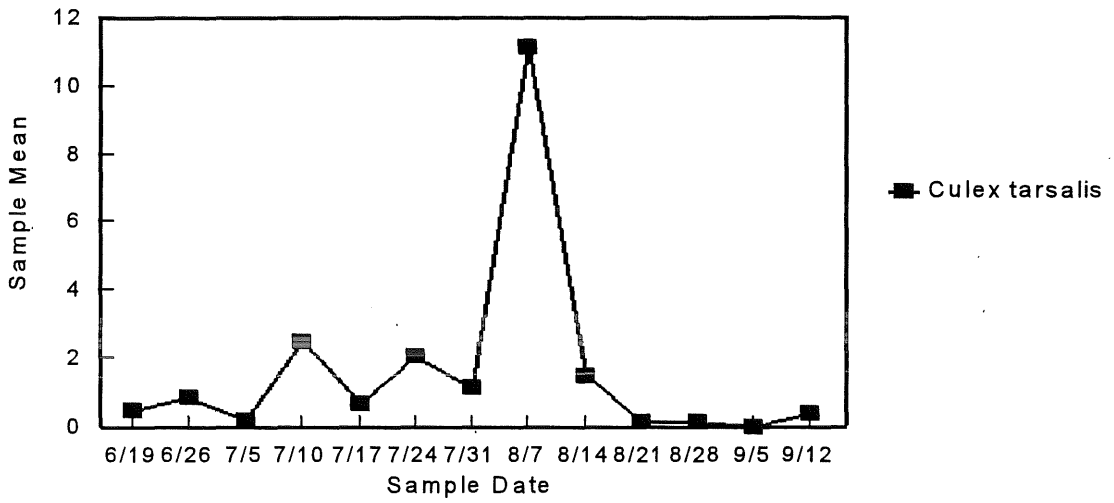


Figure 1.2 Mean number of *Culex tarsalis* captured in CO_2 traps placed once each week as part of MMCD's adult surveillance network.

Results of the initial inspections conducted in immediate response to the six LaCrosse encephalitis cases investigated by MMCD are summarized in Table 1.3 and Table 1.4. Larval samples were collected from breeding sources in the areas investigated. The mosquito larvae were reared to adults at the MMCD laboratory. Thirty-seven pooled samples of *Oc. triseriatus* adults were forwarded to MDH for viral analysis, but the LaCrosse virus was not isolated.

***Culex tarsalis* and Western Equine Encephalitis (WEE) Surveillance** *Culex tarsalis* is the vector of WEE virus throughout much of the western United States. Periodic outbreaks of the illness occur in humans and horses when vector populations are high. *Culex tarsalis* numbers in the District and surrounding area remained low in 2000 based upon CO_2 trap surveillance results (Figure 1.2). A short lived population increase was indicated by August 7 sample data.

As in the past, MMCD maintained three chicken flocks as sentinels for detection of WEE virus. The flocks were located in Sand Creek Township in Scott County, Greenfield Township in Hennepin County, and Oak Grove Township in Anoka County. Each flock consisted of 25 birds. Blood was drawn from 20 at each location weekly from the third week of May through the second week of September. Blood samples were submitted to MDH for WEE antibody analysis; no seroconversions occurred in 2000.

Cache Valley Virus Surveillance conducted by MMCD in response to a report of a possible arbovirus infection of an Edina resident resulted in the detection of Cache Valley virus. August 9, MDH contacted the District regarding a 40 year-old male who had been hospitalized with symptoms consistent with those of viral encephalitis. An arboviral screen identified antibodies to St. Louis encephalitis virus. Results were consistent with a previous infection, and likely were not related to the current illness.

MMCD initiated adult mosquito surveillance on the 10th of August. Ten aspirator samples were collected from wooded areas near the patient's residence. Also, six CO_2 traps were placed in the surrounding neighborhoods. The mosquitoes in the samples were identified and separated into pools of *Culex* species and non-*Culex* species. Thirty samples were submitted to MDH. Cache Valley virus was identified from one sample which consisted of 95 *Aedes vexans* and two unidentified *Aedes* species. The sample was collected by CO_2 trap from the patient's yard. Four CO_2 traps were placed in the area on September 9. There were no viruses isolated from the mosquitoes collected at that time. Further analysis of blood samples from the patient ruled out an infection with Cache Valley virus. The agent which caused the illness has not been identified.

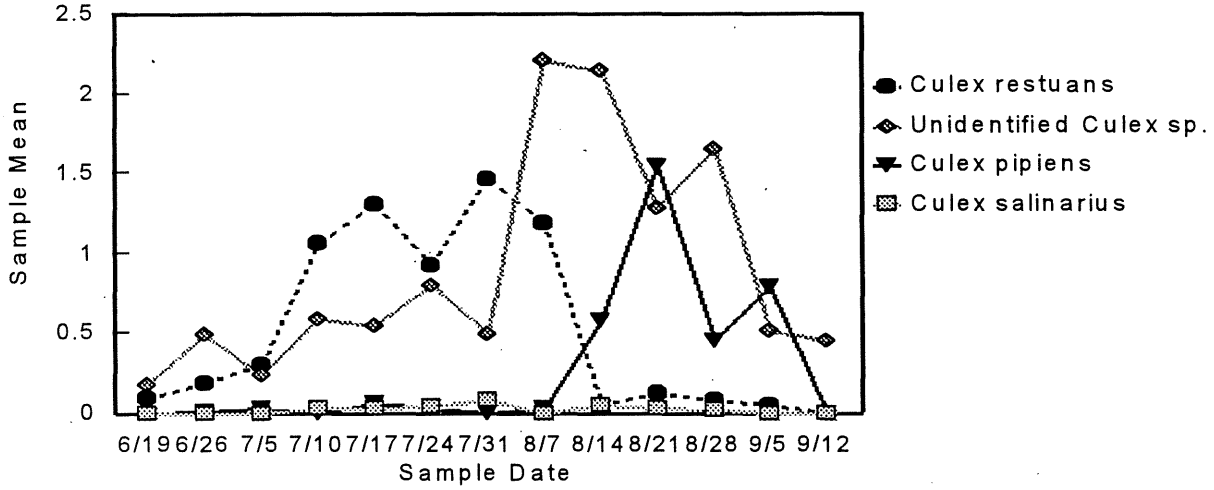


Figure 1.3 Mean number of *Culex* species captured in CO_2 traps placed once each week as part of MMCD's adult surveillance network. *Culex territans* were also captured on occasion.

West Nile Virus (WNV) West Nile virus, an old-world virus, was first identified in North America during the summer of 1999 in New York City. The natural cycle of the virus is maintained by several avian host species and mosquito vector species, however sporadic human illnesses and disease outbreaks do occur as do cases of equine illness. In the two summers since the introduction of WNV to North America 81 human cases of West Nile encephalitis have been diagnosed, 9 resulting in deaths. Also, WNV is responsible for substantial bird deaths in the northeastern United States. The virus has been particularly lethal to American crows (*Corvus brachyrhynchos*). Data from East Coast surveillance for WNV indicate a geographic expansion of the enzootic region from 1999 through 2000, and the virus is expected to continue to spread to other parts of North America.

In 2000, MMCD entered into a contract with MDH to begin surveillance for WNV. Efforts were concentrated on characterization of *Culex* species populations (Figure 1.3) and identification of *Culex* breeding sites within the District as this genus is most often implicated in maintenance and

transmission of WNV. Mosquitoes from other genera may play roles in transmission of WNV to humans and other mammals.

Data from CO_2 trap surveillance were utilized to select locations for placement of gravid traps, which have not previously been a standard tool for adult mosquito surveillance in the District. The gravid trap is designed to attract and capture female mosquitoes which are searching for an oviposition site. These are mosquitoes that have had a blood meal and are therefore more likely to have been infected with a blood-borne pathogen than mosquitoes searching for their first blood meal. The gravid trap has been an effective device for capturing mosquitoes from the genus *Culex* in other regions of the country and is a tool recommended by the U. S. Centers for Disease Control and Prevention (CDC) for use in WNV surveillance. MMCD operated gravid traps at five locations once each week from July 31 to September 12. Capture rates were low for all mosquito species.

Aedes albopictus *Aedes albopictus* is an aggressive human biting mosquito which is capable of transmitting the LaCrosse encephalitis virus in addition to several other arboviruses. *Aedes albopictus* is a container breeding species native to Asia. The North American infestation by the species was first identified in 1985 near Houston, Texas. Since then, *Ae. albopictus* has established populations through much of the eastern United States as far north as Illinois in the Midwest and New Jersey in the East.

In July 1999, adult *Ae. albopictus* were collected by MMCD staff from a wooded area located outside Greenman Technologies of Minnesota, Inc. (GTMI) a tire recycling facility in Savage, Minnesota. This was the fourth introduction of the species identified in Minnesota and the second at this location, the first occurring in 1991 when the business was operated by BFI Tire Recyclers.

During autumn of 1999, MMCD staff collected containers and tires from a wooded area bordering GTMI on the north and west. Presumably, if any unhatched *Ae. albopictus* eggs existed in the area, containers from this location had a high probability of containing some of those eggs based upon several factors. Most notable of these factors are: Adult *Ae. albopictus* were collected from within the same wooded area earlier in the year, and the containers collected exhibited characteristics indicative of preferred oviposition habitat. A total of eighteen tires and containers were collected from the site and stored outside MMCD's Jordan facility over the winter of 1999-2000 which, incidentally, was mild in comparison to normal conditions.

The containers and tires were relocated indoors and flooded with deionized water on March 9, 2000. The first mosquito larvae were observed on the 10th of March. Larvae were regularly collected from twelve of the containers for several weeks and reared to adults. Adult mosquitoes were collected from April 5 to May 31, 2000. In total, 1,406 adult mosquitoes emerged. All were identified as *Oc. triseriatus*.

Ovitrap and aspirator surveillance occurred at and near GTMI throughout the 2000 mosquito season. *Ae. albopictus* was not identified at this location or elsewhere in the District. Indications are that *Ae. albopictus* was unable to survive MMCD's abatement activities and/or the winter following this most recent introduction to Minnesota. *Ae. albopictus* have not been identified in the year following an introduction at any of the three previously identified sites of introduction in

the state. Furthermore, results from the controlled rearing described above demonstrate that any *Ae. albopictus* eggs present at the site of introduction at the end of the summer of 1999 likely did not survive the winter.

Continued, weekly surveillance for *Aedes albopictus* will occur at and around GTMI and at B&S Tire in Elko, Minnesota, the only other known site of *Ae. albopictus* introduction within the area serviced by MMCD. MMCD's larval and adult *Ae. albopictus* surveillance activities occur from late May through September.

Tick Vectors

— ***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* populations, and in 1998 *I. scapularis* was detected in Hennepin and Scott counties for the first time using this study methodology. No *I. scapularis* were re-detected in either Hennepin or Scott county in 1999, and overall 1999 results detected no major changes to *I. scapularis* distribution in the metropolitan area. Surveillance continued in 2000, but results are not yet available.

***Ehrlichia* & *Borrelia burgdorferi* Cooperative Studies** (a three-pronged effort)
Agencies involved-Dr. Russell Johnson (University of Minnesota-Mpls), Marty Skoglund and Jay Brezinka (Dept of Military Affairs, Little Falls, MN)-assisted by the US Army:
Our cooperative studies regarding the distribution and prevalence of the Lyme disease bacteria (*Borrelia burgdorferi*) and the human granulocytic ehrlichiosis (HGE) agent continued and expanded in 2000. Research consisted of a three-pronged effort – two within and one outside of the Minneapolis – Saint Paul metropolitan area. Our preliminary small mammal research results (further analyses pending) are consistent with human case data provided by MDH which show Lyme infections to be more prevalent than infections with the HGE agent.

Effort 1: Re-sampling Washington County (May and Hugo townships). District/UofM
This collaboration involving sites sampled since 1998 was reduced in scope from three sites to two in 2000, but these sites were sampled for a full season (April 25 – October 12). A preliminary total of the number of mammals collected is 99: Fifty-nine *Peromyscus leucopus*, 28 *Clethrionomys gapperi*, 6 *Tamias striatus*, 3 *Sorex cinereus*, 2 *Blarina brevicauda*, 1 *Zapus hudsonius*. None of the mammals showed active HGE infection (zero culture-positive), but a small number showed evidence of the HGE agent circulating in the metro area (3% PCR-positive for HGE). In contrast, *B. burgdorferi* appears to remain better established in the metro area (18% of the mammals were culture-positive for *B. burgdorferi*). *B. burgdorferi* PCR data are pending, as are serology data for both HGE and *B. burgdorferi*, and dragging / flagging results.

Effort 2: Re-sampling North Oaks (Ramsey county) for a four-week period. District/UofM

Background: North Oaks is a residential community in Ramsey county that was extensively examined by the District and Dr. Russell Johnson (UM-Mpls) from 1992 - 1997. It is parceled into larger acreage lots; those located on the eastern half of the community consisting generally of woody-stemmed vegetation (trees and bushes), with the western side tending towards a more open vegetative environment. Past research results found a *B. burgdorferi* small mammal infection rate ranging overall from 4.5% - 15% (rates seemingly site specific and localized). Most of the *I. scapularis* collections as well as higher *B. burgdorferi* infection rates were found on the eastern side of North Oaks. Surveys regarding Lyme disease in North Oaks residents performed by the MDH also seemed to establish a pattern of higher risk in the eastern side of the community.

The District and the UM wanted to determine whether any changes had occurred since 1997 at two areas located on the eastern side of North Oaks. Sampling was re-established for a four-week period (June 5 – July 11, 2000; no sampling during the week of July 4). Serology results and *B. burgdorferi* PCR are not completed yet, but the total number of small mammals collected was nineteen (11 *P. leucopus*, 8 *C. gapperi*). None were positive for HGE by either PCR or culture. *53% were heart and/or bladder culture-positive for *B. burgdorferi*. *We believe that this percentage is probably higher compared with other reported results primarily due to the shorter sampling duration, but we are not excluding other possible conclusions.

Effort 3: Small mammal trapping and dragging for questing ticks in Little Falls, Arden Hills, and North Oaks, Minnesota. District/UofM/Camp Ripley/US Army-assisted

Background: This study was undertaken to collect comparative data from a higher tick-borne disease risk area (Little Falls; near Brainerd) versus the metro in an attempt to understand more about the epidemiology in a higher risk area and assist with understanding potential epidemiological differences between the two areas. Note: Major Bill Sames and Bill Irwin of the US Army Center for Health Promotion and Preventive Medicine Direct Support Activity (USACHPPM)-West collected duplicate samples in this study effort. Two mammals initially tested positive for what seems to be a non-human pathogenetic hantavirus strain (likely Prospect Hill) by USACHPPM-West, but both were classified as negative in final testing results.

Small mammals were collected from a total of eight sites (4 in Little Falls; 4 in the metro area) approximately monthly from May 22 – October 27, 2000 for one trapnight each sample period. Sera was collected and processed and final results are pending. 42% of the Little Falls specimens (whole blood in EDTA) tested PCR-positive for the HGE agent. The HGE culture-positive rate was 23%. Each of the HGE culture-positives was also PCR-positive. *B. burgdorferi* PCR is not completed yet, but *B. burgdorferi* cultures were positive in 5% of the blood specimens. Metro results are pending. Results of tick load comparisons between the Little Falls and metro area samples will be made after all of the ticks have been removed and identified. Dragging/flagging results are also pending, and nymphs collected in the dragging effort will be tested in an attempt to determine the specific host that each larva had fed on.

The District is not directly involved in the following deer serology study, but the results are pertinent to the Little Falls study: Camp Ripley/UM. Blood samples from several October, 1999 hunts and one white-tailed deer live-trapping effort from January, 2000 were collected. Testing results from the October 1999 collections showed 52% of the deer PCR-positive for the HGE agent. *B. burgdorferi* PCR is pending. 78% of the October deer were seropositive for anti-HGE antibodies. For the samples collected in the January live-trapping effort, none were HGE PCR-positive, but preliminary serology results were 100% positive for the HGE agent. Collections in

Little Falls continued during the fall of 2000, were planned for January 2001, and may be expanded to include Arden Hills, MN (TCAAP) samples in 2001.

—**Tick Identification Services/Outreach** The overall scope of tick-borne disease education activities and services (including tick identifications) were maintained in 2000 utilizing previously described methods and tools. In 2001 the Public Affairs department will develop several public service announcements (PSAs) with a focus on tick-borne disease prevention. These PSAs are scheduled to be available for use by June 2001.

Plans for 2001:

Tick Vectors

Literature published January, 2001.

Background: Cases of human granulocytic ehrlichiosis (HGE) have occurred in Minnesota residents and District surveillance has shown that *I. scapularis* populations are established within portions of the metropolitan area. HGE agent DNA was found in rodent blood samples drawn from small mammals collected for our distribution study in a 1995 collaboration with Dr. Barb Greig, DVM (formerly of UM-St Paul), and portions of this work were published in the April 1997 issue of the Journal of Clinical Microbiology. Dr. Russell Johnson (UM-Mpls) tested mammals collected during our 1996 cooperative North Oaks studies with negative results. In 1997 and 1998, *P. leucopus* collected for our *I. scapularis* distribution study were used to obtain blood samples that were analyzed for the presence/absence of antibodies to *Ehrlichia* species. District staff performed the majority of the blood sample collections while the University performed the laboratory analyses. 1997 results yielded eleven samples that reacted positively to immunofluorescent antibody (IFA) testing and two more borderline positive samples, with the sample described below being the single culture-positive result.

