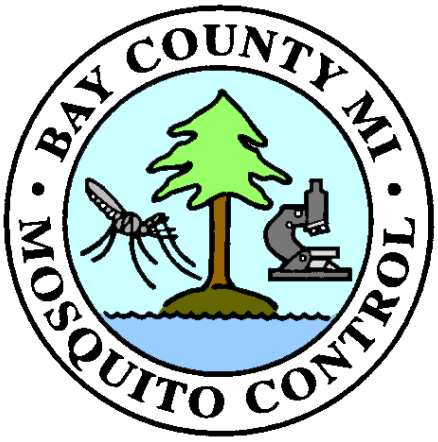
Bay County
Mosquito Control

Annual Report
2008



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Organization

Bay County Mosquito Control began operations within the organizational structure of the Bay County Health Department and under the auspices of the Bay County Executive in January of 1985. The program began in 1977 as part of the bi-county district, Saginaw-Bay Mosquito Control Commission.

Mosquito "control" doesn't mean elimination, but involves IPM (Integrated Pest Management) methods designed to reduce the number of mosquitoes so they no longer unfavorably affect the health and quality of life of Bay County residents.

As one of the divisions of the Environmental Affairs and Community Development Department, we acknowledge the importance of serving the public by providing services without producing adverse impacts on the environment. The program consists of field operations, biological surveillance, disease surveillance, and education.

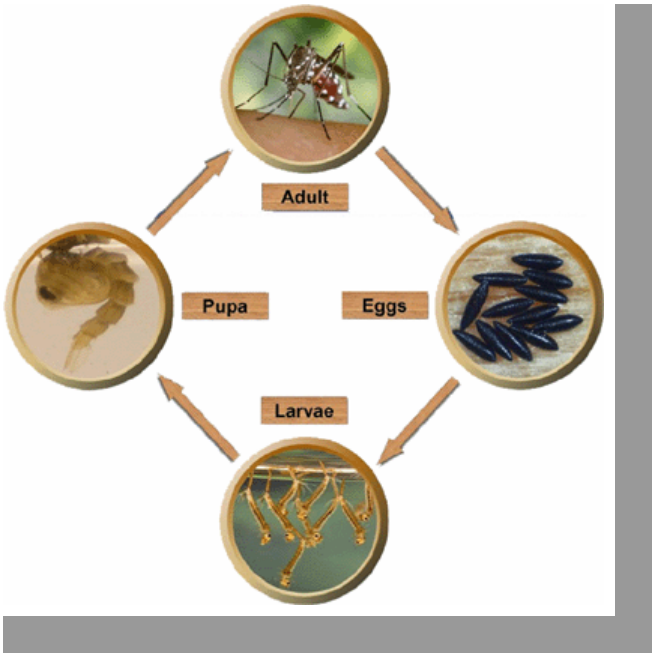
Bay County is one of four Michigan counties with formal, comprehensive mosquito control programs. A Technical Advisory Committee (TAC), composed of local and state professionals, reviews program operations each March.

Funding is received from a special millage for the control and abatement of mosquitoes and the diseases borne by mosquitoes. The current 0.45 mill tax levy was renewed on August 5, 2008 for an additional eight years in Bay County with an overwhelming approval rating of 84%. This millage rate has been in place since 1988.

Mosquito Biology and Life Cycle

Mosquitoes are aquatic insects that undergo a complete metamorphosis involving four distinct stages—egg, larva, pupa, adult—throughout their life cycles. Female mosquitoes can develop several hundred eggs with each blood meal and lay them in or around water. The eggs are laid on moist ground, on the water's surface, or attached to one another to form a raft that floats on the surface. Eggs laid on water hatch quickly and release larvae that wriggle through the water. The larvae are filter feeders that eat voraciously, outgrowing their skin, and thereby undergo several molts. About one week after the eggs hatch, larvae change to pupae, the non-feeding stage where the final transformation to adulthood takes place. Eclosion is the emergence of the adult mosquito from the pupal case. These newly-emerged adults use the cast skin for support until their wings and body dry, at which time they fly away.

After mating, females seek out an animal upon which to feed and this blood provides protein to develop eggs. Males don't bite, but they do have sucking mouthparts to obtain plant nectar as a source of energy; females do this as well. Next, females search for an aquatic habitat or moist ground to deposit eggs. Although there are exceptions to the rule, most adult mosquitoes live for a period of four to eight weeks.



Spring Larval Surveillance

As a result of spring flooding due to rainfall or snowmelt, the potential exists each year for significant spring mosquito larval development in the woodland areas of Bay County. Spring aerial applications utilizing one helicopter and two fixed wing aircraft were conducted when larvae reached the second instar growth stage. Monitoring larval development was critical in order to have a timely application of *Bti* (*Bacillus thuringiensis israelensis*), a bacterium eaten by larvae that caused mortality within 48 hours. The *Bti* can be used as a safe food source by other aquatic organisms that occupy the same woodland pool habitats.

Surveillance was an essential part of the successful mosquito control program. Mosquito larval surveillance began in early April with first instars observed in woodland pools. Pools had formed in many woodlots and monitoring indicated low or medium density (less than 10 larvae per dip) in most sites. Pre-treatment larval counts were taken between one and three days before treatment in forty-one woodlots.

Aerial calibration took place on April 15th and 16th with treatment beginning on April 17th and lasting five days until April 21st. Aircraft were calibrated to deliver approximately 5 pounds of *Bti* per acre. Quality control of the spring aerial campaign was accomplished with the help of a full-time supervisor and four certified technicians who walked through 141 treated woodlots over the course of five days in order to determine both the average number of *Bti* granules per square foot (confirm dosage rate) and possible skips or misses occurring with the aerial application.

