2004 Operational Review & Plans for 2005

Annual Report to the Technical Advisory Board

Metropolitan Mosquito Control District
Metro Counties Government Center
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Metropolitan Mosquito Control District

Mission

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

Governance

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

Metropolitan Mosquito Control Commission 2005

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

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Executive Summary

Established in 1958, Metropolitan Mosquito Control District's (MMCD) mission has expanded to include various mosquito-borne and tick-borne diseases and their vectors, as well as black flies (gnats). Recently, West Nile virus (WNV) has joined La Crosse encephalitis, eastern equine encephalitis, western equine encephalitis, and Lyme disease as a primary focus of MMCD research, operations, and services as MMCD continues its long-term mission of reducing disease risk and providing the public with the best available information and services.

Introduced into the United States in 1999, WNV was first detected in birds in Minnesota during 2002. In 2002, 48 Minnesotans were infected. By 2003, Minnesota experienced 148 human cases with four deaths. In 2004 there were 34 human cases with two deaths. The presence of West Nile virus (WNV) in Minnesota continues to strongly influence MMCD research, activities, and operations.

Efficient transmission and maintenance of WNV is believed to include different mosquito species (genus *Culex*), with separate breeding habitats, life cycles, and resting locations than those that District operations were originally developed to combat (genera *Aedes, Ochlerotatus,* and *Coquillettidia*). Although some overlap between breeding habitats is now understood (primarily between *Culex tarsalis* and *Aedes vexans*), additional mosquito breeding sites, such as urban storm water catch basins must be continually monitored and treated to control other West Nile vector species. Several staff have been hired to help with the increased workload, and various WNV-specific surveillance and control operations continue to be identified, refined and integrated into overall District operations.

> "The TAB encourages MMCD to continue research on all aspects of WNV, including biology of vectors, disease risk, and options for and consequences of control, recognizing that only through such research will there be effective control."
>
> *Technical Advisory Board (TAB) Resolution, February 18, 2004*

In response to the TAB resolution shown above, several new WNV-related research projects were undertaken. MMCD staff conducted a time and elevation adult mosquito research study. Control material product testing for 2004 was refined from 2003 results and primarily focused on potential WNV vectors in various habitats (catch basins, natural breeding areas, and adult control in croplands). MMCD has also continued to create contingency plans for a potential West Nile epidemic. A rating system for prioritization of work tasks has been created, and in 2004 a GIS model was created to better direct control efforts to prevent West Nile transmission. This model incorporates dead bird reports and mosquito population variables and adjusts the data input to create a map which highlights priority monitoring and treatment areas. It will be used operationally in 2005.

Equipment testing and incorporating improvements in computerized data entry processes also continued in 2004. Expansion of the District into western Carver County, as directed by the 2003 State Legislature, was completed in 2004. This new area was mapped and breeding habitats

located so that MMCD services could be efficiently provided (surveillance for tick vectors has been ongoing since 1990). MMCD's 2004 public opinion survey results show that mosquito control is more important than ever to metro residents.

MMCD maintained its level of surveillance and control services for La Crosse, western equine and eastern equine encephalitis in 2004. Breeding source elimination is an effective way to reduce the La Crosse encephalitis vector, *Oc. triseriatus*. In 2004, District staff removed and recycled 15,751 tires, removed 1,415 containers, and filled 1,128 treeholes. Evidence of 2004 Minnesota viral activity included one positive western equine encephalitis mosquito pool in Freeborn County and one positive La Crosse encephalitis mosquito pool in Blue Earth County.

Larval mosquito control operations begin around or just before the spring thaw and continue throughout the summer. Floodwater species emergence is driven by rain events of one or more inches which trigger mosquito hatches, or broods. There were an unusually large number of District-wide rain events in 2004 (9 total, compared with 6 recorded for a typical year). Further, it was the third consecutive year with heavy spring-early summer rains, with seven of these rain events occurring from May - mid-July (there were 12 consecutive days with rain in May alone). These heavy spring-early summer rainfall totals are reflected in our amounts of larval control materials used (185,836 total acres treated in 2004) and numbers of mosquitoes collected through the early summer, but mosquito numbers were offset somewhat by the cooler than normal temperatures recorded for the May – August period. Rainfalls were light from the week of July 23 - September 3 and then there were 2 consecutive weeks of heavy rainfalls that coincided with higher than normal September temperatures (temperature data obtained from the DNR State Climatology Office).

Adult mosquito control is performed when surveillance indicates that specific disease-vectoring mosquito populations are increasing, when the District is notified of a mosquito-borne disease case, or when thresholds of adult mosquito catches are exceeded in high-density human-populated areas. In 2004 the District treated a total of 95,648 acres with adulticides.

MMCD maintained its ongoing river non-target invertebrate monitoring and level of surveillance and control for black flies (biting gnats) with small stream and large river treatments occurring at levels consistent with past years. District staff completed a study of human response to adult black fly annoyance which showed wide variability in perceived annoyance to black flies, but with marked increases at three or more per three minutes. Those who react strongly to gnat bites were willing to pay more for increased services.

Abundance of *Ixodes scapularis,* the tick vector of Lyme disease and human anaplasmosis (HA), formerly human granulocytic ehrlichiosis (HGE), appeared to have decreased slightly in 2003 compared to the high population levels observed in 2000 – 2002, at least in the 2003 larval cohort. In 2004 MMCD continued a collaborative research study with the University of Minnesota, and staff intends to publish the results of MMCD's entire 1992-2004 effort. The Minnesota Department of Health's 2003 human case totals (473 Lyme and 78 HA) were also lower than 2002 but 2003 results were similar to their previous all-time high case totals of 2000 and 2001. In response, MMCD expanded outreach in 2004 by setting up an information booth at

several county park events. Preliminary 2004 human case totals indicate a potential large increase above record 2002 levels.

In 2005 MMCD plans a strategic shift in its large larval breeding site mosquito operations so that operational workloads and helicopter availability can be more evenly distributed if there is yet another consecutive spring with heavy rainfall. MMCD plans expanded use of larvicides (Altosid® pellets and *Bacillus sphaericus*) which have a longer field effectiveness—30 and 28 days respectively versus 24 hours for *Bacillus thuringiensis*, subsp. *israelensis*—and can treat more than one brood of mosquitoes in a single application, including *Culex* species that develop in swamps following the floodwater mosquito *Aedes vexans*.

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Chapter 1 Vector-borne Disease

2004 Highlights

- The were no La Crosse encephalitis cases in the District
- WNV illness confirmed in 34 Minnesotans, 6 are District residents
- WNV detected in only 2 District mosquito samples and 7 other samples statewide
- Discontinued sentinel chicken surveillance for WEE and WNV, replaced with improved surveillance for viruses in *Culex tarsalis*
- Conducted surveillance projects to evaluate *Culex* larval habitats and *Culex* adult habitats and behavior
- Treated 148,023 catch basins
- Continued survey of larval habitats for *Cs. melanura*, the EEE vector
- Collected and recycled 15,751 waste tires
- 2003 *I. scapularis* distribution study results were mixed, with a very high nymph count but a lower count compared to the high population levels observed in 2000-2002

Background

District staff provide a variety of disease surveillance and control services, as well as public education, to reduce the risk of mosquito-borne illnesses such as La Crosse encephalitis, western equine encephalitis, eastern equine encephalitis, and West Nile encephalitis and tick-borne illnesses such as Lyme disease and ehrlichiosis. Past District efforts have also included determining metro-area risk for infections of Jamestown Canyon virus, babesiosis, Rocky Mountain spotted fever, and Sin Nombre virus (a hantavirus).

La Crosse encephalitis prevention services were initiated in 1987 to identify areas within the District where significant risk of acquiring this disease exists. High risk areas are defined as having high populations of the primary vector *Ochlerotatus triseriatus* (eastern tree-hole mosquito) and a history of La Crosse encephalitis cases. These areas are targeted for intensive control efforts including public education, mosquito breeding site removal, and limited adult mosquito treatments. Additionally, routine surveillance and control activities are conducted at past La Crosse encephalitis case sites. Surveillance for the exotic species *Aedes albopictus* (Asian tiger mosquito) and *Ochlerotatus japonicus* routinely occurs to detect infestations of these potential disease vectors.

In past years, MMCD used sentinel chicken flocks to monitor western equine encephalitis virus activity. In 2004 the District discontinued the use of sentinel chicken surveillance in favor of viral analysis of the mosquito vector, *Culex tarsalis*.

Eastern equine encephalitis was detected for the first time in Minnesota in 2001. Since then, MMCD has conducted surveillance for the enzootic vector, *Culiseta melanura*, and will continue to do so in 2005. The District will continue to survey wetlands and wooded areas to inventory habitats that are used by this species.

2005 Plans

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

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

In 1989, the District was mandated by the state legislature "to consult and cooperate with the MDH in developing management techniques to control disease vectoring ticks." The District responded by beginning tick surveillance and forming the Lyme Disease Tick Advisory Board (LDTAB) in 1990. The LDTAB includes MMCD and MDH staff, local scientists, and agency representatives who offer their expertise to the tick-borne effort.

MMCD initiated tick surveillance to determine the range and abundance of the black-legged tick (*Ixodes scapularis*, also known as the deer tick) and the Lyme disease spirochete, *Borrelia burgdorferi*, within the District. To date, MMCD has mapped the current distribution of black-legged ticks (545 total sites sampled) and continues to monitor their populations in the metropolitan area. Additionally, District employees have assisted with spirochete and ehrlichiosis studies with the University of Minnesota. All data collected are summarized and given to the MDH for their risk analysis. Because wide-scale tick control is neither ecologically nor economically feasible, tick control is limited to public education activities which emphasize tick-borne disease awareness and prevention. District employees continue to provide tick identifications upon request and are used as a tick referral resource by agencies such as the MDH and the Minnesota Department of Natural Resources (MNDNR).

2004 Mosquito-borne Disease Services

Breeding Source Reduction

Small water-holding containers provide developmental habitat for many mosquito species including the La Crosse virus vector *Oc. triseriatus*, the exotic species *Ae. albopictus* and *Oc. japonicus*, and other probable vectors of West Nile virus. In 2004, MMCD recycled 15,751 tires that were collected from the field. Since 1988 the District has recycled 419,238 tires. In addition, MMCD cooperated with Carver County Environmental Services to remove approximately 2,100 tires from a site in Carver County. District staff eliminated another 1,415 container breeding sources and filled 1,128 tree holes. This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities including the 1,428 property inspections performed by MMCD staff in 2004.

La Crosse Encephalitis (LAC)

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

In 2004, MMCD staff collected 3,101 aspirator samples for the purpose of monitoring *Oc. triseriatus*. The District's threshold of at least two adult *Oc. triseriatus* was met in 608 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when samples reached threshold. Additionally, 500 adulticide applications to wooded areas were prompted by collections of *Oc. triseriatus* in aspirator samples.

Adult *Oc. triseriatus* were captured in 786 of 1,850 individual wooded areas sampled. This ratio is similar to recent years (Table 1.1).

Table 1.1 Individual wooded areas sampled by aspirator and the number of those where *Oc. triseriatus* were captured 2000 – 2004.

Year	Total areas surveyed	Number with *Oc. triseriatus*	Percent with *Oc. triseriatus*	Avg. number per aspirator sample
2000	1,037	575	55.4	1.94
2001	1,222	567	46.4	1.32
2002	1,343	573	42.7	1.70
2003	1,558	470	30.2	1.20
2004	1,850	786	42.5	1.34

Surveillance for *Oc. triseriatus* adults was initiated during the week of June 6. A single specimen was collected during that week. MMCD surveillance indicated an increase in *Oc. triseriatus* adult emergence through the week of June 20 (Figure 1.1). The season's peak rate of capture occurred during that same week. The *Oc. triseriatus* population appeared to remain

stable through the month of July then declined steadily through August. This decline was likely the influence of unusually cool temperatures in July and August combined with low rainfall amounts during that period

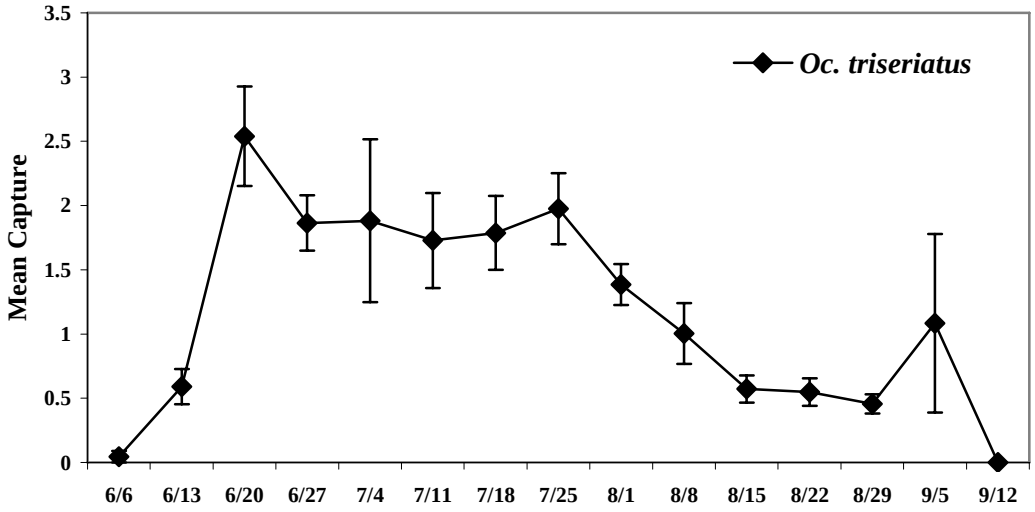


Figure 1.1 Mean number of *Oc. triseriatus* adults in aspirator samples, plotted by week. Dates listed are the first sampling day of each week. Sites sampled varied by week, although several locations were monitored repeatedly during the season. Bars represent one standard error.

La Crosse Encephalitis In Minnesota Two cases of La Crosse encephalitis were reported to MDH in 2004, neither of which occurred in the District. A twelve year-old boy from Goodhue County was diagnosed with La Crosse encephalitis in August. The date of his onset of illness was August 15th. A ten year-old girl from Brown County was diagnosed with La Crosse encephalitis in September. The date of her onset of illness was September 12th . This is the western most record of the La Crosse virus in Minnesota.

Eastern Equine Encephalitis (EEE)

During two of the past four years, EEE has been detected in horses in the upper Midwest. In 2001 an epizootic was centered in western Wisconsin but radiated into Minnesota and Iowa. During that season there were three EEE illnesses in Minnesota horses including one in Anoka County. In 2003, two horses died from EEE illnesses in Polk County Wisconsin, a county that borders MMCD. Since 2001, MMCD incorporated a surveillance program for the EEE maintenance vector *Cs. melanura*.

***Culiseta melanura* Surveillance** During the 2004 season MMCD staff continued with a plan initiated in 2002 to systematically evaluate *Cs. melanura* habitat in the District. The 2004

focus was on selected wooded and wetland habitats in areas of Anoka and Washington counties with concentrations of tamarack and other bog sites. Ninety-five larval inspections were conducted in 52 bog sites. Larvae were collected ten times and only one of these contained *Cs. melanura*. This was, however, the first recorded collection of *Cs. melanura* larvae from Washington County. Larvae of the species have now been collected from 16 wetlands in the District. Thirteen aspirator samples were collected from thirteen different wooded habitats surrounding suspected *Cs. melanura* larval habitat. None of the samples contained *Cs. melanura* adults.

Western Equine Encephalitis (WEE)

Since the District's sentinel chicken surveillance program was discontinued, an alternative method for WEE surveillance was devised. In 2004 all *Cx. tarsalis* collected in gravid traps, Monday night CO_2 traps and sweep collections were submitted for WEE as well as WNV analysis. Furthermore, the Monday night CO_2 trap network was expanded by 25 traps and *Cx. tarsalis* captures were improved by repositioning some traps to areas with historically higher populations. Seven hundred eighty-nine pools containing 5,069 *Cx. tarsalis* were submitted to MDH for analysis. There were no detections of WEE from District samples, however, a sample of 25 *Cx. tarsalis* from Freeborn County collected on August 11th by the University of Minnesota was positive for WEE.

West Nile Virus (WNV)

Progression of WNV in North America West Nile virus transmission was documented in 47 states in 2004. Only Alaska, Hawaii, and Washington went without detections of local transmission of the virus. The U.S. Centers for Disease Control and Prevention received reports of 2,470 WN illnesses from 40 states and the District of Columbia; eighty-eight of the cases were fatal. Nearly 70 percent of the cases were reported from five states: Arizona, California, Colorado, Louisiana, and Texas. Screening of the American blood supply detected WNV in 198 donors from 28 states. West Nile illness was diagnosed in 1,399 horses from 38 states.

Canada experienced a dramatic decline in WN illness in 2004. Only 29 cases were diagnosed in residents of five provinces. In 2003, 1,338 Canadians were diagnosed with WN illness.

Mexico confirmed only a single case of WNV illness in 2004, a resident of the state of Sonora. In addition 1,023 equines of 3,523 tested were seropositive for WNV although all of the animals were asymptomatic.

WNV in Minnesota West Nile virus appeared to be less active in Minnesota in 2004 than during the previous two years. The most reasonable explanation for this was the unusually cool summer temperatures experienced here. The Minnesota Department of Health reported 34 WNV illnesses in residents of 21 Minnesota counties. The first case confirmation was on August 2nd; the earliest onset of a WNV illness in the state was July 12th. Two Minnesota blood donors from two counties screened positive for WNV in 2004. Additional WNV detections in Minnesota included 11 illnesses in horses plus one asymptomatic horse, 159 birds, and 9 mosquito samples.

The WNV positive mosquito samples consisted of 6 pools of *Cx. tarsalis*, and one pool each of *Cx. restuans, Oc. canadensis*, and mixed *Culex* species.

West Nile Illness in the District Six residents of the District were diagnosed with WNV illnesses. One of the individuals was exposed in either Texas or Louisiana and one may have been exposed in North Dakota. Of the five WN illnesses that were possibly or probably exposed within the District, two individuals reside in Carver County, one is a resident of Dakota County, one is a resident of Ramsey County, and one is a resident of Scott County.

Surveillance for WNV In 2004 MMCD conducted surveillance for WNV in mosquitoes and wild birds. Sentinel chicken surveillance was discontinued in 2004 since it has not proved to be sensitive enough to use as an early virus detection system for either WNV or WEE. To compensate, the District improved surveillance for and submissions of *Cx. tarsalis* adults for WNV and WEE viral analysis.

Mosquitoes were sampled for viral analysis on a weekly basis from 30 CO_2 traps (12 elevated into the tree canopy) and 20 gravid traps. In addition, all *Cx. tarsalis* collected in Monday night CO_2 trap and sweep collections were submitted for viral analysis. A sample of mosquitoes from a Mosquito Magnet® provided by a citizen of the District was pooled for analysis, as well. MMCD submitted 3,859 mosquito pools to the Minnesota Department of Health for viral analysis. Two pools returned positive results for WNV—a pool of 25 *Cx. restuans* collected September 1st in St. Louis Park and a pool of one unidentifiable *Culex* species collected September 15th in North St. Paul. Both samples were collected by gravid trap. Table 1.2 is a complete list of mosquitoes tested for WNV.

In addition to mosquito surveillance for WNV, MMCD also contributed to Minnesota's surveillance for WNV in wild birds. In 2004 MMCD staff collected 275 birds for viral analysis, 91 fewer than in 2003 even though the mechanisms of surveillance remained consistent and bird collections ceased earlier in 2003 than in 2004. Possible explanations for this include cool weather in July and August, relaxed awareness among citizens who are relied upon for reports of dead birds, impacts of previous WNV seasons on corvid populations, and perhaps herd immunity to WNV among some bird species. Of the birds collected by MMCD, 116 returned positive results for WNV (Figure 1.2).

Table 1.2 Mosquitoes submitted to the Minnesota Department of Health for viral analysis.

	Pools Submitted by Collection Method				
Species	**CO_2 Trap**	**Gravid**	**Sweep**	**Mosquito Magnet**	**Number of Mosquitoes**
Ae. cinereus	128	35	0	0	782
Ae. vexans	170	9	0	0	3,664
Ae./Oc. species	6	0	0	0	55
An. earlei	25	4	0	0	77
An. punctipennis	124	3	0	0	326
An. quadrimaculatus	3	0	0	0	3
An. walkeri	76	7	0	0	344
An. species	2	1	0	0	6
Cq. perturbans	460	102	0	0	9,320
Cs. inornata	83	29	0	0	218
Cs. melanura	3	0	0	0	4
Cs. minnesotae	24	11	0	0	64
Cs. morsitans	26	12	0	0	58
Cs. species	0	1	0	0	3
Cx. erraticus	1	0	0	0	1
Cx. pipiens	32	9	0	0	143
Cx. pipiens/restuans	104	91	0	0	996
Cx. restuans	174	177	1	0	2,425
Cx. salinarius	18	1	0	0	21
Cx. tarsalis	745	14	24	6	5,069
Cx. territans	0	2	0	0	15
Cx. species	55	87	0	0	773
Oc. canadensis	55	1	0	0	259
Oc. hendersoni	3	0	0	0	3
Oc. triseriatus	66	49	0	0	300
Oc. trivittatus	740	58	0	0	15,635
Ps. species	1	0	0	0	2
Ur. sapphirina	0	1	0	0	1

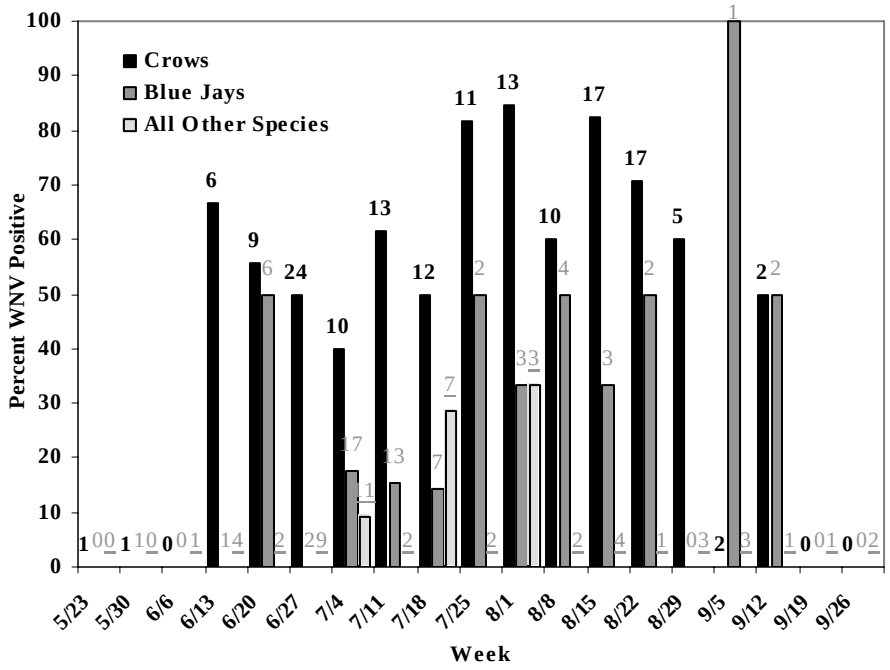


Figure 1.2 Percentage of birds collected by MMCD for WNV analysis returning positive results by week. Bars are labeled with total number of birds collected.

West Nile Virus (WNV) Research

At its February, 2004, meeting, the Technical Advisory Board passed the following resolution: "The TAB encourages MMCD to continue research on all aspects of WNV, including biology of vectors, disease risk, and options for and consequences of control, recognizing that only through such research will there be effective control." This section covers research on the vector biology and surveillance, and includes references to other parts of the report covering controls.

Species of Interest Research focused on the most likely species involved in viral amplification and transmission: *Cx. tarsalis, Cx. restuans, Cx. pipiens,* and *Cx. salinarius*. Although involvement of other species such as *Ae. vexans* can not be ruled out, we already have sufficient information on their biologies to support control. *Culex territans* is abundant but is not considered a likely WNV vector. The four likely *Culex* vector species are all found at much lower numbers than the floodwater and cattail species common in MMCD (see Surveillance chapter and 2003 report).

Research projects done in 2004 focused on the following:

- Why are larval counts so low – are we looking at the right time and place, and using the right techniques?
    - Review of previous data and studies, especially on *Cx. tarsalis*
    - "Dip day" to explore which sites have *Culex* larvae
    - "Pet sites" to explore how populations change in sites over time, and where larvae are found in sites
- Are street catch basins wet and producing *Culex* larvae?
    - Survey: "wet" catch basins still wet, "dry" still dry
    - Estimate # catch basins producing larvae
    - "Pet basins" to explore if species and counts change as year progresses

- Are adult traps placed correctly to represent *Culex* populations?
    - Test factors that might affect *Culex* capture at CO_2 traps
    - Compare elevated (15 ft) and ground (4-5 ft) trap catches
    - Test if adult *Culex* move to different elevations (5, 15, 30 ft) at different times of day

Staff also set thresholds for *Culex* for adult control (see Chapter 3), and tested control materials for *Culex* larval and adult control (Chapter 5).

Larval Mosquito Surveillance – Natural Habitats

Biology Background *Culex tarsalis, Cx. restuans, Cx. pipiens,* and *Cx. salinarius* lay rafts of eggs on the surface of standing water. For larvae to be found, adult females must have been recently active, and the area must have been wet and attractive to an egg-laying female. Larvae will tend to be clumped as a result of egg-raft oviposition.

Review of 1988 flooding studies During the drought of 1988 detailed studies of larval populations were done by using a pump to artificially flood small dry wetlands. The target of

those studies was *Ae. vexans*, but data were also collected on *Culex* species. Four sites were flooded, and sampled by taking 40 dips in a stratified random design daily through the completion of *Ae. vexans* adult emergence. Results showed several items of interest regarding *Culex*:

- All of the flooded sites had at least 1 larva of *Cx. tarsalis*, *Cx. restuans*, and *Cx. pipiens*. The lack of alternative oviposition sites that year and the intense level of surveillance probably increased chances of finding larvae.
- *Culex tarsalis*, *Cx. restuans*, and *Cx. pipiens* larvae appeared in the sites when *Ae. vexans* larvae were pupating, about 5-8 days after flooding (depending on water temperature).
- *Culex tarsalis* was found at rates of 1-2 or more per dip in the two grassy, open pasture sites in late June and late July. A shaded, grassy site had counts of under 1/dip in late August. The wooded site with little grass had only 1 larva found (mid-July).
- *Culex restuans* was found in all the sites, usually at low numbers (0.25/dip), but up to 5/dip in the shady, grassy site late in the year, with numbers still increasing at 17 days (8/31) after initial flooding.
- *Culex pipiens* was found at rates of 0.5/dip in late June in an open pasture site. Only 1 larva was found in the wooded site with little grass. The grassy pasture flooded in late July had numbers over 1/dip, and the shaded grassy site flooded in mid August had 0.5/dip, increasing to 3/dip at 17 days after flooding.
- District operational dips in 1988 recorded about 3% of samples with *Cx. tarsalis*. *Cx. tarsalis* adults were first captured in light traps in mid-May, with counts increasing substantially in early July, again at the end of July, and peaking the week of August 20.

Other Literature on *Culex* Larvae Research on *Cx. tarsalis* larval sampling at SD State University (Mike Hildreth, in "Farm & Home Research, SDSU Ag. Expt. Stn., Brookings, SD, http://agbiopubs.sdstate.edu/articles/FHR55-3.pdf) suggested this species prefers fresh water that has been standing about 1 week, and that is in sunlight. Large artificial containers in the sun were used by *Cx. tarsalis* larvae in August. Weekly samples of 10 dips from 35 natural wetlands did not detect any larvae.

District-Wide Sampling for *Culex*: "Dip Days" On June 18 and July 21, 2004, all field staff spent the day checking wetlands specifically for *Culex* larvae. Target areas were sections containing a CO_2 or gravid trap; this gave a variety of areas sampled. Instructions were to dip all wetlands encountered, including natural sites, constructed ponds, ditches, and other storm water management structures. June 18 was 5 days after a small rain (.75 inch) and 10 days after a major rain (1.55 inches). July 21 was about 10 days after a rain event of about 1.2 inches.

About 3,000 sites were inspected on each of these days. Results are given in Table 1.3 for *Cx. tarsalis* and *Cx. restuans*. No other *Culex* were collected. About two percent of the sites that were wet had *Cx. tarsalis* and three to eight percent had *Cx. restuans.*

Collections were compared with site types (an indicator of water depth and vegetation, based on Circular 39 of the U.S. Dept. of the Interior, USFWS). There was a statistically detectable relationship between site types and presence of *Cx. restuans*, but there was none for *Cx. tarsalis* (includes dry sites).

Table 1.3 Results of "Dip Day" checks of wetland sites for *Culex* larvae. Results given for each date and for those sites checked on both dates.

	18-Jun-05		21-Jul-05		Both dates	
Total sites checked	3196		2741		1402	
Number, % wet	2617	81.9%	2081	75.9%	990	70.6%
Number with *Cx. tarsalis*, % (of wet)	61	2.3%	45	2.2%	5	0.5%
Number with *Cx. restuans*, % (of wet)	213	8.1%	73	3.5%	13	1.3%

Repeated Monitoring: *Culex* "Pet Sites" A subset of 86 sites having *Culex* was picked from "Dip Day" results and sampled every 1-2 weeks for the rest of the summer (or until dry) to see if *Culex* could be found again and in what habitats. Of 55 sites with *Cx. tarsalis* in June, 17 had them again later, and of 62 sites with *Cx. restuans*, 28 had them in later samples.