- An article titled "Isolation of the Etiologic Agent of Human Granulocytic Ehrlichiosis from the White-footed Mouse (*Peromyscus leucopus*)" was published in the January, 2001 issue of the Journal of Clinical Microbiology. Co-authors, in order, are M. Dana Ravyn, Sarah Carter, Carrie Kodner, Janet Jarnefeld, and Dr. Russell Johnson (corresponding author).

New Projects 2001:

- **Risk Assessment of the Expanding Distribution of Lyme Disease in the North - Central US:** The goal of this potential effort is to expand the known risk model and maps developed for Illinois and Wisconsin to include the rest of the north-central U.S. and areas south as far as Tennessee using digitized data bases available from the USGS, GAP programs, etc. Known negative and positive sites from Michigan, Indiana, Minnesota, Ohio and Tennessee will be overlaid on the risk maps. Collaborators from throughout the Midwest will assist the co-investigators (Dr.'s Uriel Kitron, Edward Walker, and Mark Wilson) on this first phase of what could be a three-year project.
  We will collect questing *Ixodes scapularis* at several sites; possibly as few as one site where *I. scapularis* has been collected during our distribution study efforts versus one site where our study methodology has not detected *I. scapularis* to date. Samples will be collected via dragging/flagging. This study will likely expand to additional sites in future years. Dave Neitzel of the MN Dept Health is the other Minnesota collaborator on this project.
- **Radio public service announcements:** Several tick-borne disease prevention public service announcements will be developed by the Public Affairs Department and are scheduled to be aired by metro radio stations by June, 2001.

CHAPTER 1 VECTOR-BORNE DISEASE

Continuing projects 2001:

- **Collaborative research:** we will continue the collaborative study with Camp Ripley and the UM to better understand the epidemiology of tick-borne disease risk in the metro versus a higher risk (Brainerd) area. The District's ultimate goal is to create a model that could estimate tick-borne disease risk on a smaller scale than that which is currently available.
- **metro surveillance:** the metro-based *I. scapularis* distribution study that was initiated in 1990 will continue.

Discontinuing projects 2001:

- **Effort 1 2000: a three-year metro collaborative study**--intensive sampling in Washington county (May and Hugo townships) with the UM have provided generally consistent results over the three-year period.
- **Effort 2 2000: re-examination of 1992-1997 study sites**--intensive sampling in Ramsey county (North Oaks) for a 4 week period did not show any changes since 1997.

CHAPTER 2 MOSQUITO SURVEILLANCE

2000 RESULTS

- District rainfall was below average, the lowest in the last four years.
- Summer *Aedes/Ochlerotatus* mosquitoes peaked in late July following heavy rains at the beginning of the month.
- Adult collections of the cattail mosquito (*Coquillettidia perturbans*) were lower this year with their usual peak at the beginning of July.

PLANS FOR 2001

- Review New Jersey light trap procedures to improve collections.
- Continue to compare the new American Biophysics Company (ABC) CO_2 traps with old traps.

CHAPTER 2 MOSQUITO SURVEILLANCE

BACKGROUND

MMCD conducts a variety of surveillance activities to identify the need for control and to monitor the District's progress toward reducing mosquito levels. Rainfall information is collected from 73 gauges to help identify where mosquito production is likely. This rainfall information is also forwarded to the MDNR State Climatology Office to supplement their network. Larval samples taken from breeding sites before treatment are identified to detect the presence and amount of human-biting mosquito species. MMCD uses New Jersey light traps, sweep nets and CO_2 traps to monitor adult mosquitoes.

New Jersey light traps are the standard adult mosquito collection devices for many mosquito control districts. MMCD has used New Jersey light traps since 1960 to collect historical data on mosquito populations. Light from a 25-watt light bulb acts as an attractant and a timer turns traps on and off. Personnel empty traps daily from May to September.

Sweep net collections are used to detect mosquitoes annoying to people, and both species composition and abundance are evaluated. Sampling occurs during the peak mosquito activity period, five minutes after the end of twilight, which is about 35-40 minutes after sunset. Employees take two-minute collections in the evening in their yards once per week for 17 weeks.

CO_2 traps baited with dry ice are also used to monitor mosquito population levels during the peak mosquito activity period, and to monitor the presence of disease vector mosquito species. Employees set traps in their yards on the same nights as the sweep net collections, once per week for 17 weeks.

The composite genus *Aedes* was divided into two genera, *Aedes* and *Ochlerotatus* (Reinert, 2000). The Minnesota species that are included in the new *Aedes* genus are *vexans*, *cinereus* and *albopictus*. All other species are included in *Ochlerotatus*.

2000 SURVEILLANCE RESULTS

Rainfall and Number of Broods: Average rainfall per gauge in the District from May 1 through September 30, 2000 was 17.79 inches (Table 2.1). This is 1½ inches below the 42-year District average. More rain fell in the central and eastern areas of the District for the season, with lowest rainfall in Anoka County.

Table 2.1 Average amount of rainfall received in each county from May through September 1996-2000 and 42-year average.

	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
1996	13.23	11.91	15.64	13.04	12.66	13.50	14.31	14.06
1997	19.21	24.01	26.27	19.52	23.21	23.49	22.34	21.33
1998	18.95	18.70	23.53	18.30	19.26	22.06	19.89	19.43
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
42-Year Avg	18.85	NA	19.74	19.47	19.78	19.31	20.10	19.36

Rain events in 2000 produced 10 broods of floodwater mosquitoes. Brood size is determined by the amount of geographic area of the District that receives enough rain to cause mosquitoes to hatch (Table 2.2). April was very dry with two medium, isolated broods. We had two large, overlapping broods at the end of May and beginning of June (Fig. 2.1). There was a medium brood produced on June 19. On July 6-9, accumulated rains of three and up to10 inches in Eagan produced a large brood. There was one large and two medium broods in August and one medium brood at the beginning of September.

Table 2.2 Definition of brood size.

Brood size	% of District with >1 inch of rain
Small	< 50%
Medium	50-74%
Large	>75%

Larval Collections In 2000, staff identified 10,925 larval collections (Appendix A). Frequencies of occurrence for the most abundant nuisance species District-wide were *Ae. vexans* (31.7%), *Ae. cinereus* (8%), *Ochlerotatus stimulans* (4.3%) and *Ochlerotatus excrucians* (4.1%). To speed up the identification of air site samples, larvae are only identified to the genus level, resulting in a high percentage of unidentified *Aedes/Ochlerotatus* species (51.4%). Each county had a different profile of abundant mosquitoes, but *Ae. vexans* was, by far, the most abundant in all locations.

Mosquito Abundance

— Evening sweep net collections Summer *Aedes/Ochlerotatus* and *Coquillettidia perturbans* were the usual predominant species in the sweep collections (Table 2.3). In years of low rainfall, such as in 1996, *Cq. perturbans* can predominate because of low populations of floodwater mosquitoes. Weather conditions the past five years have not been conducive for high levels of *Cx. tarsalis.* Spring species were lower than usual this year due to the dry spring. *Ochlerotatus triseriatus* are daytime biters and do not fly very far from their breeding habitat, consequently, evening sweep net collections are not the best method to accurately detect this species. The number of sweep net collections varied between 62-123 per night due to different numbers of staff available to take sweeps.

Table 2.3 Average number of mosquitoes per evening sweep net collection, 1996-2000.

Species	1996	1997	1998	1999	2000
Summer *Ae./Oc.*	1.5	4.0	4.2	5.6	2.5
Cq. perturbans	2.2	0.7	1.4	1.9	0.7
Spring species	0.1	0.1	0.1	0.1	0.01
Cx. tarsalis	0.01	0.01	0.04	0.01	0.01
Oc. triseriatus	0.01	0.01	0.01	0.01	0.01

— **Evening CO_2 trap collections** Beginning in 1997, the traps were operated all night instead of the 2-hour period used in previous years. Therefore, yearly comparisons with trapping previous to 1997 cannot be made. We operated 69 traps in 2000. The trends in species abundance in the CO_2 traps (Table 2.4) are the same as the sweep net collections.

Table 2.4 Average number of mosquitoes collected per night in CO_2 traps 1997-2000.

Species	1997	1998	1999	2000
Summer *Ae./Oc.*	182.7	138.2	327.9	238.0
Cq. perturbans	30.9	31.9	45.6	40.6
Spring species	2.4	0.9	1.9	0.3
Cx. tarsalis	0.7	0.4	0.6	1.3
Oc. triseriatus	0.5	0.2	0.3	0.3

Seasonal distribution: There were two weeks in February with temperatures 25^0 above average, an event never before seen in history. Temperatures near 70^0 in late February and early March melted all the snow. Consequently, Spring species populations were very low due to the early thaw and dry spring.

Evening sweep net collections showed there were two major peaks of adult mosquito activity during the summer (Fig. 2.1). The sweep net collections detected a larger peak of mosquitoes on July 10 than the CO_2 traps (Fig. 2.2). The sudden drop in mosquitoes of all species in the sweep net collections in mid-July is a result of cool temperatures and 10 mph winds that evening. Summer *Ae./Oc.* mosquitoes produced by the rains on Memorial Day weekend were inactive due to cool temperatures until the end of June. The large storm during the first week of July produced the season's peak of activity at the end of July. *Coquillettidia perturbans* biting activity peaked at the same time as the summer *Ae./Oc.*

Figure 2.3 displays the average number of mosquitoes in sweep net collections for sampling dates during the main part of the season. White areas are tolerable annoyance levels (0-4), lightest grey is moderate (5-9), darker grey is bad (10-14) and black is extremely bad (>15). There are some hot spots within the priority 1 zone, but overall the mosquito levels are higher in outer zones of the District. The high mosquito levels on July 24 resulted from the 3-10 inch rains at the beginning of the month.

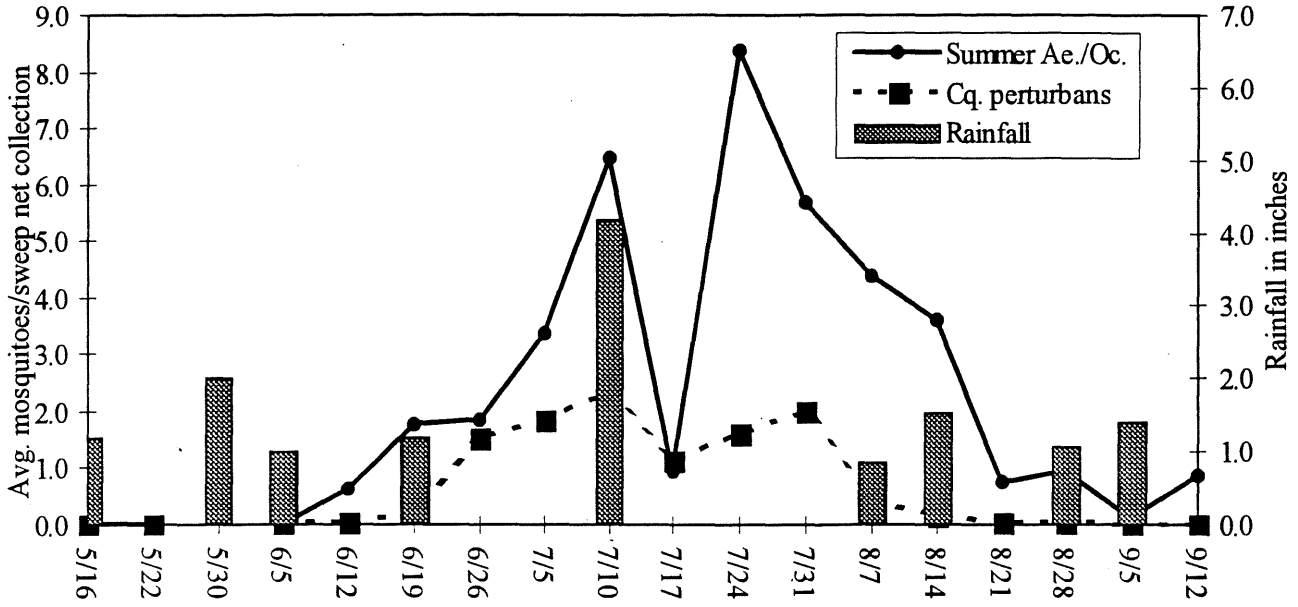


Figure 2.1 **Average number of summer *Ae./Oc.* and *Cq. perturbans* per evening sweep net collection and rainfall events, 2000. (May 30 canceled due to bad weather)**

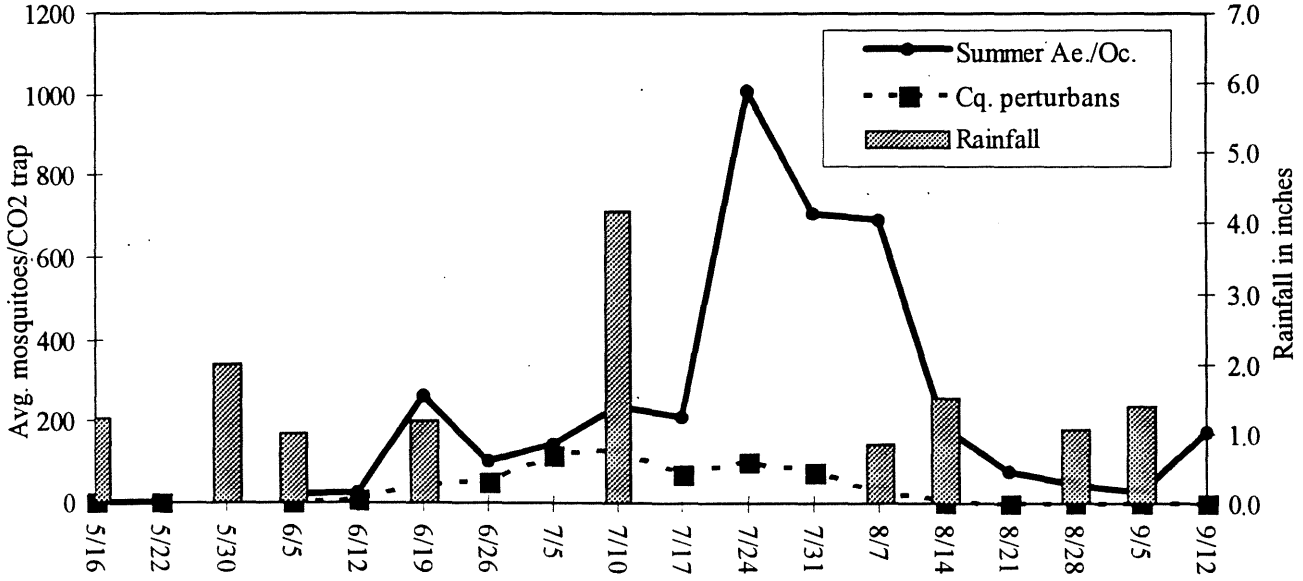


Figure 2.2 **Average number of mosquitoes per CO_2 trap and rainfall events, 2000. (May 30 canceled due to bad weather)**

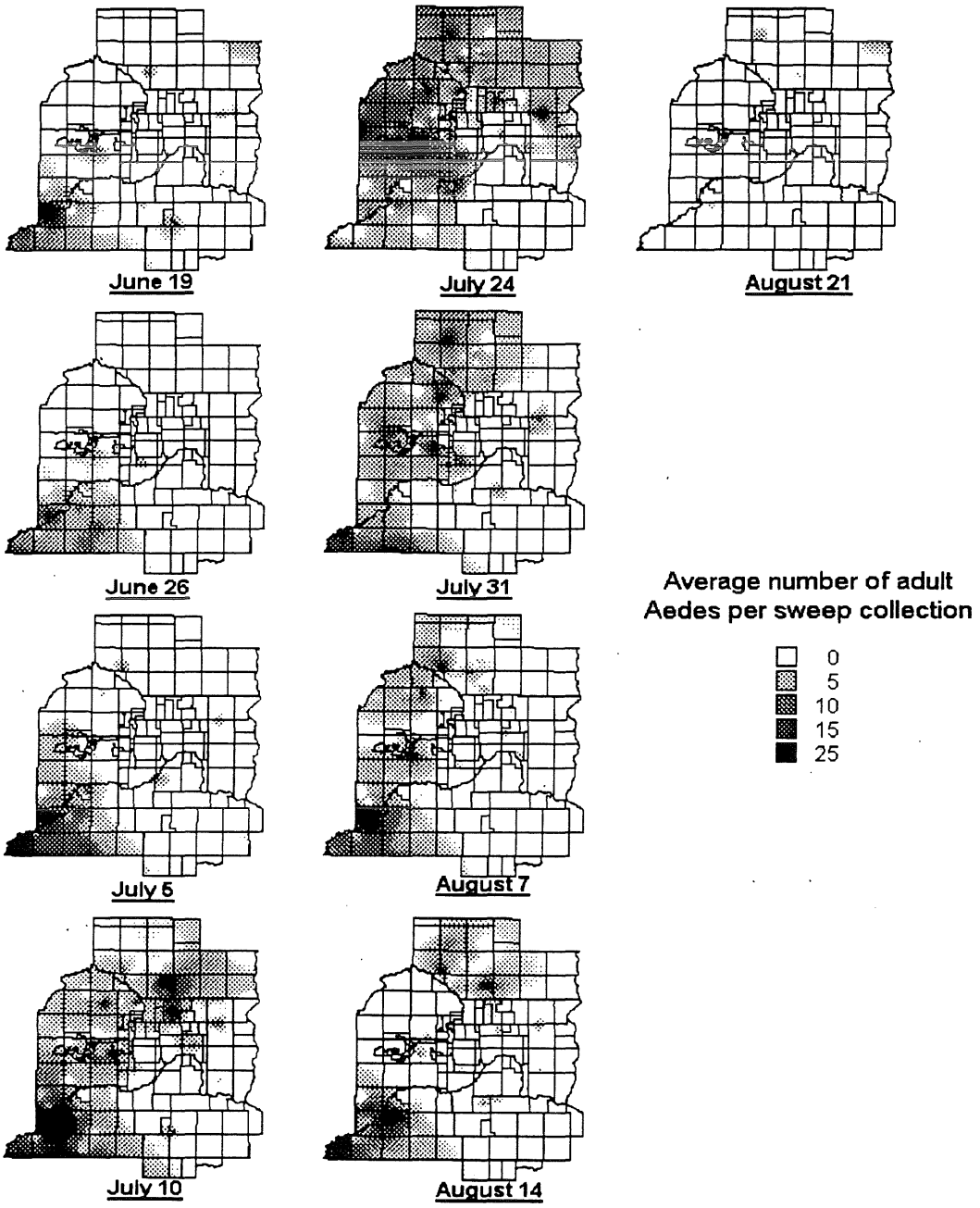


Figure 2.3 Average number of *Ae./Oc.* mosquitoes in sweep net collections, 2000.