Post counts indicated an overall average 97.5% larval mortality (Table 1). Most woodlots had excellent *Bti* coverage and, as usual, where there was *Bti*, there were either no mosquito larvae found or only dead larvae floating throughout the water column. Frogs, fairy shrimp, water fleas, copepods, and caddisflies that were observed in the woodland water habitats before treatment were found in large numbers after treatment, as well.

Table 1

Spring Treatment 2008 - Bti Evaluation

		Larval Dip Count		
Location	**Applicator**	**Pre**	**Post**	**Mortality**
Bangor 4 - Bangor Oil Well	Helicopter	4.13	0	100%
Bangor 31 - St. Maria Goretti Church	Helicopter	1.48	0	100%
Bangor 32 - State Park	Helicopter	4.8	0.06	98.8%
Bangor 33 - Bangor and Zimmer	Helicopter	2.32	0	100%
Beaver 4 - 1576 Cottage Grove	Fixed Wing	6.1	0	100%
Beaver 5 - Carter and Cottage Grove	Fixed Wing	1.26	0.54	57.1%
Beaver 9 - 1585 Cottage Grove	Fixed Wing	2.92	0.1	96.6%
Frankenlust 2 - Four Mile and Delta	Helicopter	4.94	0	100%
Frankenlust 3 - Delta by Automotive Bldg.	Helicopter	4.94	0	100%
Frankenlust 7 - 259 Amelith Road	Helicopter	4.3	0	100%
Fraser 6 - Townline 16 by 7 Mile Rd.	Fixed Wing	1.71	0	100%
Fraser 11 - Camp Fishtales	Fixed Wing	1.48	0	100%
Fraser 15 - Fraser Twp. Firebarn	Fixed Wing	3.9	0	100%
Fraser 22 - Fraser Twp. Hall	Fixed Wing	2.56	0	100%
Garfield 9 - 11 Mile N. of Erickson	Fixed Wing	4.54	0	100%
Garfield 10 - Garfield Twp. Park	Fixed Wing	7.56	0	100%
Garfield 15 - Methodist Church	Fixed Wing	1.52	0	100%
Garfield 26 - Crump Fox Club	Fixed Wing	5.22	0	100%
Kawkawlin 2 - 2080 LeBourdais Rd.	Fixed Wing	2.54	0	100%
Kawkawlin 30 - Bay City Bowmen's	Fixed Wing	1.5	0	100%
Kawkawlin 30 - White Birch Village	Fixed Wing	1.72	0	100%
Monitor 20 - Fraser and N. Union	Helicopter	1.86	0.18	90.3%
Monitor 23 - Rocking Horse Ranch	Helicopter	5.74	0	100%
Monitor 28 - Mackinaw Road Tech Park	Helicopter	1.24	0	100%
Monitor 34 - Fremont Cemetery	Helicopter	1.06	0	100%
Mt. Forest 9 - Sand and Eleven Mile	Fixed Wing	1.9	0	100%
Mt. Forest 17 - Mt. Forest and Carter	Fixed Wing	8.56	0.075	99.1%
Mt. Forest 20 - 4136 N. Flajole	Fixed Wing	2.9	0.46	84.1%
Mt. Forest 21 - Mt. Forest School	Fixed Wing	2.78	0.3	89.2%
Mt. Forest 21 - Mt. Forest Firebarn	Fixed Wing	2.3	0.12	94.8%
Mt. Forest 30 - Pinconning and County Line	Fixed Wing	6.88	0	100%
Pinconning 19 - Pinconning County Park	Fixed Wing	3.14	0	100%
Pinconning 23 - K C Hall Water Street	Fixed Wing	1.42	0	100%
Portsmouth 35 - R & R Ready Mix	Helicopter	1.36	0	100%
Williams 16 - Carter and N. Union	Fixed Wing	3.4	0	100%
Williams 19 - Victoria Woods Trailer Park	Fixed Wing	3.36	0	100%
Williams 20 - Forest School/Daycare	Fixed Wing	2.24	0	100%
Williams 21 - Columbian Hall	Fixed Wing	7.02	0.38	94.6%
Williams 30 - Rockwell and Salzburg	Fixed Wing	3.9	0.1	97.4%
Delta - Mackinaw Road	**Control**	5.05	4.05	19.8%
Mt. Forest 30 - Pinconning and County Line	**Control**	5.6	5.45	2.7%
AVERAGE MORTALITY (Treated)				**97.5%**

Summer Larval Surveillance

Surveillance is the key component of an IPM program and there are two main types — larval and adult —both of which are utilized to monitor mosquitoes county-wide to determine distribution, density, and species. Surveillance is a combined effort conducted by larviciding crews, field supervisors, and biology personnel.

Biology department staff conducted routine surveillance of probable mosquito breeding sites where stagnant water collected using a standard pint-size dipper. These sites included ditches, catch basins, flooded fields, woodlots, and tires. Roadside ditch larval site inspections (sequential sampling) occurred weekly throughout the county and larval samples were collected and identified to determine the need for control. Two hundred thirty-eight larval samples representing ten species were identified; the majority were *Culex restuans* followed by *Aedes vexans* and *Culex pipiens*. Seven percent of the mosquitoes collected were *Aedes japonicus* breeding in tires, containers, and ornamental ponds.

To assess the prevalence of mosquito catch basin activity, a total of 211 basins were randomly inspected on six occasions. *Culex* larvae were found in 59% of the inspected basins as early as May 21, which prompted the initial treatment.

Quality control continued to be an essential function for biology technicians. Habitats that were recently treated were re-checked to ensure control materials were properly applied and effective. Quality control efforts began with surveys of woodlots in April to assure proper treatment. Container, roadside ditch and catch basin surveys continued as the summer wore on.