Wetland site type (above) was not a good predictor of species occurrence in these sites. Vegetation in the actual sampling habitat was a better predictor. A chi-square analysis of presence/absence of species vs. vegetation (791 observations, including some repeated visits) showed *Cx. tarsalis* larvae were found more often (than expected by chance) in flooded upland grass, and were also positively associated with Reed canary grass and sedge. *Culex restuans* was most strongly associated with sedge, but also with grasses. *Culex territans*, not considered a WNV vector, was positively associated with broadleaf aquatics, sedges, cattail and lemna, and was negatively associated with flooded upland grass. This information could help field staff in searching for these vector larvae and avoiding *Cx. territans*. However, both *Cx. tarsalis* and *Cx. restuans* may be rare enough that random variation is a large factor in where larvae are found.

Conclusions There was no clear indicator to help target larval site inspections for *Culex* vector spp. *Culex tarsalis* habitat appears to overlap with *Ae. vexans*, but larvae may occur 1 week or more later. *Culex restuans* uses a wide variety of habitats, and may have overlap with floodwater spp. All of these vector larvae tend to be present in low numbers and may be hard to find.

Larval Mosquito Surveillance – Catch Basins

Catch Basin Larval Habitats MMCD started catch basin larval control in 2003, with extensive efforts to identify and map catch basins that might provide larval habitat. Most treatments were 30-day methoprene pellets applied in 3 rounds, with successive increases in the number of catch basins treated in each round in 2003. At the start of the 2004 season, District staff had slated 57,000 catch basins to receive treatments. The primary criterion for assuming a catch basin could provide larval habitat and thus should be treated was its capacity to hold water. Several questions arose regarding the accuracy of the initial inspections and mapping of catch basins and whether most water-holding catch basins would actually produce mosquitoes:

1. How many catch basins mapped as dry are dry?

2. How many catch basins mapped as wet are wet?
3. Of the wet catch basins, how many have mosquito larvae at any one time?
4. In the catch basins with larvae, what is the progression of species over the season?

We carried out plans for two separate, concurrent projects to re-inspect and sample catch basins each day that catch basin work occurs (answers Q 1, 2, 3) and to sample selected catch basins each week for the entire summer (answers Q 3, 4).

Catch Basin Mapping Re-inspection The original goals of the re-inspections of catch basins were to evaluate the accuracy of the initial wet/dry determinations and to provide a method for random sampling of catch basin mosquito larvae. At the start of a day's catch basin related work, staff were instructed to re-inspect the first catch basin that was identified as wet on their maps and the first catch basin that was identified as dry. Inspections for larvae were to occur at the first catch basin encountered that actually contained water. The actual amount of larval sampling that occurred was limited by equipment shortages, but still contributed the majority of the 1,421 catch basin larval inspections performed by the District in 2004.

The re-inspections to evaluate wet/dry status indicated the District would benefit by re-inspecting and remapping some areas. Overall, 17 percent of re-inspected catch basins originally mapped as dry were wet in 2004, and 22 percent of re-inspected catch basins mapped as wet were dry. However, this includes some catch basin sumps capable of holding water but filled with sediment at re-inspection. The District will continue to consider sediment-filled sumps as requiring treatments, as sediment may wash out or be cleaned out during routine maintenance.

Repeat Sampling of Selected Catch Basins The catch basins selected for repetitive sampling were sites that had a high probability of holding water all season, regardless of rainfall amounts. Crews were requested to inspect and sample these sites once each week or as frequently as possible if not every week.

- 42 sites were visited at least five times from June 20 through October 17.
- 37 of the sites contained mosquito larvae at least once.
- 34 of the sites contained larvae at least two times.
- 24 of the sites contained larvae at least four times during the season.

Staff collected 155 larval samples from these catch basins. *Culex restuans* was the predominant species found (Table 1.4, Figure 1.3). Surprisingly, *Cx. tarsalis* were found in some catch basin samples. The very low occurrence of *Cx. pipiens* may have been related to low temperatures and low populations of this species overall.

Table 1.4 Species occurrences in catch basin larval samples, 2004.

Species Present	Number of Samples
Cx. restuans	131
Cx. territans	12
Cx. tarsalis	3
Cx. pipiens	1
Cx. spp (1st instar)	26
Ae./Oc.	15
Total samples	155

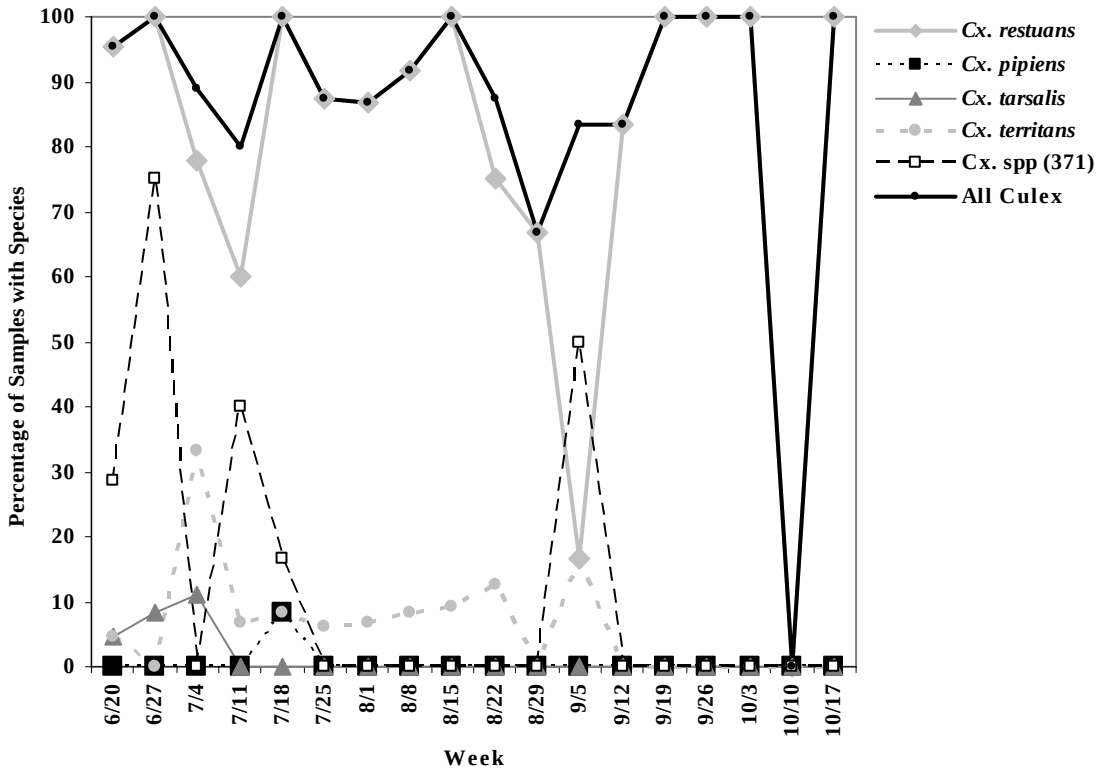


Figure 1.3 *Culex* larvae found in catch basins that were sampled repeatedly through the 2004 season by week collected. All *Culex* refers to the samples that contained one or more *Culex* species.

In total, the repeat sampling project resulted in 354 catch basin inspections. Larvae were found 171 times (48.3%). All other catch basin sampling provided similar results; of 1067 inspections of wet catch basins, 531 catch basins contained larvae (49.8%). Weekly comparisons of the two inspection types are found in Figure 1.4.

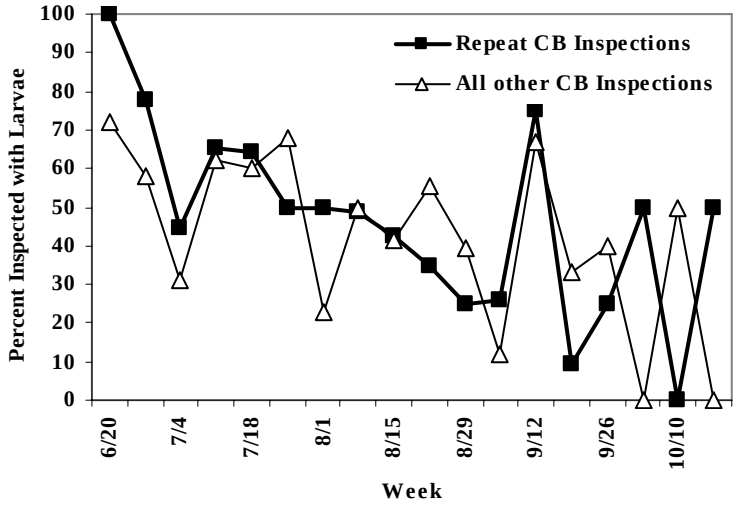


Figure 1.4 Percentage of repeat sampling project catch basins that contained larvae upon inspection, compared with the percentage of all other catch basin inspections where larvae were found, plotted by week.

Adult Mosquito Surveillance Research

CO_2 trap site descriptions Site description data for each of MMCD's 105 CO_2 trap locations was collected and analyzed to explore the following:

1. Are any descriptors associated with a higher chance of collecting a particular species of mosquito? (Increase sensitivity of detection)
2. Are any descriptors associated with capturing a larger number of a mosquito species of concern? (Increase sample for virus testing)

Answers to both questions should help us better understand surveillance data and how to optimize surveillance for species of concern.

Initial analysis used log-linear statistics to search for associations between categorical descriptors and the probability of capturing a species of concern in trap four to six feet off the ground (Table 1.5). Four species (*Ae. vexans, Cq. perturbans, Cx. tarsalis* and *Cx. restuans*) were included.

Table 1.5 Initial results of log-linear analyses CO_2 trap site descriptors

Site Descriptor	Mosquito Species			
	Culex tarsalis	***Culex restuans***	***Aedes vexans***	***Cq. perturbans***
Housing type: urban, suburban, or rural	No association	Highest chance of capturing in urban areas and lowest chance in rural areas	No association	Lowest chance of capturing in urban areas; higher but similar chance in suburban and rural areas
Topography: Hilltop, flat, or low area	No association	Highest chance of capturing in low areas (depressions) and lowest chance on hilltops	Highest chance of capturing in low areas (depressions) and lowest chance on hilltops	No association
Tree Canopy present	Lowest chance of capturing when tree canopy is present	Highest chance of capturing when tree canopy is present	No association	No association
Tree Line Present	No association	No association	No association	No association
Woodlot present	Lowest chance of capturing when a woodlot is present	Highest chance of capturing *s* when a woodlot is present	Highest chance of capturing when a woodlot is present	No association
Garden present	No association	Lowest chance of capturing when a garden is present	Lowest chance of capturing when a garden is present	No association
Ag. crop present	Highest chance of capturing when ag. crop is present	No association	No association	Lowest chance of capturing when ag. crop is present

High-Low Trap Surveillance Twelve pairs of CO_2 traps were positioned at various locations throughout the District. Low traps were hung 4-6 feet above the ground and high traps were hung 15-20 feet above the ground. The number of mosquitoes caught on different dates differed significantly for all four species (*Ae. vexans*, *Cq. perturbans*, *Cx. tarsalis* and *Cx. restuans*) (Table 1.6, Figure 1.6).

Table 1.6 Results of ANOVA comparisons of high and low CO_2 traps (all data log10(n+1) transformed; $p \leq 0.05$ considered significant).

Species	High/Low Comparison	Interaction with Collection Date
Ae. vexans	$p<10^{-6}$; Low traps caught more	$p<10^{-6}$; Low traps caught more than high traps. On some dates low traps caught slightly more than high traps. On other dates low traps caught many times more than high traps
Cq. perturbans	$p=1.4x10^{-4}$; Low traps caught more	p=0.8694; no effect of collection date upon relative amount captured by high and low traps
Cx. tarsalis	p=0.0201; Low and high traps caught different amounts. Which height caught more depended upon the collection date.	p=0.0191; Low traps caught more on 22 June and 11 August; high traps caught more between 12 July and 2 August.
Cx. restuans	p=0.0004; High traps caught more	p=0.3075; no effect of collection date upon relative amount captured by high and low traps

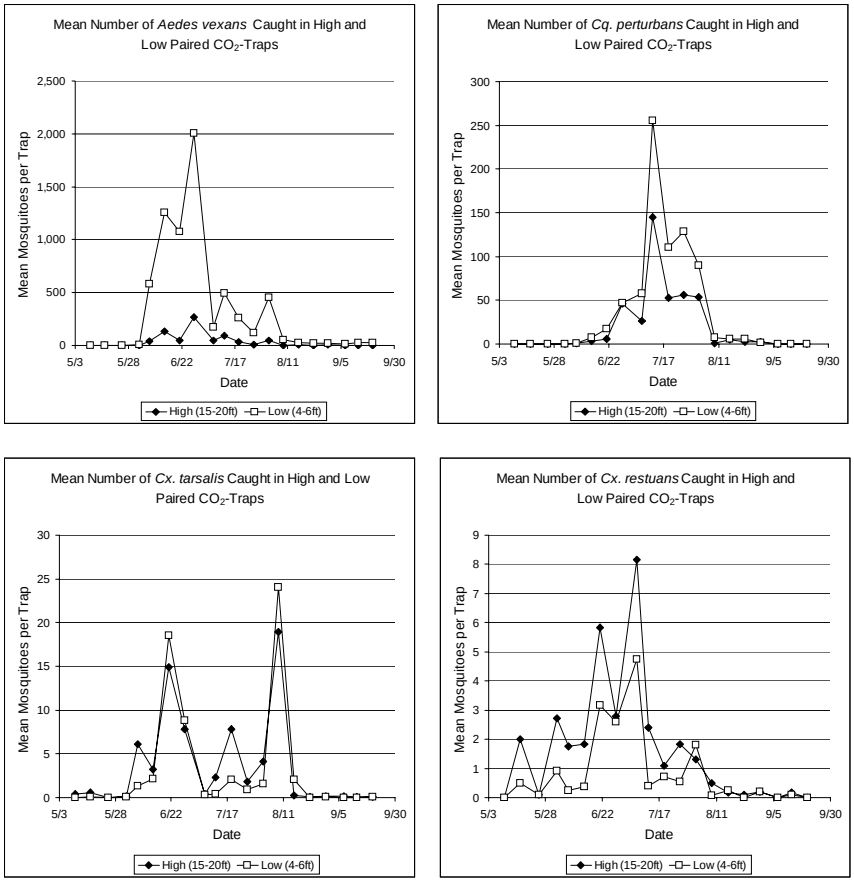


Figure 1.6 Mean number of mosquitoes captured in high (15-20 feet) and low (4-6 feet) paired CO_2 trap

These results showed similar patterns to what was found in MMCD studies and studies by Moon and Bender (personal communication) in 2003, but more statistically significant differences were found. A large proportion of *Cx. tarsalis* and *Cx. restuans* appear to be actively host-seeking at high elevations in tree canopy. This is consistent with general reports that these species use birds as a major host.

High-Low Time Study As requested by TAB members in the February 2004 meeting, District staff developed a study to examine if mosquitoes were active at different elevations in the tree canopy at different times of night.

For this study, a set of samples for a location and date consisted of trap captures from 3 heights: "high" (25-35ft), "medium" (15-20ft) and "low" (4-6ft), each split into 7 subperiods within a 24-hr period.

The subperiods were categorized as follows:

- 1 5 PM to the beginning of dusk
- 2 Dusk
- 3 End of twilight to midnight
- 4 Midnight to first light
- 5 Dawn
- 6 Sunrise to 12 noon
- 7 12 noon to 5 PM

Sets of samples were collected at 10 locations; 6 were sampled once, and the other 4 were sampled 2 to 4 times from mid-July through the end of August, resulting in 19 trap-nights of data.

All collections were expressed as mosquitoes per hour to compare collection rates during subperiods with different durations. *Aedes vexans, Cq. perturbans, Cx. tarsalis* and *Cx. restuans* were collected in sufficient numbers for analysis. Numbers were log10(n+1) transformed for analysis of variance.

Low traps captured the most *Ae. vexans* and *Cq. perturbans*. High traps caught the most *Cx. restuans*. *Culex tarsalis* collection rates at different heights did not differ (Table 1.7, Figure 1.7).

Activity as measured by capture rates for all four species was highest somewhere between dusk and midnight (Table 1.7, Figure 1.8). Rates for *Ae. vexans, Cq. perturbans* and *Cx. restuans* were highest during subperiod 2 and next highest during subperiod 3. Capture rates for *Ae. vexans* and *Cq. perturbans* dropped during subperiod 4. *Culex restuans* rates were similar during subperiods 3 and 4 but dropped thereafter.

Peak activity as measured by capture rate of *Cx. tarsalis* was slightly later than the other three species, highest during subperiod 3 and next highest during subperiod 2. All four species were much less active between dawn and dusk (Figure 1.8). Temporal activity patterns of *Cx. tarsalis*

and *Cq. perturbans* were similar at all three trap heights (lack of significant interaction, Table 1.7).

Culex restuans was most active somewhere between dusk and dawn (subperiods 2, 3 and 4) at all trap heights with the greatest peak activity occurring during subperiod 2 in high traps (Table 1.7, Figure 1.9). Differences of activity during different subperiods were much lower for medium and low traps (Figure 1.9). Observed activity of *Ae. vexans* during different subperiods differed the most in low traps. Capture rates in medium and high traps during different subperiods were much lower and much more similar (Table 1.7, Figure 1.10).

Table 1.7 Results of ANOVA comparisons of high, medium and low CO_2 traps (all data log10(n+1) transformed; $p \leq 0.05$ considered significant).

Species	High/Medium/Low Comparison	Time Subperiod Comparison	Interaction
Ae. vexans	$p<10^{-6}$; Highest capture rate for low traps	$p<10^{-6}$; Highest capture rate during subperiod 2, next highest subperiod 3	$p<10^{-6}$; capture rates during different subperiods differed the most in low traps
Cq. perturbans	p=0.0448; Highest capture rate for low traps	$p<10^{-6}$; Highest capture rate during subperiod 2, next highest subperiod 3	p=0.5832; No interaction
Cx. tarsalis	p=0.6776; No difference	$p<10^{-6}$; Highest capture rate during subperiod 3, next highest subperiod 2	p=0.9352; No interaction
Cx. restuans	p=0.0069; Highest capture rate for high traps	$P=1.5x10^{-6}$; Highest capture rate during subperiod 2, next highest subperiods 3 and 4	p=0.0439; capture rates during different subperiods differed the most in high traps

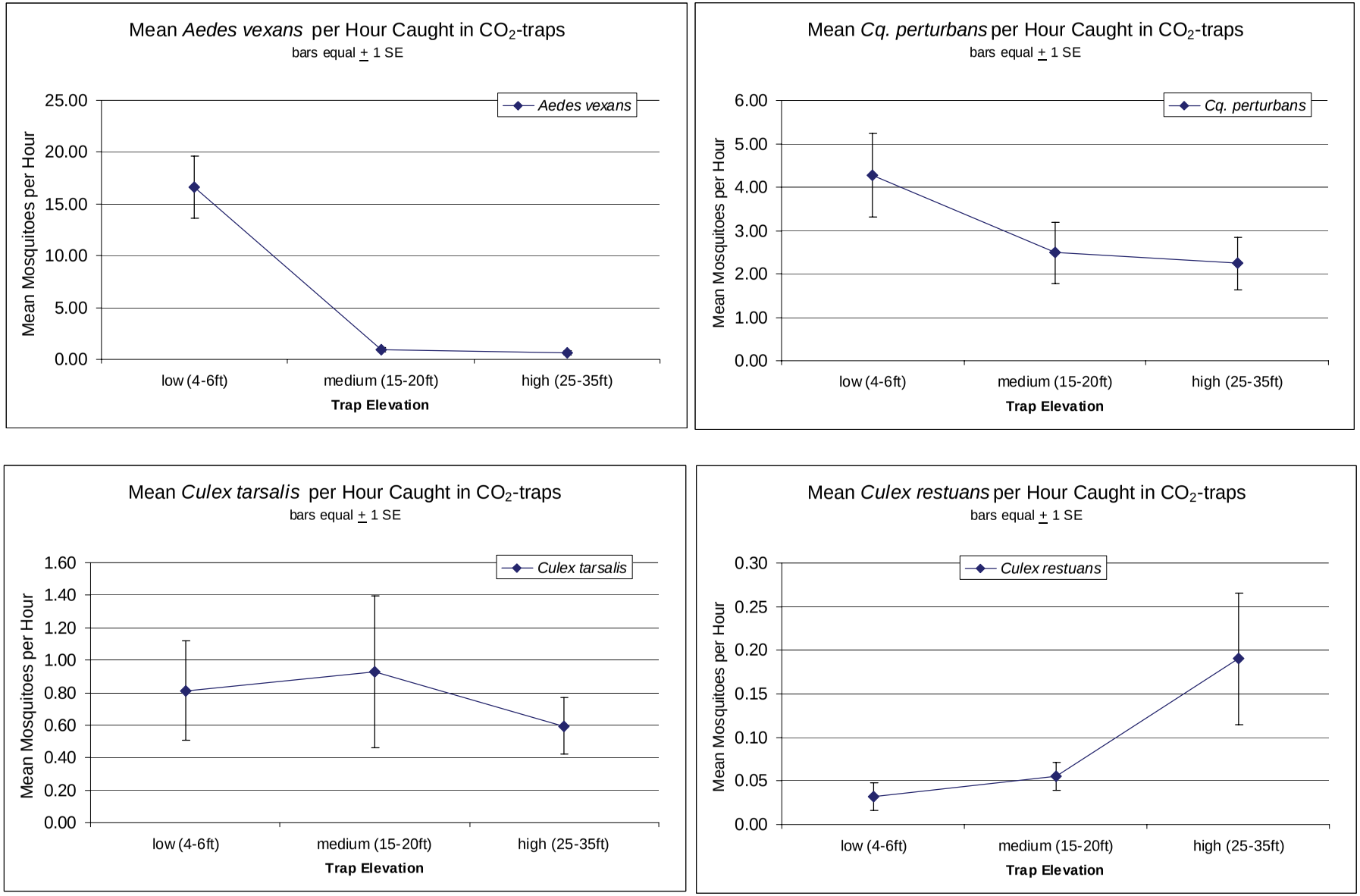


Figure 1.7 Mean number of mosquitoes per hour captured by low (4-6ft), medium (15-20ft) and high (25-35ft) CO_2 traps (all time periods pooled).

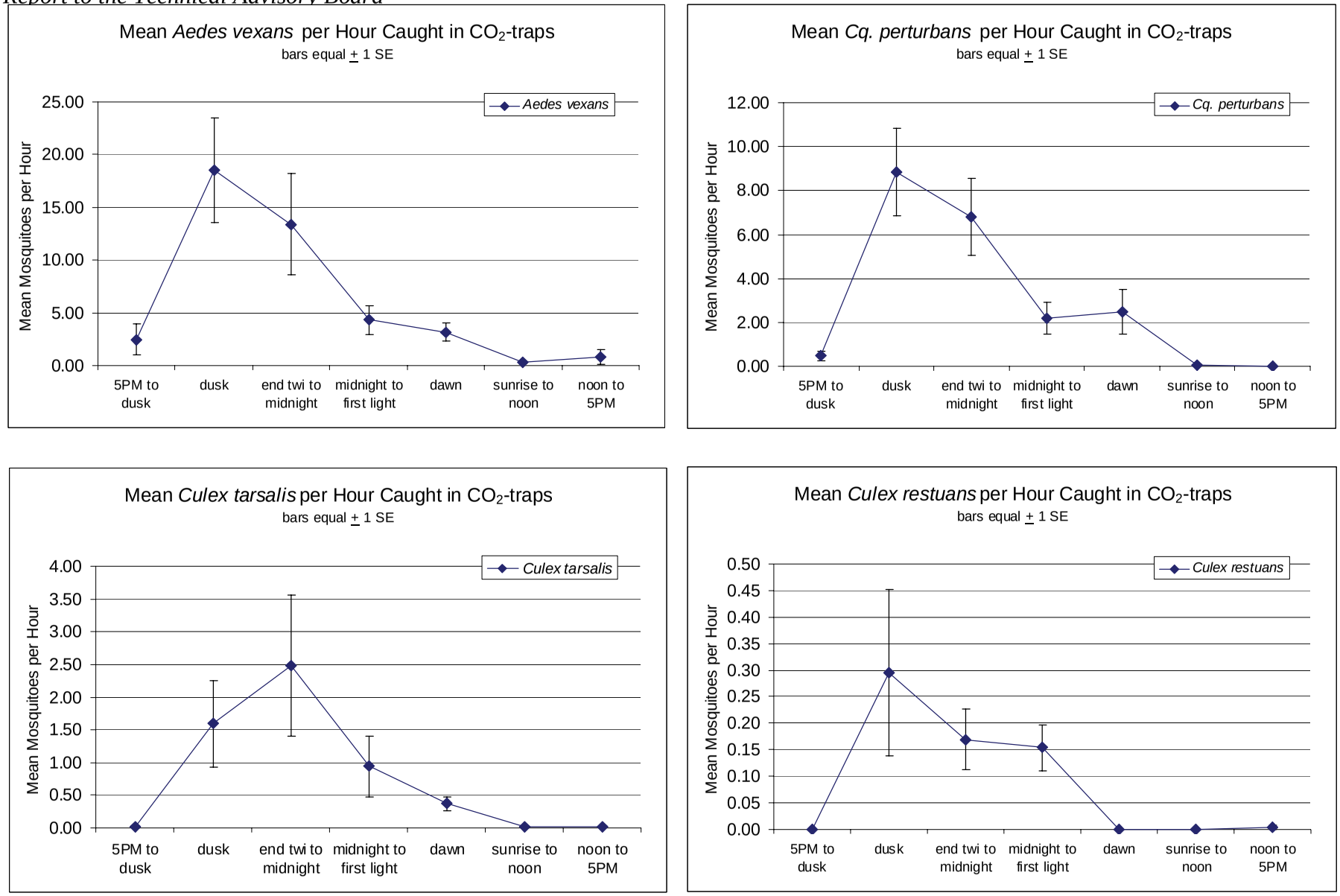


Figure 1.8 Mean number of mosquitoes per hour captured by CO_2 traps during time periods one through seven (all trap heights pooled).

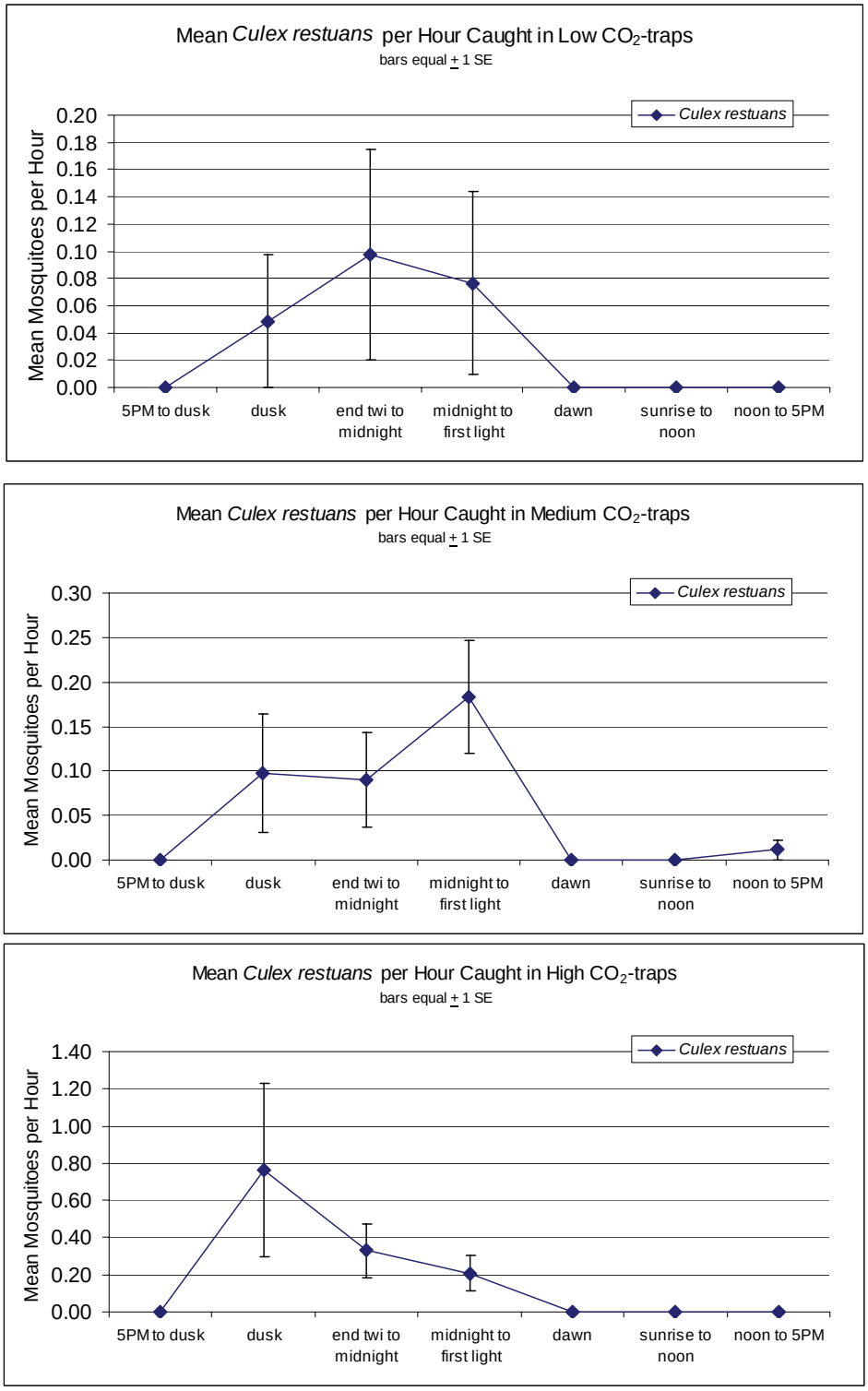
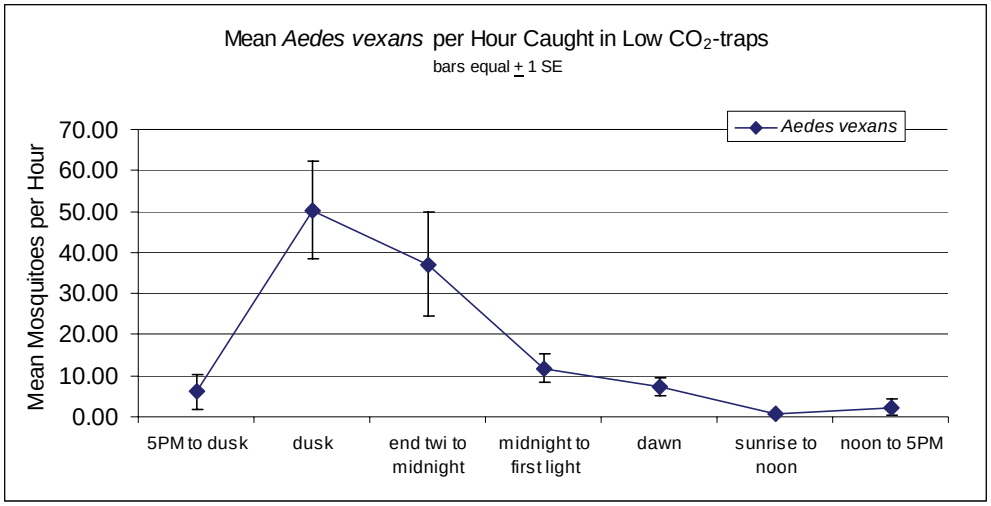
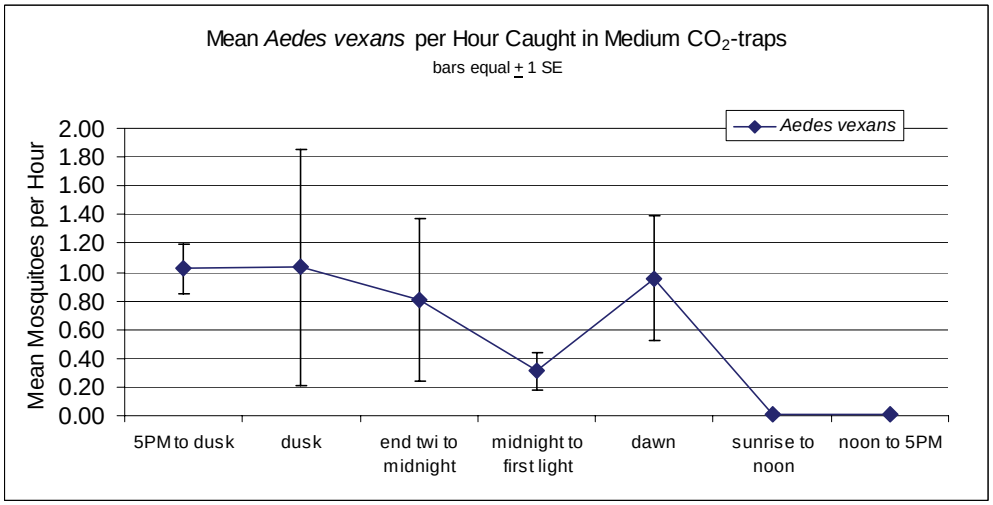


Figure 1.9 Mean number of *Culex restuans* per hour captured by CO2 traps during time periods one through seven (each trap height separately).