CHAPTER 2 MOSQUITO SURVEILLANCE

Adult Collections — New Jersey light traps

The District operated seven traps in 2000. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap16 in Lino Lakes, trap 20 in Elm Creek Park Reserve, trap CA in Carlos Avery Wildlife Refuge and trap RM at Lebanon Hills Regional Park in Eagan (Fig. 2.4). Traps 1, 9 and 16 have operated each year since 1960.

Data collected from light traps is used to compare mosquito species population levels from year to year. These are the only collections where all female mosquitoes are identified to species. A total of 85,984 female mosquitoes were identified in 2000 (Table 2.5), with *Ae. vexans* being the most predominate species and *Cq. perturbans* second. The number of mosquitoes collected per night from 1960 to 2000 is displayed in Appendix B.

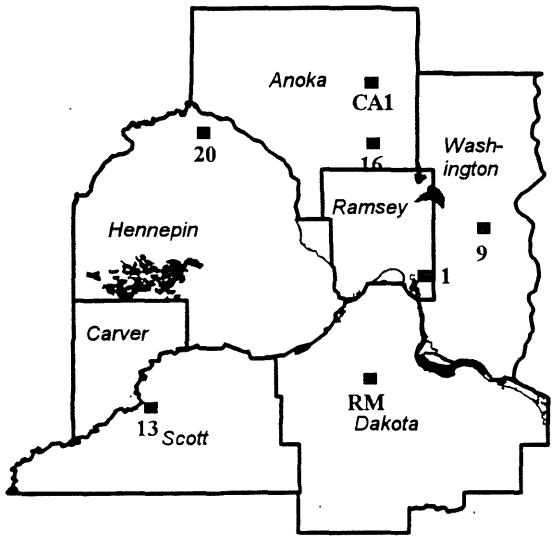


Figure 2.4 New Jersey light trap locations – 2000

CO_2 Trap Comparison Studies The current style of CO_2 trap used by the District has some inconsistencies and flaws. In 1998, we purchased a few American Biophysics Company (ABC) traps and conducted a small-scale comparison of their catch results with our current model and a trap equipped with a regulated CO_2 tank using a Latin square design. There was no significant difference between trap catches, so we purchased 130 more ABC traps. A larger-scale comparison using a similar experimental design conducted this season revealed no significant differences between the old trap and the ABC trap except possibly on one night of the study. We did not include the trap equipped with a regulated CO_2 tank because it is very expensive.

Table 2.5 New Jersey light trap collection totals May 13-Sept. 29, 2000

Trap No.	1	9	13	16	20	CA1	RM	Season	% of female	Average
Location	St. Paul	Lk. Elmo	Jordan	Lino Lks.	N. Henn.	Carlos	Rosemount	total	total	per night
No. of coll.	140	136	137	140	136	136	132	957		
1. *Oc. abs.*	0	0	0	0	0	17	0	17	0.02%	0.02
6. *aur*	0	0	0	0	0	3	0	3	0.00%	0.00
7. *Ae. cin.*	3	13	0	20	20	200	27	283	0.33%	0.30
10. *Oc. dor.*	1	0	0	0	0	0	0	1	0.00%	0.00
11. *exc.*	0	0	0	0	0	1	0	1	0.00%	0.00
18. *punc.*	0	0	0	0	0	9	0	9	0.01%	0.01
22. *stim.*	1	0	0	0	0	0	0	1	0.00%	0.00
24. *tris.*	1	4	1	0	0	1	16	23	0.03%	0.02
25. *triv.*	2	100	15	3	481	24	646	1,271	1.48%	1.33
26. *Ae. vex.*	541	3,739	2,540	6,502	15,761	13,115	11,907	54,175	63.01%	56.61
261. *Ae./Oc.* sp.	50	271	40	142	440	500	906	2,351	2.73%	2.46
118. *abs/punc*	0	0	1	3	0	355	1	360	0.42%	0.38
28. *An. earl.*	0	1	7	1	6	10	0	25	0.03%	0.03
29. *punc.*	3	24	15	11	183	89	585	910	1.06%	0.95
30. *quad.*	0	0	0	0	0	0	46	46	0.05%	0.05
31. *walk.*	0	3	32	4	174	388	2	603	0.70%	0.63
311. *An.* sp.	0	3	2	2	28	27	16	78	0.09%	0.08
33. *Cx. pip.*	1	0	0	0	7	0	3	11	0.01%	0.01
34. *rest.*	38	140	8	84	114	73	675	1,126	1.31%	1.18
36. *tars.*	5	19	8	50	26	14	26	148	0.17%	0.15
37. *terr.*	2	16	4	12	27	6	989	1,056	1.23%	1.10
371. *Cx.* sp.	32	169	10	83	127	58	943	1,426	1.66%	1.49
38. *Cs. inor.*	17	39	11	100	89	119	183	560	0.65%	0.59
40. *minn.*	5	4	6	353	49	25	11	453	0.53%	0.47
41. *mors.*	0	1	0	2	3	3	37	46	0.05%	0.05
411. *Cs.* sp.	3	8	0	53	20	26	81	191	0.22%	0.20
42. *Cq. pert.*	30	55	94	572	1,689	16,476	805	19,726	22.94%	20.61
47. *Ps. hor.*	0	0	3	0	0	0	6	6	0.01%	0.01
471. *Ps.* sp.	0	1	0	0	0	0	111	112	0.13%	0.12
48. *Ur. sapp.*	1	19	2	4	45	7	256	334	0.39%	0.35
501. Unident.	43	42	6	59	78	223	180	632	0.74%	0.66
Female Total	779	4,671	2,805	8,060	19,367	31,769	18,458	85,984		89.85
Male Total	280	2,184	274	2,655	1,623	3,196	13,392	23,741		24.81
Grand Total	1,059	6,855	3,079	10,715	20,990	34,965	31,850	109,725		114.66

PLANS FOR 2001

CO_2 Trap Comparison The new American Biophysics Company (ABC) traps will be used exclusively in 2001. A continuation of the comparison study is planned to further compare the ABC trap and the old trap.

New Jersey Light Traps Collections have been inconsistent and untimely in the past few years. The plan is to review the collection method to determine why these problems occur and take steps to improve the process.

References cited

Reinert, John F., 2000. New classification for the composite genus *Aedes* (Diptera: Culicidae: Aedini), elevation of subgenus *Ochlerotatus* to generic rank, reclassification of the other subgenera, and notes on certain subgenera and species. *J. Am Mosq Control Assoc*, 16(3):175-188.

CHAPTER 3 MOSQUITO CONTROL

CHAPTER 3 MOSQUITO CONTROL HIGHLIGHTS

2000 RESULTS

- MMCD treated about 40,374 fewer acres with larvicides in 2000 than in 1999.
- MMCD treated about 9,395 fewer acres with adulticides in 2000 than in 1999.
- MMCD updated digitized wetlands in the Priority 1 breeding layer.
- MMCD digitized property boundaries for restricted access areas using parcel data available from counties.
- MMCD added boundaries of wood lots (harborage), especially in areas with frequent LaCrosse encephalitis monitoring and treatment areas.
- MMCD acquired new aerial photos in October 2000.

PLANS FOR 2001

- No major changes to control program.
- MMCD plans to test how inexpensive Garmin GPS units can be used to more precisely record sampling, treatment and other locations.

CHAPTER 3 MOSQUITO CONTROL

Background

The mosquito control program targets the principal summer pest mosquito, *Ae. vexans*, several species of spring mosquitoes, and the cattail mosquito *Cq. perturbans*. 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. See Appendix C for a more in-depth description of biologies of the various mosquito species found in the District.

Floodwater mosquitoes are adept at using the natural resources of the metropolitan area. These same natural resources contribute to the recreation and enjoyment of the citizens living here. The rolling topography provides many highly productive breeding sites for mosquito larvae. Lush, wooded areas serve as protection from daily heat and low humidity for the resting adult mosquitoes.

Control Strategy Overview

Due to the large size of the metropolitan region (2,600 square miles), larval control was considered the most cost effective control strategy in 1958 and remains so to date. Mosquito control services target the most prolific mosquito breeding locations for all human biting mosquitoes. An insect growth regulator (Altosid® or methoprene) and a soil bacterium (*Bacillus thuringiensis israelensis* or *Bti*) are the primary larval control materials.

Adult mosquito control supplements the larval control program. Adulticide applications are performed (only after sampling detects mosquito populations meeting or exceeding threshold levels) primarily in high use park and recreation areas, for public events and in response to citizen mosquito annoyance reports. Two synthetic pyrethroids (resmethrin and permethrin) are used for adult mosquito control.

A description of the control materials is found in Appendix D. Pesticide labels are located in Appendix E. Appendix F summarizes the number of acres treated with each control material. Field life and dosage of each pesticide used by MMCD are summarized in Appendix G.

2000 Mosquito Control

Larval Mosquito Control

District-wide larvicidal treatments began in mid April and continued though August. Additional significant treatments were made in the west and east in mid September. In 2000, MMCD treated about 40,374 fewer acres with larvicides than in 1999 (Table 3.1). Larvicidal treatments last reached these levels in 1996, another relatively dry year (Appendix F).

In 2000 the number of acres treated with Altosid® briquets and Altosid® pellets was very similar

to 1999 (Table 3.1). The District decreased *Bti* treatments in 2000 compared to 1999 (Table 3.1). The thresholds for treatment with *Bti* were 0.1 larvae per dip (spring *Aedes*) and 2 larvae per dip (*Ae. vexans*) in Priority 1 Zone and higher in Priority 2 and 3 Zones (0.5 larvae per dip, spring species, and 5 larvae per dip, *Aedes vexans*) to help target limited control materials to sites with the most intense breeding and potential to affect the most citizens (i.e., proximity to human population). Thresholds remained unchanged in 2000.

Material	2000	1999
Altosid® briquets (150-day)	700 cases (533 acres)	700 cases (533 acres)
Altosid® pellets	44,484.60 lb (11,121 acres)	42,386.00 lbs (13,775 acres)
Altosand products	5,500 lb (786 acres)*	19,840.80 lbs (3,968 acres)*
Altosid® SR-20	586.60 ml (29 acres)**	10,492.26 ml (355 acres)**
Bti corncob	676,168.00 lb (84,521 acres)	950,636.45 lbs (118,733 acres)
Larvicide totals	96,990 acres	137,364 acres
Bti liquid (black fly)	820.50 gal	4,344.00 gal
Permethrin	794.10 gal (4,066 acres)	950.21 gal (4,865 acres)
Resmethrin	503.74 gal (42,986 acres)	616.28 gal (51,582 acres)
Adulticide totals	47,052 acres	56,447 acres

Table 3.1 Comparison of control material usage in 1999 and 2000.
*** Dosage applied: 5.0 lb/acre in 1999, 7.0 lb/acre in 2000**
**** Dosage applied: 29.6 ml/acre in 1999, 20 ml/acre in 2000**

Adult Mosquito Control

Adult mosquito control operations were triggered when mosquito levels were above threshold (2 mosquitoes in a 2-minute sweep or 2-minute slap test, 130 mosquitoes in an overnight CO_2 trap), with most treatments occurring in July and early August. Staff conducted treatments in areas identified by District surveillance and customer mosquito annoyance reports.

In 2000, MMCD treated about 9,395 fewer acres with adulticides than in 1999 (Table 3.1). The number of acres treated with permethrin in 2000 (4,066 acres) was slightly lower than 1999 (4,865 acres). Fewer acres were treated with resmethrin in 2000 (42,986 acres) compared to 1999 (51,582 acres).

CHAPTER 3 MOSQUITO CONTROL

2001 Plans for Mosquito Control Services

Larval Control: Cattail Mosquito

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.

Larval Control: Floodwater Mosquito and other species (except *Cq. perturbans*, *Oc. triseriatus* and *Ae. albopictus*)

The larval treatment strategy for 2001 will be similar to 2000. Staff will treat ground sites (<3 acres) with methoprene products and *Bti* corn cob granules. MMCD also plans to continue using six helicopters for the treatment of air sites. Based on the same larval thresholds as used in 2000, breeding sites in highly populated areas will receive treatments first, during a wide-scale mosquito brood. If time and resources permit, the District will expand treatments into less populated areas where treatment thresholds are higher.

The primary control material will again be *Bti* corn cob granules. Forecasted material needs (*Bti* and similar experimental materials) in 2001 are similar to 2000. 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.

Adult Mosquito Control

Budgeted permethrin and resmethrin resources in 2001 are similar to 1997, 1998, 1999 and 2000. Actual usage will depend upon the circumstances that occur during the season, including the amount of mosquito production and its temporal and geographic distribution within the District. MMCD will direct adult mosquito control treatments to provide the greatest customer benefit—generally high risk disease areas and areas that have high levels of mosquitoes. Also, MMCD will provide service in high use park and recreation areas and for public functions.

The Adult Mosquito Control Information Line (651-643-8383) will again enable citizens to hear a daily recording on where adult mosquito control operations are taking place (eg. parks, neighborhoods, and public events). MMCD will also have this information on its internet web site (www.mmcd.org). MMCD will continue notification in 2001 at the level similar to 2000.

Vector Mosquito Control

Field staff routinely monitor and control *Oc. triseriatus* (LaCrosse encephalitis vector), *Cx. tarsalis* (western encephalitis vector) and *Ae. albopictus* populations. See the Vector-Borne Disease Management section of this report for details.

Adulticide Non-target Research

In 2001, we intend to continue to evaluate effects of ULV-applied adulticides upon non-target insects as part of continued ULV adulticide efficacy tests similar to those conducted in 1999 and 2000. See the Supporting Work section for details.

CHAPTER 3 MOSQUITO CONTROL

Mapping and GPS: In 2000 MMCD staff updated digitized wetlands in the Priority 1 zone, and digitized property boundaries for restricted access areas. The property boundaries were done using parcel data available from the counties, allowing for more accurate determination than was previously available. Many staff also added boundaries of woodlots, especially in areas with frequent LaCrosse encephalitis monitoring and treatment efforts. New aerial photos (processed as digital orthophotos) became available from the Metropolitan Council in October 2000 and are being used to update maps. Digital wetland information was shared with Rice Creek and Middle Mississippi Watershed Management Districts, and with National Guard staff working on Twin City Army Ammunition Plant planning. Inexpensive Garmin GPS units were purchased and used in research fieldwork to map sample locations. Field staff have received some training in GPS use, and will continue testing possible uses next year.

CHAPTER 4 BLACK FLY CONTROL

CHAPTER 4 BLACK FLY CONTROL HIGHLIGHTS

2000 RESULTS

Small Streams

- In 2000 only about half as many small stream sites were treated compared to 1999.
- Much lower water flow in 2000 required the use of about 25% as much liquid *Bti* in 2000 as in 1999.

Large Rivers

- There were far fewer large river treatments in 2000 than in 1999.
- Much lower river discharge levels resulted in about 20% as much liquid *Bti* being used in 2000 as in 1999.

Non-target Monitoring

- Processing and identifications of multiplate samples were completed by December 2000. A final report was produced by February, 2001.

PLANS FOR 2001

- No major changes will be made to the larval monitoring and control program.
- We will begin assessing the feasibility of a human tolerance threshold for adult black flies.

CHAPTER 4 BLACK FLY CONTROL

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 did not go into effect until 1996.

2000 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.

A total of 140 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 30 sites on 10 streams met the threshold and were treated once with *Bti*. A total of 12.1 gallons of *Bti* was used (Table 4.1).

Table 4.1. Summary of *Bti* treatments for black fly control by the MMCD in 2000.

Water body	Number of Application sites	Total number of treatments	Gallons of *Bti* used
Small streams	30	30	12.1
Mississippi River	2	6	445
Crow River	1	2	9.5
Minnesota River	4	4	339.8
Rum River	2	6	14.3
Total	39	48	820.7

Large River Program
There are 3 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 *S. 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.