New Jersey Light Traps

As in previous years, Bay County Mosquito Control completed regular mosquito trapping throughout the season. Trapping data was critical to the mosquito management program as it helped recognize mosquito numbers, species, and whether or not any of those mosquitoes were a disease threat. One of the main tools used in adult surveillance was the New Jersey Light Trap. Beginning in mid-May and continuing through mid-September, adult mosquitoes were collected in sixteen traps placed throughout the county. The traps were placed in backyards where there was little or no competing light source. Samples were gathered three times each week, followed by counting and species identification. The total capture was 13,202 (Table 2), which was nearly twice as many as 2007, but which represented an "average" year.

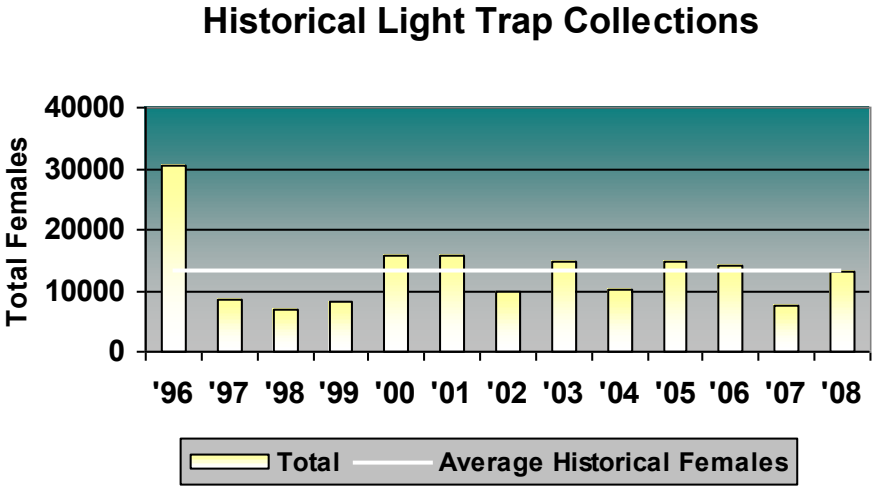
Table 2

Species	May	Jun	Jul	Aug	Sep	TOTAL
Ae. vexans	0	1980	2045	4423	263	8711
Ae. intrudens	1	7	1	0	0	9
Ae. implicatus	1	10	9	0	0	20
Ae. sticticus	0	2	18	1	0	21
Ae. stim/fitchii	22	100	20	44	0	186
Ae. canadensis	0	14	2	0	0	16
Ae. provocans	0	3	0	0	0	3
Ae. triseriatus	0	2	2	1	1	6
Ae. trivittatus	0	22	16	48	2	88
Ae. japonicas	0	3	2	4	1	10
An. punctipennis	1	48	45	111	19	224
An. quadrimaculatus	4	90	231	333	31	689
An. walkeri	1	155	642	722	110	1630
An. perplexens	0	12	10	5	4	31
Cs. inornata	2	10	11	6	1	30
Cs. morsitans	0	3	0	1	0	4
Cq. perturbans	0	33	138	29	0	200
Cx. pipiens	0	16	35	58	71	180
Cx. restuans	28	236	279	320	16	879
Cx. tarsalis	0	3	0	0	0	3
Cx. territans	0	21	109	34	3	167
Ur. sapphirina	0	1	0	3	2	6
Damaged	4	34	42	9	0	89
Male Mosquitoes	987	3586	1794	3206	663	10236
Total Females	64	2805	3657	6152	524	13202

Twenty-three species were collected during the 2008 season and the most predominant one was *Aedes vexans* (the floodwater mosquito), representing 66% of the total. It is not unusual for *Aedes vexans* to rank first in total number collected and this was due to the above-average rainfall received during each summer month. The *Anopheles* species (*quadrimaculatus*, *walkeri*, *punctipennis*, and *perplexens*) represented almost 20% of the total catch. The northern house mosquito, *Culex pipiens* and other *Culex* species ranked third. We watched, with great interest, our newest mosquito species, *Aedes japonicus,* whose numbers remained virtually unchanged from 2007 when eight were captured.

Figure 1 offers a historical perspective of light trap collections with the average number collected in a given year represented by a solid white line. As you can see, the number collected this year was perfectly "average".

Figure 1



CDC Traps

CDC Traps attract blood-seeking female mosquitoes with the use of dry ice (carbon dioxide) as bait. Traps were placed overnight within woodlots, summer festival grounds, treatment sites, and personal residences. Usually the traps held diverse species and larger mosquito numbers compared to New Jersey Light Traps. Traps were also used to assess homeowner complaints, gather arbovirus information, and record changes in abundance of mosquitoes before and after control operations.

Total number of mosquitoes captured in CDC traps this year (37,319) was about 20% more than 2007 (Table 3). *Aedes vexans* took back the top ranking spot, representing 43% of the total with *Coquillettidia perturbans* numbers down significantly from 2007 (18,596) to 2008 (2,080). Twenty species in six genera were collected and identified and the average number of females per trap was 175 compared to 118 in 2007.