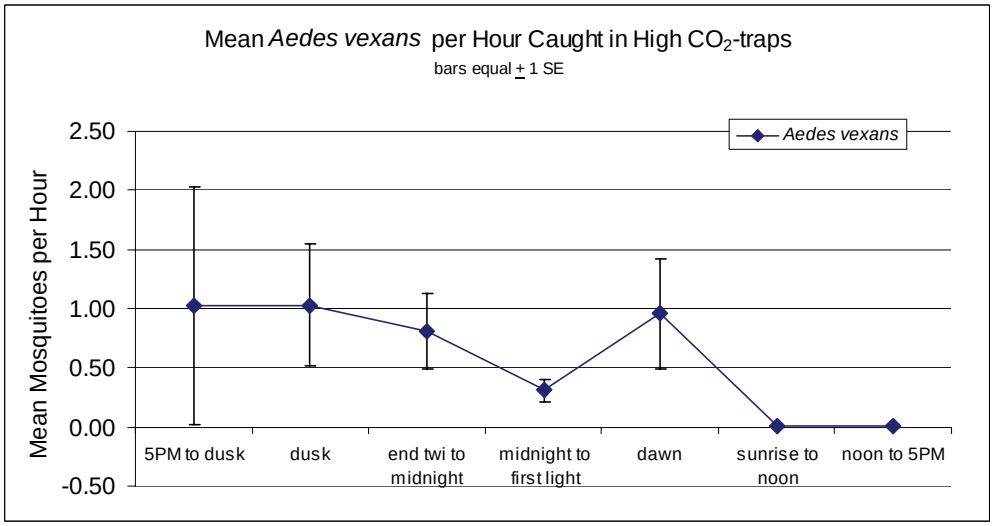


Figure 1.10 Mean number of *Aedes vexans* per hour captured by CO2 traps during time periods one through seven (each trap height separately).

Operational Implications

- Larval treatment thresholds were adjusted at the end of 2003 to include *Culex* larva (see Chap. 3, Control).
- Staff have been encouraged to dip for *Culex* larvae about a week after rainfall. Dips targeting *Culex* are noted as such in databases.
- Adult treatment thresholds have also been adjusted in 2004 to create a lower threshold for the four *Culex* species suspected as primary WNV vectors (see Chap. 3, Control).
- CO_2 trap placements are being evaluated for their contribution to *Culex* surveillance.

Finding *Cx. tarsalis* larval habitat continues to present a challenge. Work will continue on reviewing existing data, and designing studies to help field staff find these larvae efficiently.

The presence of *Culex* adults at high elevations in tree canopy (15-30 ft) poses questions for surveillance and treatments. Adulticide testing in 2005 is planned to examine these effects.

Efficacy of larvicide and adulticide products on *Culex* species is discussed in Chapter 5. Several products may be useful in providing timed-release or long-term effects, allowing floodwater mosquito control treatments to also control *Culex* (see discussion in Chapter 3, 2005 plans). Some possibilities are available for catch basin treatments that might reduce labor investments.

Plans for 2005–Mosquito-borne Disease

We will continue to develop and implement a model for assisting the direction of WNV responses within the District. The model will incorporate factors such as mosquito densities, dead bird reports, hospital and veterinary reports of WNV cases, and other WNV test results.

District staff will continue to provide mosquito surveillance and control services for the prevention of La Crosse encephalitis. Preventive measures include adult sampling, adult control, property inspections, and breeding source reduction.

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

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

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

District staff will continue to monitor *Cs. melanura* in the District, with attention focused on areas in Anoka and Washington counties where the species has been encountered in the past. MMCD staff will remain watchful for the introduction of exotic mosquito species, especially *Ae. albopictus* and *Oc. japonicus.*

2004 Tick-borne Disease Services

Ixodes scapularis Distribution

The District continued to sample the network of 100 sites set up in 1991-1992 to monitor potential changes in tick distribution over time. As in previous years, the primary sampling method involved capturing small mammals from each site and removing any attached ticks from them. Collections from the northeastern metropolitan area (primarily Anoka and Washington counties) have consistently detected *I. scapularis*, and in 1998 *I. scapularis* was detected in Hennepin and Scott counties for the first time using this study methodology. The 2004 report is expected to be available on our website (www.mmcd.org) in June, and we report here the latest data compilations available, which is from the year previous.

The 2003 results were mixed as far as the interpretation of *I. scapularis* population levels. An elevated *I. scapularis* population level first became readily apparent in 2000 and continued through 2002. Evidence for a continued high *I. scapularis* level in 2003 included a high total nymph count (in the hundreds for only the third time since 1990), the collection of *I. scapularis* for the first time at several unexpected sites, and again the tabulation a higher than typical number of positive sites (e.g. sites where at least one *I. scapularis* was collected) south of the Mississippi River. However, the overall season mean of .389 *I. scapularis* per mammal was a decrease from our elevated 2000 – 2002 averages (all $\geq$ .806) and we tabulated fewer positive sites in 2003 compared with 2000 – 2002 (39 versus $\geq$ 49). Additionally, the positive sites located south of the Mississippi River were confined to a more restricted geographic area (Dakota County only) than had been noted in recent years. Our conclusion for 2003 is that tick abundance appears to have decreased slightly compared to levels observed in 2000 – 2002, at least in the 2003 larval co-hort (Table 1.8).

In 2003 the Minnesota Department of Health (MDH) also tabulated a decrease in tick-borne disease case numbers. Their 2003 human case totals decreased to 473 Lyme and 78 human anaplasmosis—formerly known as human granulocytic ehrlichiosis or HGE—cases compared with the highest recorded totals in their databases from 2002 (Lyme 867 and human anaplasmosis 152), but 2003 results are similar to their previous all-time high case totals of 2000 and 2001. Preliminary 2004 human disease case data indicate that the 2004 case tabulations have rebounded and will become the new highest recorded totals in their databases.

Cooperative Research Study with the University of Minnesota

Dr. Russell Johnson (University of Minnesota – Minneapolis)

A cooperative study regarding the distribution and prevalence of *Borrelia burgdorferi*, the causal agent of Lyme disease, and *Anaplasma phagocytophilum*, the human anaplasmosis agent, was undertaken in 2004. Because high numbers of human tick-borne disease cases have been reported by the MDH and the District has observed an elevated *I. scapularis* population in our *I. scapularis* distribution studies in recent years, we wanted to re-examine several sites to determine if a seemingly elevated *I. scapularis* population level would lead to detecting a higher small mammal tick-borne disease infection rate at either location. *Ixodes scapularis* data is also being compared. Research consisted of weekly re-sampling at one site in North Oaks (Ramsey

County, a high prevalence area) and one site in Elm Creek Park Reserve (Hennepin County, a low prevalence area) from May through October. Results are not yet available, but we intend to publish our entire 1992-2004 research at a later date.

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services, including tick identifications and homeowner consultations, were maintained in 2004 using previously described methods and tools. Additionally, we expanded our outreach by setting up an information booth at several county park events.

Table 1.8 Numbers and percentages of tick species collected by stage and year

Year	No. sites	Total ticks collected	*Dermacentor variabilis* Percent larvae (n)	*Dermacentor variabilis* Percent nymphs (n)	*Ixodes scapularis* Percent larvae (n)	*Ixodes scapularis* Percent nymphs (n)	Other species[b] percent (n)
1990[a]	250	9957	83 (8289)	10 (994)	6 (573)	1 (74)	0% (27)
1991	270	8452	81 (6807)	13 (1094)	5 (441)	1 (73)	0% (37)
1992	200	4130	79 (3259)	17 (703)	3 (114)	1 (34)	0% (20)
1993	100	1785	64 (1136)	12 (221)	22 (388)	1 (21)	1% (19)
1994	100	1514	53 (797)	11 (163)	31 (476)	4 (67)	1% (11)
1995	100	1196	54 (650)	19 (232)	22 (258)	4 (48)	1% (8)
1996	100	724	64 (466)	20 (146)	11 (82)	3 (20)	1% (10)
1997	100	693	73 (506)	10 (66)	14 (96)	3 (22)	0% (3)
1998	100	1389	56 (779)	7 100)	32 (439)	5 (67)	0% (4)
1999	100	1594	51 (820)	8 128)	36 (570)	4 (64)	1% (12)
2000	100	2207	47 (1030)	10 (228)	31 (688)	12 (257)	0% (4)
2001	100	1957	54 (1054)	8 (159)	36 (697)	2 (44)	0% (3)
2002	100	2185	36 (797)	13 (280)	42 (922)	8 (177)	0% (9)
2003	100	1293	52 (676)	11 (139)	26 (337)	11 (140)	0% (1)

[a] 1990 data excludes one *Tamias striatus* with 102 *I. scapularis* larvae and 31 nymphs
[b] other species mostly *Ixodes muris.* 1999—second adult *I. muris* collected

2005 Plans for Tick-borne Services

Metro Surveillance

The metro-based *I. scapularis* distribution study that began in 1990 is planned to continue unchanged while the collaborative University of Minnesota/Metropolitan Mosquito Control District collaborative research study is not scheduled for continuation in 2005.

Tick Identification Services/Outreach

We plan to maintain our tick-borne disease education activities and services, including tick identifications and homeowner consultations, using previously described methods and tools. Since human tick-borne disease case totals have continued to be elevated, we also plan to follow our expansion efforts of 2004 by continuing to set up information booths at several park events. As in past years, we will continue to offer an encompassing slide presentation and stock local parks and other appropriate locations with tick identification cards and brochure.

Chapter 2 Mosquito Surveillance

2004 Highlights

- Above average rainfall in May and June followed by very low rainfall after July
- Rainstorms produced 9 broods of mosquitoes
- Staff identified 21,727 larval samples
- Summer Ae/Oc & *Cq. perturbans* most predominant species captured in sweeps and CO_2 traps
- 25 CO_2 traps added
- Highest numbers of *Cx. tarsalis* seen in years with two population peaks evident

2005 Plans

- Continue surveillance strategies as in 2004 but increase number of CO_2 traps
- Experiment with different trapping methods for *Cx. tarsalis* mosquitoes

2004 Mosquito Surveillance Results

Rainfall

Average rainfall per gauge in the District from May 1 through September 30, 2004 was 21.65 inches (Table 2.1). This is 5 inches more than last year and almost two inches above the 46-year District average. The southern counties of Carver and Scott received the most rain.

Typically a rain event ≥ 1 inch can produce a brood of floodwater mosquitoes. We experienced nine District-wide broods in 2004 (Figure 2.1). Rain events of 2-3 inches the last two weeks in May and the beginning of June produced multiple large broods of mosquitoes. The middle of the season was dry, with only 2 broods during July. There were two broods late in season.

Larval Collections

In 2004, staff identified 21,727 larval collections. To accelerate the identification of samples from sites to be treated by helicopter, *Culex* larvae were identified to species, but all other larvae were identified to genus only. Lower priority samples were identified to species. Table 2.2 shows the results of the 11,843 samples that were identified to species.

The most abundant species District-wide were *Aedes vexans* and the insidious ankle-biter, *Aedes cinereus*. *Culex restuans* had the third highest frequency of occurrence and the typically non-human biting species, *Culiseta inornata* and *Culex territans* ranked 4th and 5th overall. The spring species, *Ochlerotatus stimulans* and *Ochlerotatus excrucians* ranked 6th and 7th. *Culex tarsalis* larvae were found in 2.3% of the samples, ranking 9th. The high amount of *Ae./Oc. species* is normal and represents 1st instar larvae that are unidentifiable to species.

Table 2.1 Average rainfall received in each county from May through September, 2000-2004 and 46-year District average.

	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
2000	13.81	15.69	21.38	17.33	20.19	16.63	20.90	17.79
2001	17.40	15.38	16.23	18.98	18.94	15.01	17.78	17.73
2002	26.93	29.96	30.03	30.23	29.28	28.53	28.36	29.13
2003	17.30	14.15	14.72	17.59	18.07	13.34	18.00	16.79
2004	20.26	25.22	21.89	22.18	20.73	23.50	20.62	21.65
46-Year Avg	18.99	*20.51	19.82	19.71	19.95	19.38	20.19	19.53

*22-year average

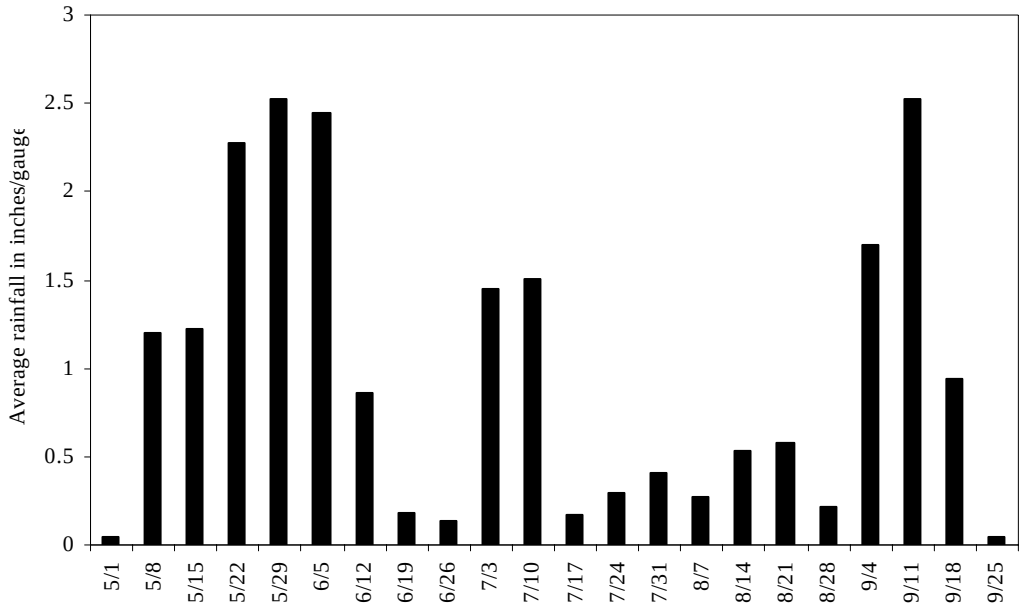


Figure 2.1 Average rainfall per gauge per week, 2004

Table 2.2 Frequency of occurrence (%) of larval species in standard dipper collections by county and District total, 2004.The total number of samples processed to species is in parentheses.

	Percent frequency of occurrence by facility						
Species	North (992)	South Jordan (1,549)	South Rosemount (1,856)	West Maple Grove (2,236)	West Plymouth (2,649)	East (2,561)	District (11,843)
Ochlerotatus abserratus	0.3	0.3	0.4	0.1	0.5	0.8	0.4
aurifer	0.2					0.1	0.04
canadensis	0.2	1.4	2.5	0.9	1.1	1.1	1.3
Aedes cinereus	19.8	19.7	12.4	17.3	16.5	17.2	16.8
Oc. communis					0.04	0.04	0.02
dianteus						0.04	0.01
dorsalis	0.3	0.7	0.3	1.7	0.7	0.7	0.8
excrucians	1.6	5.3	9.2	4.5	3.5	11.3	6.4
fitchii	0.7	1.5	4.5	1.8	0.5	3.6	2.2
flavescens					0.04		0.01
implicatus			0.05	0.1	0.1	0.5	0.2
intrudens			0.05				0.01
punctor	0.2	0.3	0.3	0.3	0.3	0.7	0.4
riparius		0.3		0.5	0.5	0.2	0.3
sticticus	2.9	0.7	1.3	1.5	1.8	2.1	1.7
stimulans	4.5	6.4	10.8	9.0	9.1	17.1	10.3
provocans		0.1	0.3	0.2	0.04	0.7	0.3
trivittatus	5.9	4.2	6.3	4.7	6.8	3.6	5.2
Ae. vexans	62.0	42.4	41.3	50.9	50.9	39.0	46.6
Ae./Oc. species	45.9	34.2	33.6	38.4	33.7	30.0	34.9
Anopheles earlei	0.1	0.1	0.05			0.04	0.04
punctipennis		0.1	0.2			0.1	0.06
quadrimaculatus						0.1	0.02
walkeri					0.04		0.01
An. species		1.3	1.7	0.6	0.6	1.8	1.1
Culex pipiens	0.1		2.7	0.3		0.1	0.1
restuans	11.2	12.1	12.3	13.1	13.5	12.4	12.6
salinarius		0.1	0.05	0.04			0.03
tarsalis	2.2	3.2	2.1	2.2	2.2	2.0	2.3
territans	7.6	14.2	11.4	7.8	6.9	18.9	11.4
Cx. species	2.6	3.6	4.5	3.1	2.9	1.8	3.0
Culiseta inornata	9.0	12.1	17.0	9.7	12.6	9.5	11.7
melanura						0.04	0.01
minnesotae	0.3	0.2		0.1	0.2	0.3	0.2
morsitans					0.04		0.01
Cs. species	1.3	1.3	0.2	0.4	0.4	0.9	0.7
Psorophora ferox			0.01		0.2	0.04	0.06
Ps. species	0.1	0.1	0.2	0.04	0.2	0.2	0.2
Uranotaenia sapphirina	0.3	0.5	0.5	0.1	0.2	1.2	0.5

Adult Collections

Sweep Net Collections Sweep net collections are used to monitor human annoyance during the peak mosquito activity period, which is 35-40 minutes after sunset for most mosquito species. Employees took two-minute collections in their yards once per week for 20 weeks. The number of collectors varied from 87-178 per evening. Summer species of *Aedes/Ochlerotatus* and *Coquillettidia perturbans* were predominant in the evening sweep net collections (Table 2.3).

Table 2.3 Average numbers of mosquitoes collected per evening sweep net collection within the District, 2000-2004.

Year	Summer *Ae./Oc.*	*Cq. perturbans*	Spring *Ae./Oc.*	*Cx. tarsalis*
2000	2.4	0.5	0.01	0.01
2001	2.6	0.3	0.1	0.02
2002	4.2	0.5	0.1	0.01
2003	4.7	0.8	0.2	0.01
2004	3.4	0.3	0.02	0.01

CO_2 Trap Collections CO_2 traps baited with dry ice are used to monitor mosquito population levels and to monitor the presence of disease vector species. Employees set traps in their yards on the same night as the sweep net collections are taken, once per week for 20 weeks. The number of traps operated varied from 82-107. As in the case of sweep netting, summer *Ae./Oc.* and *Cq. perturbans* were the predominant species captured in the traps, and were the highest in the past 5 years (Table 2.4). *Coquillettidia perturbans* and spring *Ae./Oc.* populations decreased due to the lack of rain in 2003 and little spring snow melt in 2004. The increase in the levels of *Cx. tarsalis* could be attributed to the areas we targeted for sampling. There were more traps set in the tree canopy in 2004 than other years (see Chapter 1, WNV Research) and additional traps were placed in communities with histories of high *Cx. tarsalis* collections. More *Cx. tarsalis* than usual were caught in areas that typically have low populations.

Table 2.4 Average number of mosquitoes collected in CO_2 traps within the District, 2000-2004**.**

Year	Summer *Ae./Oc.*	*Cq. perturbans*	Spring *Ae./Oc.*	*Cx. tarsalis*
2000	245.0	34.6	0.3	1.3
2001	253.0	35.2	7.7	1.6
2002	426.3	58.6	7.7	0.6
2003	457.8	103.7	6.9	1.2
2004	391.9	35.3	1.5	2.3

New Jersey Light Traps Data collected from New Jersey light traps are used to compare mosquito species population levels from year to year. These are the only collections where all adult female mosquitoes are identified to species. The District operated seven traps in 2004. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap ML in Maple Grove, trap CA in Carlos Avery Wildlife Refuge, and trap AV at the Minnesota Zoo in Apple Valley (Figure 2.2). Traps 1, 9 and 16 have operated each year since 1960.

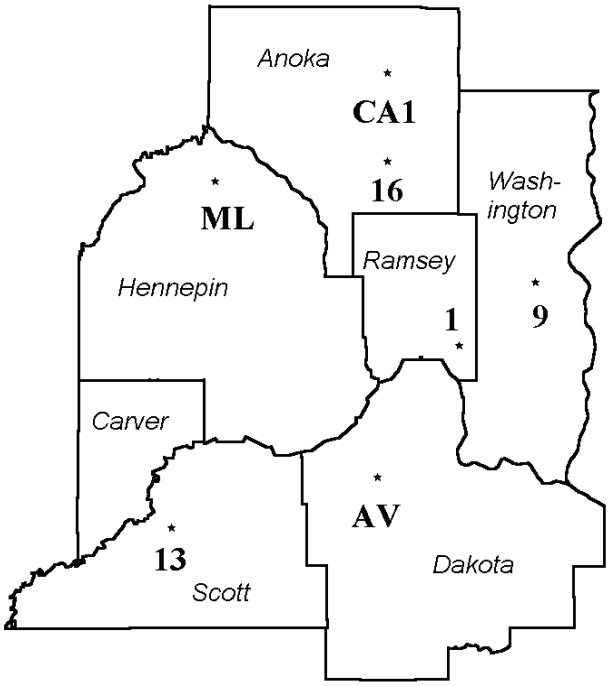


Figure 2.2 New Jersey light trap locations – 2004

A total of 44,036 females were identified in New Jersey traps in 2004 (Table 2.5). *Aedes vexans* was the most numerous comprising 62% of the total and *Cq. perturbans* was the second most numerous at 24%. The number of mosquitoes collected per night from 1965 to 2004 is shown in Appendix A.

Table 2. 5. Total number and frequency of occurrence for each species collected in New Jersey light traps, May 8-Sept. 24, 2004.

	Trap Code, Location, and Number of Collections							Summary Statistics		
	1	9	13	16	ML	CA1	AV	Season		
	St. Paul	Lk. Elmo	Jordan	Lino Lks.	N. Henn.	Carlos	Apple Valley	Total	% Female	Avg per
Species	136	130	138	136	123	131	117	911	Total	Night
1. Oc. abserratus	0	0	0	0	0	22	0	22	0.05%	0.02
3. aurifer	0	0	0	0	0	6	0	6	0.01%	0.01
6. canadensis	0	1	0	0	1	21	0	23	0.05%	0.03
7. Ae. cinereus	8	33	17	122	14	1435	4	1,633	3.71%	1.79
10. Oc. dorsalis	0	0	5	1	3	11	0	20	0.05%	0.02
11. excrucians	2	1	0	1	0	41	0	45	0.10%	0.05
12. fitchii	0	1	0	0	0	3	0	4	0.01%	0.00
13. flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
16. nigromaculus	0	0	0	1	0	0	0	1	0.00%	0.00
18. punctor	0	0	2	0	0	25	0	27	0.06%	0.03
19. riparius	0	0	0	0	0	7	0	7	0.02%	0.01
20. spenceri	0	0	0	0	0	1	0	1	0.00%	0.00
21. sticticus	9	20	80	12	12	344	4	481	1.09%	0.53
22. stimulans	0	0	0	1	2	5	1	9	0.02%	0.01
23. provocans	0	0	0	0	0	1	0	1	0.00%	0.00
24. triseriatus	2	2	0	5	1	0	1	11	0.02%	0.01
25. trivittatus	18	55	259	8	111	165	37	653	1.48%	0.72
26. Ae. vexans	2664	3663	2631	4507	2654	9959	1174	27,252	61.89%	29.91
118. Oc. abs/punct.	0	1	0	1	0	399	0	401	0.91%	0.44
261. Ae. species	41	87	55	101	32	201	68	585	1.33%	0.64
262. Spring Ae/Oc	1	1	0	1	0	12	0	15	0.03%	0.02
264. Summer Ae/Oc	0	0	2	0	7	19	5	33	0.07%	0.04
27. An. barberi	0	0	0	0	0	0	0	0	0.00%	0.00
28. earlei	0	0	0	1	5	27	1	34	0.08%	0.04
29. punctipennis	5	1	10	0	4	15	13	48	0.11%	0.05
30. quadrimac.	1	0	0	0	1	0	1	3	0.01%	0.00
31. walkeri	1	1	36	7	6	680	6	737	1.67%	0.81
311. An. species	1	0	7	0	1	75	0	84	0.19%	0.09
32. Cx. erraticus	0	0	0	0	0	1	0	1	0.00%	0.00
33. pipiens	0	0	0	0	0	0	0	0	0.00%	0.00
34. restuans	43	48	20	53	8	162	39	373	0.85%	0.41
35. salinarius	0	0	0	2	1	0	0	3	0.01%	0.00
36. tarsalis	10	10	27	37	19	23	4	130	0.30%	0.14
37. territans	3	4	2	8	2	10	10	39	0.09%	0.04
371. Cx. species	11	10	1	5	1	19	11	58	0.13%	0.06
372. Cx. pip/rest	13	14	3	17	8	39	15	109	0.25%	0.12
38. Cs. inornata	52	26	39	44	78	157	37	433	0.98%	0.48
39. melanura	0	0	0	0	0	0	0	0	0.00%	0.00
40. minnesotae	2	0	2	24	2	42	1	73	0.17%	0.08
41. morsitans	4	4	2	5	3	148	1	167	0.38%	0.18
411. Cs. species	0	1	1	1	0	39	3	45	0.10%	0.05
42. Cq. perturbans	68	24	20	423	92	9681	71	10,379	23.57%	11.39
44. Ps. ciliata	0	0	0	0	0	0	0	0	0.00%	0.00
47. horrida	0	0	0	0	0	0	0	0	0.00%	0.00
471. Ps. species	0	0	0	0	0	0	0	0	0.00%	0.00
48. Ur. sapphirina	3	6	1	3	0	2	3	18	0.04%	0.02
501. Unident.	8	8	5	2	3	36	10	72	0.16%	0.08
Female Total	2970	4022	3227	5393	3071	23833	1520	44,036	74.52%	48.34
Male Total	574	653	3806	2414	1631	5740	235	15,053	25.48%	16.52
Grand Total	3544	4675	7033	7807	4702	29573	1755	59,089	100.00%	64.86

Seasonal and Geographic Distributions

Seasonal Distribution Sweep net and CO_2 trap collections detected one major peak of *Ae./Oc*. mosquitoes in 2004 (Figures 2.3 and 2.4). Population levels of *Ae./Oc*. increased sharply in late May, remained high, peaked in early June, then declined thereafter. *Coquillettidia perturbans* populations peaked in mid-July, later than their typical July 4 peak.