CHAPTER 4 BLACK FLY CONTROL

The black fly population size at each treatment location was measured every seven days in 2000 using artificial substrates at 21 sites permitted by MDNR on the Rum, Mississippi, Crow and Minnesota rivers. The treatment thresholds were the same as those used since 1990. Staff made 18 treatments using 808.6 gallons of *Bti* for control of large river breeding black fly larvae in 2000. In 1999, a total of 4299 gallons of *Bti* was used on the large rivers in 50 treatments. In 1998, 4209 gallons of *Bti* were used in 77 treatments. Substantially less *Bti* was used in 2000 compared to previous years because river discharge was well below normal due to drought conditions that prevailed throughout the spring and summer. Discharge on the Mississippi River was only 61% of the long term average for April - September; on the Minnesota River discharge was 65% of the long term average; on the Crow River it was 40% of the long term average and on the Rum River it was only 29% of the long term average.

Adult Population Sampling

The adult black fly population was monitored in 2000 at the 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 and 10 AM. The average number of all species of adult black flies captured in 2000 was 2.38 (Table 4.2). This is within the range of the average net sweep counts observed since the District-wide larval control program was started in 1991 and is well below the counts observed in 1984 through 1986 before any *Bti* treatments were done on the large rivers (Table 4.2). Only limited experimental *Bti* treatments were done on the large rivers in 1987, 1989 and 1990. No treatments were done in 1988, which was a year of extreme drought and very low black fly populations. In 1998 and 1999, the overall average number of adults captured was 2.85 and 1.63, respectively (Table 4.2).

The average number of adult *S. venustum* captured in 2000 was 0.02, which is in the range of the number captured in previous years. However, as in previous years, S. *venustum* made up a low percentage of the total black flies collected. The number of *S. venustum* captured in the net-sweep samples always is low and is not representative of the actual population density. This is due to the fact that samples are averaged for the entire field season and *S. venustum* adults are rare after late May because there is only a single generation in the spring.

The most abundant black fly collected in the over head net-sweep samples in 2000 was *S. luggeri,* comprising 88.9% of the black flies collected. The overall average number of *S. luggeri* captured in the net-sweep samples in 2000 was 2.11, which is in the range observed since the operational level controls began on the Mississippi River in 1992. *Simulium luggeri* was most abundant in Anoka County in 2000, as it has been in prior years. The average number of *S. luggeri* captured in Anoka County was 9.07 in 2000 versus 5.02 per sample in 1999. The high number *of S. luggeri* captured in Anoka County is most likely due to its close proximity to the Rum and Mississippi rivers which have abundant *S. luggeri* larval habitat.

Adult black fly populations were also monitored twice weekly in May through early June by CO_2-baited light traps at 4 sites in Scott/Carver counties, at 4 sites in northern Anoka County and at 3 sites outside the MMCD treatment area in Monticello, MN. Sampling was done in May when *S. venustum* is most abundant. The sampling sites in Anoka and Scott/Carver counties were located near *S. venustum* breeding sites on small streams and the Rum River. The three sampling sites in

Monticello were located near the Mississippi River and were selected to serve as a reference site outside the MMCD black fly treatment area.

The average number of *S. venustum* captured per CO_2 trap in 2000 was 3.38 (exclusive of the Monticello traps, which were not collected in 1997 and 1998). In 1998 and 1999, the average number of *S. venustum* captured per trap was 10.5 and 3.7, respectively. The average number of *S. luggeri* captured per trap at the three reference sites in Monticello in 2000 was 98.2 versus 20.01 per trap at the 7 sites within the MMCD.

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

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

Table 4.2. 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.

CHAPTER 4 BLACK FLY CONTROL

Non-target Monitoring

The District conducts biennial monitoring of non-target invertebrate populations in the Mississippi River as a requirement of its permit from MDNR. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. Sampling was last conducted in 1999 (as well as in 1995 and 1997). A report on the 1999 results has been submitted to MDNR. The results of the monitoring study do not indicate that any large-scale changes have occurred within invertebrate community (collected on Hester-Dendy multiplates) in the *Bti* treated reaches of the Mississippi River. Sampling will be repeated again in 2001.

Black Fly Control Services - 2001 Plans

Our goal is to continue to effectively control black flies in the large rivers and small streams. The thresholds for treatment will remain the same as they were in 2000. We will begin preliminary studies on human response to adult black flies. These studies are part of our long-term goal to determine the human tolerance threshold for black flies in the MMCD. We also will continue to monitor adult black fly populations with the over-head net sweep method and CO_2 traps.

CHAPTER 5 QUALITY ASSURANCE

CHAPTER 5 QUALITY ASSURANCE HIGHLIGHTS

2000 RESULTS

- Bioassays of Altosid® pellets (≈84%) indicated that they effectively controlled *Ae. vexans*, similar to results in 1998.
- Aerially-applied Vectobac® *Bti* achieved ≈91% control of larval floodwater mosquitoes.

MMCD certified the following products for operational use:

- Anvil 2+2 certified for ULV adulticide applications.
- LarvX SG Biological Soluble Granules certified for ground applications.
- XR-G Altosid® Granules certified for ground applications.
- Altosand Granules certified for ground applications.

MMCD sponsored its first equipment demonstration day attended by all full time staff during which six vendors showed their mosquito control products and equipment.

MMCD repeatedly evaluated two truck-mounted electric ULV cold foggers in 2000 and demonstrated that they held their calibration settings and optimized droplet distributions.

PLANS FOR 2001

MMCD plans additional tests of the following control materials:

- Aerially-applied Altosand and Altosid® pellets to verify 2000 bioassay results.
- IcyPearl *Bti* granules
- Teknar *Bti* Granules

MMCD will continue to:

- Improve calibration techniques to optimize adult mosquito control equipment.
- Standardize backpack sprayers and optimize the barrier treatment program.
- Optimize ULV equipment droplet distributions.
- Increase knowledge of aerial adulticiding to be prepared for mosquito-borne disease outbreaks.

CHAPTER 5 QUALITY ASSURANCE

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 provide coordination of field testing and data collection.

2000 Projects

Quality assurance processes focused on equipment and new product evaluations. The District continued the certification process on four control materials and introducted one new control material in 2000. These ongoing material evaluations lead to four products being certified. These additional materials will provide MMCD with more tools to utilize in its operations. This process provides important information on which to base purchasing, budgeting, and operational decisions.

Vendor Introductions to MMCD Field Operations: During the treatment season, control material and equipment vendors were invited to participate in field operations to better understand how their products were being utilized by MMCD. We had two vendors participate during the 2000 season. Each vendor stated these introductions were valuable to their general understandings of our District and will lead to their ability to provide better service and improved products. MMCD will continue to build relationships with vendors by open communications and working together to develop mutually advantageous products.

Acceptance Testing of Altosid® (methoprene) Briquets, Pellets and XR-G Sand
During 2000, warehouse staff collected random Altosid® product samples from shipments received from the Wellmark International for methoprene content analysis. MMCD contracted an independent testing laboratory, Interpoll Laboratories, to complete the analysis. Zoecon Corporation, Dallas, Texas, furnished 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". Tests of all samples indicated the presence of the label claim of percent methoprene (Table 5.1).

Efficacy of Control Materials
Altosid® Briquet, XR-G Sand and Altosand Applications In previous years, low sample sizes and highly variable bioassay results, sometimes including lower than desirable mean efficacy results, have rendered evaluation of efficacy difficult. Dry conditions during 2000 hampered successful collection of bioassays because many sites dried completely before mosquito pupae for a bioassay could be collected. In 2000, studies focused on Altosid® briquets, Altosid® pellets, and aerially applied Altosid® XR-G sand, and Altosand.

CHAPTER 5 QUALITY ASSURANCE

Methoprene product	Samples analyzed	Methoprene content: label claim	Methoprene content: analysis average	SD
150-day XR briquets	24	2.10%	1.69% *	0.09
30-day pellets	25	4.25%	4.31%	0.18
20-day XR-G Sand	10	1.50%	1.28% **	0.15

* Interpoll Laboratories did not precisely follow the methodology of CAP No. 311 and correct for the moisture content of the briquet samples. The samples were re-analyzed by Interpoll but did not achieve results near label claim of 2.10%. As part of MMCD's requirements of product acceptance, MMCD receives the manufacturer's certification of analysis that states lot numbers and active ingredient levels. To confirm our product's active ingredient (AI) levels, MMCD sent blind samples to Zoecon for re-analysis to compare AI levels with original values. This re-analysis mirrored the manufacturer's original results and found the briquets were within acceptable limits. To clarify this procedural issue in the future, MMCD will work directly with the manufacturer and the independent laboratory personnel to assist the lab to duplicate methodologies of the original procedures.

** XR-G sand samples were from product received in1999. The lower than label results were expected due to the breakdown of the AI over time. The XR-G samples were part of an evaluation to demonstrate product stability in our warehouse conditions over winter.

Table 5.1 Methoprene analysis for Altosid® briquets and pellets.

Untreated control emergence averaged 84.51%, essentially the same as 88.13% in 1999 and 86.64% in 1998. This translates to an average natural mortality of 15.49% (Table 5.2).

	n	Mean % emergence	Median % emergence	SD	Min % emergence	Max % emergence
Untreated control	25	84.51	90.00	25.94	0	100

Table 5.2 Bioassay results for untreated control sites

Mean and median Altosid® briquet efficacy values were fairly low; results in 2000 and 1999 were similar (Table 5.3, 5.4). Mean and median Altosid® pellet efficacy values in 2000 were both excellent and slightly better than in 1998, the most recent year before 2000 when pellets were bioassayed (Table 5.3, 5.4). Pellets maintained efficacy beyond the 30-day field life of the product.

In 1999 efficacy of aerially-applied XR-G sand and Altosand at 5 lb/acre was disappointing (Table 5.4). In 2000 the aerial dosage was increased to 7 lb/acre. Altosand efficacy appeared to improve, especially when bioassays were collected within the 10-day field life of the material (Table 5.3, 5.4). More bioassays should be collected in 2001 to confirm this conclusion. Efficacy of aerially-applied XR-G sand remained unchanged in 2000 (Table 5.3, 5.4). Both Altosid® XR-G and Altosand were certified only for ground applications.

Material	Sample taken days post-treatment	n	Mean % EI	Median % EI	S.D.	Min % EI	Max % EI
Briquet (150-day)	0 to 146	27	65.30	66.87	36.06	0.00	100.00
Pellet (30-day)	0 to 74	84	84.33	100.00	26.99	0.00	100.00
≤ 30 days	0 to 30	58	87.87	100.00	26.85	0.00	100.00
> 30 days	31 to 74	26	76.43	100.00	26.09	0.00	100.00
XR-G Sand (20-day)	8 to 24	20	45.38	40.33	38.02	0.00	100.00
≤ 20 days	8 to 20	13	61.78	63.32	35.12	0.00	100.00
> 20 days	21 to 24	7	14.92	2.97	21.10	0.00	100.00
Altosand (10-day)	9 to 16	10	57.69	73.06	41.54	0.00	100.00
≤ 10 days	9 to 10	7	72.78	82.25	34.61	1.96	100.00
> 10 days	11 to 16	3	22.74	0.00	38.92	0.00	67.42

Table 5.3 Bioassay results for Altosid® briquets, pellets, XR-G sand, and Altosand in 2000. Emergence inhibition (EI) is corrected for untreated control mortality.

Material	2000				1999 (1998 for Pellets)			
	Sample taken days post-treatment	n	Mean % EI	Median % EI	Sample taken days post-treatment	n	Mean % EI	Median % EI
Briquet (150-day)	0 to 146	27	65.30	66.87	9 to 143	41	58.92	71.63
Pellet (30-day)	0 to 74	84	84.33	100.00	6 to 120	74	71.44	92.63
≤ 30 days	0 to 30	58	87.87	100.00	6 to 30	29	72.26	97.11
> 30 days	31 to 74	26	76.43	100.00	31 to 120	45	70.95	91.92
XR-G (20-day) (7 lb/acre)	8 to 24	20	45.38	40.33	(5 lb/acre)			
≤ 20 days	8 to 20	13	61.78	63.32	3 to 16	34	57.01	62.09
> 20 days	21 to 24	7	14.92	2.97				
Altosand (10-day) (7 lb/acre)	9 to 16	10	57.69	73.06	0 to 14 (5 lb/acre)	53	35.91	27.06
≤ 10 days	9 to 10	7	72.78	82.25	0 to 10	28	44.44	36.71
> 10 days	11 to 16	3	22.74	0.00	11 to 14	25	26.36	8.59

Table 5.4 Bioassay results for Altosid® briquets, pellets, XR-G sand, and Altosand in 2000 compared to 1999 (1998 for pellets). Includes only aerial applications of XR-G sand and Altosand. Emergence inhibition (EI) is corrected for untreated control mortality.

These data illustrate the importance of collecting bioassay samples before the end of the field life of control materials (including XR-G sand and Altosand) that are applied to water containing floodwater mosquito larvae (Table 5.3, 5.4). This effect is not observed for longer field life materials including Altosid® briquets and Altosid® pellets, presumably because most are applied to dry sites long before flooding and *Ae. vexans* breeding occurs.

***Bti* Corncob Applications** Vectobac® brand *Bti* (5/8 inch mesh size corncob granules) from Abbott Laboratories was the main *Bti* product applied by helicopter in 2000. Efficacy as calculated in terms of pre-treatment and post-treatment larval counts was similar in 2000 and 1999 (Table 5.5). Large numbers of evaluations were completed in 1999 and 2000 (Table 5.5).

Number of checkbacks (2000)(% total treatments)	Average % mortality (2000)	Number of checkbacks (1999)(% total treatments)	Average % mortality (1999)
n=571 (12%)	90.8	n=425 (8%)	91.1

Table 5.5 Efficacy of aerial *Bti* applications in 1999 and 2000 (8 lb/acre).

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 practice to use the most environmentally friendly products possible while achieving acceptable control rates. As part of this process, MMCD certifies materials acceptable with District-run evaluations before using the products operationally.

LarvX SG Biological Soluble Granules (Meridian Vector Management) In 1999, ground-applied LarvX granules achieved a good rate of control (81.5%) but the efficacy of applications made by helicopter in 1999 was too low (Table 5.6). MMCD increased the aerial dosage of LarvX granules using a 5 lb/acre rate in 2000. Efficacy increased in 2000 (Table 5.6) but still remained well below that achieved by Vectobac® brand *Bti* (Table 5.5). LarvX was certified for ground applications.

Per acre dosage (number of checkbacks) (2000)	Average % mortality (2000)	Per acre dosage (number of checkbacks) (1999)	Average % mortality (1999)
5 lb/acre (n=10)	69.1	3 lb/acre (n=16)	48.4

Table 5.6 Efficacy of aerial LarvX applications in 1999 and 2000.

Laginex® AS (AgraQuest, Inc.) No applications of Laginex® AS were completed because Laginex® AS was not available in 2000.

Vectolex (Valent BioSciences) Vectolex is a dry granular product that contains *Bacillus sphaericus*. Very dry conditions in late 1999 and 2000 reduced larval *Cq. perturbans* populations enough to preclude all tests of Vectolex against *Cq. perturbans*. We plan to test Vectolex as soon as larval *Cq. perturbans* populations increase. This probably will not occur before 2002.

CHAPTER 5 QUALITY ASSURANCE

Anvil 2+2 (Clarke Mosquito Control Products, Inc) Anvil 2 +2 is a newly available non-restricted use adulticide containing sumithrin/PBO. Efficacy was measured by placing three CO_2 traps in wooded harborage areas adjacent to trails in each of three campgrounds on three consecutive nights. To obtain pre- and post-treat counts, traps were set up between 4:00-5:00 PM. On the night of the treatment, traps were set up around 10:00 PM (30 minutes after ULV treatments). Traps were retrieved at about 8:00 AM on each day. Captured mosquitoes were identified and tallied. ULV treatments using ATV-mounted sprayers were applied at two campgrounds, one being treated with Scourge (1.5 oz/acre) and one with Anvil (3.0 oz/acre). The third campground was not treated. Scourge and Anvil dosages were chosen to equalize the amount of active ingredient (0.0035 lb/acre) applied.

We were only able to complete one test comparing Anvil and Scourge because of low mosquito levels. Both ULV Scourge® or Anvil® applications significantly suppressed (≈90%) mosquitoes caught in CO_2-baited CDC traps the night of application. Mosquito populations rebounded somewhat the following night (see "non-target research" in Supporting Work chapter for more details). Based upon this test and three successful tests in 1999, Anvil® was certified for operational use in 2001.

Aqua Reslin (AgrEvo Environmental Health) This water-based permethrin/PBO product was not tested in 2000.

Mosquito Beater 4+4 (Bonide Products Inc.) This special formulation of this permethrin/ PBO adulticide was not tested in 2000.

Equipment Evaluations

Equipment Demonstration Day: MMCD invited all manufacturers and distributors of adulticiding equipment to attend a demonstration day at the Scott County Fairgrounds in Jordan, Minnesota. Six vendors attended this first-time event. This exposition was intended to allow manufacturers to present and demonstrate their product lines. In the past, vendors did not have the opportunity to show their products to a large number of MMCD staff that directly utilize their products. MMCD staff was able to interact with the manufacturers and provide input into future purchasing decisions. The event was well received by both employees and vendors. MMCD will explore the option of hosting future demonstrations to increase communication between staff and manufacturers.