Table 3

Species	May	Jun	Jul	Aug	Sep	TOTAL
Ae. vexans	1	1289	7644	6556	604	16094
Ae. intrudens	615	31	5	0	0	651
Ae. implicatus	400	17	20	0	0	437
Ae. sticticus	0	44	18	1	0	63
Ae. stim/fitchii	209	2616	608	152	0	3585
Ae. canadensis	7	343	99	14	1	464
Ae. provocans	1	1	4	0	0	6
Ae. triseriatus	0	1	70	62	28	161
Ae. trivittatus	0	713	1021	8104	383	10221
Ae. japonicus	0	0	0	0	0	0
An. punctipennis	1	31	69	130	6	237
An. quadrimaculatus	0	32	206	45	11	294
An. walkeri	0	252	1521	16	39	1828
An. perplexens	0	0	2	4	2	8
Cs. inornata	0	0	1	3	0	4
Cq. perturbans	0	604	1290	166	20	2080
Cx. pipiens	0	0	1	26	21	48
Cx. restuans	1	84	280	292	19	676
Cx. territans	0	0	5	0	0	5
Ps. ferox	0	12	64	144	13	233
Damaged	1	168	43	10	2	224
Total Females	1236	6238	12971	15725	1149	37319

Gravid Traps

Gravid traps offered another method to collect female mosquitoes, primarily *Culex* species that had taken a blood meal and were searching for a suitable place to lay eggs (oviposit). This trap was selective for female mosquitoes that had at least one blood meal; therefore, the traps provided a good means for early West Nile Virus (WNV) detection.

A solution containing water, brewer's yeast, whey, and guinea pig pellets was allowed to ferment for about a week before being poured into a plastic tub, over top of which sat the gravid trap. This organically-rich water was the attractant to gravid (egg-bearing) females.

Gravid trap placement ran from June through September and traps captured 547 mosquitoes (505 *Culex* species, 1 *Ae. japonicus*, 3 *Ae. vexans*, 2 *Anopheles* species, 3 *Ae. trivittatus*, and 33 males). Traps were placed in a variety of locations, including the immediate area of WNV activity. *Culex* mosquitoes collected in gravid traps were grouped together and submitted to MSU for WNV-detection or tested in-house with the VecTest kit.

Disease Surveillance

Since the inception of Bay County Mosquito Control, mosquito control efforts have been targeted at controlling nuisance mosquito species and known disease vectors. Our goal has always been to reduce mosquito numbers in order to decrease the risk of diseases transmitted by them. Since WNV came on the scene in 2001, our efforts at disease prevention and public education have taken on a bigger role.

Mosquito pools (up to 25 mosquitoes of the same species from the same location placed in a vial) and House Sparrow blood samples were submitted to MSU's Microbiology and Molecular Genetics Department to be analyzed. Some mosquito pools were also tested in-house using the VecTest kit.

Two hundred one pools containing 3,681 females representing a variety of species were tested with the following results: *Cq. perturbans* (93 pools/1,854 females/2 pools tested weakly positive for Eastern Equine Encephalitis), *Culex* species (99 pools/1,813 females/no positives), *Aedes japonicus* (5 pools/7 females/no positives), and *Cs. inornata* (4 pools/7 females/no positives). House sparrows were live-trapped , sampled by obtaining a small amount of blood, and released. Sixty-three samples were submitted to MSU—results are pending.

We continued to rely on Bay County citizens reporting dead birds as one method of WNV surveillance. Using the WNV VecTest kit, American Crows and Blue Jays were tested to determine infection rates. One hundred phone calls were received reporting 102 dead birds, most of which were Blue Jays (28), American Robins (18), Common Grackles/European Starlings/other blackbirds (25), and American Crows (9). All dead bird sightings were logged onto Michigan's Emerging Diseases website www.michigan.gov/emergingdiseases. Seventeen crows or jays were tested using the VecTest and two were positive. The first was a crow from Bangor Township on July 9 and the second was a crow from Portsmouth Township tested on September 16 and confirmed by MSU's Diagnostic Center for Population and Animal Health. Compared to 2007, disease activity remained at a fairly low level for our county and statewide. In addition to the human cases highlighted in the table below, there was one WNV-horse case reported from Montcalm County this year as well as two positive mosquito pools from Saginaw and Oakland Counties.

One of the Michigan WNV human cases was from Bay County — a man (over 50) who was discovered via blood donor screening in early September. The case was originally assigned to Kent County by mistake and was reassigned to Bay County in early December. The man had West Nile fever and became ill on 9/1/08 with what he described as a severe case of the flu and was ill for a week; he has since recovered.

Table 4

Statewide WNV

(as of 12-31-08)

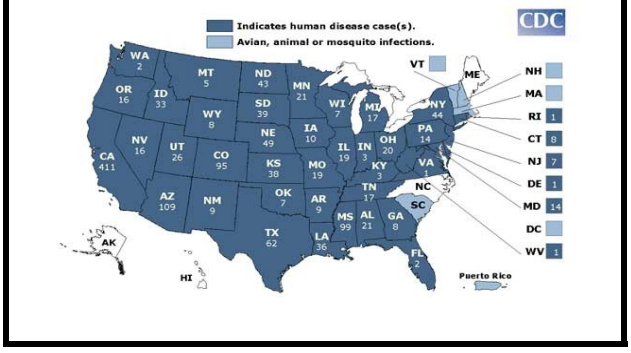
Michigan Human WNV Cases

Year	Total Cases	Fatalities
2008	17	0
2007	13	2
2006	55	7
2005	62	4
2004	16	0
2003	19	2
2002	614	51

Figure 2

Nationwide WNV

(as of 12-16-08)



Weather

Weather has a direct impact on mosquito control operations. Rainfall, specifically, dictates how the mosquito population will rise and fall. Warm air temperatures lead to increased water temperatures, which speed up the length of the life cycle and warm breezes and low humidity aid in evaporation of water habitats that breed mosquitoes. Weather conditions must also be appropriate to conduct operations. Environmental conditions like temperature and wind velocity must be conducive for treatment.

It is imperative, therefore, to maintain weather data to predict both larval occurrence and when biting adults will emerge. Table 5 lists weather data occurring in Bay County during November and December of 2007 and January through October, 2008.