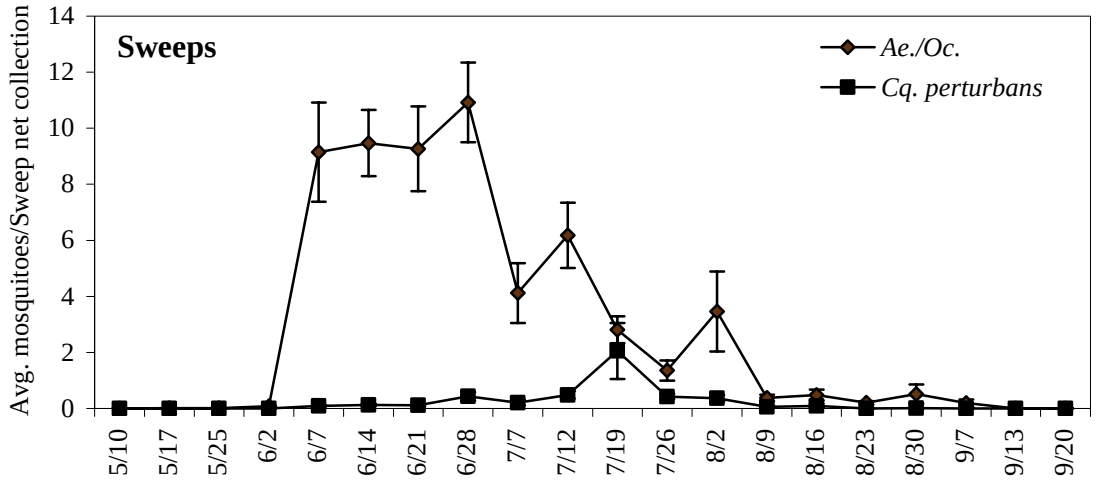


Figure 2.3 Average number of Summer *Ae./Oc.* and *Cq. perturbans* per evening sweep net collection, 2004. Heights of bars indicate 1 standard error.

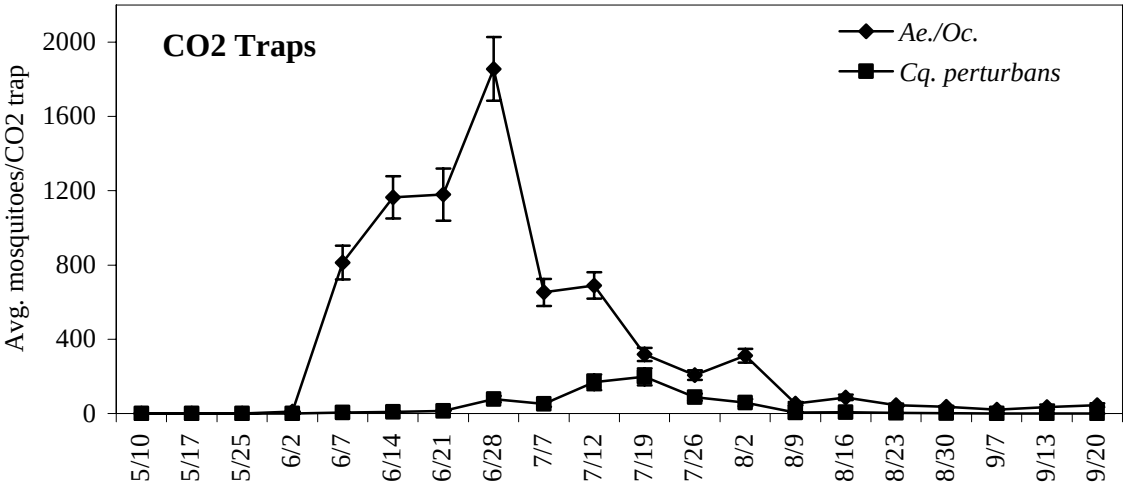


Figure 2.4 Average number of Summer *Ae./Oc.* and *Cq. perturbans* per CO_2 trap, 2004. Heights of bars indicate 1 standard error.

Geographic Distribution Figure 2.5 displays the geographic distribution of mosquitoes captured in sweep net collections inside and outside the District. White areas are tolerable annoyance levels (0-4 mosquitoes), lightest gray is moderate (5-9), darker gray is bad (10-14) and black is extremely bad (>15 mosquitoes). There are some hot spots within the interior of the District, but overall mosquito levels are higher in outer areas. Figure 2.6 depicts the sweep net collection locations for 2004.

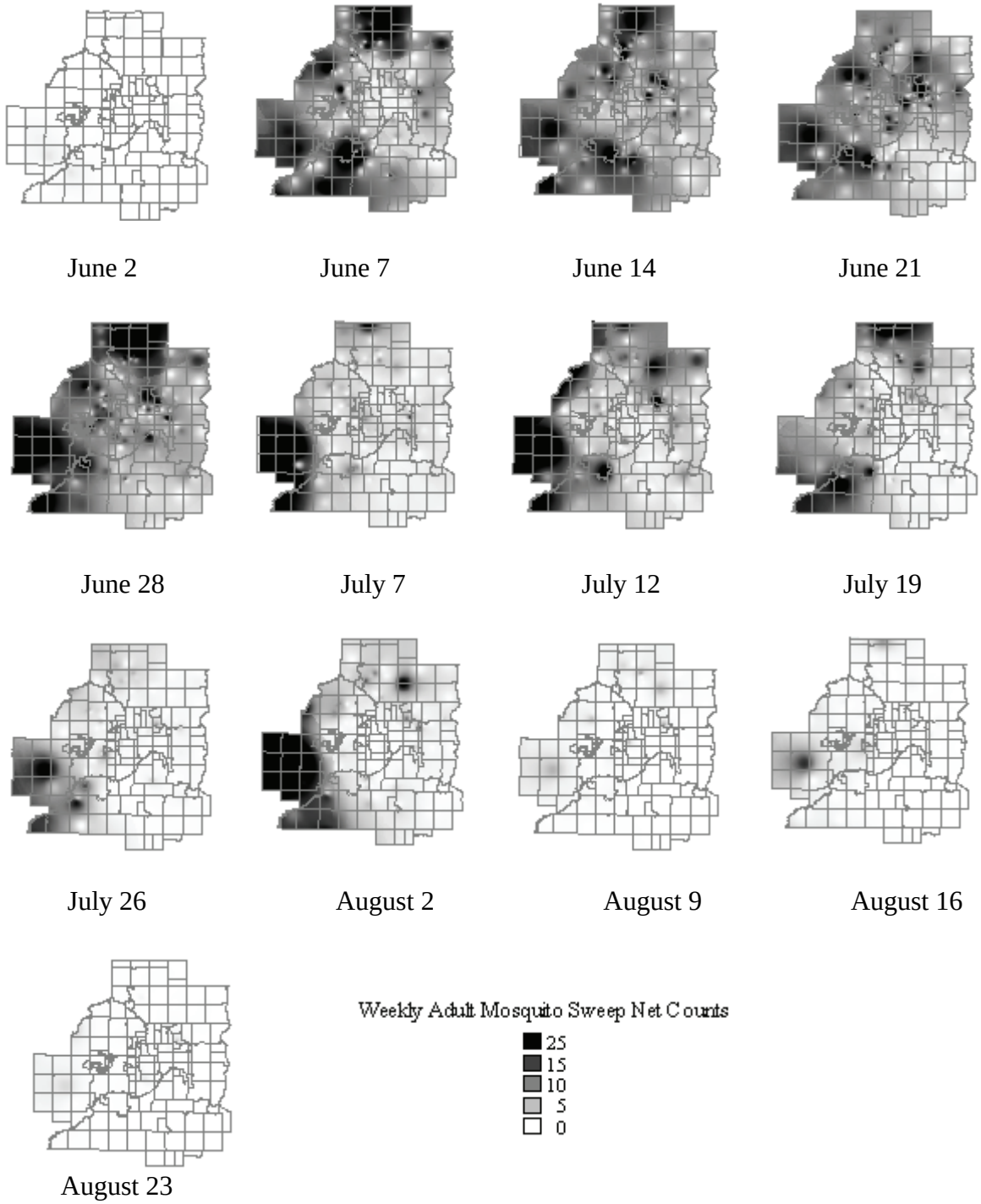


Figure 2.5 Average number of *Ae./Oc.* mosquitoes in sweep net collections, 2004

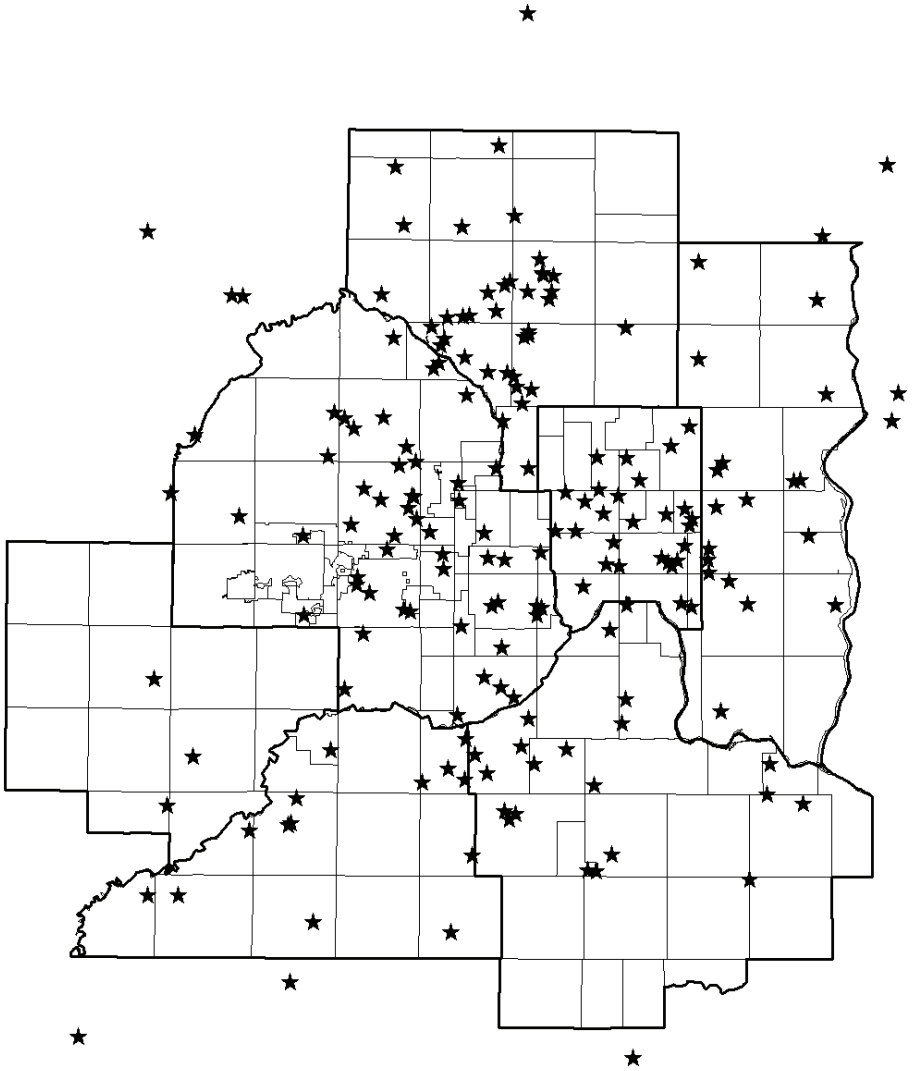


Figure 2.6 Locations of weekly evening sweep net collections, 2004

Culex Surveillance

Since *Culex* species can transmit WNV as well as WEE, surveillance for these species has increased in recent years. In addition to CO_2 traps, gravid traps are used to monitor *Culex* adults. The gravid trap is designed to attract female mosquitoes that are seeking oviposition sites while the CO_2 trap is used for collecting female mosquitoes in their host seeking phase.

Culex tarsalis has been identified as the most likely vector of WNV to humans in our area. Because of this, MMCD took measures to improve surveillance for the species in 2004. The Monday night CO_2 trap network was enhanced by adding 25 traps and also by repositioning

some traps to obtain more uniform coverage of the agency's service area. All of the *Cx. tarsalis* captured in Monday night sweeps, Monday night CO_2 traps, and gravid traps were submitted to MDH for viral analysis (see Table 1.2). Surveillance indicated two peaks in the *Cx. tarsalis* population in 2004 (Figure 2.7), the first during the week of June 22, the second during the week of August 10.

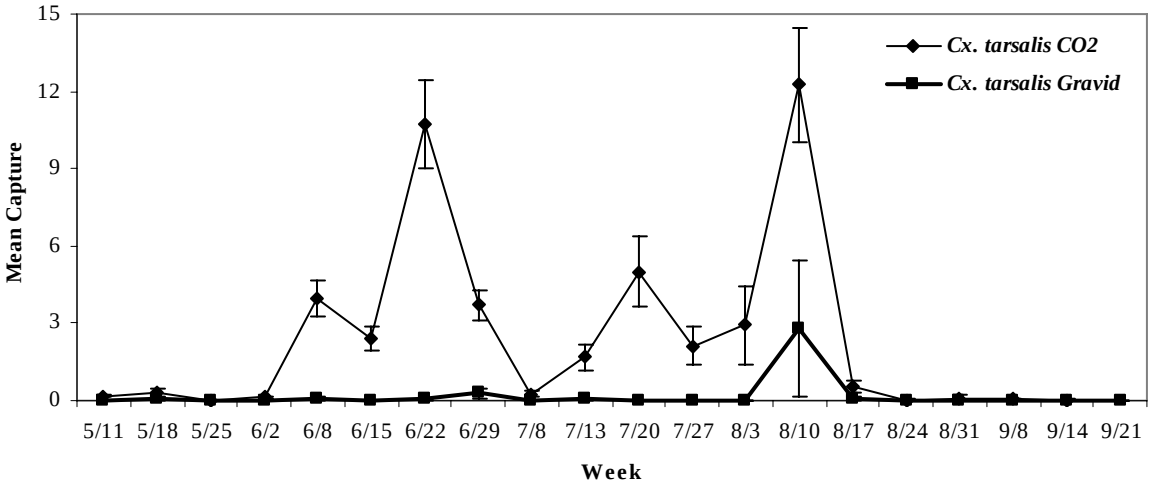


Figure 2.7 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2004. Heights of bars indicate 1 standard error.

Culex restuans is another important vector of WNV in Minnesota. The species appears to be largely responsible for the early season amplification of the virus and possibly for season-long maintenance of the WNV cycle. As is typical, *Cx. restuans* collections were low in 2004 (Figure 2.8). Gravid traps tend to capture more *Cx. restuans* than CO_2 traps; however, the two traps are actually sampling different portions of the population. The gravid traps collect mosquitoes that are searching for an oviposition site and the CO_2 trap samples those seeking a blood meal.

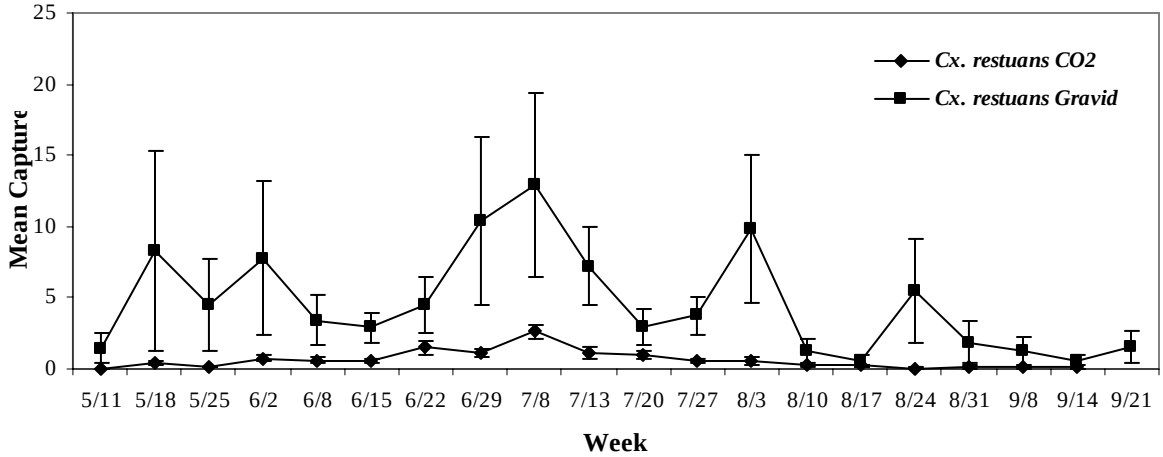


Figure 2.8 Average number of *Cx. restuans* in CO_2 traps and gravid traps, 2004. Heights of bars indicate 1 standard error.

Culex pipiens has been an important vector of WNV in much of the United States. The species tends to prefer warmer temperatures than *Cx. restuans*, therefore populations of *Cx. pipiens* in the District peak late in the summer when temperature are typically warmer. That pattern persisted in 2004 (Figure 2.9); however, capture rates were very low in both gravid traps and CO_2 traps. This is most likely due to the unusually cool summer we experienced.

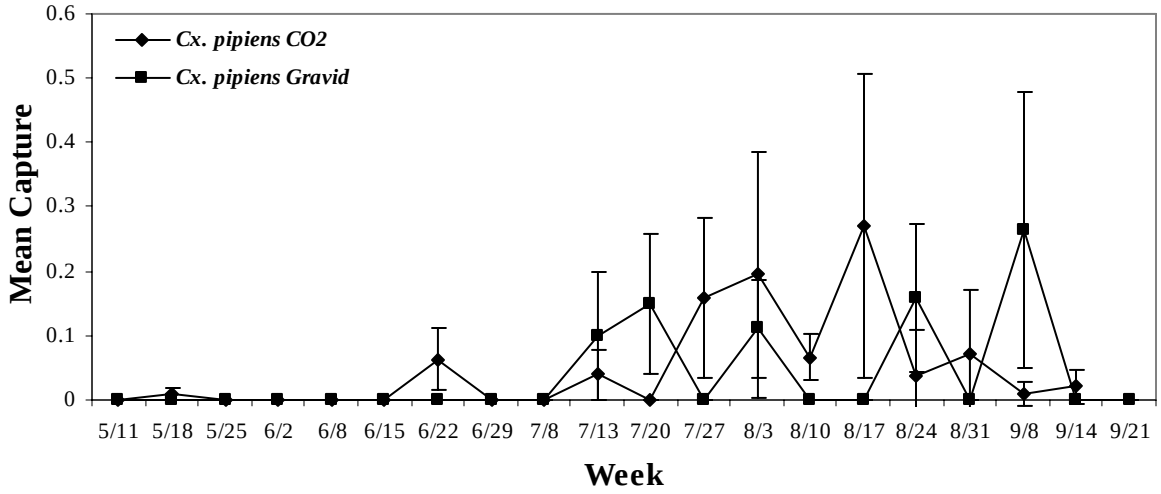


Figure 2.9 Average number of *Cx. pipiens* in CO_2 traps and gravid traps, 2004. Heights of bars indicate 1 standard error.

Plans for 2005

Surveillance strategies for *Ae./Oc*. mosquitoes will remain unchanged. Staff will research surveillance strategies for adult and larval *Culex* mosquitoes. We will continue to review the distribution and type of CO_2 trap locations. A greater number of CO_2 traps will be operated to increase the collection of *Cx. tarsalis*. CO_2 traps will also be placed in known *Cs. melanura* habitat to detect adult activity.

Chapter 3 Mosquito Control

2004 Highlights

- 53,824 more acres of wetlands were treated with larvicides than in 2003
- 6,733 more acres treated with adulticides than in 2003
- A cumulative total of 148,023 catch basins treated in three rounds to control vectors of WNV
- Adult treatment thresholds for *Cx. restuans, Cx. pipiens, Cx. salinarius* and *Cx. tarsalis* were designated

2005 Plans

- Targeting WNV vectors, primarily *Culex*, will result mostly in increased larvicide applications
- Aerial applications of larvicides with a longer field activity than *Bti* (Altosid® pellets, Vectolex® CG) will be conducted to control *Culex* that develop more than 24 hours after treatment in the same site
- Less frequent aerial re-treatments will free up time for staff to inspect and treat additional sites to control *Culex* and floodwater mosquitoes
- Adulticide applications may increase if there is an increase in mosquito-borne disease risk

Background Information

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

Aedes/Ochlerotatus larvae hatch in response to snow melt or rain with adults emerging at various times during the spring and summer. Cattail mosquito larvae develop in cattail marshes over twelve months and emerge as adult mosquitoes in June and July. *Culex* species also breed during periods of greater precipitation but inhabit more permanent waters and therefore are not as dependent upon rainfall. Catch basins can support breeding of *Cx. pipiens* and *Cx. restuans* and were the primary source of WNV vectors in heavily urbanized areas during the 2002 WNV epidemic in Chicago. Chapter 1 provides detailed information about control of *Oc. triseriatus*. In-depth descriptions of the biology of the various mosquito species found in the District is in Appendix B.

MMCD uses "Priority Zones" to focus service in areas where it will benefit the highest number of citizens. Priority Zone 1 contains the majority of the population of the Twin Cities metro area and has boundaries similar to the Metropolitan Urban Service Area (MUSA, Metropolitan Council). Priority Zone 2 includes sparsely populated and rural parts of the District. Small towns or population centers in Priority Zone 2 are considered satellite communities and receive services similar to Priority Zone 1.

Adult mosquito control supplements the larval control program. Adulticide applications are performed after

sampling detects mosquito populations meeting threshold levels, primarily in high use park and recreation areas, for public events, or in response to citizen mosquito annoyance reports. Three synthetic pyrethroids are used: resmethrin, permethrin, and sumithrin. A description of the control materials is found in Appendix C. Appendix D indicates the dosages of control materials used by MMCD, both in terms of amount of formulated (and in some cases diluted) product applied per acre and the amount of active ingredient (AI) applied per acre. Appendix E contains a historical summary of the number of acres treated with each control material. Pesticide labels are located in Appendix F.

2004 Mosquito Control

Larval Mosquito Control

District-wide ground larvicide treatments for the cattail mosquito, *Cq. perturbans*, began in March while spring *Ae./Oc*. treatments began in mid-April. Floodwater mosquito treatment began in mid-May and continued though September. The majority of larvicide treatments occurred in late April, May, June, early July, and mid-September (Figure 3.1), which is when the District received much of the season's rainfall. Drier conditions in late July through early September required fewer larvicide treatments. MMCD treated 53,824 more acres with larvicides in 2004 than in 2003 (Table 3.1), primarily because of more frequent broods in May, June and early July 2004. In June, July and August 2004, MMCD treated a total of 148,023 catch basins with larvicides to control vectors of WNV, 12,045 more than in 2003. MMCD did not treat catch basins in 2002.

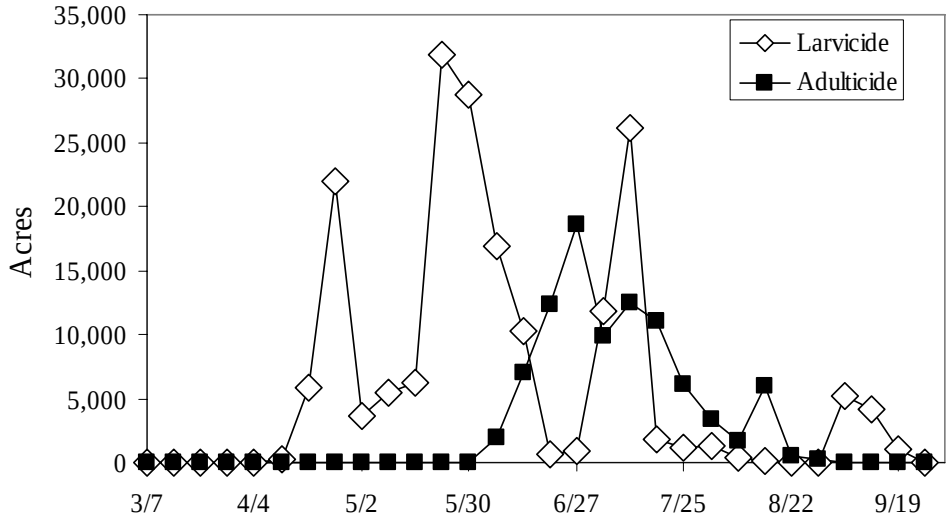


Figure 3.1 Acres of larvicide and adulticide treatments each week (March-September 2004).

Table 3.1 Comparison of larval control material usage in 2004 and 2003.

	2004		2003	
Material	Amount used	Area treated	Amount used	Area treated
Altosid® briquets	550 cases	398 acres	548 cases	323 acres
Altosid® pellets	56,897.34 lb	19,139 acres	57,607.59 lb	18,458 acres
Altosid® pellets	1,215.51 lb	148,023 CB[1]	1,259.05 lb	135,978 CB[1]
Altosand products	0.00 lb	0 acres	2.36 lb	0.47 acres
Altosid® SR-20	0.00 ml	0 acres	654.57 ml	33 acres
Bti corncob	1,330,442.20 lb	166,299 acres	905,657.34 lb	113,198 acres
Larvicide totals		185,836 acres 148,023 CB[1]		132,012 acres 135,978 CB[1]

[1]CB-catch basin treatments

Beginning in April 2004, the threshold for treatment with *Bti* was 0.1 larvae per dip for spring *Ae./Oc.* in Priority Zone 1. A higher threshold of 0.5 larvae per dip was used in Priority Zone 2 to target limited control materials to sites with the most intense breeding. After mid-May, the threshold was increased to control the summer floodwater mosquitoes and *Culex*. For sites with only *Culex* (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*), the threshold was 1 per dip in all priority zones. For sites with both *Culex* and floodwater mosquitoes, the threshold was 2 per dip in Priority Zone 1 and 5 per dip in Priority Zone 2.

Catch basin treatments began in early June and ended in late August. Most catch basins were treated three times with Altosid® pellets (3.5 grams per catch basin) to control *Culex* mosquitoes from June through mid-September.

Adult Mosquito Control

In 2004, MMCD treated about 6,733 more acres with adulticides than in 2003 (Table 3.2), primarily in response to WNV surveillance. Adulticide treatments began in early June, peaked in late June, and continued until late August (Figure 3.1). Adult mosquito control operations were considered when mosquito levels rose above established thresholds of two mosquitoes in a 2-minute sweep or 2-minute slap count or 130 mosquitoes in an overnight CO_2 trap. In 2004, we established surveillance thresholds for adult control specific to four *Culex* species (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*). The thresholds are one of any of these *Culex* species in a 2-minute sweep, five in an overnight CO_2 trap, five in an overnight gravid trap, and one *Cx. tarsalis* in a vacuum aspirator sample.

Table 3.2 Comparison of adult control material usage in 2004 and 2003.

	2004		2003	
Material	Amount used	Area treated	Amount used	Area treated
Permethrin	1,608.19 gal	8,292 acres	1,251.55 gal	6,411 acres
Resmethrin	841.96 gal	71,847 acres	817.66 gal	68,057 acres
Sumithrin	383.41 gal	15,508 acres	347.77 gal	14,447 acres
Total		95,648 acres		88,915 acres

2005 Plans for Mosquito Control Services

Larval Control

Cattail Mosquitoes Control of *Coquillettidia perturbans* in 2005 will use the same strategy as in 2004. MMCD will focus control activities on the most productive cattail marshes near human population centers. Altosid® briquet applications will start in early March to frozen sites (e.g., floating bogs, deep water cattail sites, remotely located sites). Beginning in late May, staff will treat with pellets applied by helicopter at a rate of 4 lbs/acre.

Floodwater mosquitoes and *Culex* species MMCD has expanded control of four *Culex* species since the arrival of WNV in 2002. Ground and aerial larvicide treatments of wetlands have been increased to control *Culex*. Catch basin treatments control *Cx. restuans* and *Cx. pipiens* breeding in urban areas. Since 2002, the number of acres treated aerially with *Bti* more than once per month has increased, especially in May (Figure 3.2). In 2005 the larval treatment strategy will include aerial applications of larvicides with a longer field activity than *Bti* (Altosid® pellets, Vectolex® CG) to decrease the number of times air sites are repeatedly treated in May, June and July. This should enable one larvicide treatment to also control *Culex* that develop later in the same site. Less frequent treatments will free up time for staff to inspect and treat additional sites. MMCD plans to use seven helicopters for the treatment of air sites.

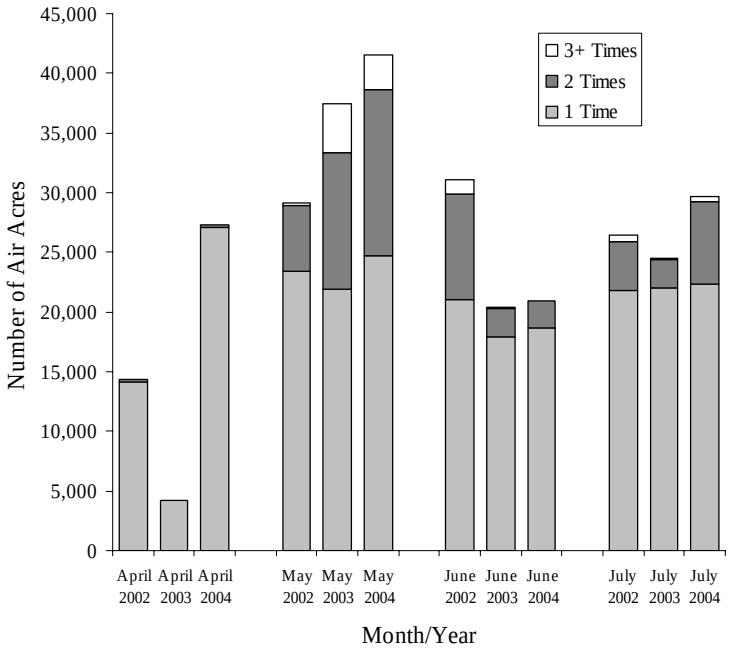


Figure 3.2 Total acres treated aerially 1, 2, and 3 or more times per month with *Bti* in April, May, June and July (2002, 2003, 2004).

The primary control material will again be *Bti* corn cob granules. Forecasted *Bti* (Vectobac® G), Altosid® pellet and Vectolex® CG needs in 2005 are higher than in 2004, primarily due to increased aerial applications. As in previous years, to minimize shortfalls, control material use may be more strictly rationed during the second half of the season, depending upon the amount of the season remaining and control material supplies. Regardless of annoyance levels, MMCD will maintain sufficient resources to protect the public from potential disease risk.