Helicopter Swath Analysis and Calibration Procedures: Technical Services and field staff conducted three helicopter calibrations during the 2000 season. Two sessions were held at the municipal airport in LeSueur, MN and one session was located in Lino Lakes, MN. MMCD completed calibrations for six different operational and experimental control materials. In total, six helicopters were calibrated and each helicopter was set up to apply an average of three different control materials.

CHAPTER 5 QUALITY ASSURANCE

Refurbishing of Beecomist Spray Heads for Aerial Adulticide Applications: In order to prepare for the possibility of a large-scale disease outbreak in Minnesota, the helicopter-mounted spray units (model 360A) were dismantled, cleaned and tested for proper operation. Both 24V spray heads appeared to be in proper working order. During spring 2001, these units will be evaluated for operational use and swath patterns will be analyzed.

National Aerial Application Self-Regulating Application & Flight Efficiency (S.A.F.E.) Analyst Training Course: MMCD is available as a statewide resource for information and technical assistance. In previous years, the Minnesota Agricultural Applicators Association (MAAA) has utilized MMCD's expertise in calibrating aircraft to apply dry granular materials. In 2000, the MAAA approached Mark E. Smith of Technical Services to work as an aerial application analyst for the Association's fly-in calibration workshops. The MAAA sponsored the training program and in September 2000, Mark attended a training course in Goodland, Kansas. Mark received his certification as S.A.F.E. analyst from the National Agricultural Aviation Association (NAAA) and will assist the MAAA to calibrate both fixed wing and rotary aircraft to judiciously apply products according to label and legal guidelines.

KLD Model DC-III Droplet Analyzer: MMCD staff optimized all fifty of our Ultra Low Volume (ULV) insecticide generators to produce an ideal droplet range of 8-20 microns. By adjusting our ULV sprayers to produce a tighter, more uniform droplet spectrum, control materials are being used more effectively. This field analysis creates more droplets of the correct size to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and respective insecticide swath coverage throughout the district.

A sub-sample of the spray mists of different brands of backpacks was also completed. Due to the variability of the backpack brands and various ages of the equipment, the testing demonstrated the need for a standard expected output to be developed for each backpack type. MMCD developed baseline specifications for each backpack brand. This baseline standard will allow MMCD the ability to evaluate each backpack unit and assist in purchasing and use decisions. Technical Services staff will continue to use this technology to improve the consistency of the output of the backpack and barrier treatment program.

Baseline Specifications for Evaluating Equipment Performance: Technical Services worked directly with manufacturers to produce baseline specifications of new spray equipment. MMCD gathered information on truck-mounted cold foggers, ATV-mounted cold foggers, handheld ULV units, and backpacks. The purpose of this data collection is to have a standard to use for comparison of MMCD equipment. By comparing our equipment to the original production standards, we will have enhanced our ability to evaluate equipment, create improved calibration standards and build our database to make quality decisions in our purchasing processes. Pilot

Study of Calibration Settings of truck-mounted ULV Generators: The Technical Advisory Board (TAB) suggested that a pilot study be completed that would check the droplet producing performance of the truck-mounted cold foggers over time. An electric and a gas-powered ULV generator were evaluated between the scheduled calibration sessions. Both units maintained their original calibration parameters and recommended droplet spectra. MMCD will continue this sampling to include a broader sample of our ULV generators and gather additional data to be incorporated in our purchasing processes.

CHAPTER 5 QUALITY ASSURANCE

Beecomist Truck-Mounted Electric ULV Cold Fogger: MMCD purchased a Beecomist Pro-Mist HD sprayer and continued to evaluate the sprayer. This electric cold fog unit rotated through four regional facilities and staff continues to highly recommend the electric cold foggers for district use. MMCD will explore the option of purchasing more electric units in 2001.

Development of Beecomist Head Cleaner: A vacuum pump system was developed to backflow the porous spray sleeves of the Beecomist electric ULV generators. This system will remove trapped particulates from the spray sleeves to allow the truck-mounted foggers to produce a more uniform swath pattern. This cleaning system will be incorporated into our maintenance program.

Evaluation of the ElectraMist Truck-mounted Electric ULV Generator: ADAPCO, Inc. and ElectraMist supplied a demonstration unit to evaluate their new rotary atomizer truck-mounted cold fog unit. The model EM2000 provided a fixed flow output and consistent ULV droplet generation. Staff stated they liked the compact size because the unit was approximately one-half the size of other cold fog units. This size difference made available sufficient truck bed space to be used in our daily larvicide program. The cab control unit was very small, unobtrusive and easy to use. Staff emphasized that the greatest benefit of the electric foggers was the reduced noise level of operation. This quiet operation allowed for increased driver awareness, more applicator comfort and reduced citizens noise concerns during applications in the evening hours. Overall, staff found this unit to be a well-engineered product and would recommend this cold fogger for purchase and further evaluation.

Monitor 3 Variable Flow Monitoring System for Truck-Mounted Cold Fog Units: ADAPCO, Inc. and London Fog supplied a demonstration unit to evaluate their variable flow monitoring control system. This unit has a computerized data collection system that accurately records the various components of a spray event. The data collected includes site information, date and time of applications, vehicle identification, quantities of material applied, acres sprayed, on/off pump operation and other application components. The unit did require additional training for operators to run the system and properly download the stored information. At times, staff found the unit to be confusing but alleviated this concern by rewriting an operator's instruction guide. Overall, staff found the data collection to be a benefit and recommended the unit to undergo further evaluation throughout the District.

Maruyama 155DX Dry Backpack: MMCD purchased gas-operated backpacks for the purpose of applying dry granular materials. Due to the large amount of hand-treated ground sites in the District, MMCD is exploring different options to increase the efficiency of our operations. This new backpack design met the desired specifications. Overall, these packs worked well but seem to be suited for larger sites with low vegetation. In situations in which staff encountered high vegetation or soft mud, it was difficult to evenly apply the product. In addition, some employees felt it was unsafe to walk through deeper water with a large piece of equipment strapped to their back. MMCD will continue to explore the best uses for this piece of equipment.

Plans for 2001

Quality assurance processes will continue to be incorporated into the everyday operations of the regional process teams. A primary goal is to assure the collection of adequate information for all evaluations. The District will continue to improve and make quality decisions based upon data.

CHAPTER 5 QUALITY ASSURANCE

We plan to repeat tests of aerially-applied methoprene sand products (Altosid® XR-G and Altosand) to verify efficacy during the claimed field life. The ultimate goal is to use each product where it will most effectively achieve District goals, and to determine how best to measure efficacy using bioassay data.

We also plan to test IcyPearl, a new frozen *Bti* formulation. The new formulation has obvious drawbacks, one being that it must be kept frozen until used. A big advantage is that the amount of *Bti* per pound of formulated product can be adjusted to modify the per acre *Bti* dosage without changing the weight of formulated product applied per acre meaning that no helicopter recalibration is required.

Continued field evaluation featuring up to four adulticides (Aqua Reslin, Anvil, Mosquito Beater and Scourge) is planned to simultaneously test these adulticides under similar field conditions.

We will continue to improve our calibration techniques to optimize our adult mosquito control equipment. MMCD will continue this sampling to include a broader sample of our ULV generators and gather additional data to be incorporated in our purchasing processes.

CHAPTER 6 SUPPORTING WORK

CHAPTER 6 – SUPPORTING WORK HIGHLIGHTS

2000 RESULTS

Adulticide Non-target Research

- UV-baited traps were added to adulticide efficacy tests to compare adulticide impacts on mosquitoes and non-target insects.
- ULV Scourge® or Anvil® applications consistently suppressed mosquitoes caught in CO_2-baited CDC traps.
- Changes in the number of non-target insects caught in UV-baited CDC traps were not associated with ULV Scourge® or Anvil® applications like the consistent concurrent suppression of mosquitoes caught in CO_2-baited CDC traps. Research in California observed similar results.

Adulticide Impact on Loosestrife Biocontrol

- Examination of data about the success of beetle introductions showed that proximity to District treatments was not sufficient to explain beetle success or failure in the East metro area. Of the 55 beetle sites examined, 14 (25%) had adulticide treatments within 600 ft that occurred between the release date and the grade date. The 10 sites with treatments within 300 feet were less likely to have grades of A or B than the untreated sites, but were not more likely to have grades of D or F. Many locations with poor beetle success were not close to adult mosquito treatments.

Wright County Long-Term Nontarget Study

- A report on 1998-1999 frog field studies (not funded by MMCD) was released by NRRI. Analysis by individual frogs within treatment group or by proportion malformed per site showed no significant difference in malformation rates related to either *Bti* or methoprene treatments.

Public Opinion Survey

- A telephone survey of 400 metro residents was done, as has been done biennially since 1994. Most residents felt it was important to control mosquitoes and gnats in the metro area. Respondents reported effects of mosquitoes on their lives in terms of decreased enjoyment of the outdoors, someone in their household reacting strongly to bites, or repellent or control use. Most respondents were aware of mosquito control activities, felt MMCD is a good value and were satisfied with MMCD's efforts. However, awareness of black fly and tick services was fairly low. Most felt controls are worth the risk, although some felt controls were harmful.

PLANS FOR 2001

- Facilitate publication of results from 1997-'98 non-target invertebrate sampling by coordinating with members of the review panel and providing appropriate support to Dr. Balcer of LSRI.
- Survey insects present in areas including parks and campgrounds where mosquito adulticides (pyrethroids) are applied to better define the biology of insects at these sites and how they could be affected. This information will indicate which insects are most

likely to be exposed to mosquito adulticides and delineate assays to evaluate mosquito adulticide effects.

- Summarize all available pyrethroid non-target research according to the pyrethroid dosage and application method and compare to the dosages and application methods used for adult mosquito control treatments. This goal of this type of summary is to more clearly relate different non-target studies to MMCD mosquito control operations.

CHAPTER 6 SUPPORTING WORK

Adulticide Non-target research: The Metropolitan Mosquito Control District uses pyrethroid adulticides to augment its larval control program. The toxicity and environmental impacts of various pyrethroids have been evaluated in many different ways ranging from controlled lab assays to field tests (see NRCC 1986, WHO 1989, WHO 1990 for extensive reviews). The Environmental Protection Agency (EPA) requires such data to justify approval of each insecticide registration and to design label restrictions that will minimize non-target impacts of insecticides including mosquito adulticides.

MMCD reviewed non-target research including California studies performed in two wildlife refuges (Jensen et al., 1999) and initiated similar research in 1999 and 2000 at specific campgrounds in Anoka County. Our initial goal was to determine if effective mosquito adulticide treatments also killed comparably large numbers of night-flying non-target insects. In both the California and MMCD research, mosquitoes were suppressed significantly after adulticide applications (high mortality of caged mosquitoes in California research and significantly fewer mosquitoes caught in CO_2-traps in MMCD research). The number of non-target insects caught in adjacent UV-traps did not decrease after adulticide applications the way mosquitoes decreased which suggests that non-targets were not affected the way mosquitoes were. Overall results were similar to the California research (no consistent direct immediate decrease of non-target insects was observed). More will be done in 2001 to confirm results and draw conclusions from the study.

Materials and Methods

Test overview We chose three similar campgrounds in northern Anoka County, Minnesota. All were in heavily wooded areas near numerous mosquito breeding sites. One campground was treated with Scourge®, another with Anvil® and the third left untreated. We estimated mosquito populations using three CO_2-baited traps placed in each campground before and after the ULV application. Non-target insect populations were estimated using two UV-baited traps placed in each campground before and after the ULV application. We performed the test twice (17-19 August 1999, 26-28 July 2000) and used the same trap placement pattern in both tests.

Mosquito population measurements We placed three CO_2-baited traps in each campground for three consecutive nights starting the night before the ULV application. The CO_2-baited traps were hung in the afternoon (4:00-5:00PM) and retrieved the next morning (7:00-8:00AM) EXCEPT for the night of ULV treatments. That night CO_2-baited traps were hung 30 minutes after ULV treatments (2nd night of trapping). We tallied and identified all captured mosquitoes.

Non-target insect population measurements We placed two UV-baited traps in each campground for three consecutive nights starting the night before the ULV application. The UV-baited traps were hung in the afternoon (4:00-5:00PM) and retrieved the next morning (7:00-8:00AM) EXCEPT for the night of ULV treatments. That night UV-baited traps were hung 30 minutes after ULV treatments (2nd night of trapping). We tallied and identified captured insects (all to Order and most to Family).

ULV treatments Treatments were applied using ATV-mounted Mag (London Aire) sprayers with a 150-foot swath (ATV speed of 2-5 mph). All sprayers were calibrated the afternoon before treatment including optimization of their droplet size distributions (8-20μm MMD). Both

Scourge® 4%+12% (Formula II) and Anvil® 2+2 were applied at 0.0035 lbs/ai per acre (1.5oz/acre of Scourge® (4.2 oz/min) and 3.0 oz/acre of Anvil® (8.4 oz/min)). We began ULV treatments about 45 minutes after sunset.

Results

Mosquito population measurements *Aedes vexans* comprised the vast majority of mosquitoes (>90%) caught in CO_2-baited traps in both tests. *Coquillettidia perturbans* was the second most numerous species, more so in the July 2000 test (5-10%) than the August 1999 test (<2%). Small numbers of *Cx. tarsalis*, *Oc. triseriatus*, *Ae. cinereus* and other *Aedes* species were also captured. During the night of application Scourge® suppressed mosquitoes 91% (August 1999) and 92% (July 2000) and Anvil® suppressed mosquitoes 95% (August 1999) and 89% (July 2000). All species of mosquitoes were suppressed by both products. Mosquitoes caught in the untreated control increased 27% (August 1999) and 63% (July 2000) during the same sampling period (Fig. 6.1, 6.2).

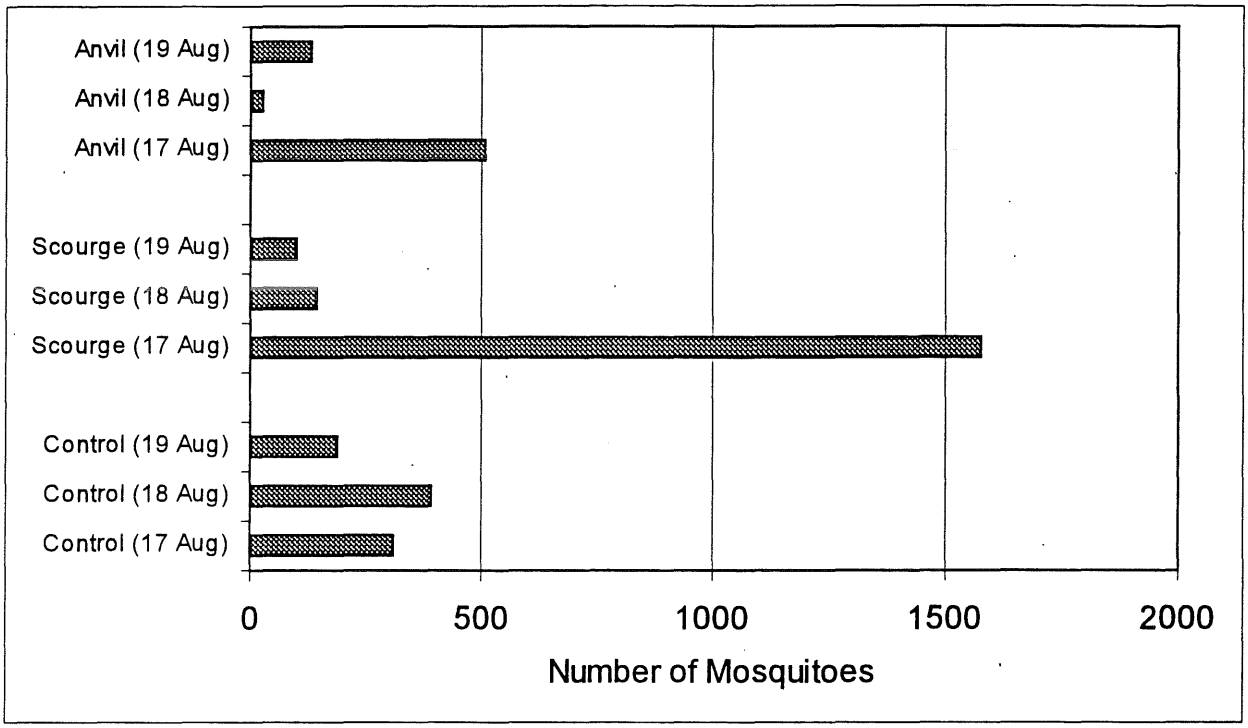
Non-target insect population measurements Eleven orders of insects were collected in UV-baited traps. Six of these orders included a total of 38 distinct families; the remaining five orders were not identified further (Table 6.1). Between 80-94% of insects captured were flies (Diptera), 5-10% moths (Lepidoptera) with the remaining nine orders totaling 1-10%. Four families of flies (Cecidomyiidae, Tipulidae, Chironomidae, Mycetophilidae) were captured most frequently.

In both trials, changes in non-target insects caught in UV-baited CDC traps were not associated with ULV Scourge® or Anvil® applications like the consistent concurrent suppression of mosquitoes caught in CO_2-baited CDC traps. In the August 1999 test, the relative number of non-target insects caught at each campground changed in different ways (Fig. 6.1). The relative number of non-target insects caught at all three campgrounds changed in similar ways (Fig. 6.2) in the July 2000 test.

