Annual Report

Bay County Mosquito Control

2013

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History of Organization

Bay County Mosquito Control (BCMC) 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" does not mean elimination, but involves Integrated Pest Management (IPM) methods designed to reduce the number of mosquitoes so they no longer unfavorably affect the health and quality of life of Bay County residents. BCMC provides a variety of services to the 109,000 residents living in an area covering 443 square miles.

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.

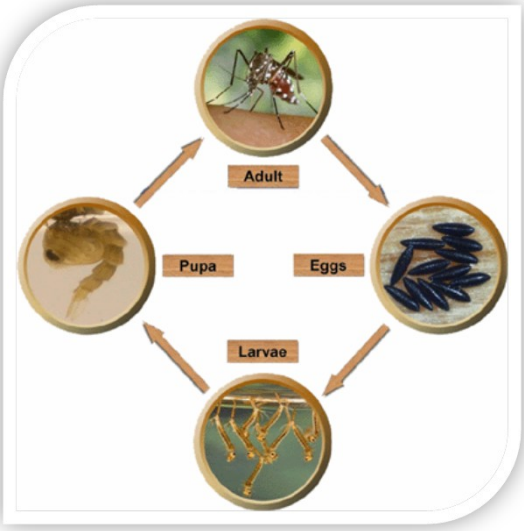
Bay County is one of four Michigan counties with formal, comprehensive mosquito control programs. A Technical Advisory Committee (TAC), composed of local and state professionals, reviews program operations each March.

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 cycle. Female mosquitoes can develop several hundred eggs with each blood meal and lay them in or around water. The eggs are laid (where standing water accumulates after rain or flooding) either singly or attached to one another to form an egg raft that floats on the water's surface. Once eggs hatch, larvae emerge, wriggling through the water. The larvae are filter feeders that eat voraciously and outgrow their skin. Larvae undergo four stages or instars before they change into pupae, which happens about one week after the eggs initially hatch. Pupae do not feed and are often found at the surface of water (like larvae) so they can breathe. Inside the pupa's protective shell, the mosquito transforms into the winged adult. 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. The whole life cycle is typically a quick process, taking about a week to complete. The time required to complete the life cycle is dependent on temperature—the warmer the water, the more quickly a mosquito develops.

After mating, females seek out an animal upon which to feed and this blood provides protein to develop eggs. Males do not bite, but 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 treatment utilizing two fixed wing aircraft was conducted when larvae reached the second or third 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* could be used as a food source by other aquatic organisms occupying the same woodland pool habitats.

Surveillance was an essential part of the spring mosquito control program. Mosquito larval surveillance began in early April with first instars observed in woodland pools on April 8, which is about two weeks later than normal. A week later on April 15, we had received 4-5" of rain leading to many new areas flooded and another hatch, but due to cold temperatures larvae were still first instars. Larval density was also quite low with less than 1 larva/dip recorded on average. By April 22, density was increasing in some woodlots and we were able to set pools and count larvae to look at pre-treatment populations; however four woodlots could not be set due to low larval counts. The aerial treatment began on April 26, which is the latest start-date in BCMC history! In 2012 we had our earliest start date of March 25, so we've certainly experienced extremes during the last two seasons.

Woodlots had lower-than-average water levels at the onset of surveillance, but a rainy April saw flood warnings issued for Bay and surrounding counties with cross country drains overflowing into farm fields. By the end of April, 7.3" had fallen (4.5" above the historical average); the trend continued in May with 5.17" recorded, which runs nearly 2" above normal!

Field technician, Katlyn Smrecak checks a flooded field for mosquito larval activity

Pre-treatment larval counts were taken between 1-4 days before treatment in 37 woodlots and post counts followed within 2-6 days of treatment. Aerial calibration took place on April 26 with treatment beginning immediately and lasting 8 days until May 3. Fixed wing aircraft were calibrated to deliver 3 and 4 pounds of *Bti* per acre.