Staff will treat ground sites (<3 acres) with methoprene products (Altosid® pellets, Altosid® briquets) or *Bti* corn cob granules. Breeding sites in highly populated areas will receive treatments first during a wide-scale mosquito brood. The District will then expand treatments into less populated areas where treatment thresholds are higher. In 2005, larval treatment thresholds will be the same as in 2004.

In 2005, Altosid® pellets will be used in catch basins chosen for treatment. Catch basins selected for treatment include those found holding water, those that potentially could hold water based on their design, and those for which we have insufficient information to determine whether they will hold water. Treatments could begin as early as the end of May and no later than the third week of June. We have tentatively planned to complete a first round of pellet treatments by June 26 with subsequent treatments every 30 days.

Adult Mosquito Control

Forecasted permethrin, resmethrin and sumithrin requirements in 2005 are higher than in 2004 with the increase due primarily to WNV vector control and the addition of western Carver County to the District. MMCD will direct adult mosquito control treatments to provide the greatest customer benefit, generally higher risk disease areas and human populated areas that have high levels of mosquitoes. Also, MMCD will provide service in high-use park and recreation areas and for public functions

Vector Mosquito Control

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

Chapter 4 Black Fly Control

2004 Highlights

- Completed study of public perception of annoyance due to adult black flies
- 2003 multiplates processed
- Monitored black fly adults and larvae in Carver County expansion area

2005 Plans

- Threshold for treatments the same as previous years
- Non-target study from 2003 will be submitted in April
- Collect 2005 multiplate samples
- Continue to monitor larval and adult black fly sites in Carver County expansion area

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 began in 1996.

2004 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.

Ninety-eight 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 45 sites on 11 streams met the threshold and were treated once with Vectobac® 12AS formulation of *Bti*. A total of 24.1 gallons of *Bti* was used (Table 4.1).

Table 4.1. Summary of *Bti* treatments for black fly control by the MMCD in 2004.

Water body	No. of application sites	No. of treatments	Gallons of *Bti* used
Small streams	45	45	24.1
Mississippi River	3	12	660.0
Crow River	4	13	160.0
Minnesota River	7	20	1,778.6
Rum River	4	24	192.1
Total	63	114	2,814.8

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 *Simulium johannseni* breed primarily in the Crow and Minnesota rivers. These species are most abundant in May and June, although *S. meridionale* populations will remain high throughout the summer if stream flow is also high.

The black fly larval population was monitored weekly between May and early September using artificial substrates at the 21 sites permitted by the Minnesota Department of Natural Resources on the Rum, Mississippi, Crow and Minnesota rivers. The treatment thresholds were the same as those used since 1990. Sixty-nine treatments totaling 2790.7 gallons of Vectobac® 12AS (*Bti*) were used to control large river-breeding black fly larvae in 2004 (Table 4.1). The average monthly discharge on the Rum, Crow and Minnesota rivers was 6.5%, 8.9%, and 9.2% above the long-term average, respectively, during the 2004 black fly breeding season (April - September). In contrast, on the Mississippi River discharge was 25% below the long-term average during the same period. A summary of the large river *Bti* treatments and discharge between 2000 and 2004 is in Table 4.2.

Bti treatment effectiveness was excellent in 2004. The average post-*Bti* treatment larval mortality measured at least 250 m downstream of the point of the *Bti* application was 99.7% on the Crow River, 96.6% on both the Mississippi and Rum rivers, and 88.5% on the Minnesota River.

The geographic region covered by the MMCD was formally expanded to include all of Carver County in 2004. The MMCD Board of Commissioners requested that staff examine the need for black fly control in the rivers within the expanded District area. Preliminary larval sampling indicated that the South Fork Crow River was likely to be a candidate river so six larval sampling stations were established and sampled during the spring and summer. Sampling was done using MMCD-standard 125 cm^2 Mylar samplers that were held *in situ* for one week. Threshold-level populations of *S. luggeri* and/or *S. meridionale* larvae were recorded in several of the weekly samples. Consequently, in the 2005 permit application for black fly control submitted to the Minnesota Department of Natural Resources the MMCD included six candidate *Bti* treatment sites on the South Fork Crow River.

Table 4.2. *Bti* treatments and large river discharge between 2000 and 2004.

Year	No. of *Bti* treatments on large river	Total gallons of *Bti* used on large rivers	Average monthly discharge May - Sept. (cu ft/sec) Rum River	Mississippi River	Minnesota River	Crow River
2000	18	808.6	338	6,595	4,412	332
2001	45	4,045.0	1,693	20,185	20,391	2,705
2002	55	3,145.0	1,678	15,277	5,961	3,044
2003	49	3,393.5	1,332	11,166	4,740	1,687
2004	69	2,790.7	889	8,074	7,247	1,283

Adult Population Sampling

The adult black fly population was monitored in 2004 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 once weekly from early May to mid-September, generally between 8 and 10 AM. The average number of all species of adult black flies captured per sample in 2004 was 0.97. Between 1998 and 2003, the overall average number of adults captured was 2.85, 1.63, 2.38, 1.30, 0.61, and 1.96, respectively (Table 4.3). In 1984 and 1985, which was before any large river treatments were done, the average number of black flies captured per sample was 17.95 and 14.56, respectively (Table 4.3).

The most abundant black fly species collected in the overhead net-sweep samples in 2004 was *S. meridionale*, comprising 40% of the total black flies captured, with an average count in the net-sweep samples of 0.39. The next most abundant species captured was *S. luggeri*, comprising 36% of the total collection with an average per sample count of 0.35. This is the first time since the black fly control program began that *S. luggeri* was not the most abundant black fly collected in the adult sweep samples (Table 4.3). The peak *S. meridionale* population occurred at the end of June, which was two weeks after flood-level flows occurred on the Minnesota River. The reason *S. meridionale* was more abundant in 2004 was likely due to the higher than normal flows that occurred in the Minnesota River between June and September, and in particular high June flows. The weekly larval monitoring samples indicated continued breeding by *S. meridionale* in the Minnesota River through August. The largest number of *S. meridionale* captured in the adult net-sweep samples was in Carver County. Similarly high adult populations of *S. meridionale* were observed in 2001 when flows on the Minnesota River were high in May and June and *Bti* treatments were suspended.

The overall average number of *S. luggeri* captured per net-sweep sample in 2004 was 0.35 (Table 4.3). This was the lowest number of *S. luggeri* observed in the net-sweep samples since the program began in 1984. Peaks in the S. *luggeri* population occurred in late June, mid-July and mid-August. *Simulium luggeri* was most abundant in Anoka County in 2004, as it has been in all previous years of the program. The average number of *S. luggeri* captured in Anoka County was 1.82 in 2004 compared to 8.92 in 2003 and 1.65 in 2002. In 2001 the average was 3.45 and in 2000 it was 10.38. The higher number *of S. luggeri* captured in Anoka County

compared to other counties within the MMCD is most likely due to its close proximity to the prime larval habitat in the nearby Rum and Mississippi rivers.

Table 4.3. Annual mean number of black fly adults captured in over-head net sweeps in bi-weekly samples taken at 48 standard sampling locations throughout the MMCD between mid-May and mid-September. Samples were taken once weekly in 2004 and twice weekly in previous years. The first operational treatments of the Mississippi River began in 1990 at the Coon Rapids Dam. 1988 was a severe drought year and limited black fly production occurred.

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

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

Supplemental adult net sweep samples were collected at five sites in Carver County in 2004 in order to establish background data in the event that all of Carver County is included in the black fly control area in 2005. Samples were collected once per week following the standard adult sampling protocols. Sampling was conducted from early May through late September. The most abundant black fly species collected at the five new Carver County sites was *S. meridionale,* comprising 96.4% of the black flies collected. The overall average number of black flies captured per net sweep sample was 1.41.

Adult black fly populations were also monitored between mid-May and late June with CO_2-baited light traps in 2004 at four sites in Scott/Carver counties and four sites in Anoka County. These sites have been monitored with CO_2 traps since 1998. An additional five sites were sampled in the proposed expansion area of Carver County within the vicinity of the South Fork Crow River.

Simulium meridionale was the most abundant species captured in all three sample areas, with the largest numbers being from the five sites in the Carver County area that is presently outside the black fly program area. The average number of *S. meridionale* in the Carver County traps was 327 compared to 14 in the Anoka County traps and 0.65 in the Scott/Carver County traps. The number of *S. johannseni* were also highest in the Carver County area with an average of 33 per sample. The average number of *S. johannseni* per trap in the Anoka County traps was 5.1 and 0.17 in Scott/Carver County traps. *Simulium luggeri* numbers were lower than observed in previous years with CO_2 traps, a trend that was also observed in the net-sweep sampling results.

Non-target Monitoring

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

Public Perception of Annoyance from Black Flies

As part of an integrated pest management approach for black fly control, MMCD needs to be able to:

- estimate public annoyance relative to black fly numbers,
- establish what level is tolerable, and
- estimate the value the public places on reducing black fly annoyance.

In 2001, the black fly team developed plans for a study to provide this information, and data was collected and analyzed in subsequent years. A draft report, “Public Perception of Annoyance from Black Flies (Biting Gnats): Report from Studies in 2001-2004” by K. Simmons, N. Read, and J. Walz (2004, MMCD) is now available for review.

In the study, the relationship between black fly numbers sampled in overhead sweep nets and the perception of annoyance by the public was examined using simultaneous sampling and surveys. A randomized sample of individuals was asked to stand in their yard for 3 minutes, during which time a staff member took a sweep sample at a location 20 feet from the participant, and another staff member observed participant defensive behaviors and measured environmental conditions 20 ft from both the participant and the sampler.

A total of 274 samples were collected over two years during times when black flies were active and there were few mosquitoes. Results suggest that black fly levels of three or more were related to an apparent increase in annoyance, reduced time outdoors, and interest in wearing repellent. Levels of 10 or more were related to a stronger response. Median reported tolerance for "gnats around you" was 5, for landings was 3, and for bites was 1. One-third of respondents reported "reacting strongly" to gnat bites. Median amount participants were willing to spend to reduce gnat levels was $10 overall; those reacting strongly had a median of $15. Difficulties encountered included relatively few samples with high numbers of black flies, and highly variable results at low black fly levels, similar to those found with mosquitoes (Read et al. 1994) Observed behavior counts did not appear to be closely related to black fly counts or annoyance in this data set.

2005 Plans

Our goal is to continue to effectively control black flies in the large rivers and small streams. The larval population monitoring program and thresholds for treatment will continue as in previous years. Six new larval treatment sites on the South Fork Crow River have been included in the 2005 black fly control permit that has been submitted to the Minnesota Department of Natural Resources. Taxonomic identification and enumeration of the non-target samples collected in 2003 are in the process of being finished. It is anticipated that a report will be submitted to MDNR in April 2005.

References

Read, Nancy R., Jay R. Rooker and Joseph P. Gathman. 1994. Public perception of mosquito annoyance measured by a survey and simultaneous mosquito sampling. J. American Mosq. Cont. Assoc. 10(1):79-87.

Chapter 5 Product & Equipment Tests

2004 Highlights

- Vectobac® G *Bti* achieved 89.5 % control of *Ae. vexans* in air sites
- Altosid® briquets and Vectolex® CG (*B. sphaericus*) effectively (≥90%) controlled *Culex* and other mosquitoes in catch basins
- Test results from catch basins treated with Altosid® pellets were not as good as tests conducted in 2003
- Vectolex® CG effectively controlled mosquitoes in wetlands for 28 days
- Pyrenone® and Pyrocide® effectively controlled adult mosquitoes. Both products contain natural pyrethrins and have no crop restrictions
- Pyrenone® effectively controlled adult *Cx. tarsalis* at a farm

2005 Plans

- Evaluate larger scale applications of Vectolex® CG and Altosid® pellets to control *Aedes* and *Culex* mosquitoes
- Continue testing Altosid® pellets in catch basins
- Further test Pyrocide® for adult mosquito control in croplands
- Expand evaluation of the effectiveness of adulticide treatments against vectors of WNV or other mosquito-borne diseases

Background

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

2004 Projects

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

Acceptance Testing of Altosid® (methoprene) Briquets and Pellets

Warehouse staff collected random Altosid® product samples from shipments received from Wellmark International for methoprene content analysis. MMCD contracts an independent testing laboratory, Legend Technical Services, to complete the active ingredient (AI) analysis. Zoecon Corporation, Dallas, Texas, provided the testing methodologies. The laboratory protocol used was CAP No. 311, “Procedures for the Analysis of S-Methoprene in Briquets and Premix.” All 2004 samples were within acceptable values of the label claim of percent methoprene (Table 5.1).

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

Methoprene Product	Samples Analyzed	Methoprene Content: Label Claim	Methoprene Content: Analysis Average	SE
XR-Briquet	5	2.10%	2.03%	0.007
Pellets	10	4.25%	4.14%	0.021

Evaluation of New Protocol for Preparing Methoprene Products for Laboratory Analysis

To reduce costs of independent laboratory analysis, Technical Services attempted to lessen the preparation time of individual methoprene samples. The laboratory procedure CAP No. 331 directs the laboratory analyst to prepare a powdered sample for extraction by hand scraping the methoprene-impregnated plaster matrix. It was proposed to use liquid nitrogen to deeply freeze the product and then crush it to a powder while in this frozen state. Legend Technical Services was directed to split one sample and to run a side by side comparison of both preparatory methods. Although the liquid nitrogen method greatly reduced preparation time, the results demonstrated that the liquid nitrogen method significantly reduced the active ingredient level when compared to the original method (Table 5.2). Therefore, we will continue to use the original methodology for future analyses.

Table 5.2 Comparison of active ingredient levels using specific preparation procedures

Methoprene Product	CAP 311 Scrape Method	CAP 311 Liquid Nitrogen Method
Briquet (% AI)	1.83%	1.72%
Pellet (% AI)	3.63%	3.47%

Evaluation of Storage on Active Ingredient Levels of Briquet & Pellets

Carrying over control materials from one season into the next season is always a possibility when applications often depend upon rainfall levels. Technical Services evaluated Altosid® briquets and pellets for long-term viability during storage. We looked at the amount of active ingredient breakdown over a one-year and two-year periods. Briquets lost approximately 10% of its AI after one year (Table 5.3). The cork-shaped briquet seemingly stabilized and only lost an additional 1% in the second year. Pellets similarly lost 10% after one year but continued to breakdown an additional 14% in the second year. Technical Services would recommend to minimize the amount of methoprene products carried over and to use remaining quantities first in the upcoming treatment season.

Table 5.3 Active ingredient (methoprene) breakdown in stored briquets and pellets

Year sampled	Product	Date analyzed	Methoprene Content: Analysis Average	% AI breakdown
2002	XR-Briquet	02/2002	2.09%	
2002	XR-Briquet	09/2004	1.90%	11%
2004	XR-Briquet	02/2004	2.03%	
2004	XR-Briquet	09/2004	1.83%	10%
2002	Pellets	02/2002	4.23%	
2002	Pellets	09/2004	3.65%	24%
2004	Pellets	02/2004	4.14%	
2004	Pellets	09/2004	3.74%	10%

Evaluation of Active Ingredient Levels in Adult Mosquito Control Products

MMCD has requested the certificates of Active Ingredient (AI) analysis from the manufacturers to verify product AI levels at the time of manufacture. All of the products received by MMCD in 2004 were guaranteed by the manufacturer to contain label required AI levels. MMCD has incorporated AI analysis as part of our product evaluation procedures and will submit samples of all adulticide control materials to an independent laboratory for AI analysis. This process will assure that all adulticides (purchased, formulated and/or stored) meet the necessary quality standards. Although it was a goal to have this procedure in place for the 2004 season, we did not collect a complete set of samples from all adulticide materials and decided not to submit the available samples for analysis. An improved sampling procedure has been established for the 2005 season and active ingredient levels of the adulticide materials will be independently verified. These independent results will be compared to manufacturer's Certificates of Analysis to assure quality of purchased products or used to confirm our formulation processes are meeting established standards.

Movement of MMCD's Liquid Control Material Warehouse

The District transferred the liquid control material warehouse from our Rosemount, MN warehouse to our Oakdale, MN facility. This move was based upon five primary advantages; the Oakdale facility is environmentally controlled year round (product integrity), has a permanent berm structure (product mixing safety), is more centrally located (reduced mileage and saved employee time), increased accessibility (highway access), and has multiple loading docks (more functionality). The resulting Oakdale warehouse facility design helped to streamline processes and improved employee safety. In addition, the Oakdale facility was used to store additional dry materials (*Bti*, Altosid® products) to service neighboring MMCD facilities.

In evaluating this move, we compared 2003 & 2004 control material transfers between regional facilities and found MMCD saved an average of 12 miles per transfer in 2004 (over 440 miles

during the season). This mileage reduction is reflected in saved fuel costs, related vehicle expenses and increased work time for employees to complete other tasks.

Recycling of Pesticide Containers

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

Warehouse personnel arranged for all of MMCD's plastic containers to be collected and properly stored until they could be processed. MMCD staff collected over 3,906 jugs for this recycling program. The control materials that use plastic 2.5-gallon containers are sumithrin (153 jugs), *Bti* liquid (1,125 jugs) and Altosid® pellets (2,628 jugs). Twelve MMCD staff members (two employees from each regional facility) assisted in the jug grinding process which was completed in one day and resulted in approximately 3,300 lbs of recycled shredded plastic.

Reduced Production of Hazardous Waste

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

MMCD's centralized triple-rinsing process used our warehouse personnel expertise to maintain low quantities of hazardous waste created by our operations. By rinsing all the containers at the same time, warehouse staff was able to utilize a minimal quantity of mineral spirits in the recycling process. MMCD produced 19.0 gallons of mineral spirit rinsate in 2004. The increase of rinsate is mainly due to moving the liquid warehouse facilities and the related cleanup of equipment prior to transfer. In addition, the warehouse triple-rinsed and recycled numerous steel drums and containers stored in the former liquid warehouse facility.

Efficacy of Control Materials

Vectobac® G Applications Vectobac® G brand *Bti* (5/8 inch mesh size corncob granules) from Valent BioSciences was the primary *Bti* product applied by helicopter in 2004. Efficacy as calculated in terms of pre-treatment and post-treatment larval counts was similar in 2003 and 2004 (Table 5.4).

Table 5.4 Efficacy of aerial Vectobac® G applications in 2004 and 2003. SE=standard error.

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2003	687	88.2	100.0	1.1 %	0.0	100.0
2004	294	89.5	100.0	1.6 %	0.0	100.0

New Control Material Evaluations

The District, as part of its Continuous Quality Improvement philosophy, desires to continually improve its control methods. It is the District's policy to attempt to use the most environmentally friendly products possible while achieving acceptable control rates. Much testing has focused upon controlling potential vectors of WNV since WNV arrived in Minnesota in 2002.

Altosid® Treatments in Catch Basins In 2004, MMCD again treated catch basins to control potential mosquito vectors of WNV. This year staff continued conducting bioassays of Altosid® briquets and pellets in catch basins to better understand results observed in 2003. In 2004, collecting bioassays required significant effort, 343 inspections to successfully collect enough pupae for 36 bioassays. No pupae were found in catch basins during most inspections. In 2005, we are considering evaluating larval abundance in Altosid®-treated catch basins in addition to pupal bioassays to better understand larval and pupal abundance in catch basins.

Untreated control emergence in 2004 was lower than observed in 2003 (Table 5.5).

Table 5.5 Bioassay results for untreated control catch basins in 2003 and 2004.

Year	n	Mean % emergence	Median % emergence	SE	Min % emergence	Max % emergence
2003	11	83.8	82.0	2.7%	72.9	100.0
2004	5	72.8	68.0	5.5%	62.0	86.0

Efficacy measured by bioassays of catch basins treated with Altosid® ingot briquets in 2004 was much better than that observed in 2003 (Table 5.6). This difference may in part be due to how long after treatment the bioassay was collected which, in 2004, was an average of about 14 days after treatment. In 2003 bioassays were collected an average of 42 days after treatment (Table 5.7) (Figure 5.1). Low values of some bioassays collected relatively soon after treatment in 2003, suggest that other factors are also affecting efficacy (Figure 5.1). More research is necessary to determine how to maximize ingot briquet efficacy in catch basins.

Bioassays from catch basins treated with Altosid® pellets in 2003 indicated high efficacy while bioassays collected in 2004 suggested lower effectiveness (Table 5.6). This could be in part because bioassays were collected near the end of the 30-day effective life (mean of 26.5 days after treatment) in 2004 but were collected over 11 days earlier (mean of 15 days after treatment) in 2003 (Table 5.7) (Figure 5.2). A major reason that bioassays were collected so much later in 2004 was the inability of staff to find pupae when pellet-treated catch basins were inspected sooner after treatment. Larval abundance was not evaluated in pellet-treated catch basins; however, concurrent inspections of untreated catch basins to evaluate the efficacy of Vectolex® CG detected larvae (and potentially pupae) throughout the evaluation period.

Table 5.6 Results of bioassays from catch basins treated with Altosid® ingot briquets and Altosid® pellets in 2003 compared to 2004. Emergence inhibition (EI) is corrected for untreated control mortality.

Material		n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
Altosid® ingot	2003	33	36.1	16.5	6.2%	0.0	100.0
	2004	14	81.6	100.0	8.3%	0.0	100.0
Altosid® pellet	2003	56	84.3	99.0	4.2%	0.0	100.0
	2004	17	51.9	58.5	10.1%	0.0	100.0

Table 5.7 Days after treatment with Altosid® ingot briquets or Altosid® pellets that bioassays were collected in 2003 and 2004.

Material		n	Mean	Median	SE	Min	Max
Altosid® ingot	2003	33	41.9	44.0	2.2	8.0	81.0
	2004	14	13.8	17.0	3.0	1.0	32.0
Altosid® pellet	2003	56	16.5	15.0	1.2	6.0	43.0
	2004	17	24.0	26.5	1.8	9.0	35.0

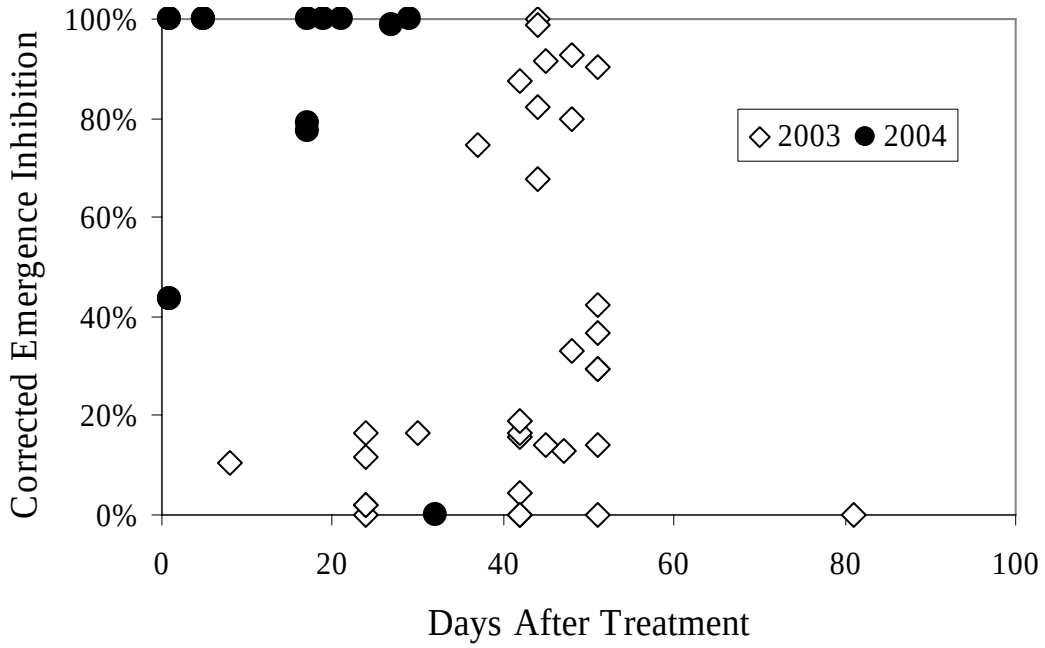


Figure 5.1 Results of bioassays from catch basins treated with Altosid® ingot briquets in 2003 and 2004 compared to the number of days after treatment that the bioassay was collected. Emergence inhibition (EI) is corrected for untreated control mortality.

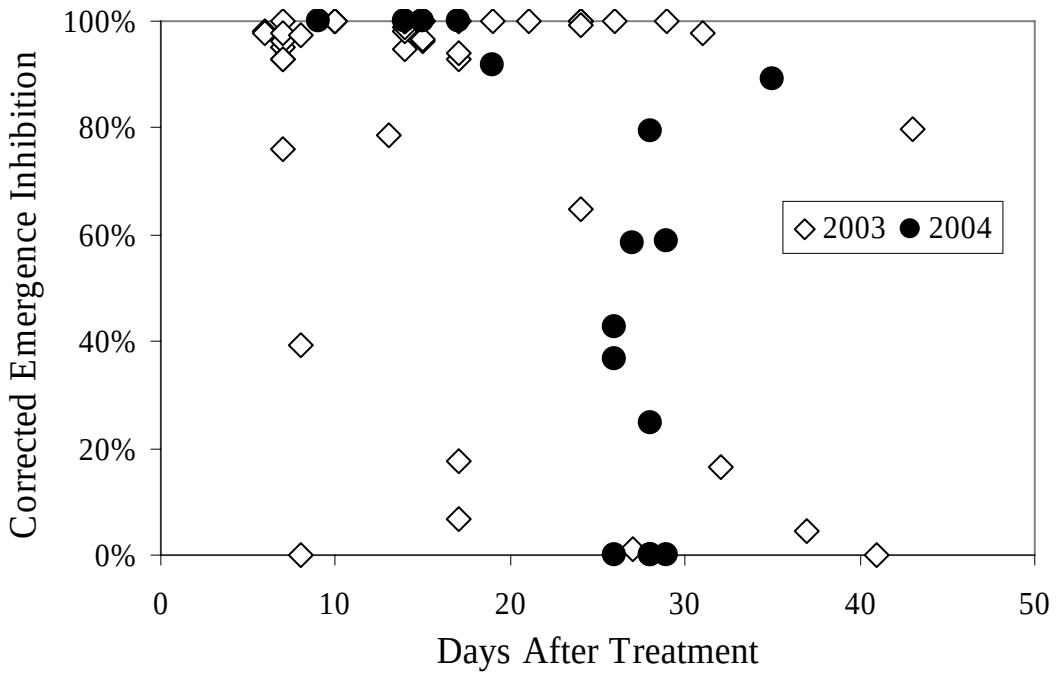


Figure 5.2 Results of bioassays from catch basins treated with Altosid® pellets in 2004 and 2003 compared to the number of days after treatment that the bioassay was collected. Emergence inhibition (EI) is corrected for untreated control mortality.

Vectolex® CG Granules in Catch Basins In 2003, results of preliminary tests of Vectolex® CG were promising. Larger scale tests were conducted in 2004. We included larval inspections of untreated catch basins to better understand larval distributions and abundance in the absence of treatment. Vectolex® CG effectively controlled mosquitoes in catch basins throughout the 28-day control period (Table 5.8) (Figure 5.3).

Table 5.8 Efficacy of Vectolex® CG granules in catch basins in 2004. Efficacy was calculated using Mulla's formula (Control n=4, Vectolex n=31).

		Days Post-treatment				
Treatment Group	Pre-treat	2 days	7 days	14 days	21 days	28 days
Control (larvae/dip)	8.17	5.50	78.75	7.50	15.33	10.0
Vectolex® CG (larvae/dip)	10.43	1.53	11.78	0.70	0.61	0.32
Efficacy	---	78.2%	88.3%	92.7%	96.9%	97.5%

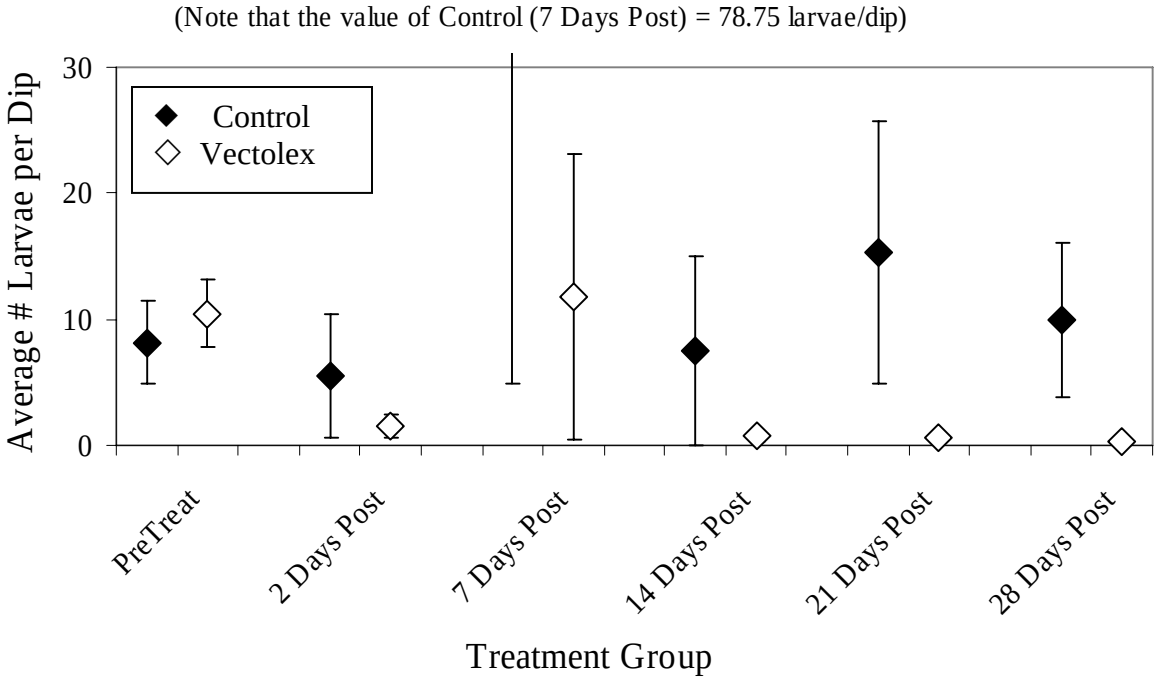


Figure 5.3 Mean larval counts from untreated catch basins and catch basins treated with Vectolex® CG in 2004. Error bars equal ± 1 standard error of the mean.