Order	Family
Diptera	Cecidomyiidae
	Chironomidae
	Tipulidae
	Mycetophilidae
	Psychodidae
	Dolichopodidae
	Syrphidae
	Sarcophagidae
	Asilidae
	Agromyzidae
	Otitidae
	Tephritidae
	Other
Lepidoptera	Geometridae
	Noctuidae
	Arctiidae
	Pyralidae
	Gelechiidae
	Tortricidae
	Pterophoridae
	Other
Coleoptera	Coccinellidae
	Scarabaeidae
	Staphylinidae
	Scolytidae
	Cantharidae
	Cerambycidae
	Dermestidae
	Elateridae
	Mordellidae
	Carabidae
	Other
Hemiptera (Homoptera)	Cicadellidae
	Other
Hemiptera (Heteroptera)	Tingidae
	Miridae
	Nabidae
	Other
Hymenoptera	Ichneumonidae
	Braconidae
	Vespidae
	Other
Neuroptera	Chrysopidae
	Hemerobiidae
	Other
Psocoptera*	
Odonata*	
Trichoptera*	
Plecoptera*	
Ephemeroptera*	

Table 6.1. Orders and Families of non-target insects caught in UV-baited traps. "Other" denotes insects that could not be identified to further than Order.

*** Insects in these Orders were not identified further.**



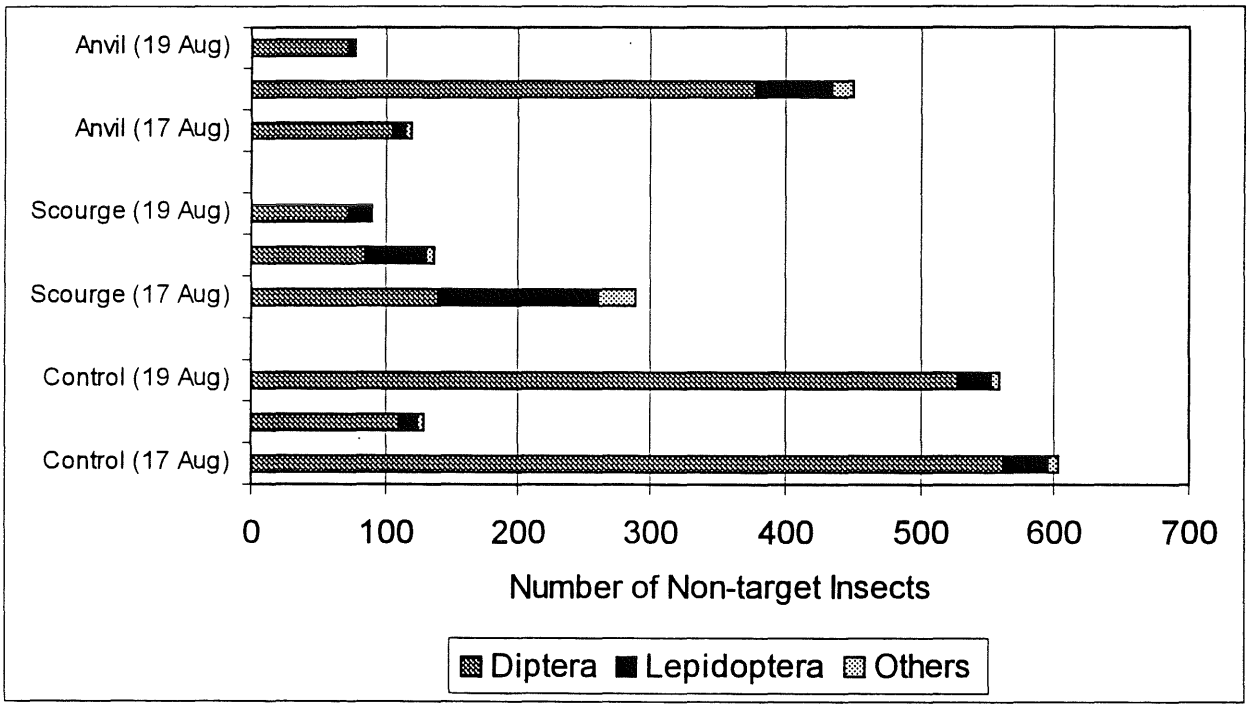


Figure 6.1. Insects caught in CO_2-baited (mosquito) and UV-baited (non-target) traps in the test performed on 17-19 August 1999.

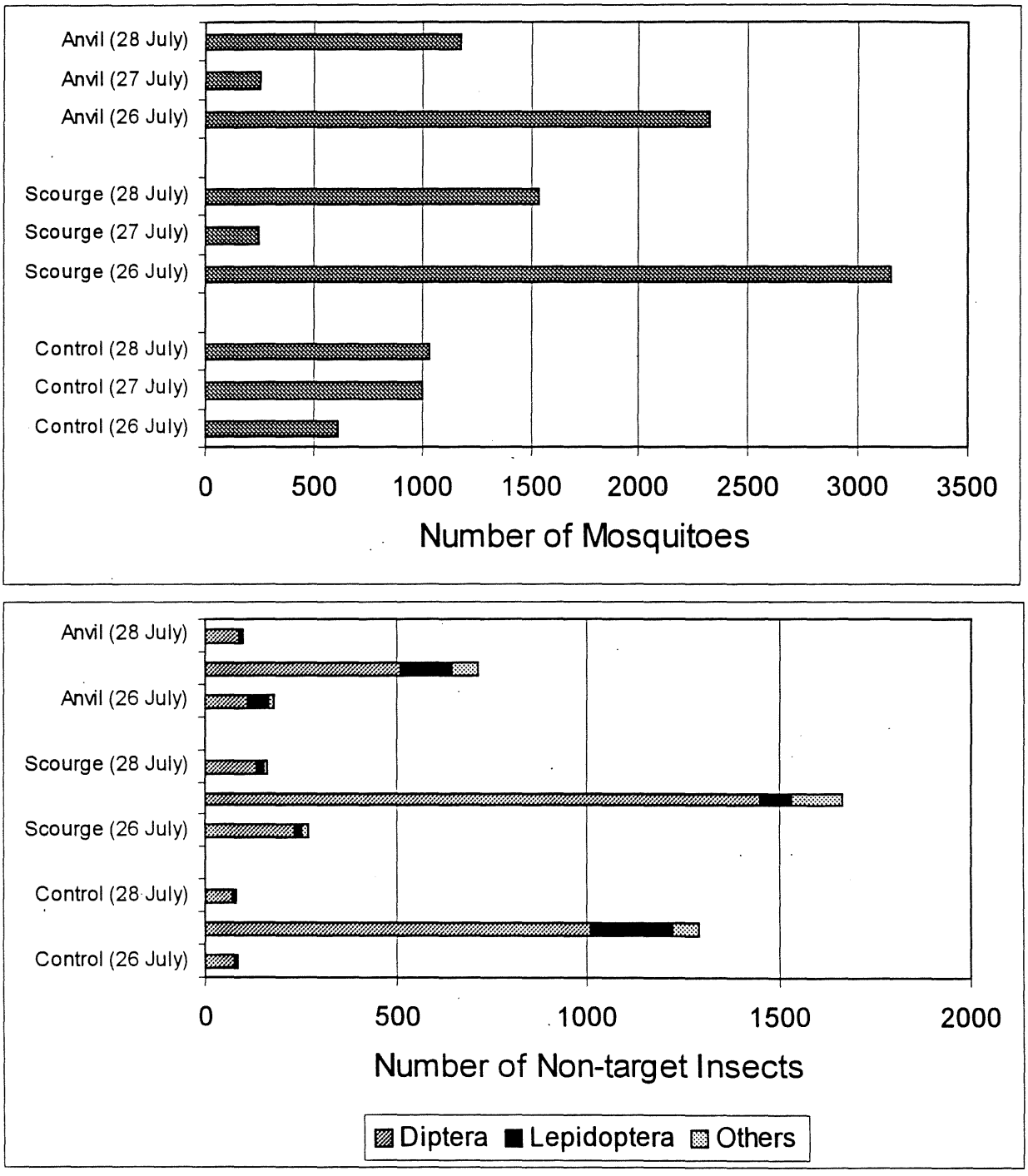


Figure 6.2. Insects caught in CO_2-baited (mosquito) and UV-baited (non-target) traps in the test performed on 26-28 July 2000.

CHAPTER 6 SUPPORTING WORK

References:

Jensen, T., Lawler, S. P. and Dritz, D. A. 1999. Effects of Ultra-Low Volume Pyrethrin, Malathion, and Permethrin on Non-Target Invertebrates, Sentinel Mosquitoes, and Mosquitofish in Seasonally Impounded Wetlands. Journal of the American Mosquito Control Association. 15(3): 330-338.

Pyrethroids: Their effects on aquatic and terrestrial ecosystems. 1986. National Research Council Canada (NRCC) No. 24376

Permethrin. 1990. World Health Organization (WHO) Environmental Health Criteria 94

Resmethrin. 1989. World Health Organization (WHO) Environmental Health Criteria 92

Loosestrife

Testing for possible nontarget effects of mosquito adulticides on beetle introductions for Purple loosestrife biocontrol: Purple loosestrife (*Lythrum salicaria*), a highly invasive exotic wetland plant species, has in the past decade been the target of a biological control program by the Minnesota Department of Natural Resources (MDNR). Using beetles (*Galerucella pusilla* and *G. calmariensis*) that selectively attack purple loosestrife, a certain amount of control has been observed statewide. In the seven county metropolitan area, however, fewer beetle populations have been successful.

MMCD primarily treats mosquitoes in their larval stage with target specific, biological controls that do not affect loosestrife beetles. However, loosestrife beetles have a known sensitivity to pyrethroid-based products such as those MMCD uses for localized treatments to reduce adult mosquitoes. Although the MMCD does not treat wetland areas with pyrethroids, a question was raised as to whether or not proximity to MMCD adult mosquito treatments could be related to reduced beetle success.

This project examined whether adult mosquito control treatments made by MMCD in nearby areas could be related to reduced beetle success. Locations of MDNR-recorded loosestrife beetle release sites in Ramsey and Washington counties were obtained from Luke Skinner, Purple Loosestrife Coordinator, and Nick Proulx, Exotic Species Specialist with the MDNR. Dr. Dave Ragsdale, Univ. of Minnesota Dept. of Entomology, also provided information on the beetles and analysis of their success. Adulticide treatment locations for dates after beetle release were mapped based on MMCD treatment records. Distances between treatments and beetle release sites were compared with beetle activity success or failure "grade" recorded by MDNR observers (Grades A and B represent widespread high beetle densities and damage, C represents beetle density and damage low, D represents beetles rare, and F represents no beetles or damage found).

Of the 55 beetle sites examined, 14 (25%) had treatments within 600 ft that occurred between the release date and the grade date. The 10 sites with treatments within 300 feet were less likely to have grades of A or B than the untreated sites (Chi-squared analysis, p=0.012, 2 df), but were not more likely to have grades of D or F. Looking at the 55 sites as a group, however, the number of treatments within 300 ft was not a significant predictor of grade (R^2=0.007, p=0.55). We concluded that:

- There were some sites where adult mosquito treatments may have reduced the success and spread of beetle populations.
- Of the sites near mosquito treatments, most had some beetles surviving (grade D or better), few received an F grade (no beetles left).
- Many locations with poor beetle success were not close to adult mosquito treatments.
- Mosquito control activity alone did not account for a significant portion of the variability in grade in the east metro area, although it may have affected some sites.

Additional data for other metro counties are available that may be used for further testing.

Beetle populations are most likely to be affected by treatments shortly after release, when populations are low. Established populations are unlikely to be affected by treatments. By notifying MMCD of release sites, a temporary treatment buffer could be established that might increase the likelihood of beetle success during the early phase after release. Many local cooperators, however, are involved in beetle releases and it can be challenging to keep track of new release sites. GPS units, digital photos, and GIS software are making it easier to record exact locations and communicate between agencies.

Wright County Long-Term Studies of Nontarget Effects of Larvicides

In 2000, no treatments were made at the 25 remaining Wright County long-term study sites for the first time since treatments began in 1991, and no field studies were done. Efforts are continuing toward publication of the 1997-1998 invertebrate studies, which found generally high numbers of insects and other invertebrates in all the sites. The only difference between treated and untreated sites was lower populations of some groups within the Chironomidae in treated sites, but other chironomid groups were higher, resulting in no difference in chironomid numbers or biomass as a whole (Balcer et al. 1999).

Results of a study of frog malformation rates done in 1998 and 1999 at the Wright County sites, begun at the request of MMCD's independent Peer Review Panel and funded by Wellmark Intl., were released by the Natural Resources Research Institute, Univ. of Minn. Duluth. In this study 18 sites were surveyed for anuran presence and specimens inspected for malformations in Aug. 1998 and Aug. and Sept.1999. The treated sites (6 *Bti*, 6 methoprene) had been treated 6 times per year each year starting in 1991, and the remaining 6 sites were untreated. Most of the 1215 frog metamorphs (current year's young) captured were leopard frogs, and although counts varied widely by site, similar total numbers were captured from each treatment group. Percent malformed, by site, ranged from 1.2 to 11.1% in the 10 sites with malformations. Analysis of individual frogs within treatment group or by proportion malformed per site showed no significant

difference in malformation rates related to either of the treatments. The full report is available from NRRI or will be available on the MMCD web site (www.mmcd.org).

References

Balcer, M.D., K.L. Schmude, and J. Snitgen. 1999. Long-term effects of the mosquito control agents *Bti* (*Bacillus thuringiensis israelensis*) and methoprene on non-target macro-invertebrates in wetlands in Wright County, Minnesota (1997-1998). Report submitted to Metropolitan Mosquito Control District February 4, 1999.

Johnson, Catherine M., Lucinda B. Johnson, Joseph Murphy and Val Beasley. 2001. Evaluation of the potential effects of methoprene and *Bti* on anuran malformations in Wright County, MN. Report submitted to the Scientific Peer Review Panel, Metropolitan Mosquito Control District, St. Paul, MN. NRRI Technical Report Number NRRI/TR-2001/01. 34 pp plus Appendix.

Public Opinion Survey

MMCD has conducted a public opinion survey every 2 years since 1994 to help assess customer awareness, satisfaction and concerns and track changes over time. This year's telephone survey of 400 metro-area residents was done July 20 -Aug. 15, 2000. Results can be generalized to the metro area population within the District with a margin of error of ± 5%. In summary:

Most residents feel it is important to control the mosquito and gnat populations in the metro area.

- 82% of respondents rated the importance of controlling mosquitoes 5, 6, or 7 on a 7-point scale (1 = not important, 4 = neutral, 7 = very important), about the same as in 1998 (83%), and significantly higher than 1994 (72%).
- 64% rated gnat control important, about the same as in 1998 (60%) and 1994 (58%).

Respondents reported effects of mosquitoes on their lives.

- 42% said mosquitoes in their neighborhood this year decreased their enjoyment of the outdoors very often or somewhat often.
- 40% reported having someone in their household that reacts strongly to mosquito bites (swelling or itching that lasts more than a few hours). Households with children were more likely to have someone who reacts (57%, vs. only 32% of households without children).
- 68% use repellents, 18% use yard spray, fog, or powder, 47% use citronella candles, and 1.3% had paid a company to treat their yard.
- Median amount spent on control or repellent was $10.

Most respondents are aware of mosquito control activities.

- 66% reported being aware of "a local government agency called the Metropolitan Mosquito Control District", vs. 1998 (61%), 1996 (64%) and 1994 (62%).
- An additional 12% are aware of larval or adult control, although not of MMCD

Sources of info included TV, major papers, radio, contact with employees or seeing trucks, local papers, or presentations and fairs. 7% reported seeing the ad in the paper this spring.

Few were aware of MMCD's activities to control gnats (21%) or monitor ticks and prevent Lyme disease (24%). These questions were new this year and will serve as baseline for evaluating further public education efforts.

Most felt MMCD is a good value and were satisfied with MMCD's efforts.

- 77 % agreed "MMCD provides an important service to the community"
- 67% agreed "MMCD is a good buy for the money"
- 56% agreed "Mosquito and gnat control should be increased," 18% disagreed
- 43% agreed "MMCD funding should be increased," 19% disagreed
- 57% were satisfied with MMCD's efforts to control mosquitoes, up from 51% in 1998; only 10% were dissatisfied.

Most felt controls are worth the risk, although some felt controls are harmful.

- 18% agreed larval control harms environment or health, 32% disagree, 50% neutral or don't know.
- 21% agreed adult control harms environment or health, 36% disagree, 43% neutral or don't know.
- 57% agreed "Spraying has some risk, but the benefit of a professionally-done spray program outweighs the risk," slight decrease from 63% in 1998.
- 43% agreed "MMCD would stay away from my property if I asked them to," 6% disagreed, 51% neutral or don't know; decreased from 50% agreed in 1998.

The results of this survey provide quantitative support for many of the findings of the focus group study on attitudes toward MMCD done in October 1999 by Wilder Research Center. A full report of the survey is expected to be available in May 2001.

Plans for 2001

Continuation of Wright County Long Term Study: Publication of the 1997-1998 results is important not only to MMCD but to mosquito control districts around the country as they deal with continued questions about the 1992-1993 results presented in Hershey et al., 1998. Staff will coordinate with members of the review panel and provide Dr. Balcer whatever support is appropriate to facilitate publication. MMCD has no plans to continue research or treatments at the Wright County sites in 2000.