Table 5

Month	Normal Rainfall	2007/2008 Rainfall	Departure from Normal	Normal Average Temp.	2007/2008 Temp.	Departure from Normal
November	2.65"	1.42"	- 1.23"	38.1°	37.1°	- 1.0
December	2.18"	2.43"	+ 0.25"	26.7°	27.6°	+ 0.9
January	1.57"	2.49"	+ 0.92"	21.3°	26.9°	+ 5.6
February	1.35"	2.35"	+ 1.0"	23.8°	21.7°	- 2.1
March	2.22"	2.00"	- 0.22"	33.7°	31.1°	- 2.6°
April	3.13"	2.18"	- 0.95"	45.4°	49.5°	+ 4.1°
May	2.74"	1.32"	- 1.42"	57.1°	55.2°	-1.9°
June	3.07"	5.57"	+ 2.5"	66.2°	68.3°	+2.1°
July	3.17"	4.52"	+ 1.35"	70.6°	71.9°	+1.3°
August	3.43"	3.88"	+ 0.45"	68.5°	68.7°	+0.2°
September	3.76"	5.10"	+ 1.34"	60.7°	62.8°	+2.1°
October	2.34"	1.55"	- 0.79"	49.2°	49.3°	+ 0.1°

Spring Aerial Campaign

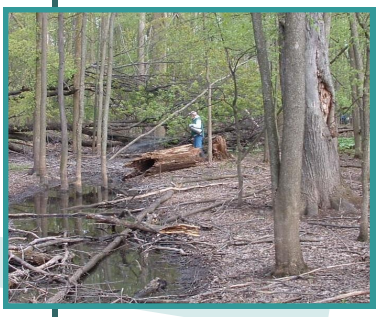
The 2008 mosquito control season began in April with aerial larviciding to control spring woodland mosquitoes. The operation targeted vulnerable larvae before they reached the adult, biting stage. The aerial program has gone on for over three decades in the Saginaw Valley, yet remains the best way to dramatically decrease numbers of spring *Aedes* mosquitoes. The preferred control method has been using a bacterial product known as *Bti* (*Bacillus thuringiensis israelensis*).

Reed's Fly-On Farming of Mattoon, Illinois used two aircraft to apply *Bti* to 28,560 woodland acres in the following townships: Beaver (3,640 acres), Fraser (3,700 acres), Garfield (4,700 acres), Gibson (390 acres), Kawkawlin (1,820 acres), Mt. Forest (5,680 acres), Pinconning (5,920 acres), and Williams (2,710 acres). Calibration, loading, and fueling of the aircraft took place at Barstow Airport in Midland and sites were treated with VectoBac® *Bti* corncob granules at a 4-5 pounds per acre rate.

Clarke Mosquito Control of Roselle, Illinois utilized one Jet Ranger helicopter to apply *Bti* to 6,696 acres the following townships: Bangor (2,728 acres), Frankenlust (768 acres), Hampton (576 acres), Garfield (960 acres), Merritt (336 acres), Monitor (1,056 acres), and BCE/Portsmouth (272 acres).

Spring Ground Larviciding

The battle against Spring *Aedes* mosquitoes continued this year on a smaller scale, too. Table 6 lists the number of acres treated by foot crews and material used in smaller tracts of woodlots during the 2008 spring season.



Four certified technicians helped with aerial quality control, conducting post-treatment surveys to assess *Bti* application. These same technicians were the first to begin inspections and subsequent ground treatment using primarily *Bti* and BVA2 larvicide oil to manage the spring mosquito larvae or pupae. A few hard-to-reach woodlots that had been treated by ground crews in the past were assigned to an aerial application. Almost 400 acres received larval treatment by ground crews to control the emergence of the pestiferous spring *Aedes* mosquito.

Table 6

Spring Ground Treatment

Township	Acres Treated	Briquets	GB-1111 (gal)	BVA2 (gal)	Bti (lb)	Abate (lb)
BCE	4.8				24.3	
BCW	16.2	12.0			81.1	
BANG	9.2	12.0	1.6	0.9	26.9	13.7
ESSE	1.5				7.3	
FRAN	16.6			11.3	26.7	
FRAS	23.9			23.9		
GARF	112.4			111.8	2.8	
GIBS	45.3			44.1	5.9	
HAMP	45.5				227.4	
KAWK	17.3			17.3	0.02	
MERR	0.1				0.5	
MONI	28.7		3.0	18.1	38.5	
MTFO	25.3			24.3	5.0	
PINC	20.1	0.5		20.1		
PORT	1.2				5.0	1.5
WILL	1.8			1.8		
TOTAL	**369.9**	**24.5**	**4.6**	**273.6**	**451.42**	**15.2**

Summer Larviciding

Bay County residents enjoy spending time outdoors during summertime, but the presence of mosquitoes can interfere with outdoor recreation. We try hard, therefore, to reduce mosquito numbers so residents can enjoy Michigan's all-too-short summer.

Our comprehensive mosquito control program focused on routine surveillance and control of potential breeding sites to prevent adults from emerging. This program involved MDA-certified technicians applying insecticides to stagnant water throughout the county. During the breeding season, a team of twenty-three technicians inspected water habitats guided by a database of known breeding sites, citizen complaints, and high trap numbers. Homeowners were notified of property inspections either in person or through the use of a door hanger.

Day Crew

Efforts directed at larval control were accomplished by using bacteria, chemicals, or sanitary (dumping water from containers) methods. Three bacterial products utilized to control larvae were VectoBac®G (*Bti*), *Bti* Briquets™, and VectoLex® CG (*Bacillus sphaericus*); chemical insecticides included 1% Skeeter Abate®, ProVect 4E and Abate® 4-E (temephos), Agnique® MMF (monomolecular surface film), and Golden Bear—1111 and BVA2 (petroleum-based oils).