Vectolex® CG Granules in wetlands In 2003, results of preliminary tests of Vectolex® CG were promising. Larger scale tests were conducted in 2004. We included larval inspections of untreated wetlands to better understand larval distribution and abundance in the absence of treatment. Mosquito larvae were present in untreated wetlands throughout the 28-day duration of the test. Vectolex® CG effectively controlled mosquito larvae of all species for 28 days in wetlands (Table 5.9) (Figure 5.4). In 2005, we plan to increase use of Vectolex® CG to treat wetlands that remain wet longer than the typical five-day summer floodwater developmental period to control both floodwater and *Culex* mosquitoes breeding in these sites.

Table 5.9 Efficacy of Vectolex® CG granules in wetlands in 2004. Efficacy was calculated using Mulla's formula (Control n=7, Vectolex n=14).

		Days Post-treatment				
Treatment Group	Pre-treat	2 Days	7 Days	14 Days	21 Days	28 Days
Control (larvae/dip)	1.51	0.85	1.23	0.54	0.44	0.83
Vectolex® CG (larvae/dip)	2.06	0.00	0.21	0.06	0.02	0.05
Efficacy	---	100.0%	87.7%	91.3%	96.7%	95.6%

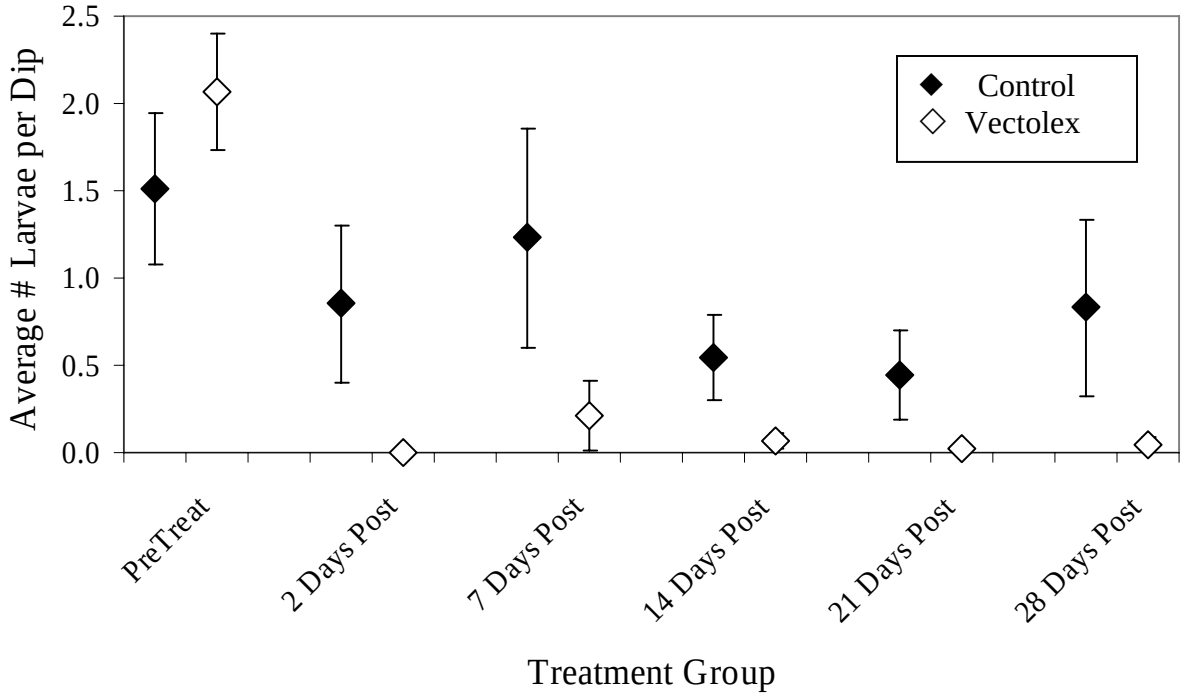


Figure 5.4 Mean larval counts from untreated wetlands and wetlands treated with Vectolex® CG in 2004. Error bars equal ± 1 standard error of the mean.

Cattail Mosquito Control (Altosid® XR-G sand) In 2003, Altosid® XR-G sand performed very well compared to Altosid® pellets. These tests were not repeated in 2004 as planned because larval cattail mosquito counts were too low. We hope to repeat the tests in 2005.

Pyrenone® 5+25 ULV applications (1.5 oz/acre; 0.00172 lb ai/acre) of Pyrenone® 5+25 controlled adult mosquitoes as effectively as Scourge® (1.5 oz/acre; 0.0035 lb ai/acre) in three tests, two at campgrounds and one near a farm (Table 5.10). Efficacy was evaluated using Mulla's equation (a correction that accounts for changes in the control as well as the treatment) that compares mean mosquito captures the first night of trapping (pre-treatment counts) with mean mosquito captures the second and third nights of trapping (post-treatment counts). Test materials were applied the evening of the second night of trapping; CO_2-traps placed 30 minutes after the treatments were completed at both treated locations and the untreated control location. High enough numbers of *Cx. tarsalis* were caught during the farm test to evaluate efficacy against *Cx. tarsalis* (Table 5.10). Pyrenone® 5+25 effectively controlled *Cx. tarsalis*.

Table 5.10 Efficacy of Scourge® and Pyrenone® against adult mosquitoes in two tests in June and July 2004 at the Ajawah, Guy Robinson, and Rum campgrounds and one test at a farm in July 2004. Counts of total mosquitoes and *Cx. tarsalis* from the farm test are summarized separately. Efficacy was calculated using Mulla's formula.

Test Site	Date	Treatment	Efficacy	Average mosquitoes per trap	SE
Guy Robinson	June 30		---	5,121	2,719
Campground	July 1	Scourge®	99.2%	76	43
	July 2		18.9%	6,317	2,103
Rum River	June 30	Untreated	---	3,655	1,347
Campground	July 1	Control	---	6,469	2,691
	July 2		---	5,562	2,472
Ajawah	June 30		---	7,768	1,592
Campground	July 1	Pyrenone®	98.3%	188	81
	July 2		51.9%	5,688	776
Guy Robinson	July 28		---	283	41
Campground	July 29	Scourge®	90.6%	47	13
	July 30		16.8%	199	22
Rum River	July 28	Untreated	---	384	139
Campground	July 29	Control	---	675	108
	July 30		---	325	106
Ajawah	July 28		---	1,018	114
Campground	July 29	Pyrenone®	99.4%	10	7
	July 30		74.1%	223	45
Farm Site	July 17		---	2,891	1,043
	July 18	Pyrenone®	98.7%	55	13
	July 19		86.5%	505	38
Jordan	July 17	Untreated	---	682	287
	July 18	Control	---	976	104
	July 19		---	880	248
				Ave. *Cx. tarsalis*	
Farm Site	July 17		---	25	8
	July 18	Pyrenone®	84.8%	3	1
	July 19		48.7%	25	17
Jordan	July 17	Untreated	---	5	2
	July 18	Control	---	4	0
	July 19		---	10	5

Pyrocide® 5+25 Pyrocide ® 5+25 is another adulticide that contains natural pyrethrins and does not have a crop restriction on its label. We tested Pyrocide ® 5+25 to gather data on another adulticide that we can legally use near crops. ULV applications (1.5 oz/acre; 0.00217 lb ai/acre) of Pyrocide ® 5+25 effectively controlled adult mosquitoes in one test at a campground (Table 5.11).

Table 5.11 Efficacy of Pyrocide® against adult mosquitoes in one test in July 2004 at the Guy Robinson and Rum campgrounds. Efficacy was calculated using Mulla's formula.

Test Site	Date	Treatment	Efficacy	Average mosquitoes per trap	SE
Guy Robinson	July 14		---	1,849	191
Campground	July 15	Pyrocide®	98.3%	40	10
	July 16		15.1%	984	807
Rum River	July 14	Untreated	---	1,036	314
Campground	July 15	Control	---	1,519	165
	July 16		---	901	154

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services and field staff conducted three aerial calibration sessions for dry granular materials during the 2004 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so each helicopter's dispersal characteristics are optimized. One session was held at the municipal airport in LeSueur, MN and two sessions were located in Lino Lakes, MN. Staff completed calibrations for four different operational and experimental control materials. In total, six helicopters were calibrated and each helicopter was configured to apply an average of three different control materials.

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

Helicopter Aerial Adulticide Trials (Scott's Helicopter Service, LeSueur, MN) Technical Service staff continued to work with our helicopter contractor to evaluate the Beecomist 360A Electric rotary atomizers. A single Beecomist unit was mounted on the Bell 47 helicopter and was properly calibrated. Using blank material (i.e. mineral oil), we conducted three separate evaluations to better understand the characteristics and capabilities of the system.

The goal of the first trial was to examine swath coverage and setback parameters. The helicopter flew at 150 feet parallel to a single line of 200-ft line of rotating impingers. Each impinger held

two Teflon-coated slides to collect droplets as swath passed through the collection zone. The helicopter started the first spray run directly upwind using a 200-ft offset and then continued to fly upwind at 50-ft intervals until droplets were collected. The helicopter made a total of six passes before droplets were noticed on indicators. It was theorized that the swath could be visually observed from the point of release through the target area but that was not the case. Since we are using Ultra Low Volume (ULV) technology, the minimal quantity released is observed leaving the spray unit but quickly dissipates to inhibit further visual tracking. Therefore, we lost the ability to identify which single pass or passes traveled through the target zone. Slides were microscopically analyzed and all impingers collected droplets in the proper size range (8-20 microns) for quality mosquito control.

A second trial was conducted to determine the proper setback needed to hit the target area. During this evaluation, the helicopter flew upwind and perpendicular to a 1,000 ft line of rotating impingers. This single pass flight would determine the precise setback distance for the swath to properly reach the target area. Relative to the environmental conditions and flight parameters, the swath was detected at 400 ft and droplets remained detectable on slides until 900 ft. This trial was duplicated with similar results.

The third trial was carried out to determine the effect of vegetation on swath coverage. This evaluation was conducted in rural woodlot which contained various densities of foliage. We set up four parallel lines of impingers utilizing four types of vegetation coverage. The four vegetation categories were: Heavy (dense mature tree canopy), Medium (smaller trees and shrubs), Light (sparse shrubs), and Open (short grass). The lines were approximately 200 ft apart. The helicopter was directed to follow the upwind border of the woodlot and make a single application pass. Technical Services intended to check the slides to assure coverage and adjust the setback distance if it was inadequate on the first pass. The pilot radioed that an active construction site would be directly under the helicopter on the next pass and it was decided to abort further passes even though the construction site would not have been treated.

These slides were microscopically analyzed and we did not collect any droplets from this aerial application. Additional site analysis revealed the most logical explanation for not detecting the swath droplets. There was a downwind elevation change of approximately 150 ft and the helicopter application height was most likely increased due to the large oak trees on the woodlot border. Adding these variables to our setback model, our setback distance was most likely inadequate for even the most distance droplet collectors and the effect of the vegetation was immeasurable. Further evaluations need to be completed on the effects of vegetation on aerial applications. Study sites with less terrain variables have been reviewed and this trial will be repeated in 2005 season.

If these 2005 aerial application trials are successful using blank materials, Technical Services tests will expand to include active control materials and live caged mosquitoes to incorporate efficacy measurements of these flights.

As we continue to gain experience on how to use this equipment to pinpoint adulticide aerial applications, we will continue to review literature and discuss various issues with experts in the field to further our knowledge. These evaluations will be incorporated into our decision-making

process to assist in the control of an emergency, wide-scale disease outbreak or exotic species infestation that were deemed necessary by the Centers for Disease Control (CDC), Metropolitan Mosquito Control Commission (MMCC), and MMCD guidelines.

Droplet Analysis of Ground-based Spray Equipment Technical Service staff optimized fifty-four Ultra Low Volume (ULV) insecticide generators (truck-mounted, ATV-mounted or handheld) using the KLD Model DC-III portable droplet analyzer. Staff use this analyzer to fine-tune equipment to produce an ideal droplet spectrum of 8-20 microns. Adjusting our ULV sprayers to produce a more uniform droplet range maximizes efficacy by creating droplets of the correct size to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and swath coverage throughout the District.

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

A new maintenance program was designed to standardize our truck-mounted ULV foggers. This program will create a specific three-man team which will use staff expertise to conduct maintenance on a District-wide level. It is our desire to have equipment that can be readily transferable to other regions and it will be at an equivalent operational level of their current equipment.

Database for Evaluating Equipment Performance The equipment database continued to develop to combine spray equipment performance with other fixed asset equipment databases. This expanded database extends the ability of the field staff to more easily access data about individual equipment (e.g. dates of evaluation, calibration data, equipment settings, evaluations of performance) and make better informed decisions regarding equipment. MMCD staff expanded data collection to include more comments from our seasonal staff and developed a rating system so everyone that uses a piece of equipment has the opportunity to record pertinent information. The rating system helped to standardize all of the six regional facilities equipment which in turn, improved staff ability to wisely replace the correct equipment on an organizational level.

Plans for 2005

Quality assurance processes will continue to be incorporated into the everyday operations of the regional process teams. Technical Services will continue to support field operations to improve their ability to complete their responsibilities most effectively. A primary goal will be to continue to assure the collection of quality information for all evaluations so decisions are based upon good data. We will continue to improve our calibration techniques to optimize all of our mosquito control equipment.

In 2005 MMCD plans to evaluate larger scale applications of Vectolex® CG (*B. sphaericus*) and Altosid® pellets to control *Aedes* and *Culex* mosquitoes breeding in wetlands. Tests of Altosid® XR-G sand against the cattail mosquito (*Cq. perturbans*) will be repeated if sampling for larvae in the spring detects sufficient larval densities. We also plan to repeat tests of Pyrocide® for adult mosquito control. Finally, we plan to continue evaluating the effectiveness of adulticide treatments against vectors of WNV or other mosquito-borne diseases.

References

Mulla's Formula

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

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

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

Chapter 6 Supporting Work

2004 Highlights

- Completed full roll-out of field data entry using PDAs
- Updated catch basin maps for WNV control. Wetland maps updated as needed
- Presented stormwater management implications for mosquito control to professional groups
- Dr. Karen Oberhauser continued tests of adulticide toxicity to monarch butterfly larvae
- Public opinion survey of metro residents found increased concern about mosquitoes and disease, including Lyme disease
- Requests for service from the public were high early in season
- Ran a radio PSA and contacted cities to get links to MMCD treatment schedules on city web pages

2005 Plans

- Computerize lab data entry to support field decision-making
- Update map data and start NWI pilot project
- Develop and disseminate stormwater information on how management designs affect mosquito production
- Continue adulticide nontarget impact studies

2004 Projects

PDA Field Data Entry

For the first time, all MMCD field data for larval inspections and control were entered using Palm OS-based Personal Digital Assistants (PDAs). Tests in 2002-3 had gone well, and the project was expanded to equip 178 inspectors with PDAs. Custom data entry software was developed to enter wetland inspections and ground treatments, catch basin treatments, container and tire inspections and removal, and adult mosquito and black fly surveillance. Field staff uploaded PDAs to local server databases daily, making data available for use in recording and planning.

Using PDA entry forms eliminated many kinds of errors and made it easier to check for others. Sample tracking sheets, printed from inspection data, made it easier to handle lab samples. Work has begun on setting up data entry systems for the lab to speed field access to identification results. Staff are also developing new pre-programmed reports to take advantage of the daily data available District-wide.

Eliminating the cost of the data entry service previously used for paper forms will pay for the PDA hardware in about 3 years.

Mapping

Staff continued work on mapping locations of stormwater catch basins for WNV control, using orthorectified aerial photos and metro area streets, both obtained through the MetroGIS project at the Metropolitan Council.

Efforts in 2004 focused on determining which catchbasins would hold water that could be mosquito habitat. The proportion constructed such that they hold water varies widely from city to city and in developed areas within cities.

Staff continued to update digitized wetlands and wooded areas, and have mapped wetlands in the western Carver County area recently added to the District. Although we hoped to use new aerial photography being flown by the Metropolitan Council, the spring flight could not be completed due to weather problems and will be reflown in 2005.

Digital wetland files have been provided on request to other units of government, including the UM Dept. of Biosystems and Ag. Eng., MN-DNR Waters, Lower St. Croix Watershed Management Org., Rice Creek Watershed District, and the city of Lino Lakes. MMCD continues to participate in MetroGIS, serving on the Coordinating Committee and working with local governments on addressing issues. We are continuing work with USFWS, Metro Council Envt. Services, MN-DNR and Ramsey Conservation District on how our data can be used in an update of the National Wetlands Inventory in the metro area.

Stormwater Management and Mosquitoes

Many local units of government and construction sites are changing the ways they handle stormwater in order to meet federal requirements. However, public concerns about mosquitoes and West Niles virus have led to questions about wetlands and storm water management structures. MMCD staff embarked on a major outreach program in 2004 to provide information to stormwater and wetland designers on mosquito biology and control to help reduce problems and answer public concerns when designing restorations. A presentation describing types of mosquitoes, habitats, the importance of hydroperiod, and examples of storm water structures was developed, and can be viewed on the MMCD web site at
http://www.mmcd.org/2004MosqAndWetlands ForWeb_files/frame.htm
A fact sheet summarizing the presentation is also available (Storm water management and mosquitoes draft.doc).

Staff members made presentations to the following water management groups:

Feb. 12	Carver Co. Stormwater Infiltration Workshop (40 developers and engineers)
Feb. 26	"Healthy Ponds" product sales staff training, Bioverse, Inc. Inver Grove Heights. (12 sales and marketing people, wetland management products)
Mar. 5	Minn. Erosion Control Assn. Annual Conference (350 stormwater management professionals from 5-state area)
Mar. 23	Minn. Water 2004 – Policy & Planning Conference (130 state and local govt. staff)
Apr. 16	Emmons & Olivier Engineering "Lunch Talk" (15 engineers)
Apr. 22	Met with Friends of Mississippi River watershed education coordinator
May 14	Minn. Public Works Assn. annual conference (150 public works coordinators and engineers)
May 19	Solid Waste Management Association meeting, St. Paul (12 Minnesota members met to discuss implications for solid waste management issues)
June 15	Dakota County Health and Environmental Services
June 16	Met with City of Richfield Public Works employees, visited and sampled city grit chambers
June 21	Public Works Forum hosted by Ramsey/Washington Watershed District (15 public works directors from Ramsey and Washington counties)
July 20	Society of Wetland Scientists annual meeting (120+ wetland resource specialists and designers, US & Canada) – NR 30 min presentation

Sept. 29	MnDOT Hydraulics Workshop (45 engineers)
Oct. 25	Met with Ramsey County Soil & Water Cons. District staff and a townhome owners board in Roseville regarding a proposed wetland restoration and mosquito concerns
Oct. 26	Water Resources Conference, Soc. of Civil Engineers (300 engineers and water resource specialists, Minnesota)

Nontarget Studies

As requested by the Technical Advisory Board in previous years, MMCD has continued to sponsor or assist in efforts to evaluate possible nontarget effects of adulticides. The MMCD 2003 Operational Review has a summary of previous work, including literature on resmethrin and sumithrin, toxicity to loosestrife beetles, exposure estimates for loosestrife beetles, and trap catches of nontarget flying insects.

In 2003 a TAB subgroup (Karen Oberhauser, Roger Moon, Nancy Read, and Stephen Manweiler) designed tests in cooperation with Karen Oberhauser's monarch butterfly lab that showed that permethrin, as applied by MMCD as a barrier treatment, caused mortality to monarch (*Danaus plexippus* (L.)) larvae that fed on treated leaves. These studies were reported at the February, 2004, TAB meeting. TAB members agreed that the subgroup should continue studies, and Steve Hennes joined the group.

Monarch Butterfly Toxicity Testing, 2nd Year Two experiments involving resmethrin ULV fog were done in 2004: exposure of caged insects to ULV resmethrin, and bioassay of ULV resmethrin residue on leaves. MMCD coordinated with Dr. Oberhauser's lab staff to arrange treatments and is providing some funding to cover expenses and lab staff time for these studies.

Trial 1 (July 1, 2004) – Cages of monarch larvae on milkweed leaves, plus cages of mosquitoes, were placed at 25, 50 and 75 ft on either side of ULV fog truck path in 2 transects (6 cages each) at a campground in Anoka County. Wind was perpendicular to sprayer path, so "upwind" and "downwind" exposures were clearly defined. At 3 days after the exposure, most untreated control or upwind larvae were still alive, but about 2/3 of larvae on the downwind side of the spray path died. Distance from the spray path or larval instar (1st or 3rd) did not make a measurable difference. Most caged mosquitoes survived in the controls, but only ¼ survived upwind and none survived downwind from the spray path within 18 hours. These results indicate monarch larvae are at risk of being killed if they are within 75 ft of evening resmethrin fog applications although this risk is much lower than mosquito mortality.

Trial 2 (July 29, 2004) – Similar to Trial 1, but larvae were exposed in vertical or horizontal cages or on open plants, and exposed plants were fed to larvae the next day (residue test). Wind was oblique to spray path, so "downwind" was not as clearly defined. Overall larval mortality in downwind area was about 1 in 3. Survival tended to be higher for larvae in cages than those on open plants. Unexposed larvae placed on exposed leaves the day after treatment had survived at higher rates than those that were on the plants during the treatment, but lower rates than those in the cages. Adult monarchs were also exposed in cages; most survived upwind, and about ½ survived 75 feet downwind. Of caged mosquitoes included in this trial, 4/5 of those in control cages survived, about half survived upwind, and none survived downwind within 18 hours.

These results indicated that the level of larval mortality downwind may vary with wind direction and speed, that adult monarchs may be affected by resmethrin spray, that residue from evening spraying may persist at potentially harmful levels into the following day and that adult mosquitoes are much more susceptible to resmethrin spray than monarch larvae or adults.

Additional studies are designed to more clearly understand how 2003 and 2004 results relate to population level risk. Population level risk involves the overlap in time and space between the non-target organism (monarch) and risk agent (adulticide), the probability of a toxic effect on non-target organisms exposed to the toxic agent and the proportion of the population exposed to the toxic agent.

Four additional studies have been planned for 2005:

1. Oviposition choice – will monarch females lay eggs on treated leaves? An experimental protocol was developed in 2004.
2. Effects of environmental factors on pyrethroid persistence on leaves. A protocol was developed in 2004. Tests will determine how exposure to UV light and other factors affects the persistence of both resmethrin and permethrin.
3. Toxicity of resmethrin ULV spray treatments to monarch eggs. Since exposure to resmethrin could occur during the egg stage, tests will be conducted to determine the effects of exposure to the spray using eggs at various time intervals after oviposition.
4. Spatial overlap of milkweed distribution with areas treated. Some scouting was done in one of the parks used to collect milkweed to compare the recorded permethrin treatment path and locations of milkweed stands. A larger study using land use or land cover information for the metro area in conjunction with a sampling design is being planned for 2005. Based on the 2004 results, it should address both resmethrin and permethrin treatments.

Previous Larvicide Nontarget Impact Studies We continue to get requests for earlier publications, including reports on Wright County Long-term Study and other studies on *Bti* and methoprene done under the direction of the Scientific Peer Review Panel assembled by MMCD. Reports were sent as requested to the following:

King Co. Parks and Rec., Seattle, WA
Dept. of Fisheries and Wildlife, University of Idaho
Dr. Jacques Boisvert, University of Quebec, Trois-Riviers

No further progress has been made on assembling a peer-reviewed journal publication from the 1997-1998 results of the Wright County *Bti* and methoprene non-target study.

Public Opinion Survey

MMCD has conducted a series of public opinion surveys to help assess customer awareness, satisfaction and concerns and track changes over time. From 1994-2000 surveys were done every 2 years; when year-to-year changes were found to be small, the time between surveys was increased to 4 years. This year's telephone survey of 404 metro-area residents was done July 7 - Aug. 6, 2004 by C. J. Olson Inc. The survey uses standard polling techniques (i.e., random-digit sample, participant chosen by most recent birthday). Results of can be generalized to the population of the 7-county metro area with a margin of error of ± 5%.

Most residents felt it is important to control the mosquito and gnat populations in the metro area. Importance of controlling mosquitoes increased.

- 89% 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), significantly higher than in previous years (Figure 6.1).
- 60% rated gnat control important, similar to previous years (range 58% to 64%)

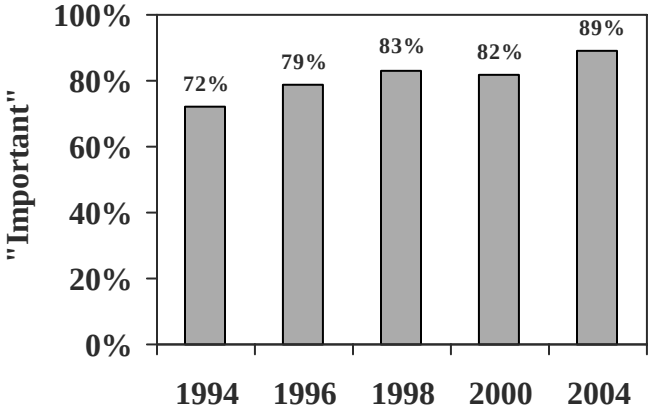


Figure 6.1 "How important do you feel it is to control the mosquito population in the metro area?" Proportion of respondents replying 5, 6 or 7 given scale where 1 is not at all important, 4 is neutral, and 7 is very important.

Respondents reported increased effects of mosquitoes on their lives.

- 72% said mosquitoes in their neighborhood this year decreased their enjoyment of the outdoors very often or somewhat often. This is a large increase from previous years (Figure 6.2) and may reflect both West Nile virus concerns and high mosquito populations in early 2004.

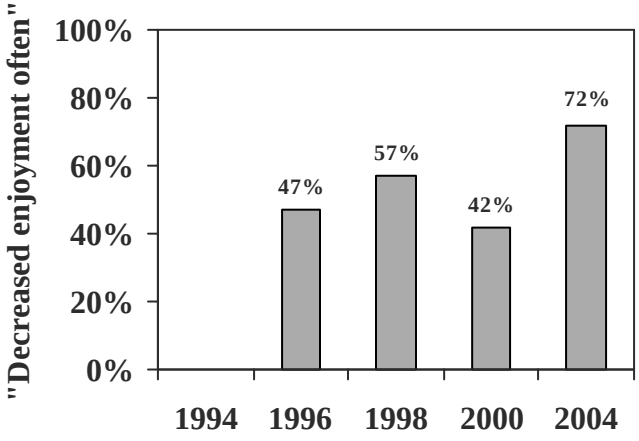


Figure 6.2 "In your neighborhood this year, how often have mosquitoes decreased your enjoyment of the outdoors? Would you say very often, somewhat often, a few times, or never?" Proportion of respondents replying somewhat or very often.

- Repellent use jumped to 84% in 2004, up from 68% in 2000 (Figure 6.3).

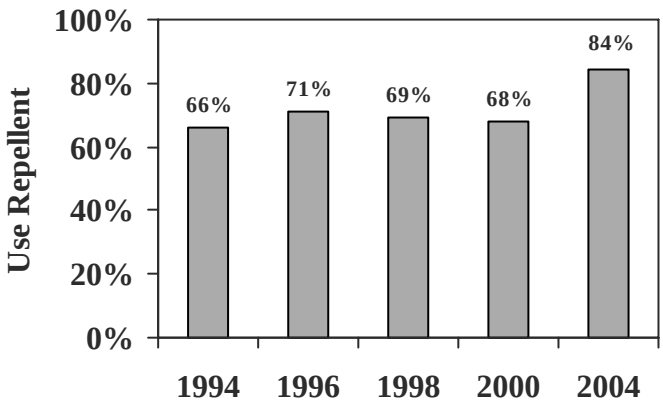


Figure 6.3 "Please indicate which of the following methods or products you use to repel or control mosquitoes or gnats. Do you use . . . Repellent?"

Yard spray, fog or powder use also increased to 29% in 2004, up from 18% in 2000. Citronella candle use (43%) and paid pest control (2%) were about the same, and 4% reported using mosquito traps. Median $ spent on control or repellent was $15, up from $10 in 2000.

Most respondents were aware that mosquitoes can transmit disease. Those aware that metro-area mosquitoes can transmit disease (96%) was up significantly from 1994 (80%), the most recent time that question was asked. Those reporting checking their yard weekly to clean out containers (64%) were also up from previous years (Figure 6.4).

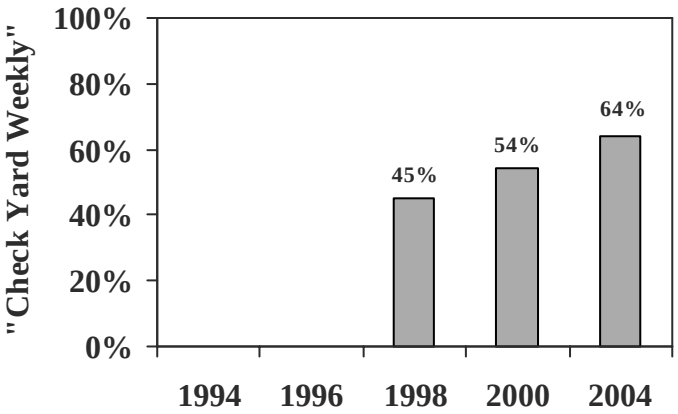


Figure 6.4 "About how often do you check your yard and remove or clean out water-holding containers that might breed mosquitoes that carry disease? Would you say weekly, monthly, once a year, or never?"

Those aware of MMCD's activities to prevent Lyme disease increased to 30% in 2004, up from 24% in 2000.