CHAPTER 6 SUPPORTING WORK

References

Balcer, M.D., K.L. Schmude, and J. Snitgen. 1999. Long-term effects of the mosquito control agents *Bti* (*Bacillus thuringiensis israelensis*) and methoprene on non-target macro-invertebrates in wetlands in Wright County, Minnesota (1997-1998). Report submitted to Metropolitan Mosquito Control District February 4, 1999.

Hanowski, J., G. Niemi, A. Lima, and R. Regal. 1997. Response of breeding birds to mosquito control treatments of wetlands. Wetlands 17(4):485-492.

Appendix A

FREQUENCY OF OCCURRENCE (%) OF LARVAL SPECIES IN STANDARD DIPPER COLLECTIONS, 2000.[a]

	Anoka	Carver	Scott	Dakota	Hennepin	Ramsey	Wash.	District
No. of Collections	1,013	613	1,119	1,586	3,611	1,870	1,113	10,925
1. Oc. abserratus	2.6	0.0	0.2	0.7	0.5	0.4	1.3	0.7
6. canadensis	0.4	1.5	0.4	1.3	0.2	0.3	0.1	0.5
7. Ae. cinereus	16.8	6.2	5.9	7.7	6.3	8.7	8.7	8.0
10. Oc. dorsalis	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
11. excrucians	5.7	0.3	1.5	5.4	2.7	3.7	10.4	4.1
12. fitchii	1.0	0.2	0.4	1.2	0.5	0.5	2.7	0.9
14. implicatus	0.1	0.0	0.1	0.1	0.1	0.0	0.2	0.1
18. punctor	1.3	0.0	0.0	0.4	0.2	0.6	0.3	0.4
19. riparius	1.1	0.3	0.4	0.5	1.1	0.2	0.9	0.7
21. sticticus	0.0	0.2	0.0	0.2	0.0	0.2	0.1	0.1
22. stimulans	3.5	2.3	3.1	2.8	4.9	3.8	8.8	4.3
23. provocans	0.2	0.0	0.0	0.0	0.1	0.0	1.3	0.2
25. trivittatus	0.3	1.8	4.9	9.8	4.8	5.2	3.3	4.9
26. Ae. vexans	22.9	14.0	23.8	38.8	33.8	40.5	25.4	31.7
261. Ae./Oc. species[b]	62.3	65.1	53.4	44.7	54.5	41.6	47.8	51.4
28. Anopheles earlei	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.1
29. punctipennis	0.0	0.0	1.0	0.4	0.2	0.7	0.7	0.4
31. walkeri	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
311. An. species[b]	1.0	1.3	1.5	1.6	1.0	1.1	1.4	1.2
33. Culex pipiens	0.8	1.0	1.7	0.5	1.0	2.1	1.2	1.2
34. restuans	5.6	4.9	8.7	7.8	7.5	16.2	6.1	8.7
35. salinarius	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
36. tarsalis	1.9	0.8	2.7	1.3	1.1	1.0	0.5	1.3
37. territans	4.2	3.4	11.9	6.6	4.1	6.4	9.2	6.2
371. Cx. species[b]	6.1	9.0	9.2	6.0	5.5	7.4	5.9	6.6
38. Culiseta inornata	1.7	5.1	3.3	6.4	3.6	5.9	4.8	4.4
40. minnesotae	0.9	0.7	0.6	0.3	0.7	1.0	1.2	0.7
41. morsitans	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0
411. Cs. species[b]	5.7	6.2	6.0	2.5	4.1	3.2	6.7	4.4
46. Psorophora ferox	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
47. horrida	0.0	0.0	0.2	0.5	0.1	0.2	0.1	0.2
471. Ps. species	0.1	0.0	0.0	0.2	0.1	0.1	0.2	0.1
48. Ur. sapphirina	0.0	0.0	0.4	0.3	0.1	0.2	0.5	0.2
501. Unidentifiable	2.7	2.8	2.1	2.4	1.2	1.0	0.5	1.6

[a] Other collection methods are used to sample *Cq. perturbans* and *Oc. triseriatus*.

[b] Genus level identifications only.

Appendix B

Average Number of Common Mosquito Species Collected per Night in New Jersey Light Traps 1960-2000

Year	*Ochlerotatus abs/punc*	*Aedes cinereus*	*Ochlerotatus sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Coquilletidia perturbans*	All species	Average Rainfall
1960	0.20	0.76	0.00	5.49	84.50	0.69	0.22	98.10	20.11
1961	0.51	0.32	0.34	2.51	41.10	0.49	0.87	51.23	16.56
1962	2.04	0.92	0.34	0.22	125.30	1.13	3.01	143.70	24.65
1963	1.09	0.58	0.89	0.16	72.00	0.25	6.55	89.58	16.03
1964	0.07	0.19	0.07	0.01	32.90	0.70	1.30	39.18	21.07
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

Appendix C

Mosquito Biologies 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 which include: disease vectors, spring species, summer *Aedes/Ochlerotatus*, permanent water species, and the cattail mosquito, *Coquillettidia perturbans*.

Disease vectors One exception to the habits of the summer *Ae./Oc.* is *Ochlerotatus triseriatus*. Also known as the eastern tree hole mosquito, it breeds in tree holes and artificial containers, especially discarded tires. *Ochlerotatus triseriatus* is the vector of LaCrosse encephalitis. 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* is the vector of western equine encephalitis. In late summer, egg laying spreads to temporary pools and artificial containers, and feeding shifts from birds to horses or humans. MMCD closely monitors this species using New Jersey light traps and CO_2 traps. Viral activity is monitored by testing blood from sentinel chicken flocks.

Spring species Spring *Ae./Oc.* 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*. Spring *Ae./Oc.* adults are not attracted to light, so human or CO_2-baited trapping is recommended.

Summer *Aedes/Ochlerotatus* Summer *Ae./Oc.* 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. *Ae. vexans*, the floodwater mosquito, is our most numerous pest. Others include *Ae./Oc.* 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.

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 There are three genera of mosquitoes that breed in permanent and semipermanent sites: *Anopheles*, *Culex*, and *Culiseta*. 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. We do not usually target these species for surveillance or control.

Appendix D

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 2000 are given. The generic products will not change in 2001, 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) SR-20 LIQUID

(Wellmark International/Zoecon-Altosid® Liquid Larvicide Concentrate-A.L.L. Liquid)

Altosid® liquid is mixed with water and applied in the spring to mosquito breeding sites containing spring *Aedes* mosquito larvae. Typical applications are to woodland pools. Sites 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 1st of each season.

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 3 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.

BACILLUS THURINGIENSIS ISRAELENSIS (*BTI*) CORN COB

(Valent Biosciences-Vectobac® G; Becker Microbial Aquabac G)

Bti corn cob may be applied in all types of mosquito breeding sites which have targeted mosquito larvae in the water. *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* may be applied to pockety sites by ground crews with cyclone seeders or power back packs.

Appendix D

BACILLUS THURINGIENSIS ISRAELENSIS (*BTI*) LIQUID

(Valent Biosciences-Vectobac® 12AS; Becker Microbial-Aquabac XT)

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

LARVX SG

(Meridian Vector Management-LarvX SG)

LarvX SG is a soluble granular formulation of *Bti* applied aerially or by ground crews using cyclone seeders or power back packs to sites suitable for corn cob formulated *Bti*. This formulation is designed to pass through the water column (larval mosquito feeding zone) while slowly disintegrating and releasing *Bti*.which should prolong direct exposure of feeding larvae to *Bti* thereby enhancing efficacy.

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 evaluate 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).

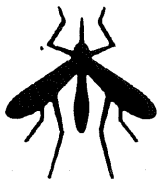
RESEMETHRIN

(Aventis-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 an 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. Resmethrin is applied at a rate of 1.5 ounces of mixed material per acre. Resmethrin is a restricted used compound and is applied only by Minnesota Department of Agriculture licensed applicators.

Appendix E

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, one 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 one 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.

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.

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

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ZOECON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

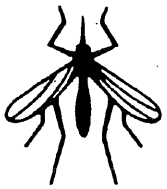
21-24-019

Made in the U.S.A.

November 2000
Schaumburg, IL

Appendix E

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

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

APPLICATION SITES AND RATES (CONT.)

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.

STORAGE AND DISPOSAL

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.

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ZOECON Professional Products

Wellmark International
Bensenville, Illinois U.S.A.

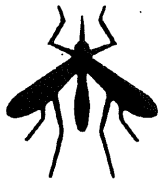
20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Appendix E

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.

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ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

21-24-004

Made in the U.S.A.

October 2000
Schaumburg, IL

Appendix E

AQUABAC™ xt

Biological Larvicide Aqueous Suspension

SPECIMEN

AQUABAC™ xt is a microbial insecticide effective against mosquitoes and blackflies in a variety of habitats.

ACTIVE INGREDIENT: *Bacillus thuringiensis var. israelensis,* 1200 International Units (ITU) per milligram*	1.2%
INERT INGREDIENTS	98.8%
TOTAL	100.0%

*Equivalent to 4.84 billion ITU/gallon (1.28 billion ITU/liter)

EPA Reg. No. 62637-1

KEEP OUT OF REACH OF CHILDREN
CAUTION!

STATEMENT OF PRACTICAL TREATMENT

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

See Additional Precautionary Statements on Next Page.

In case of an emergency endangering life or property involving this product, call collect day or night. Area Code 954-474-7590.

Appendix E

PRECAUTIONARY STATEMENTS

CAUTION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS:

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

DIRECTIONS FOR USE

It is a violation of Federal law to apply 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 in a cool, dry place.

Pesticide Dispoal: 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.

AQUABAC$_{xt}$ may be applied to any water sites except treated, finished drinking water reservoirs or drinking water receptacles.

DISCLAIMER

The label instructions for the use of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the use or application of the product contrary to label instructions, all of which are beyond the control of Becker Microbial Products, Inc. All such risks shall be assumed by the user.

Becker Microbial Products, Inc. warrants only that the material contained herein conforms to the chemical description on the label and is reasonably fit for the use therein described when used in accordance with the directions for use, subject to the risks referred to above.

Any damages arising from a breach of this warranty shall be limited to direct damages and shall not include consequential commercial damages such as loss of profits or values or any other special or indirect damages. Becker Microbial Products, Inc. makes no other express or implied warranty, including any other express or implied warranty of FITNESS or of MERCHANTABILITY.

MOSQUITOES:

Habitat	Rate Required for Control
Flood water, roadside ditches, irrigation ditches, rice fields, pastures, woodland pools, snow melt pools	0.25-1.0 pts./A
Tidal water, salt marshes, catch basins, storm water retention areas	0.50-1.0 pts./A
Polluted water (sewage lagoons, etc.) water with moderate organic matter, and water with a high concentration of suspended solids	1.0-2.0 pts./A

SPECIFIC APPLICATION INSTRUCTIONS

AQUABAC$_{xt}$ may be applied in conventional aerial and ground application equipment with sufficient water to provide thorough coverage of the target area. The amount of water needed will be dependent on weather, type of spray equipment and mosquito habitat.

Ground applications should be made in 5-100 gallons per acre in conventional equipment. As low as one gallon per acre surface area can be used when the target area is open with a light vegetative cover. Aerial applications may be done diluted or undiluted. For undiluted applications, apply 0.20 to 2.0 pts./A of AQUABAC$_{xt}$ through fixed wing aircraft or helicopters equipped with conventional boom and nozzles or rotary mist atomizers. For diluted applications, fill the mix tank or aircraft hopper with the appropriate volume of water and agitate before adding AQUABAC$_{xt}$. Maintain agitation during loading and spraying.

BLACKFLIES:

SUGGESTED CONCENTRATION RANGE	0.5-75 ppm (0.5-75 mg/liter of stream water)

The concentration should be maintained in the stream for 15 minutes.

SPECIFIC APPLICATION INSTRUCTIONS

Apply with conventional ground and aerial application equipment or metered release systems from infested sites to achieve larvicidal concentrations. Insecticidal activity should occur within 24 hours. Reapply as needed AQUABAC$_{xt}$ may be applied undiluted through appropriate ULV application equipment.

Manufactured by: Becker Microbial Products, Inc., 9464 N.W. 11th St., Plantation, FL 33322

Appendix E

ABBOTT LABORATORIES

VectoBac® 12AS

Biological Larvicide
Aqueous Suspension

ACTIVE INGREDIENT:

Bacillus thuringiensis, subsp. *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. 275-102
EPA Est. No. 33762-IA-1 List No. 5605

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KEEP OUT OF REACH OF CHILDREN

CAUTION

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 treated, 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 irrigation system unless the 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 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. Do not reuse container.

5.0 APPLICATION DIRECTIONS

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

Mosquito Habitat	Suggested Rate Range*
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing 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 1 - 2 pts/acre
(such as sewage lagoons, animal waste lagoons).

CONTINUED

Appendix E

5.0 APPLICATION DIRECTIONS (continued)

*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.

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

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

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

6.0 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

7.0 GROUND AND AERIAL APPLICATION

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

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

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

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

Rinse and flush spray equipment thoroughly following each use.

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

8.0 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.

8.1 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.

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.

Abbott Laboratories - Quality Health Care World Wide
Agricultural Products, North Chicago, IL 60064 (800) 323-9597 04-2711/R3 3/99

Appendix E

ABBOTT LABORATORIES

VectoBac® G

Biological Larvicide
Granules

ACTIVE INGREDIENT:
Bacillus thuringiensis, subsp. *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. 275-50
EPA Est. No. 33762-IA-1 List No. 5108

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KEEP OUT OF REACH OF CHILDREN
CAUTION

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 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.

4.0 APPLICATION DIRECTIONS

VectoBac G is an insecticide for use against mosquito larvae.

Mosquito Habitat (Such as the following examples):	Suggested Rate Range*
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 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.

Abbott Laboratories - Quality Health Care World Wide
Agricultural Products, North Chicago, IL 60064 (800) 323-9597 04-2028/R1 9/97

Appendix E

LarvX™ SG

Biological Larvicide Soluble Granules

ACTIVE INGREDIENT:

Bacillus thuringiensis, subspecies *israelensis*
262 International Toxic Units (ITU) per mg
(Equivalent to 0.119 billion ITU per pound) 00.26%

INERT INGREDIENTS: 99.74%

100.00%

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENTS OF PRACTICAL TREATMENT

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

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

DIRECTIONS FOR USE

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

LarvX™ SG is a microbial insecticide effective against mosquitoes in a variety of habitats.

Mosquito Habitat Examples	**Rate Range***
Irrigation runoff, flood water, woodland pools, snow melt pools, ponds, pastures, rice fields, freshwater marshes, ditches, tidal water, salt marshes.	2 - 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 deep, heavily polluted, and/or algae is abundant. Soft bottom sites may require the higher rates.

Apply uniformly by conventional aerial or ground equipment as needed to maintain mosquito control. For permanently flooded habitats, a 7 to 14 day interval between applications may be employed.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS: Causes moderate eye irritation. As a general precaution when exposed to potentially high concentrations of living mircrobial 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. Avoid contact with skin and eyes, or clothing. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS: Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles. 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 these factors when making decisions.

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 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.

NOTICE TO USER

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

Meridian LLC
5137 14th Avenue South
Minneapolis, MN 55417-1801

EPA Reg. No. 69504-1
EPA Est. No. 54094-MN-1

Lot No: _____

Net Weight: 40 Pounds (18.2 Kg.)

MERIDIAN
Vector Management

U.S. Patent Number 5,484,600

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 areas 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, Rocky Mountain fever and western encephalitis. Apply product with mist blower, power backpack or ULV machine. If ULV machine is used, adjust pressure to deliver particles from 35-200 microns. Do not allow spray treatment to drift on pasture land, crop land, poultry ranges or water supplies. Do not use on crops used for food, forage or pasture.

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

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

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

ACTIVE INGREDIENT:	
Permethrin (3-Phenoxyphenyl)methyl (±) cis, trans-3-(2,2-dichloroethenyl)-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

SAMPLE LABEL

MANUFACTURED BY

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

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

NET CONTENTS_____

LOT NO. _____

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

This is equivalent to 0.1 lb. of Permethrin/Acre. Apply the product with sufficient carrier to allow distribution over the area to be treated using particle sizes from 35-200 microns mmd. To obtain optimum results, cover the immediate surroundings of housing, buildings including plant surfaces where mosquitoes may rest. For large recreational areas such as football fields, stadiums, racetracks, and public parks, spray the insecticide-oil mixture at the above mentioned application rate on the interface of weeds 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 12.5 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. Areas to be treated include but are not limited to parks, campsites, woodlands, golf courses, residential areas and municipalities, gardens, recreational areas, overgrown waste areas. Do not apply this product within 100 feet of lakes and streams. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges or water supplies. Best results are obtained when applications are made when active and weather conditions are expected to keep the insects near the ground, e.g. cool temperatures and [illegible] no wind or [illegible] 10 mph. Applications during the cool hours of the night and early morning are usually preferable. Repeat treatment as needed.

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

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

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

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

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

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

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

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

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

STORAGE & DISPOSAL

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

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

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

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

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

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

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

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

12/97

Appendix E

RESTRICTED USE CLASSIFICATION
Due to Acute Fish Toxicity
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators Certification.

Aventis

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%
OTHER INGREDIENTS†:	83.44%
	100.00%

*Cis/trans isomers ratio: max. 30% (±) cis and min. 70% (±) trans.
Aventis Environmental Science SBP-1382® brand of resmethrin insecticide.
**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.
716rest 06/00tk

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

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.

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

NET CONTENTS:

AVENTIS ENVIRONMENTAL SCIENCE USA LP

Appendix E

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.