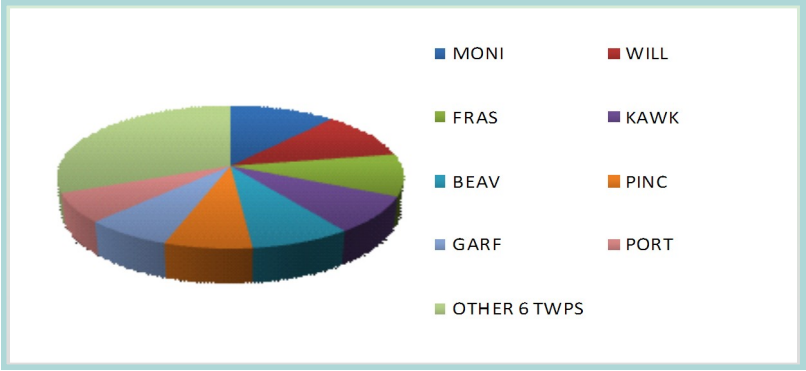
- Larval Sites: The total number of breeding sites increases each year as new sites are added to the database. A total of 12,101 larval site inspections were conducted this season, but only 25% were actually treated. These numbers are in keeping with previous years' data, but higher than 2007. Some of these sites were permanent breeding habitats while others were transient and included ditches, containers, fields, woodlots, tires, idle pools, ornamental pools, and Saginaw Bay beachfront. Larvae were sampled by quickly skimming the water's surface with a dipper; some were collected and returned to the lab for identification. Technicians also controlled mosquitoes by dumping water from buckets, pails and other man-made containers (one method of source reduction) on a regular basis.

- Events: In addition to surveillance and control in neighborhoods

throughout the county, special attention was given to summertime outdoor recreational events, such as the Auburn Cornfest, Munger Potato Festival, Pig Gig Ribfest, and River of Time. According to the Bay Area Convention and Visitors Bureau, over a half million people attend these types of festivals. Larviciding prevents adults from emerging and interfering with outdoor recreation and activities.

- Ditch Treatments: Over 1,400 miles of roadways are maintained in Bay County. Most of these roads are flanked by ditches, which serve as exceptional breeding sources for mosquitoes. Ditches were surveyed by lab personnel once each week. Due to the timing of rainfall events, ditches dried and re-flooded often, thereby stimulating numerous hatches. Ditch trucks logged 13,435.4 miles driven, dispensing 9,171.5 gallons of mix (7,947.7 gallons of Abate 4E mix and 1,223.8 gallons of ProVect mix). This amounts to about 23 gallons of Abate 4E and 6 gallons of ProVect concentrate. Figure 3 offers a breakdown of where the bulk of treatment took place based on each township's breeding propensity.

Figure 3



- Catch Basins: BCMC staff monitored mosquito breeding in catch basins and used 1,235.9 lb of VectoLex® CG bacterial larvicide to treat 40,681 catch basins. In addition, 5.76 gallons of Abate 4E mix was dispensed into BCE catch basins.

- Sewage Lagoons: Sewage lagoons are perfect breeding zones for *Culex* mosquitoes as they're filled with polluted, highly organic water all summer long. Seventeen sewage lagoons were monitored this season and the following products were dispensed: 47 gallons of Abate 4E mix, 2 gallons of ProVect mix, 8 pounds of 1% Skeeter Abate, 20 ounces of Agnique, 88 *Bti* Briquets, and 32.44 gallons of GB-1111.

- Retention Ponds: These ponds were designed to hold storm water until the water either percolated or evaporated, which returned the area to its normal dry state. Floodwater mosquitoes were usually the first to appear in retention ponds, but *Culex* mosquitoes could also be found. BCMC surveyed 106 retention ponds throughout the county, treating them with a variety of products: Abate 4E mix (12.37 gal), Abate 1% (326 lb), Agnique (4 oz), *Bti* Briquets (38), *Bti* (29 lb), GB-1111 (12 gal), and Vectolex Water Soluble Packets (5).

Adulticiding

While larval control was the preferred method of treatment, it was virtually impossible to find and treat all breeding sites, so adulticiding (fogging to kill adult mosquitoes in flight) was also carried out to control mosquitoes. Adult mosquito activity increased following periods of heavy rains, which caused new mosquito broods to hatch. Fogging adult mosquitoes included the use of ULV (Ultra Low Volume) equipment that allowed a relatively small amount of material to be dispensed. Application rates were adhered to by using GPS units with SmartFlow technology in each truck. Label recommendations were followed strictly to assure dosage rates were adhered to and individual spray droplets fell within the acceptable range. To accomplish the latter, droplet measurements were taken several times throughout the season. The first droplet characterization session took place in early May with Clarke Mosquito Control's Jake Britton using the AIMS (Army Insecticide Measuring System) to measure aerosol droplets; software was utilized to store electronic files. Photos below show Jake placing the test probe into the fog (left) and a close-up of the probe with its fine filament (right).

When weather conditions were conducive to fogging, nine certified technicians fogged cities and townships with the highest mosquito counts and/or noted disease activity. This year saw the routine use of permethrin products, especially Kontrol® 4-4. Anvil® 2+2 was also used during the 2008 season. Mosquitoes must come in contact with the droplets in order for the insecticide to be effective so adulticide activities took place after sunset when most species were active and when bees had returned to their hives.