Most respondents were aware of mosquito control activities.

- 63% reported being aware of "a local government agency called the Metropolitan Mosquito Control District", similar to previous years (range 61% to 66%). Men were more likely to agree they had heard of MMCD than were women (69% vs. 59%).
- An additional 17% were aware of larval or adult control, although not of MMCD.

Sources of information included TV, major newspapers, radio, contact with employees or seeing trucks, local newspapers, presentations and fairs, and MMCD's web site/e-mail. Those aware of MMCD listing TV news as a source of information increased from 68% to 77%. Respondents listing local papers or newsletters or seeing trucks or employees also increased.

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

- 74% agreed "MMCD provides an important service to the community"
- 62% agreed "MMCD is a good buy for the money"
- 63% agreed "Mosquito and gnat control should be increased" (Figure 6.5), 11% disagree.
- 46% agreed "MMCD funding should be increased," 17% disagree
- 57% were satisfied with MMCD's efforts to control mosquitoes, up from 51% in 1998; 15% were dissatisfied.

There was a decrease in those agreeing that "MMCD is a good buy" (down to 62% from 67% in 2000), which may be related to the cost given ($9.70 per $160,000 house in 2004, vs. $5.40 per $120,000 house in 2000). However, the number agreeing that "Control should be increased" was up significantly to 63% from 56% in 2000. Those reporting frequent problems with mosquitoes are more likely to support increased control, and may be related to this increase.

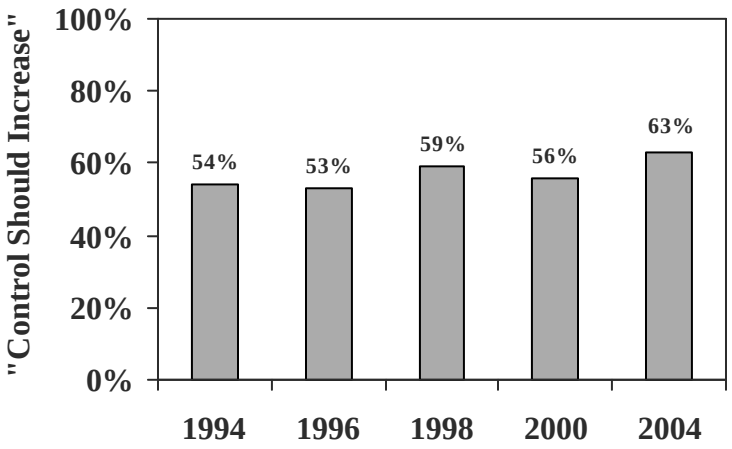


Figure 6.5 "If 1 is strongly disagree, 4 is neutral, and 7 is strongly agree, please indicate the extent to which you agree with the following statement: The level of mosquito and gnat control should be increased." Respondents indicating 5, 6 or 7 on agreement scale.

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

- 12% agreed with a statement suggesting larval control harms the environment or human health, lower than 2000 (18%). 37% disagreed, 51% replied neutral or don't know.
- 12% agreed with a statement suggesting adult control harms environment or health, significantly lower than 2000 (Figure 6.6). 40% disagreed, 48% replied neutral or don't know.
- 60% agreed "Spraying has some risk, but the benefit of a professionally-done spray program outweighs the risk," unchanged from previous years (range 57% to 63%).

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

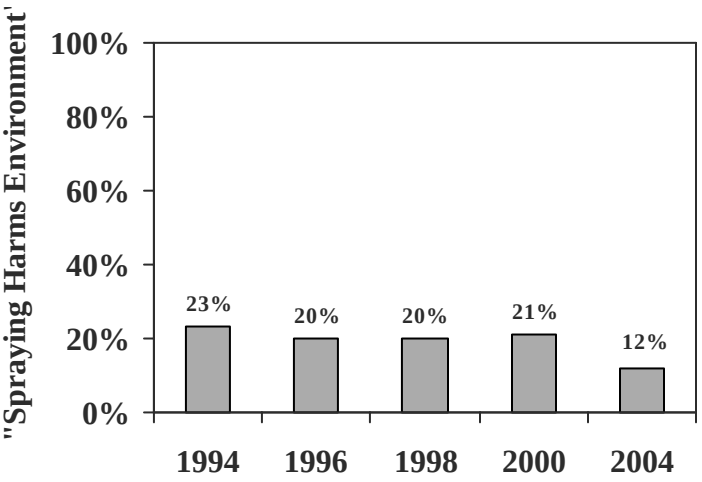


Figure 6.6 "If 1 is strongly disagree, 4 is neutral, and 7 is strongly agree, please indicate the extent to which you agree with the following statement: Spraying to control adult mosquitoes at parks, events, and wooded areas is harmful to the environment." Respondents indicating 5, 6 or 7 on agreement scale.

Public Information

Notification The District continues to post daily adulticide information on its website (www.mmcd.org) and on its "Bite Line" (651-643-8383), a pre-recorded telephone message interested citizens can call to get the latest information on scheduled treatments. The District also publishes a three column by nine-inch ad in local newspapers each spring advising citizens how they can find out where and when adulticiding will take place throughout the season. The daily public meetings attempted in 2003 were discontinued because no metro citizens chose to attend. In place of the meetings, the District developed a public service announcement that was aired on local radio stations, directing people to its web or phone notification services. Staff also contacted cities to encourage them to put a link on their web sites to MMCD's mosquito treatment notices.

Direct email notification In 2004 the District continued direct email notification of citizens who requested advance notification. A local company, GovDocs, houses and maintains lists of subscribers to this service. GovDocs was chosen for its experience in managing direct email notification of snow emergencies in the city of St. Paul. Citizens can subscribe by visiting MMCD's website and are offered a choice from among the eight lists published daily by the District (North Hennepin, South Hennepin, Anoka, Dakota, Carver, Scott, Ramsey, and Washington facilities). Email notices are identical to notices posted each day on the District's website. Subscriptions to this service increased to 732 during mid-summer 2004, compared to 440 in mid-summer of 2003.

Calls Requesting Service Calls reporting annoyance generally followed the seasonal pattern shown by sweep net counts for human-biting mosquitoes (Figure 6.7 and Chapter 2). Increases in calls followed major floodwater mosquito broods, indicated by larvicide activity, and were in turn followed by adulticide activity (Figure 6.8 and Chapter 3).

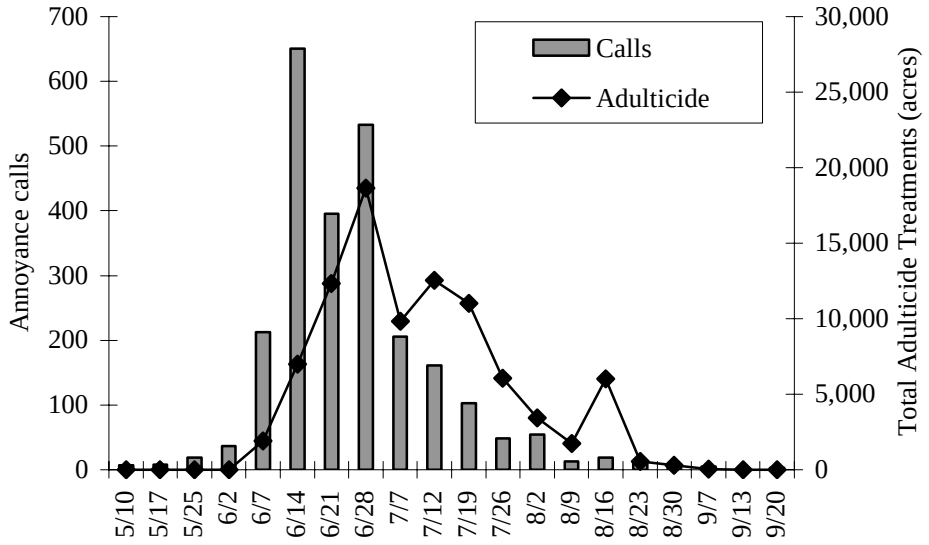


Figure 6.8 Calls requesting annoyance service and acres treated with adulticides by week, 2004.

Other calls received are listed in Table 6.1. A total of 3,469 calls were recorded during 2004, down from 4,185 calls recorded during 2003. Lower than average mosquito levels during late summer precipitated fewer calls, and lower West Nile virus activity produced less anxiety among District citizens. Calls requesting a dead bird pick-up for WNV testing were not included in this table; most of these were directed to the Minnesota Department of Health and referred back to MMCD if action was needed. Requests for limited or no treatment continued the downward trend that coincided with the arrival of West Nile virus in Minnesota.

Table 6.1. Citizen calls per year (2004 compared to three previous years) tallied by service request.

	# Calls/Year			
Caller Concern	2004	2003	2002	2001
Check a breeding site	984	1516	1307	1050
Request adult treatment	2506	2714	3062	2598
Public event, request treatment	135	132	171	115
Request tire removal	255	236	321	252
Request or confirm limited or no treatment	38	60	190	199

2005 Plans

Additional software will be developed to expand PDA field data entry and improve data reporting. A similar streamlining of lab data entry practices will be completed, allowing rapid access to data for decision-making.

Staff will provide wetland map data through Metro GIS for distribution to any users through a web interface. Work will begin on the cooperative project with US Fish and Wildlife and Metropolitan Council Environmental Services on updating the National Wetlands Inventory.

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

Nontarget impact studies of adulticides will continue as designed by TAB subgroup members and carried out in cooperation with Dr. Karen Oberhauser's lab.

Appendices

APPENDIX A Average Number of Common Mosquito Species Collected per Night in New Jersey Light Traps 1965-2004

APPENDIX B Mosquito Biology

APPENDIX C Description of Control Materials

APPENDIX D 2004 Control Materials: AI Identity, Percent Active Ingredient (AI), Per Acre Dosage, AI Applied Per Acre and Field Life.

APPENDIX E Acres Treated with Control Materials Used by MMCD for Mosquito and Black Fly Control for 1996-2004. The actual geographic area treated is smaller because some sites are treated more than once.

APPENDIX F Control Material Labels

APPENDIX G Technical Advisory Board Meeting Notes, February 16, 2005

APPENDIX A Average Number of Common Mosquito Species Collected per Night in New Jersey Light Traps 1965-2004

Year	*Ochlerotatus abs/punc*	*Aedes cinereus*	*Ochlerotatus sticticus*	*Ochlerotatus trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Coquillettidia perturbans*	All species	Average Rainfall
1965	1.03	0.77	0.19	0.08	89.00	4.70	1.43	111.74	27.97
1966	1.29	0.13	0.00	0.02	33.70	0.69	17.66	61.78	14.41
1967	0.64	0.24	0.65	0.12	75.40	1.61	14.37	101.55	15.60
1968	0.14	1.60	0.04	0.77	119.30	1.25	2.43	136.54	22.62
1969	0.70	0.19	0.02	0.17	19.90	0.65	4.27	30.82	9.75
1970	0.17	0.57	0.06	0.33	73.10	0.76	2.78	83.16	17.55
1971	0.69	0.55	0.15	0.33	52.10	0.28	3.51	62.93	17.82
1972	0.98	2.13	0.41	0.35	124.50	0.39	8.12	142.35	18.06
1973	1.29	0.70	0.11	0.06	62.20	0.41	25.86	95.14	17.95
1974	0.17	0.32	0.14	0.12	30.30	0.15	7.15	40.09	14.32
1975	0.28	0.63	0.44	0.17	40.10	6.94	4.93	60.64	21.47
1976	0.10	0.05	0.04	0.00	2.30	0.23	4.42	9.02	9.48
1977	0.20	0.16	0.01	0.02	17.50	2.44	1.16	25.17	20.90
1978	0.17	0.74	0.33	0.24	51.40	1.35	1.04	62.63	24.93
1979	0.07	0.24	0.10	0.21	18.30	0.13	4.39	25.59	19.98
1980	0.02	0.26	0.33	0.77	47.40	0.25	13.87	65.28	19.92
1981	0.01	0.10	0.25	1.03	57.00	0.44	3.98	65.30	19.08
1982	0.01	0.21	0.08	0.03	23.10	0.15	8.63	34.60	15.59
1983	0.03	0.24	0.08	0.14	55.60	0.58	8.72	69.71	20.31
1984	0.08	0.16	0.14	0.35	65.40	1.82	1.60	92.42	21.45
1985	0.05	0.17	0.05	0.02	21.20	0.21	5.07	28.51	20.73
1986	0.40	0.23	0.12	0.03	25.80	0.92	2.61	34.30	23.39
1987	0.00	0.11	0.01	0.15	29.10	0.96	3.37	37.77	19.48
1988	0.01	0.51	0.00	0.00	21.00	0.72	1.40	27.28	12.31
1989	0.66	1.60	0.01	0.12	14.40	1.01	0.12	26.35	16.64
1990	0.83	11.37	1.22	0.34	125.80	2.65	0.99	159.45	23.95
1991	1.17	2.67	1.55	0.51	90.80	1.37	6.03	14.44	26.88
1992	0.09	0.09	0.02	0.24	36.00	0.49	38.31	79.81	19.10
1993	0.54	0.50	1.01	1.50	71.20	1.20	34.10	120.45	27.84
1994	0.70	0.47	0.46	0.33	29.70	0.15	68.45	104.52	17.72
1995	2.13	1.62	0.25	0.40	129.01	0.37	48.28	193.26	21.00
1996	0.82	0.62	0.58	0.47	25.82	0.09	40.65	72.05	13.27
1997	1.53	1.91	0.19	4.46	72.66	0.10	48.47	132.48	21.33
1998	1.86	0.66	0.08	0.54	53.93	0.05	36.16	89.89	19.43
1999	2.48	0.93	0.31	0.37	60.73	0.04	28.71	82.64	22.41
2000	0.38	0.30	0.00	1.33	56.61	0.15	20.61	89.85	17.79
2001	1.20	2.65	1.38	6.05	76.77	0.23	10.93	114.23	17.73
2002	0.30	1.07	0.07	2.18	92.77	0.39	5.07	108.35	29.13
2003	6.54	1.69	1.00	2.31	76.80	0.17	51.13	149.75	16.79
2004	.44	1.79	.53	.72	29.91	.14	11.39	48.34	21.65

APPENDIX B Mosquito Biology

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

Disease Vectors

Ochlerotatus triseriatus Also known as the eastern treehole mosquito, *Oc. triseriatus*, is the vector of La Crosse encephalitis. It breeds in tree holes and artificial containers, especially discarded tires. The adults are found in wooded or shaded areas and stay within ¼ to ½ miles from where they emerged. They are not aggressive biters and are not attracted to light. Vacuum aspirators are best for collecting this species.

Culex tarsalis *Culex tarsalis* is the vector of western equine encephalitis (WEE) and a vector of West Nile virus (WNV). In late summer, egg laying spreads to temporary pools and artificial containers, and feeding shifts from birds to horses or humans. MMCD monitors this species using New Jersey light traps and CO_2 traps. WEE and WN viral activity is monitored by testing blood from sentinel chicken flocks.

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

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

Floodwater Mosquitoes

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

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

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

Cattail Mosquito

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

Permanent water species

Other mosquito species not previously mentioned breed in permanent and semipermanent sites. These mosquitoes comprise the remaining *Anopheles, Culex,* and *Culiseta* species. These mosquitoes are multi-brooded and lay their eggs in rafts on the surface of the water. The adults prefer to feed on birds or livestock but will bite humans. The adults overwinter in places like caves, hollow logs, stumps or buildings. The District targets four *Culex* and one *Culiseta* species for surveillance and/or control.

APPENDIX C Description of Control Materials

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Bacillus sphaericus Valent Biosciences-VectoLex® CG

Bs corn cob may be experimentally applied in all types of *Culex* mosquito breeding. *Bs* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical experimental applications are by helicopter in sites which are greater than three acres in size at a rate of 5-10 lbs per acre. In sites less than three acres, *Bs* is applied to pockety sites with cyclone seeders or power back packs at rates of 7 lbs per acre. This product is also being evaluated as a control material for catch basin applications..

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

Agnique liquid is applied directly to small mosquito breeding sites to control pupae. Experimental treatments are applied when mosquito larvae are no longer actively feeding or affected by other larvicides. Application rates are 0.2-0.3 gals per acre. Agnique® is applied by hand using a squirt bottle or pressurized sprayer to the surface of the water creating a thin self-spreading film layer and applications lowers the surface tension of the water's surface. This loss of surface tension does not allow the pupae to easily access the water's surface and breathe without significant effort. Therefore, pupae will eventually drown and control is obtained.

Permethrin Clarke Mosquito Control Products-Permethrin 57% OS

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

Adult control is initiated when MMCD surveillance (sweep net and light trap collections) indicates nuisance populations of mosquitoes, when employee conducted landing rate collections document high numbers of mosquitoes, or when a large number of citizen complaints of mosquito annoyance are received from an area. In the case of citizen complaints, MMCD staff evaluates mosquito levels to determine if treatment is warranted. MMCD also treats functions open to the public, and public owned park and recreation areas upon request and at no charge if the event is not-for-profit.

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

Resmethrin Bayer-Scourge® 4+12

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

Sumithrin Clarke-Anvil® 2+2

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

Natural Pyrethrin Bayer-Pyrenone® 25-5

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

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

Pyrocide is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrocide is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand held cold fog machines that enables the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrocide is applied at a rate of 1.5 ounces of mixed material per acre (0.00217 lb active ingredient per acre). Pyrocide is a non-restricted use compound.

APPENDIX D 2004 Control Materials: AI Identity, Percent Active Ingredient (AI), Per Acre Dosage, AI Applied Per Acre and Field Life.

Material	AI	Percent AI	Per acre dosage	AI per acre (lbs)	Field life (days)
Altosid® briquets [a]	Methoprene	2.10	220	0.4481	150
			330	0.6722	150
			440	0.8963	150
			1*	0.0020*	150
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063	30
			4 lb	0.1700	30
			0.0077 lb* (3.5 g)	0.0003*	30
Altosid® SR-20 [b]	Methoprene	20.00	20 ml	0.0091	10
Altosid® XR-G	Methoprene	1.50	5 lb	0.0750	20
Altosand	Methoprene	0.05	5 lb	0.0025	10
Vectobac® G	*Bti*	0.20	5 lb	0.0100	1
			8 lb	0.0160	1
Vectolex® CG	*Bs*	7.50	8 lb	0.6000	7-28
			0.0077 lb* (3.5 g)	0.0006*	7-28
Permethrin 57%OS [c]	Permethrin	5.70	25 fl oz	0.0977	5
Scourge® [d]	Resmethrin	4.14	1.5 fl oz	0.0035	<1
Anvil® [e]	Sumithrin	2.00	3.0 fl oz	0.0035	<1
			1.5 fl oz	0.00175	<1
Pyrenone® [f]	Pyrethrins	2.00	1.5 fl oz	0.00172	<1
Pyrocide® [g]	Pyrethrins	2.50	1.5 fl oz	0.00217	<1

[a] 44 g per briquet total weight (220 briquets=21.34 lb total weight)
[b] 1.72 lb AI per 128 fl oz (1 gal); 0.45 lb AI per 1000 ml (1 liter)
[c] 0.50 lb AI per 128 fl oz (1 gal) (product diluted 1:10 before application, undiluted product contains 5.0 lb AI per 128 fl oz) [d] 0.30 lb AI per 128 fl oz (1 gal) [e] 0.15 lb AI per 128 fl oz (1 gal)
[f] 0.147 lb AI per 128 fl oz (1 gal) (product diluted 1:1.5 before application, undiluted product contains 0.367 lb AI per 128 fl oz)
[g] 0.185 lb AI per 128 fl oz (1 gal) (product diluted 1:1 before application, undiluted product contains 0.37 lb AI per 128 fl oz)
* Catch basin treatments—dosage is the amount of product per catch basin.

APPENDIX E Acres Treated with Control Materials Used by MMCD for Mosquito and Black Fly Control for 1996-2004. The actual geographic area treated is smaller because some sites are treated more than once.

Control Material	1996	1997	1998	1999	2000	2001	2002	2003	2004
Altosid® XR Briquet 150-day	422	501	371	533	533	589	628	323	398
Altosid® XR Briquet 90-day	0	0	961	0	0	0	0	0	0
Altosid® Sand-Products	712	1,096	1,868	3,968	786	1,889	1,822	0.5	0
Altosid® Pellets 30-day	10,654	8,851	10,432	13,775	11,121	14,791	16,521	18,458	19,139
Altosid® Pellets Catch Basins	0	0	0	0	0	0	0	135,978	148,023
Altosid® SR-20 liquid	565	1,645	529*	355	29	91	51	33	0
Bti Corn Cob granules	68,355	106,755	113,539*	118,733	84,521	90,527	202,875	113,198	166,299
Bti Liquid Black Fly (gallons used)	3,025	5,445	4,233	4,343	821	4,047	3,169	3,408	2,813
Permethrin Adulticide	5,914	6,340	6,164	4,865	4,066	3,444	5,734	6,411	8,292
Resmethrin Adulticide	120,472	106,065	65,356	51,582	42,986	41,311	43,302	68,057	71,847
Sumithrin Adulticide	0	0	0	0	0	8,423	32,230	14,447	15,508

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

PRECAUTIONARY STATEMENTS
Hazards To Humans & Domestic Animals

CAUTION

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

Environmental Hazards

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

DIRECTIONS FOR USE

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

STORAGE AND DISPOSAL

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

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

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

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

READ ENTIRE LABEL FOR DIRECTIONS

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

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

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

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

ULTRA LOW VOLUME APPLICATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IMPORTANT: READ BEFORE USE

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

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

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

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

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

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

ANVIL® 2+2 ULV

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

CLARKE

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

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

ENVIRONMENTAL HAZARDS

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

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

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

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

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

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

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

NET CONTENTS

LOT NO.

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

* Equivalent to 1.60% (butylcarbityl) (6-propylpiperonyl) ether and 40% related compounds
** Contains a petroleum distillate
Contains 0.15 pounds of Technical SUMITHRIN®/Gallon and 0.15 pounds Technical Piperonyl Butoxide/Gallon

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

KEEP OUT OF REACH OF CHILDREN
CAUTION

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

STATEMENT OF PRACTICAL TREATMENT

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

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

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

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

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

DISTRIBUTED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.

159 N. GARDEN AVENUE • ROSELLE, ILLINOIS 60172

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

GROUND ULV APPLICATION

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

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

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

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

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

AERIAL APPLICATION

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

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

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

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

STORAGE & DISPOSAL

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

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

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

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

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

12/11/00

PYRENONE® 25-5

PUBLIC HEALTH INSECTICIDE

Specimen Label

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

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

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

KEEP OUT OF REACH OF CHILDREN

CAUTION

See Rear Panel For Additional Precautions

EPA REG. NO. 432-1050 EPA EST. NO.

NET CONTENTS:

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

FIRST AID

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

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

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

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

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

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

PRECAUTIONARY STATEMENTS

Hazards To Humans & Domestic Animals

CAUTION

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

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

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

Environmental Hazards

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

DIRECTIONS FOR USE

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

STORAGE AND DISPOSAL

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

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

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

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

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

SPACE AND/OR CONTACT USE AREAS:

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

OUTDOOR USE AREAS:

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

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

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

INDOOR USE AS A SPACE SPRAY, DILUTED:

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

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

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

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

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

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

USE IN MOSQUITO CONTROL

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

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

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

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

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

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

IMPORTANT: READ BEFORE USE

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

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

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

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

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

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

PYROCIDE® Mosquito Adulticiding
Concentrate for ULV Fogging 7396

Recommended for use by Commercial or Governmental Mosquito Control Personnel

	ACTIVE INGREDIENTS:	
	Pyrethrins	5.00%
*	Piperonyl butoxide, Technical	25.00%
**	OTHER INGREDIENTS	70.00%
		100.00%

* Equivalent to 20.00% (butylcarbityl) (6-propylpiperonyl) ether and 05.00% related compounds.
** Contains petroleum distillate
PYROCIDE® - Registered trademark of McLaughlin Gormley King Co.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
IF SWALLOWED:	▪ Immediately call a poison control center or doctor. ▪ Do not give any liquid to the person. ▪ Do not induce vomiting unless told to do so by a poison control center or a doctor. ▪ Do not give anything by mouth to an unconscious person.
IF IN EYES:	▪ Hold eye open and rinse slowly and gently with water for 15-20 minutes. ▪ Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. ▪ Call a poison control center for treatment advice.
IF ON SKIN OR CLOTHING:	▪ Take off contaminated clothing. ▪ Rinse skin immediately with plenty of water for 15-20 minutes. ▪ Call a poison control center or doctor for treatment advice.
IF INHALED:	▪ Move person to fresh air. ▪ If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. ▪ Call a poison control center or doctor for further treatment advice.
NOTE TO PHYSICIAN: This product contains petroleum distillate and may pose an aspiration pneumonia hazard. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information regarding medical emergencies or pesticide incidents, call the International Poison Center at 1-800-749-8712.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

ENVIRONMENTAL HAZARDS

This product is toxic to fish and other aquatic invertebrates. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of wastes. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

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

This concentrate is formulated to be diluted with a suitable oil diluent, such as (but not restricted to) light mineral oil, deodorized kerosene or petroleum distillate, for use in cold fog aerosol generators.

This concentrate may be diluted or used as supplied for mosquito control programs involving residential, industrial, recreational and agricultural areas, swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur.

Use in agricultural areas should be in such a manner as to avoid residues in excess of established tolerances for pyrethrins and piperonyl butoxide on crops or commodities.

Best results are expected from application when the meteorological conditions favor an inversion of air temperatures in the area treated, and when the wind is not excessive. Repeated applications may be made as necessary to obtain the desired reduction in adult mosquitoes.

This pesticide may be applied with equipment designed and operated to produce a suitable ultra low (ULV) spray application, which meets the dosage per acre objective of not more than .0025 pounds of pyrethrins and .0125 pounds of piperonyl butoxide per acre.

Back pack application may require a greater rate of dilution than the dilution used for vehicle or aircraft mounted sprayers, in order to achieve the desired rate of application of active ingredients per acre.

STORAGE AND DISPOSAL

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

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

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

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

Net Contents _____
Manufactured by:
Mc LAUGHLIN GORMLEY KING COMPANY
8810 Tenth Avenue North
Minneapolis, MN 55427

EPA Reg. No. 1021-1569

EPA Est. No. 1021-MN-2

APPENDIX F Control Material Labels

Altosid® XR
EXTENDED RESIDUAL BRIQUETS

A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

ACTIVE INGREDIENT:

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

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

EPA Reg No. 2724-421

KEEP OUT OF REACH OF CHILDREN
CAUTION

INTRODUCTION

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

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

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

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIRONMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

APPLICATION TIME

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

APPLICATION RATES

Aedes and *Psorophora* spp.: For control in non-(or low-) flow shallow depressions (≤ 2 feet in depth), treat on the basis of surface area, placing 1 briquet per 200 ft². Briquets should be placed in the lowest areas of mosquito breeding sites to maintain continuous control as the site alternately floods and dries up.

Culex, Culiseta, and *Anopheles* spp.: Place one **ALTOSID XR BRIQUET** per 100 ft².

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

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

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

Altosid XR Briquets Application Chart

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

APPLICATION SITES

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

STORAGE AND DISPOSAL

STORAGE

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

DISPOSAL

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Wellmark

ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

22-24-001

Made in the U.S.A.

January 2002
Schaumburg, IL

Altosid® Pellets
MOSQUITO GROWTH REGULATOR

A GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

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

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIROMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

INTRODUCTION

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

GENERAL DIRECTIONS

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

APPLICATION SITES AND RATES

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

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

APPLICATION METHODS

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

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

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

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

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Wellmark

ZOECON

Wellmark International
Schaumburg, Illinois U.S.A.

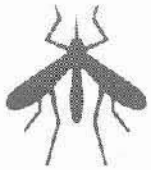
Zoecon®, A Wellmark International Brand
ALTOSID® Pellets, ALTOSID® Insect Growth Regulator and ZOECON® are registered trademarks of Wellmark International.

20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Altosid® Liquid Larvicide CONCENTRATE



PREVENTS EMERGENCE OF ADULT FLOODWATER MOSQUITOES

SPECIMEN LABEL

ACTIVE INGREDIENT:

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

* CAS # 65733-16-6

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

EPA Reg No. 2724-446

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE ADDITIONAL PRECAUTIONARY STATEMENTS

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

CAUTION

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

ENVIRONMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

CHEMIGATION

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

MIXING AND HANDLING INSTRUCTIONS

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

RECOMMENDED APPLICATIONS

INTRODUCTION

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

METHODS OF APPLICATION

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

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

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

APPLICATION SITES

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

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

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

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

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

STORAGE AND DISPOSAL

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

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

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

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

For information call 1-800-248-7763

Always read the label before using the product.

Wellmark

ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

21-24004

Made in the U.S.A.

October 2000
Schaumburg, IL

Altosid® XR-G

AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

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

EPA Reg No. 2724-451

EPA Est. No 2724-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION

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

FIRST AID

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

ENVIRONMENTAL HAZARDS

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

DIRECTIONS FOR USE

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

GENERAL DIRECTIONS

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

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

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

APPLICATION TIME

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

APPLICATION RATES

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

APPLICATION SITES

NON-CROP AREAS

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

CROP AREAS

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

NOTE

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

STORAGE AND DISPOSAL

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

STORAGE

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

PESTICIDE DISPOSAL

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

CONTAINER DISPOSAL

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

WARRANTY AND CONDITIONS OF SALE

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

Always read the label before using this product.

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

Wellmark

ZOECON

Wellmark International
Bensenville, Illinois U.S.A.