Appendix E

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.

APPLICATION INSTRUCTIONS FOR PRODUCT IN AIRCRAFT USAGE

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, it is impossible to eliminate all risks associated with the use of this product. Ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Aventis Environmental Science USA LP. All such risks shall be assumed by the user or buyer.

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*Scourge and SBP-1382 are registered trademarks of the Aventis Group.

Aventis Environmental Science USA LP
95 Chestnut Ridge Road
Montvale, NJ 07645
S4-12-SL-6/00

Appendix F

ACRES TREATED WITH CONTROL MATERIALS USED BY MMCD FOR MOSQUITO AND BLACK FLY CONTROL FOR 1992-2000.

Control Material	1992	1993	1994	1995	1996	1997	1998	1999	2000
Altosid® XR Briquet 150-day	10,376	10,537	8,557	7,303	422	501	371	533	533
Altosid® XR Briquet 90-day	0	0	0	0	0	0	961	0	0
Altosid® Sand-Products	625	630	678	871	712	1,096	1,868	3,968	786
Altosid® Pellets 30-day	5,689	5,562	5,374	8,212	10,654	8,851	10,432	13,775	11,121
Altosid® SR-20 liquid	3,279	15	13	668	565	1,645	529*	355	29
Bti Corn Cob granules	101,877	126,778	102,860	131,589	68,355	106,755	113,539*	118,733	84,521
Bti Liquid Black Fly (gallons used)	4,418	5,090	4,047	3,606	3,025	5,445	4,233	4,343	821
Permethrin Adulticide	12,812	8,261	10,499	6,305	5,914	6,340	6,164	4,865	4,066
Resmethrin Adulticide	48,716	53,345	40,687	61,858	120,472	106,065	65,356	51,582	42,986

* These values are updated, therefore some values may differ from similar values in earlier publications. The actual geographic area treated is smaller because some sites are treated more than once.

Appendix G

2000 CONTROL MATERIALS: PERCENT ACTIVE INGREDIENT (AI), AI IDENTITY, PER ACRE DOSAGE, AI APPLIED PER ACRE AND FIELD LIFE

Material	AI	Percent AI	Per acre dosage	AI per acre	Field life
Altosid® briquets	Methoprene	2.10	220 briquets [a]	0.4481 lb	150 days
			330 briquets [a]	0.6722 lb	150 days
			440 briquets [a]	0.8963 lb	150 days
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063 lb	30 days
			4 lb	0.1700 lb	30 days
Altosid® SR-20	Methoprene	20.00	20 ml [b]	0.0091 lb	10 days
Altosid® XR-G	Methoprene	1.50	5 lb	0.0750 lb	20 days
Altosand	Methoprene	0.05	5 lb	0.0025 lb	10 days
Vectobac® G	*Bti*	0.20	5 lb	0.0100 lb	1 day
			8 lb	0.0160 lb	1 day
Permethrin 57%OS	Permethrin	5.70	25 fl oz [c]	0.0977 lb	5 days
Scourge®	Resmethrin	4.14	1.5 fl oz [d]	0.0035 lb	<1 day

[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)

Appendix H

JANUARY 2001 TAB MEETING MINUTES AND LETTER FROM TAB CHAIR TO MMCC CHAIR

6 August 2001

Commissioner Dallas Bohnsack, Chair
Metropolitan Mosquito Control Commission
2099 University Avenue West
St. Paul, Minnesota 55104

Dear Commissioner Bohnsack:

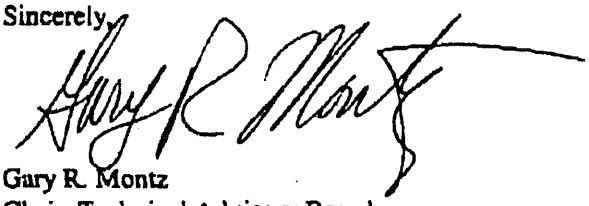
The Technical Advisory Board (TAB) met on January 29, 2001 to review and discuss the Metropolitan Mosquito Control District (MMCD) operations from 2000 and plans for 2001. Minutes of this meeting are attached. The TAB did not recommend any significant changes to the Operational Plans as presented by the MMCD. The following two motions were passed by the TAB.

Motion 1. The TAB strongly recommends that the MMCD communicate with environmental groups in advance of the next TAB meeting, providing them with an agenda and access to TAB reports on the internet, requesting comments, and forwarding all comments to all TAB members.

Motion 2. The TAB commends the MMCD on work done on evaluating non-target effects of adulticide treatments, and encourages the MMCD to continue this work.

The TAB urges the MMCC to endorse and support both of these motions. If you have any questions or need additional information, please contact me.

Sincerely,



Gary R. Montz
Chair, Technical Advisory Board
(651) 297-4888

c: J. Sanzone
S. Manweiler

attach: 2001 TAB meeting minutes

Appendix H

Monday, January 29, 2001, 12:30 p.m. Technical Advisory Board (TAB) Meeting

TAB Members in Attendance:
Dave Neitzel – MN Department of Health
Roger Moon – University of Minnesota Department of Entomology
Larry Gillette – Hennepin County Parks
Greg Busacker - MN Department of Transportation
Gary Montz – TAB Chair – MN Department of Natural Resources
Susan Palchick – Hennepin County Department of Public Health
Bob Sherman – Statistician (Retired)
Karen Oberhauser – University of Minnesota Department of Ecology
Anne Selness – Minnesota Department of Agriculture (Anne was representing Geir Friisoe who is the current MDA representative on the TAB)
Steve Hennes – MN Pollution Control Agency

MMCD Staff in Attendance:
Mike McLean
Nancy Read
Cara Hansmann
Joe Sanzone
Sandy Brogren
Janet Jarnefeld
Mark Smith
Kirk Johnson
Stephen Manweiler

Guests:
Judy Bellairs

Gary Montz called the meeting to order at 12:30PM.

Introduction and overview – Joe Sanzone
MMCD Director Joseph Sanzone gave a brief overview of District plans for 2001. New goals include heightened West Nile Virus (WNV) surveillance, continuation of non-target studies, evaluating new formulations of control materials, and an adult black fly annoyance study. A roughly 3.8 percent budget increase will keep District service levels for 2001 comparable to 2000.

Overview: Mosquito vectors
Kirk Johnson, MMCD Vector Ecologist, gave an overview of MMCD's vector control program. The District maintains three sentinel chicken flocks to monitor for presence/absence of Western Equine Encephalitis (WEE) on the outskirts of the metro area. None of the chickens tested positive for antibodies to the virus. There were six human cases of LaCrosse encephalitis (LAC) reported in Minnesota during 2000, two cases were within District boundaries, four were just outside the District.

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Kirk Johnson also presented a review of the status of the West Nile Virus in the eastern United States. When West Nile Virus was first detected in 1999 there were 69 human cases and 29 equine cases. In 2000 there were 21 human cases and 65 equine cases diagnosed. Because this disease has the potential to spread to Minnesota, plans are underway, in cooperation with the Minnesota Department of Health (MDH), to monitor birds for West Nile virus detection as part of the Center for Disease Control (CDC) national surveillance network. Kirk Johnson also noted that sentinel chickens – already used to monitor for the presence of Western Equine encephalitis – apparently are not good indicators of West Nile activity because evidence of West Nile virus exposure has shown up too late in the season to be an effective early warning signal.

Questions and Comments
Discussion began with a description of the epidemiological relationship between mosquito population density, virus prevalence and mosquito-borne disease transmission.
Roger Moon said he would like to see research on LAC infection rates in mammals.
Dave Neitzel noted that mammals are only viremic for a few days at most.
Gary Montz asked whether the District identifies *Culex* to species and whether anyone has done a *Culex* inventory here in Minnesota.
Roger Moon asked if house sparrows could be reservoirs for West Nile Virus. Kirk Johnson answered yes and noted a wide range of bird species that are affected by West Nile.
Dave Neitzel suggested more horse surveillance for West Nile Virus.

Overview: Tick vector surveillance and collaborative research.
Janet Jarnefeld gave an overview of the District's tick vector services. 2000 tick surveillance data were not finished being compiled, but 1999 data showed no spread in the range of the deer tick in the metro area. The District began comparative sampling in the Little Falls area through a new cooperative research project with Camp Ripley personnel and the University of Minnesota; testing for HGE and *Borrelia*. In another collaborative project with the University of Minnesota, intensive sampling continued in Washington County. Three percent of ticks were HGE PCR-positive, and roughly 25 percent were infected with *Borrelia*. In 2001, the District will collect additional data with the Little Falls study and continue its tick surveillance efforts. District public affairs and tick experts plan to develop radio public service announcements featuring former University of Minnesota men's hockey coach Doug Woog, himself a recent victim of Lyme disease.

Questions and Comments
Karen Oberhauser asked about the status of the Lyme vaccine. Dave Nietzel noted that rumors of negative auto-immune responses to the vaccine are circulating. The Department of Health, he said, wants to study this matter, but they are having trouble finding enough people who have been vaccinated. Meanwhile, Gary Montz noted, the commercials for the vaccine are still going strong.

Mosquito Surveillance Issues
Sandy Brogren, MMCD Chief Entomologist, characterized the 2000 mosquito season as comparatively lower than average in terms of mosquito numbers related to the dry spring. District staff examined between 10,000 and 12,000 larval samples in 2000.

Appendix H

Questions and Comments

Gary Montz asked whether species identification of larvae is done in the field or at the main office. Sandy Brogren noted that it is usually done in the main office, but that technical staff are sometimes sent out into the field to do ID's.

Larry Gillette asked if the District could do a better job of showing partial broods in its year-end activity recap, based on total mosquito numbers and affected areas. He suggested this would help correlate mosquito density with control efforts.

Roger Moon suggested showing the number of times adult sampling site counts were above threshold.

Mosquito Control Discussion

Mark Smith and Stephen Manweiler lead a discussion of mosquito control efforts in 2000. Overall, there were fewer treatments than in 1999. A drier summer meant fewer acres treated with *Bti* and fewer adulticide acres.

Questions and Comments

Susan Palchick asked about equipment calibration and droplet optimization. Mark Smith said that the droplet size distribution produced by spray equipment is checked with a droplet optimizer. Repeated sampling shows that District equipment maintains its calibration and optimized droplet site distribution over time. The District plans to look at all pieces of equipment in 2001.

Non-target Impact Discussion

Stephen Manweiler outlined plans to continue work on non-target effects of adulticide treatments in local settings. He gave an overview of non-target research in California performed in two wildlife refuges and similar research initiated by MMCD in 1999 and continued in 2000 at specific campgrounds in Anoka County. In both the California and MMCD research, mosquitoes were suppressed significantly after adulticide applications (high mortality of caged mosquitoes in California research and significantly fewer mosquitoes caught in CO_2-traps in MMCD research). The number of non-target insects caught in adjacent UV-traps did not decrease after adulticide applications the way mosquitoes decreased which suggests that non-targets were not suppressed the way mosquitoes were. Overall results were similar to the California research (no consistent direct immediate suppression of non-target insects was observed), but more will be done in 2001 to confirm results and draw conclusions from the study.

Questions and Comments

Roger Moon suggested including butterfly gardens in the treatment area to see if they are affected. Other suggestions included looking at the affect of adulticide treatments on pollinators, leaf feeders, leaf miners and other taxa. Drs. Oberhauser and Moon suggested that more sites should be used, with the site being the experimental unit, to provide replication for statistical aanalysis. Stephen Manweiler suggested that TAB members interested in the details of further studies plan to meet again with staff prior to 2001 tests.

Loosestrife impact discussion

Nancy Read gave an overview of a statistical analysis of the effect of District adulticide treatments on newly released loosestrife beetles – a species introduced by the Department of Natural Resources and volunteers in order to control the exotic species purple loosestrife. There has been

concern expressed that adulticiding might prevent these beetles from establishing themselves in wetland settings. Examination of data about the success of beetle introductions showed that proximity to District treatments was not sufficient to explain beetle success or failure in the East metro area. There was some evidence, however, that treatments may have slowed or reduced beetle success at a few sites.

Questions and Comments

The need for heightened communication was advised.

Icypearl Testing

Stephen Manweiler outlined plans to test a new frozen formulation of *Bti*, called Icypearl. The manufacturer is willing to fund tests in field situations. The new formulation has obvious drawbacks, one being that it has to be kept frozen until used. A big advantage is that the amount of *Bti* per pound of formulated product can be adjusted to modify the per acre *Bti* dosage without changing the weight of formulated product applied per acre meaning that no helicopter recalibration is required.

Public Opinion Survey

Nancy Read gave a preliminary analysis of the District's biannual public opinion survey. Awareness and support of MMCD remains high. One item of note was that awareness of the need to dump water-holding containers is up nine percent.

Questions and Comments

Roger Moon and Susan Palchick noted the impact of use of certain hot-button words, such as "spray" and "pesticide" on survey results. Susan Palchick asked about the impact of recent laws requiring notification of pesticide uses on school grounds. Mike described MMCD's efforts to communicate with school officials.

Environmental Representative Discussion

TAB Chair Gary Montz lead a discussion about environmental group representation. He suggested that a group called the Minnesota Environmental Partnership should have been consulted before selecting a new TAB member to represent environmental issues.

The mission of the TAB is to provide technical advice to the MMCD. Citizen input is not a responsibility of TAB. TAB members have historically served because of their technical knowledge and their service in academia, government or industry. This has been done with the added view toward gaining individual perspectives that are concerned with program effectiveness, innovation, environment and health (in no particular order of importance). There is no requirement that the TAB include members of political organizations, environmentalist or otherwise.

The issue of importance is that environmentalist concerns are considered by the TAB, MMCD and MMCC (Metropolitan Mosquito Control Commission). Dr. Karen Oberhauser was invited to join the TAB because of her technical expertise with butterfly ecology, expertise that should be very useful to help MMCD and MMCC rationally and scientifically evaluate environmental safety and address issues of concern to environmentalists including the effects of mosquito adulticides on

non-target insects such as butterflies. Dr. Oberhauser was not invited to join the TAB to represent any specific environmentalist group.

The TAB did indeed recommend that MMCD get a representative supportive of environmental concerns (see notes for 28 January 2000 TAB meeting, November 1999 TAB meeting, December 1999 memo from MMCD Director describing TAB). Gary Montz stated that at the January 2000 TAB meeting, he specifically suggested that MMCD contact Char Brooker of the Minnesota Environmental Partnership. Stephen Manweiler responded that the TAB is responsible for providing technical advice to MMCD and MMCC. TAB is not a political or citizen input group (see December 1999 memo from MMCD Director describing TAB).

A discussion ensued that explored how various environmental groups might be drawn into the technical review process. Comments included adding a public forum to the TAB meeting process and expanded communication via web site.

Stephen Manweiler asked if the MDNR contacted targeted environmentalist groups. Gary Montz said this is done often, and gave an example of the annual Fisheries Roundtable meetings. Roger Moon responded that MDNR is mandated to solicit such input from environmentalist groups whereas MMCD and MMCC are not.

Roger Moon also responded that the TAB is a technical advisory group only and has no authority to mandate any actions by MMCD or MMCC.

Susan Palchick stated that including a time period in the TAB meeting for public comments (i.e., for environmentalists to voice their concerns) did not work when tried in the past because few attended.

Bob Sherman suggested that MMCD could solicit input from environmentalist groups by placing the TAB reports (Operational Reviews) and TAB meeting agenda on the MMCD website before the next meeting and forward that input to all TAB members before the next meeting. Roger Moon proposed motion 1 based on this suggestion.

Gary Montz said that he would have liked to have been consulted during the selection process. As a result of this discussion Gary Montz proposed a motion (Second by Karen Oberhauser) that the TAB report not be given its final presentation to the MMCC until environmental groups were formally given an opportunity to comment on it. This motion failed. Two subsequent motions were passed.

Motion 1: Roger Moon proposed (2nd by Susan Palchick) that the TAB strongly recommend that MMCD communicate with environmental groups in advance of the next TAB meeting, providing them with an agenda and access to TAB reports on the internet, requesting comments, and forwarding all comments to all TAB members. Motion passed without dissent.

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Motion 2: Larry Gillette proposed (2nd by Susan Palchick) that the TAB commend MMCD on work done on evaluating non-target effects of adulticide treatments, and encourage MMCD to continue this work. Motion passed without dissent.

Gary Montz noted that the next TAB chair will be Dave Neitzel, MDH, effective after Gary Montz reports the TAB recommendations (from this meeting) to the MMCC in spring 2001.

Susan Palchick made a motion to adjourn (2nd by Karen Oberhauser). The motion passed without dissent. The meeting was adjourned at 3:50PM.

EDITORIAL STAFF

MIKE MCLEAN, PUBLIC AFFAIRS
STEPHEN MANWEILER, PH. D., TECHNICAL SERVICES COORDINATOR

ACKNOWLEDGMENTS

THANK YOU TO THE FOLLOWING PEOPLE WHO WROTE OR REVIEWED MAJOR PORTIONS OF THIS DOCUMENT: SANDRA BROGREN, JANET JARNEFELD, KIRK JOHNSON, STEPHEN MANWEILER, NANCY READ, KEN SIMMONS, MARK SMITH, AND JOHN WALZ. THANKS ALSO TO MARTY KIRKMAN FOR PRODUCING THE ARTWORK FOR THE COVER.

AUGUST 2001

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FIRST REVISION, JUNE 2001
FINAL, AUGUST 2001