Adulticiding Treatment

Table 7

Township	Miles Treated	Kontrol 4-4 (gal)	Anvil 2 + 2	Others*
BANG	2847.8	195.2	546.2	16.5
BCE	604.3	121.5	7.9	
BCW	495	113.8	6.9	
BEAV	1097.5	196.7	0.7	
ESSE	95.6	22.7		
FRAN	705.5	38.9	106.8	0.7
FRAS	845.7	187.4	7.2	1.9
GARF	1307.6	231.7		
GIBS	1054.1	212.9		
HAMP	1086.6	227.5		2.5
KAWK	1982.3	413.3	5.7	0.6
MERR	748.2	146.8	2.8	
MONI	2807.8	538.1	18.9	
MTFO	1175.9	200.7		
PINC	975.7	209.3	0.3	0.7
PORT	822.3	132.6	21.6	2.8
WILL	1527.3	156.7	168.2	
TOTAL	**20179.2**	**3345.8**	**893.2**	**25.7**

* Other adulticides included Biomist 4 + 4, Scourge 4 + 12, Evoluer 4-4 ULV, and Aqualuer 20-20.

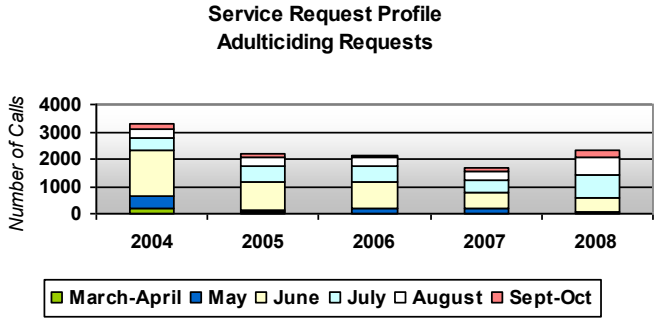
Night Crew

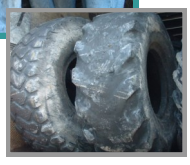
Service was also provided to “Medicals”, citizens who register each year for additional surveillance/control due to allergic reactions to mosquito bites or other verifiable medical needs. During the 2008 season, the “Long Driveway Program” was initiated. This program was designed to fog inhabited properties a minimum distance off the main road because they do not receive adequate adult mosquito control during normal fogging operations. Addresses were placed on route maps to be fogged on a regular basis.

Customer Calls

Traps were the primary indicator of mosquito activity, but customer calls were also used as a means to indicate where adult populations may be problematic. Technicians responded to 2,295 service requests received from Bay County citizens. Most (1,411) of the calls were regular service requests for adulticide treatment due to nuisance mosquitoes, but an additional 884 calls represented special event spray requests. Twenty-six percent of these calls also reported standing water with potential mosquito breeding. In comparison to 2007, the level of customer service requests increased by 35%. Most of those calls were received in July (828), followed by August with 633; calls peaked about two weeks after major rain events. Regardless of the type of service request, all were responded to in a professional, courteous, and prompt fashion. Figure 4 represents a historical profile of adulticide requests; the number of calls positively correlates with rainfall.

Figure 4





Scrap Tire Drives

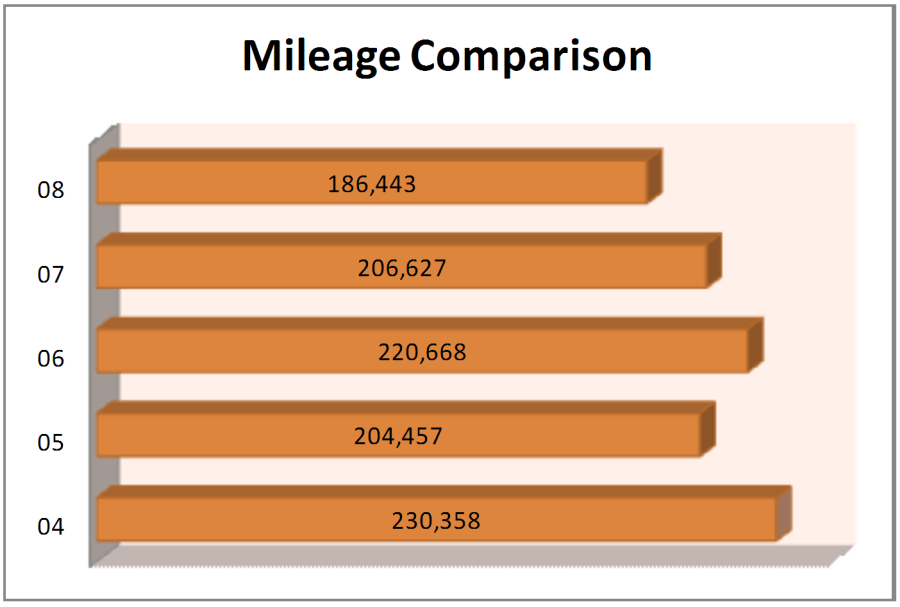
Scrap tire drives were one method of source reduction, the removal or elimination of breeding sources that currently are or have the potential to breed mosquitoes. Two community tire drives were held this summer (June 6-7 and October 3-4) with 4,179 tires collected.

Vehicle Maintenance

Bay County Mosquito Control's state-certified mechanic maintained the 31-vehicle fleet as well as four Bay County Animal Control vehicles, which were billed for parts and labor. During the 2008 season, as Figure 5 shows, 186,443 miles were driven, which represents nearly 90% of the average miles driven in a given year.

Vehicle maintenance repairs included the following: brake systems (20), fuel systems (4), front end repairs (11), truck oil changes (75), electrical systems (20), drive lines (8), new tires (32), and used tire repair (20). In addition to maintaining the vehicles, the mechanic was responsible for repairing and maintaining equipment used by mosquito control staff. Equipment repairs included 52 ULV oil changes, ULV repairs (50), ditch truck repairs (11), Hudson® pressure sprayer repairs (9), and spreader repairs (10).