20 - 24 - 023

Made in the USA

January, 2000
Bensenville, IL

VectoBac® 12AS

Biological Larvicide
Aqueous Suspension

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

EPA Reg. No.73049-38
EPA Est. No. 33782-IA-001 List No. 5605

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

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

1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS)

CAUTION

Hazards to Humans

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

2.2 Physical and Chemical Hazards

Diluted or undiluted VectoBac 12AS can cause corrosion if left in prolonged contact with aluminum spray system components. Rinse spray system with plenty of clean water after use. Care should be taken to prevent contact with aluminum aircraft surfaces, structural components and control systems. In case of contact, rinse thoroughly with plenty of water. Inspect aluminum aircraft components regularly for signs of corrosion.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Do not apply directly to fir shed drinking water reservoirs or drinking water receptacles.

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

3.1 Chemigation

Do not apply this product through any type of irrigation system unless labeling on chemigation is followed.

4.0 STORAGE AND DISPOSAL

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

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

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

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Do not reuse container.

5.0 GROUND AND AERIAL APPLICATION

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

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

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

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

CONTINUED

[redacted]

Rinse and flush spray equipment thoroughly following each use.

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

6.0 APPLICATION DIRECTIONS

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

Suggested Rate Range*

Mosquito Habitat	VectoBac 12AS
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	0.25 - 1 pt/acre

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

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

Polluted water (such as sewage lagoons, animal waste lagoons).	1 - 2 pts/acre

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

Suggested Rate Range*

Black flies Habitat	VectoBac 12AS
Streams	
stream water** (=ppm) for 1 minute exposure time	0.5 - 25 mg/liter
stream water** (=ppm) for 10 minutes exposure time	0.05 - 2.5 mg/liter

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

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

7.0 CHEMIGATION

Apply this product through flood (basin) irrigation systems. Do not apply this product through any other type of irrigation system.

Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from nonuniform distribution of treated water.

If you have any questions about calibration, you should contact State Extension Service Specialists, equipment manufacturers or other experts.

A person knowledgeable of this chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise.

7.1 RICE-FLOOD (BASIN) CHEMIGATION

Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from backflow if water flow stops.

VectoBac 12AS is metered or dripped into rice floodwater at application stations positioned at the point of introduction (levee cut) of water into each rice field or pan. Two to three pints of VectoBac 12AS are diluted in water to a final volume of 5 gallons. The diluted solution is contained in a 5 gallon container and metered or dispersed into the irrigation water using a constant flow device at the rate of 80 ml per minute. Introduction of the solution should begin when 1/3 to 1/2 of the pan or field is covered with floodwater. Delivery of the solution should continue for a period of approximately 4 1/2 hours. Floodwater depth should not exceed 10-12 inches to prevent excessive dilution of VectoBac 12AS which could result in reduced larval kill.

Agitation is not required during the period in which the VectoBac 12AS solution is being dispersed.

Application of VectoBac 12AS into rice floodwater is not permitted using a pressurized water and pesticide injection system.

8.0 SMALL QUANTITY DILUTION RATES

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

VectoBac 12AS
Rate in Pints

Per Acre	10 Gal/A	25 Gal/A	50 Gal/A
0.25 (4 oz)	0.4	0.16	0.08
0.5 (8 oz)	0.8	0.32	0.16
1.0 (16 oz)	1.6	0.64	0.32
2.0 (32 oz)	3.2	1.28	0.64

9.0 NOTICE TO USER

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

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 • 800-323-6967

Valent BioSciences Corporation

VectoBac® G

Biological Larvicide
Granules

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

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

INDEX:

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

1.0 STATEMENT OF PRACTICAL TREATMENT

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

2.0 DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

3.0 STORAGE AND DISPOSAL

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

Storage: Store in a cool, dry place.

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

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

4.0 APPLICATION DIRECTIONS

VectoBac G is an insecticide for use against mosquito larvae.

Mosquitoes Habitat (Such as the following examples):	Suggested Range Rate*
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields	2.5 - 10 lbs / acre

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

* Use 10-20 lbs. / acre when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted (sewage lagoons, animal waste lagoons), and/or algae are abundant.

Apply uniformly by aerial or ground conventional equipment.

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

5.0 NOTICE TO USER

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

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

VectoBac® WDG

Biological Larvicide

ACTIVE INGREDIENT:
Bacillus thuringiensis, subsp. *israelensis* fermentation solids and solubles 37.4%
INERT INGREDIENTS 62.6%
TOTAL 100.0%
[potency: 3000 International toxic units (ITU) per mg]
Equivalent to 1.36 billion ITU/lb.

EPA Reg. No. 73049-56
EPA Est. No. 33752-IA-001 List No. 60215

INDEX:

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

1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

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

2.2 ENVIRONMENTAL HAZARDS

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

3.0 DIRECTIONS FOR USE

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

3.1 Chemigation

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

4.0 STORAGE AND DISPOSAL

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

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

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

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

5.0 APPLICATION DIRECTIONS

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

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

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

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

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

[redacted]

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

6.0 SMALL QUANTITY DILUTION RATES

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

VectoBac WDG

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

7.0 GROUND AND AERIAL APPLICATION

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

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

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

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

7.1 AERIAL APPLICATION

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

Rinse and flush spray equipment thoroughly following each use.

8.0 NOTICE TO USER

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

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 · 800-323-0620

04-3277/R2 ©Valent BioSciences Corporation October 2000

Valent BioSciences Corporation

VectoLex® CG

Biological Larvicide Granules

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

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

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

INDEX:

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1.0 STATEMENT OF PRACTICAL TREATMENT

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

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

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION

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

2.2 Environmental Hazards

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

3.0 DIRECTIONS FOR USE

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

4.0 STORAGE AND DISPOSAL

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

Pesticide Storage: Store in a cool, dry place.

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

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

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

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

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

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

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

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

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

* Mosquito species effectively controlled by VectoLex CG:

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

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

CONTINUED

[redacted]

6.0 NOTICE TO USER

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

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

AGNIQUE® MMF

MOSQUITO LARVICIDE & PUPICIDE

MONOMOLECULAR SURFACE FILM FOR CONTROL OF IMMATURE MOSQUITOES AND MIDGES

ACTIVE INGREDIENT

Poly(oxy-1,2-ethanediyl),α-isooctadecyl-ω-hydroxyl (10.2%)

CAUTION

KEEP OUT OF THE REACH OF CHILDREN

FIRST AID TREATMENT

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

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

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

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

DIRECTIONS FOR USE

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

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

STORAGE AND DISPOSAL

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

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

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

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

APPLICATION DIRECTIONS

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

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

APPLICATION NOTES

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

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

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

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

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

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

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

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

NOTICE

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

MOSQUITO HABITAT

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

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

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

MIDGE HABITAT

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

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

cognis agrosolutions

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

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

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

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

PERMETHRIN 57% OS

CLARKE

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

Precautionary Statements

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

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

STATEMENT OF PRACTICAL TREATMENT

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

ENVIRONMENTAL HAZARDS

This product is highly toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated area may be hazardous to aquatic organisms in neighboring areas. Do not allow spray treatment to drift to 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 activity and control of mosquitoes that may transmit diseases such as La Crosse encephalitis, dog heartworm, dengue fever and western equine encephalitis. Apply product with mist blower, power backpack or Ulvamachine 1 DEV machine is used, adjust pressure to deliver particles from 25-200 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 bark 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 residency. 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 options 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	3.0 Parts	25.0	5.0
1 Part	3.8 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. 25%(+)cis and max. 65%(+)trans.

Contains 5 lb./gal. Permethrin

CAUTION

KEEP OUT OF REACH OF CHILDREN

MANUFACTURED BY

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

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

NET CONTENTS_____

LOT NO. _____

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

This is equivalent to 0.1 lb. of Permethrin/Acre. Apply this product with sufficient carrier to allow distribution over the area to be treated using particle sizes from 35-200 microns mind. To obtain optimum results, cover the immediate surroundings of housing, buildings including plant surfaces where mosquitoes may rest. For large recreational areas such as football fields, stadiums, racetracks, and public parks, spray the insecticide-oil mixture at the above mentioned application rate on the interface of woods surrounding the main area where the overflights 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 Tentocaterpillars 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 12.8 Fl. Oz./min. This is equivalent to 0.25 lb. of Permethrin/acre. Apply thoroughly to all foliage and insect nests.

TRUCK MOUNTED –ULV– EQUIPMENT

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

U.L.V. Nonthermal Aerosol (Cold Fog) Application: To control Mosquitoes, Midges and Blackflies, apply PERMETHRIN 57% using any standard U.L.V. ground applicator capable of producing a nonthermal aerosol spray with droplets ranging in size from 3 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 dilutions 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 nozzles 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 apply 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 3.6 fluid ounces per acre of PERMETHRIN 57% is not exceeded. Both aerial and ground applications should be made when wind is less than 10 MPH.

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

STORAGE & DISPOSAL

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

PESTICIDE STORAGE AND SPILL PROCEDURES: Do not store at temperatures below 40° F (4.5°C). If this material has been exposed to temperatures below 40° F (4.5°C), there may be precipitates. Check for crystallization. If evident, warm to 80°F (26.6°C) and thoroughly mix before using. DO NOT USE OPEN FLAME. Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

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

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

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

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

IN CASE OF EMERGENCY, CALL INFOTRAC 1-800-535-5053

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

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- *FOR AERIAL AND GROUND APPLICATION*

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

*Cis/trans isomers ratio: max. 30% (±) cis and min. 70% (±) trans.
**Equivalent to 9.94% (butylcarbityl) (6-propylpiperonyl) ether and 2.48% related compounds.
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KEEP OUT OF REACH OF CHILDREN
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APPENDIX G Technical Advisory Board Meeting Notes

16 February 2005

Attending:
Greg Busacker, MN Department of Transportation, *Chairman*
Laurence Gillette, Three Rivers Park District
Steve Hennes, MN Pollution Control Agency
Val Cervenka, MN Department of Agriculture
Roger Moon, University of Minnesota
Karen Oberhauser, University of Minnesota
Kirk Smith, MN Department of Health
Brian Lee, MN Department of Health
Susan Palchick, Hennepin County Community Health
Robert Sherman, Independent Statistician
Terry Schreiner, US Fish and Wildlife Service

Absent:
Gary Montz, MN Department of Natural Resources
Dave Neitzel, MN Department of Health
Danny Tanner, US EPA

MMCD Representatives

Joe Sanzone, MMCD
Stephen Manweiler, MMCD
Nancy Read, MMCD
Kirk Johnson, MMCD
Mark E. Smith, MMCD
Sandy Brogren, MMCD
Diann Crane, MMCD
Janet Jarnefeld, MMCD
Jim Stark, MMCD
John Walz, MMCD
Carey LaMere, MMCD

Meeting was called to order 12:30 PM by Chairman Greg Busacker.

Public introduction of TAB members and attendees

It was noted that the MN Department of Natural Resources representative, Gary Montz, was absent due to prior meeting commitments and no MN DNR representative attended this meeting. MN Department of Health representative Dave Neitzel was absent due to the death of his father. The Board gave their condolences to Dave on his loss. The MN Department of Health was represented by Kirk Smith and Brian Lee. US EPA representative Danny Tanner recently retired and a replacement has not yet been assigned to represent EPA on the MMCD TAB.

Welcome and opening statements

MMCD Director Joe Sanzone welcomed TAB members and pointed out that the Mosquito Control Commissioners have chosen to expand larval control, augmented by adult control, to reach closer to the District borders. The new larvicide strategy will be implemented in 2005 and will be discussed in more detail later in the meeting.

The following agenda was introduced:

- 2004 Season Recap (Kirk Johnson)
- Larval and Adult Surveillance (Nancy Read)
- Larvicide and Adulticide Efficacy (Stephen Manweiler)
- 2005 Operational Strategy (Stephen Manweiler)
- Non-Target Research (Karen Oberhauser)
- Discussion and 2005 TAB Resolutions (Greg Busacker)
- Assignment of 2006 Chairman (MN Department of Natural Resources)
- Adjourn (Greg Busacker)

Agenda was approved without dissent.

2004 Season Recap (12:40 p.m.)
Kirk Johnson briefly reviewed the 2004 season.

- Temperatures in July and August were colder than the 20-year mean
- Rainfall was very high in May and June
- Mean weekly CO_2-trap catch was high throughout the District starting in late May and continuing through July
- No La Crosse encephalitis cases were reported in District, and only 2 in MN
- 6 cases of West Nile virus were reported in District residents, 34 in Minnesota
- In 2003, Lyme disease cases were down, but still high from the 2002 peak, (latest year with data available, based on monitoring and tick vector surveillance)
- The annual average black fly sweep count continued low in 2004
- 2004 Public Opinion Survey results showed some marked changes since 2000, probably related to public awareness and concern about West Nile virus

Kirk Smith, MDH, noted that his agency has seen an increase in tick-borne illnesses in Minnesota and stated they have seen over 1,000 cases of Lyme disease in 2004.

Bob Sherman asked about the percentage of infected ticks in the metropolitan area and Janet Jarnefeld noted that testing is compromised due to the fact that the majority of ticks collected that would be conducive for testing are already bloodfed. She also stated that testing has not been performed in recent years but the infection rate had been 5-15% in very limited studies.

Karen Oberhauser asked when black fly treatments were started. John Walz answered that experimental larvicide treatments began in 1987, operational treatments of the Mississippi River in 1991, and the current full program in 1995.

Larry Gillette commented on the Public Survey and did not think that asking people the question whether they felt spraying was harmful or worth the risk was a fair question. fair. He felt the public was basically uninformed about the possible negative effects of the MMCD spray program and they do not have enough information on which to base their answers. Kirk Johnson responded that the question was valid as a measure of public opinion, and was not intended to be a scientific measure of risk.

Joe Sanzone reviewed some information presented at the CDC-sponsored WNV conference held last week in California. He stated similar public opinion surveys were reported and showed similar results. The surveys were conducted in the Southwestern US and showed the public had 90% recognition of WNV but only 30% of the people took action to protect themselves from the dangers of WNV. The response “taking action” here was much higher, which might reflect differences of regional attitudes and lifestyles but did show that information is getting to the public regarding the public health risks. Larry Gillette suggested the higher Minnesota response could be due to higher levels of nuisance mosquitoes in Minnesota.

Karen Oberhauser also expressed concern over the public opinion survey question and thought the public might feel differently if they fully understood possible nontarget impacts on the environment. She also expressed concern over how MMCD would use the survey results that suggest that mosquito control is more important than environmental concerns, and asked how MMCD plans to use the data and avoid misuse. Nancy Read discussed the five different wordings of these questions in the survey, and pointed out that citizens’ concern about

environmental damage tends to decrease as their understanding about MMCD's larviciding program increases. She also explained that the survey was a measure of what citizens are thinking, and does not determine MMCD policy or its operations. The survey is a tool to help MMCD better serve our citizens and understand their points of view.

Kirk Johnson concluded the 2004 Season Recap by reviewing the 2004 TAB resolution:

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

MMCD's research in response to this resolution was presented in the next two sections.

WNV Research: Larval and adult surveillance (1:00 p.m.)
Research done by District staff on West Nile virus vectors and their habitats was presented by Nancy Read.

Species: Four *Culex* species - *Culex tarsalis*, *Culex restuans*, *Culex pipiens*, and *Culex salinarius* – (hereafter denoted as "4Cx") were identified as likely vectors and chosen for intensive study in 2004.

Timing: Nancy Read said earlier studies suggest *Culex* larvae can be found in newly-flooded areas about one week after flooding. She showed a graph relating rainfall to the percent of samples that contained 4Cx and hypothesized that peaks in larval 4Cx abundance preceded peaks in adult 4Cx abundance.

Roger Moon asked if the percent of samples that contained 4Cx estimated occurrence, not absolute larval density, and Nancy Read confirmed it was occurrence.

Susan Palchick commented that peaks for larval and adult 4Cx populations in June appeared to be simultaneous, and said it seemed to conflict with a hypothesis Nancy was proposing. Nancy Read explained that there was a five day overlap of data and that the 4Cx have a short incubation period. Also, you need high number of adult 4Cx to produce large number of 4Cx larvae and population peaks could appear concurrent. Susan also questioned the conclusion that 4Cx larval peak was followed by 4Cx adults in September.

(1:15 p.m. – Kirk Smith, MDH left the meeting for other commitments)

Larval Habitats: Nancy Read reported *Cx. pipiens* and *Cx. restuans* have been found in catch basins on the US East Coast, dry detention ponds in Michigan and in catch basins, containers and tires in Minnesota. In 2004 MMCD staff dipped over 3,000 breeding sites in one day to try to find 4Cx larvae, and found *Cx. restuans* in about 8% and *Cx. tarsalis* in about 2% of the wet sites. Data showed that there was no clear indicator of particular sites or site types that were more likely to have *Culex*, especially *Cx. tarsalis*. However, there were some habitats within sites that we could target to improve our collections of *Culex* species.

Roger Moon asked if the one-day site dipping included any place that contained water, and Nancy Read replied artificial containers were not included.

Susan Palchick asked if the data were examined to search for interperson variation, as her experience was that dip technique can make a difference in number of larvae collected, especially for *Cx. tarsalis*. Nancy Read replied that this had not been tested in this data. Roger Moon and Karen Oberhauser briefly discussed statistical techniques to eliminate this "human effect" including accounting for different areas within sites being sampled by different people. Nancy Read discussed research from elsewhere suggesting that *Culex* may dive more often, but MMCD studies in 1988 were able to catch *Culex* by dipping. MMCD will consider this discussion in developing future dipping protocol and site evaluations.

Steve Hennes asked about the size of sampled sites and if the number of dips in each site was equivalent. Kirk Johnson explained differences between *Aedes* and *Culex* sampling, for example having staff dip not only site edges but also many other subhabitats within sites. Nancy Read explained how habitats (e.g. vegetation types and water depths) within each site and number of dips varied.

Joe Sanzone asked if water quality was studied in 2004 in relation to 4Cx. Nancy Read responded that not much water quality research was completed in 2004.

Stormwater Management: Nancy Read showed the TAB information on stormwater management and mosquitoes that has been presented to engineering groups around the metro area.

Susan Palchick noted that for the Cedar Lake stormwater, the original plan by the Minneapolis Park Board stated the wetland habitat was to remain "cattail free" but that is no longer the case. MMCD should review these stormwater management areas periodically to determine if these or any manmade structures change over time and become unintentional mosquito habitat. These reviews would be especially important for disease vector species.

Catch Basins: Sampling from catch basins suggested that those that hold water are likely to serve as larval habitat sometime during the year, especially for *Cx. restuans.*
Bob Sherman noted that these manmade structures would be a good place for the 150-day Altosid briquets. MMCD staff noted that the high cost of briquets and the lack of consistency of city maintenance programs (i.e. catch basin cleaning) can hinder this control strategy.

- At 1:40 p.m., Chairman Busacker noted that the reports were running over the allotted time and Stephen Manweiler stated he would amend his presentations to get back on schedule. Nancy Read continued her adult sampling presentation.

Adult Sampling: Of the various types of traps used by MMCD, gravid traps catch more *Cx. restuans* and have been a good source for WNV-positive mosquitoes. Last year some TAB members asked if the mosquitoes moved through different elevations in the canopy and therefore might be susceptible to ground-based spray even if a portion of the population is high in the canopy. An MMCD study using carbon dioxide-baited traps at different elevations and times showed differences in peak elevations and activity times in different species, but did not support the hypothesis that host-seeking *Culex* mosquitoes move to different elevations at different times of night.

Val Cervenka asked how gravid traps worked, and Nancy Read explained how they use water with rotting vegetation as bait for attracting ovipositing females.

Bob Sherman asked if these presentations could be placed on the MMCD website for the public to review. MMCD noted that the Operational Review will be available when the final draft is completed. Operational Reviews from recent years are currently available on our website.

Roger Moon questioned whether we could make generalizations on the mosquito's movements from elevated trapping results; the study design did not actually provide data on movement patterns, just relative abundance. These mosquitoes eventually travel to ground level to lay eggs (e.g., success of gravid trapping). Roger Moon noted that MMCD would need to design a specific study to answer movement questions.

Karen Oberhauser asked about the risk of these mosquitoes if they stay in the treetops and if this risk justified attempting to control these species. Kirk Johnson noted that the birds in these treetop areas can amplify WNV in their populations and the danger is when these birds come in contact with mosquitoes in lower areas. The virus can be transferred to humans or other species at that time.

Susan Palchick stated vector mosquitoes might only be coming down to lay their eggs and this might affect our surveillance methods. A standard CO_2-trap might be totally ineffective at sampling this mosquito population and we should possibly expand our gravid trap collections to increase our vector detection.

Roger Moon stated MMCD needs more information on the daily movements and vertical distribution on these vector species before we can attempt to answer some of these questions. Roger Moon referenced some studies completed in Africa that looked at vertical distribution that might provide useful methodologies.

Larry Gillette noted the fast spread of WNV across the country and didn't think that it should be a realistic objective to try to control these high level mosquitoes to reduce disease risk. Is it a valid approach especially when birds fledge and move in and out of these areas quickly? Can spraying realistically reduce the risk and be considered as an operational approach? Where is the best point to attempt to control WNV? MMCD needs to identify the targeted species before increasing the amount of spraying especially in urban areas. Discussion followed on the possible importance of *Culex* control early in the season to reduce risk, and plans for targeting work.

Larvicide and Adulticide Efficacy (2:00 p.m.)
Stephen Manweiler presented results of efficacy tests, including Altosid ingot briquets and pellets in catch basins, Vectolex (*Bacillus sphaericus*) in wetlands and catchbasins, and two natural pyrethroid adulticides.

Susan Palchick asked why the ingot briquet did not have a specimen label attached to the 2004 Operational Review. Was the XR briquet label applicable to the ingot briquet? Stephen Manweiler replied it used the same label as the XR briquet.

Bob Sherman asked about the cost of catch basin applications. Stephen Manweiler said briquets cost about $2.00 per catch basin, compared to pellets at about $0.20.

Karen Oberhauser asked if Vectolex was mosquito specific, and Stephen Manweiler answered yes, similar to *Bti*. There was discussion whether related Diptera were affected and Roger Moon noted that "not all flies are bad."

Larry noted the period of control provided by the natural pyrethrin adulticides was short (one night), with quick rebound of mosquito populations to pretreatment levels, and asked if these would be useful only for "event-type" applications. Roger Moon pointed out that the duration of effect would be related to how big an area was treated and how quickly mosquitoes from surrounding areas could move in.

Roger Moon was interested in the Scott County farm adulticide evaluation because he believed this type of application might be useful in hog farm protection.

Steve Hennes asked if Agnique MMF was planned for widespread use. Stephen Manweiler explained it was being evaluated as a pupacide and MMCD did not intend to use it widely in 2005.

2005 Operational Strategy (2:30 p.m.)
Stephen Manweiler presented MMCD's plans to expand larviciding to try to control larvae of prime, as well as possible bridge, vector species. Vectolex could be useful because of its longer period of activity compared with *Bti* (VectoBac). Altosid pellets could also be useful for this reason because they can be placed in sites before breeding occurs.

Steve Hennes asked if a pre-hatch version of Vectolex is available. Stephen Manweiler answered "no."

Larry Gillette was impressed by the plan. He asked "what is the definition of a WNV outbreak?" Stephen Manweiler and Kirk Johnson replied that it involves a high infection rate of mosquitoes and dozens of human cases. Susan Palchick noted that there would be a statement from MDH.

Nontarget Research (2:45 p.m.)
Karen Oberhauser described her nontarget testing research using monarch butterfly larvae and adults placed in the path of truck-mounted ULV spray of resmethrin (Scourge). There was significant mortality reported at test locations immediately downwind of the spray path. Mosquito mortality was much higher than monarch mortality. Leaves that were exposed in the immediate downwind spray path and taken directly to the lab (not exposed to open sunlight, UV) were related to significant larval mortality when fed to larvae the next day. This work was funded by MMCD and the project was a group effort between Karen's lab at the Univ. of MN and MMCD.
Many questions remain including longevity of the toxic effect, egg exposure effect, sub-lethal effects on fitness (reduced mass, migratory ability, longevity, fecundity, ability to escape predation). This research shows Scourge can affect exposed individuals, but has not yet evaluated actual exposures and potential risk to the population -- work to be undertaken in 2005.

Bob Sherman asked if the insect cage offers protection (i.e., shielding effect) from the insecticide. Karen stated it shows some effect for monarch larvae. Stephen Manweiler noted that cages work well in insecticide studies as shown in controls, field studies and literature. The type of cages used in this research is standard for mosquito tests.

Roger Moon said it is important to do research on the amount of exposure occurring on a landscape level. The key question is the amount of overlap of spray and actual habitat. The group has proposed a GIS study of land use, milkweed habitat, and actual treatments and urged that money to do the study be found. We need perspective on possible effects and compare with other sources of mortality.

Diann Crane asked where monarchs rest overnight. What is their habitat? Karen Oberhauser replied that larvae are on milkweed plants and adults perch in protected places, many times on the undersides of leaves.

General Discussion and Resolutions (3:15 p.m.)
Bob Sherman was encouraged and pleased with the job MMCD is doing, progress made on making treatments effective and efficient, and in answering questions proposed by TAB last year. He proposed to renew the 2004 TAB resolution.

Terry Schreiner said MMCD does a good job controlling mosquitoes, but expressed concerns about nontarget effects of adulticide program. MMCD should make sure the public knows there is an environmental cost of treatments. He thinks the public would be concerned. What are the overall effects on the food chain and the long term effects on the environment? The public needs to understand what they are losing. He proposed that MMCD should stop using their current adulticides until all effects are known. He asked if less toxic materials are available. Joe Sanzone replied that the pyrethroid adulticides used by MMCD are the most specific and least toxic adulticides available for mosquitoes. Alternates mainly include organophosphate insecticides.

Steve Hennes agreed that this is an issue, and public knowledge is important; how do we translate this into a reasonable cost-benefit analysis?

Bob Sherman asked if the nontarget risks actually are sufficient that we shouldn't treat. He said we should continue to study risks first.

Karen asked if benefits of treatment that only last 24 hours confer enough protection against WNV to justify potential nontarget effects.

Terry Schreiner thought that single treatment might not do anything to protect from WNV and asked for any evidence that this material helps to curtail the transmission of WNV?

Stephen Manweiler replied that MMCD is attempting to find the most effective use of adulticides as part of our Integrated Pest Management (IPM) program. There is evidence from some WNV epidemic areas that an IPM program has reduced transmission (e.g., Chicago, Colorado, Michigan). A single adulticide treatment might reduce the transmission cycle in an area if completed at the right time. If you take away this one tool, it's hard to say whether you could still do a "good enough" job. Public reaction to nontarget impacts may be out of proportion to actual risk. Also we may be able to reduce risk to nontargets by adjusting treatments, as we did with loosestrife beetle release sites.

Karen Oberhauser stated that public reaction to WNV was also probably out of proportion and that WNV was not that big a risk.

Terry Schreiner said that we need to provide the facts and scientific results to the public and let them decide on what is best for the area. These pesticides can kill mosquitoes but also kill other things (nontargets). What does the public want?

Stephen Manweiler replied that we need to finish the science (e.g., landscape nontarget study) to acquire enough information.

Steve Hennes said that he did not know if he has enough information to make a statement regarding how effective control is with adulticides, especially at reducing WNV.

Roger Moon said that what Terry Schreiner has stated is the "Precautionary Principle" [that we should not act until we know the action will not cause environmental harm.] "On the other hand, other agencies are charged with protecting public health, and are expected to take action to prevent disease. We are drifting off to philosophic arguments that cannot be answered here. We can work on pieces of the puzzle to get a better picture of what is happening. Let's focus on some concrete science issues that we are interested in and try to develop some studies that can address those points."

Draft Resolution discussion: Roger Moon suggested starting with last year's resolution. Karen Oberhauser added "and environmental consequences" or "non-target"; Greg Busacker suggested including research "and communication"; Bob Sherman proposed to expand WNV to include other mosquito-borne diseases, discussion recommends leaving as WNV.

Karen asked if WNV research in other parts of the country can be used here. Stephen Manweiler replied that we have used some by others, and have also used study designs.

3:40 p.m. – Susan Palchick leaves before voting on resolution.
3:41 p.m. – Final resolution is approved.

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

3:41 p. m. – Terry Schreiner leaves after voting on resolution.

Larry Gillette said he would appreciate a graph showing the number (not just acres) of adulticide treatments (e.g., graphs pp. 39-40), if possible subdivided by primary intent of the application (e.g. WNV, nuisance control, event, etc.).

Stephen Manweiler explained the difficulty of separating these applications but saw a possible way to break it down by which threshold was used to justify the application. Kirk Johnson reiterated the difficulty in separating all aspects of our operations when looking at vector control because all species might have the ability to transmit the virus. Our operations do many different

tasks at the same time (e.g. remove tires or fill tree holes while surveying sites, educate the public when in field, etc.).

Roger Moon stated that he would like to see an adulticide breakdown by LAC/WNV/annoyance, also public events, etc. MMCD can probably develop some themes to clarify data regarding adulticide treatments, staff need to think about it. He referred to a good example provided by Sandy Brogren regarding habitat. Also Usage, Table 3.1, could be clarified similarly, especially with catch basin number presentation.

Larry Gillette referred to p. 36, fig. 2.7, mosquito distribution, in the draft report. More sampling locations are required to support the distribution shown, or we should modify the map. For example, in July and August Larry had minimal bugs at his house in western Hennepin County but the contour map showed very high mosquito populations in his area. Stephen Manweiler replied that we will revisit the algorithm used to create the map.

Greg Busacker stated that the next chairman of the TAB will be a representative of the MN Department of Natural Resources, as indicated in the Chair rotation schedule. Gary Montz will be contacted about the appointment.

Roger Moon, Val Cervenka and Karen Oberhauser all commented positively on the Operational Review. Members thought the document continues to improve and commented on the professional quality of the report. They commended MMCD on the good job and thanked staff for their efforts.

3:50 p. m. – Meeting adjourned: motion by Val Cervenka, second by Karen Oberhauser.

Editorial Staff

Diann Crane, M.S., Assistant Entomologist
Stephen Manweiler, PhD, Technical Services Coordinator
Mike McLean, Public Affairs

Acknowledgments

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April 14, 2005