Figure 5



Education

Extensive efforts were made to inform and educate Bay County residents about mosquito control methods and mosquito-borne diseases. A great deal of education took place every day through hundreds of personal contacts in the field and calls to the office. Periodic interviews by newspaper, television, and radio allowed discussion of news affecting the public, such as spring aerial treatment, summer programs, homeowner property inspections for water elimination, West Nile encephalitis, and scrap tire drives. Staff training was also held on a regular basis to update staff on various topics including safety, disease activity, and policies and procedures.

Presentations were also given to various groups, including school-based programs, and the Website (www.baycounty-mi.gov/MosquitoControl) was updated on a regular basis. Public relations brochures and handouts were developed and distributed.

Membership/Certification

Membership in professional organizations remained vital in accessing updated and new information and maintaining good working relationships with peers. Membership with the non-profit Michigan Mosquito Control Association (MMCA), American Mosquito Control Association (AMCA), and The Entomological Society of America were maintained. All were beneficial due to conferences, publications, networking, and legislative advocacy.

All staff members maintained certification with the Michigan Department of Agriculture in both the Core category and 7F (Mosquito Control). Two training sessions were held April 4 and May 2 with thirty-four new and returning technicians in attendance. Staff also attended the MMCA annual meeting in Kalamazoo, Michigan on February 6-7 and the National Environmental Health Association (NEHA) workshop “Biology and Control of Insects and Rodents” on October 22-23 in Saginaw, Michigan.

BCMC’s program plan was reviewed and approved in January by the Department of Agriculture as part of our Comprehensive Community Outreach as mandated in Regulation 637.

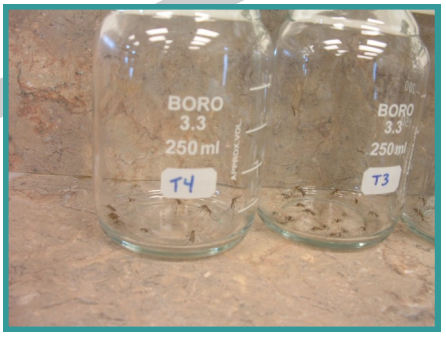
Notification

Public notification for aerial woodlot treatment, summer field operations, scrap tire drives, and disease surveillance activity were accomplished through press releases, radio ads and television announcements. Letters and flyers were also sent to governmental, regulatory, and public safety departments to keep them informed of our various projects.

Product Evaluation

A permethrin adulticide, Evoluer™ 4-4 ULV, was field-tested this summer. In landing counts (collections of mosquitoes landing/biting) we saw a reduction in mosquitoes averaging 70% at 20 minutes post-treatment and 93% at 30 minutes post. In a caged mosquito test with spring and summer *Aedes* mosquitoes we saw 70% reduction in cages placed 50-100 feet from the application route.

Two bottle bioassays were also carried out (primarily with *Aedes vexans* and *Ae. trivittatus*) to determine their response to Evoluer™ 4-4 ULV and Anvil® 2 + 2 ULV. The bottle bioassay was used as an indicator of a mosquito's response to the dosage rate, measuring mortality by how long it took to kill all test mosquitoes. In the first test using Anvil 2 + 2 ULV, between 10-15 females were introduced into 1 of 6 jars (4 treated and 2 controls); no test mosquitoes were alive after 15 minutes. With Evoluer 4-4, between 15-24 females were tested per jar. An average mortality of 93% was achieved at 15 minutes-post treatment, 97% at the 30-minute mark, and 100% at 45 minutes-post.



2008 Insecticide Use Summary

Trade Name	Application Rate	Active Ingredient Dosage	Amount Used
1% Skeeter Abate®	10 lbs/acre	0.1 lb temephos/acre	2147.6 lb
Abate® 4E or Provect 4E	1.5 fl oz/acre	0.0468 lb temephos/acre	29.1 gal
Summit Bti Briquets™	1/100 square feet	7000 AA (Aedes aegypti) Bti ITU/ mg	1382 briquets
VectoLex® CG	5-10 lbs/acre	1.52 billion Bs ITU/acre	1127.6 lb
VectoBac® G	3-5 lbs/acre	0.4555 billion Bti ITU/acre	178,411.1 lb
Agnique® MMF	0.2—1.0 gal/acre	0.2—1.0 gal alcohol-based surface film/acre	27 gal
BVA2 Mosquito Larvicide Oil	1—5 gal/acre	0.987-2.96 gal petroleum distillates/acre	881 gal
Mosquito Larvicide GB-1111	1—5 gal/acre	0.987-2.96 gal petroleum distillates/acre	251 gal
Anvil® 2 + 2 ULV	1.02 fl oz/acre	0.0012 lb sumithrin/acre 0.0012 lb PBO/acre	842.7 gal
Masterline Kontrol 4-4	0.676 fl oz/acre	0.00176 lb permethrin/acre 0.00176 lb PBO/acre	3218 gal
Scourge® 4 + 12	0.75 fl oz/acre	0.00175 lb resmethrin/acre 0.00351lb PBO/acre	5 gal
Biomist 4 + 4	0.75 fl oz/acre	0.00176 lb permethrin/acre 0.00176 lb PBO/acre	3 gal
Evoluer™ 4-4 ULV	0.78 fl oz/acre	0.00175 lb permethrin/acre 0.00175 lb PBO/acre	1.8 gal
Aqualuer® 20-20	0.1155 fl oz/acre	0.0015 lb permethrin/acre 0.0015 lb PBO/acre	2 gal

Map of Bay County, Michigan