Quality control of the spring aerial campaign was accomplished with the help of two full-time staff and one certified technician. Staff walked through 76 treated woodlots over the course of the program in order to determine both the average number of *Bti* granules per square foot, which helped confirm the dosage rate, and locate possible skips or misses occurring with the aerial application. 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, tadpoles, seed shrimp, 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.

Post counts indicated an overall average 95.4% larval mortality (Table 1). Favorable control was seen at both the 3- and 4-pound per acre dosage; results were not significantly different. Adult emergence of spring *Aedes* and *Aedes vexans* mosquitoes from seasonally flooded woodlots took place from approximately May 7-15.

Field technician, Jim Hughes, checks for the presence of *Bti* in a woodlot after aerial treatment

Table 1

Bay County Mosquito Control Spring Treatment 2013 - Bti Evaluation				
		Larval Count		
Location	**Dosage Rate**	**Pre**	**Post**	**Mortality**
Bangor 4 - Bangor Oil Well	4#/acre	0.77	0	100%
Bangor 31 - St. Maria Goretti Church *	4#/acre			
Bangor 33 - Bangor and Zimmer	4#/acre	0.6	0.1	83.3%
Beaver 4 - 1576 Cottage Grove	3#/acre	0.9	0.14	84.4%
Beaver 5 - Carter and Cottage Grove *	3#/acre			
Beaver 9 - 1585 Cottage Grove	3#/acre	1.24	0	100%
Frankenlust 2 - Four Mile and Delta	4#/acre	0.82	0	100%
Frankenlust 3 - Delta by Automotive Bldg.	4#/acre	0.58	0	100%
Frankenlust 7 - 259 Amelith Road	4#/acre	0.98	0	100%
Fraser 6 - Townline 16 by 7 Mile Rd.	4#/acre	1	0.02	98%
Fraser 11 - Camp Fishtales	4#/acre	0.95	0	100%
Fraser 15 - Fraser Twp. Firebarn	4#/acre	1.4	0.03	97.9%
Fraser 22 - Fraser Twp. Hall	4#/acre	0.74	0.02	97.3%
Garfield 9 - 11 Mile N. of Erickson	3#/acre	1.26	0.12	90.5%
Garfield 10 - Garfield Twp. Park	3#/acre	0.92	0.04	95.7%
Garfield 15 - Methodist Church	3#/acre	0.5	0	100%
Garfield 26 - Crump Fox Club	3#/acre	2.2	0	100%
Kawkawlin 2 - 2080 LeBourdais Rd.	3#/acre	2.12	0	100%
Kawkawlin 30 - White Birch Village *	3#/acre			
Monitor 9 - 1306 Wheeler	4#/acre	0.86	0.06	93%
Monitor 20 - Fraser and N. Union	4#/acre	1.1	0	100%
Monitor 23 - Rocking Horse Ranch	4#/acre	0.75	0.05	93.3%
Monitor 28 - Mackinaw Road Tech Park	4#/acre	0.6	0	100%
Monitor 34 - Fremont Cemetery *	4#/acre			
Mt. Forest 9 - Sand Rd. Road Commission	3#/acre	1.09	0.2	81.7%
Mt. Forest 17 - Carter N. of Cody-Estey	3#/acre	0.96	0	100%
Mt. Forest 21 - Daycare	3#/acre	1.65	0.05	97%
Mt. Forest 21 - Mt. Forest Firebarn	3#/acre	0.9	0.04	95.6%
Mt. Forest 30 - Pinconning and County Line	3#/acre	1.66	0	100%
Pinconning 23 - K C Hall Water Street	3#/acre	1.74	0	100%
Pinconning 30E - Pinconning County Park	3#/acre	0.84	0.1	88.1%
Williams 16 - Carter and N. Union	3#/acre	1.34	0	100%
Williams 19 - Victoria Woods Trailer Park	3#/acre	0.625	0.15	76%
Williams 20 - Forest School/Daycare	3#/acre	0.76	0.02	97.4%
Williams 21 - Forest Edge	3#/acre	0.74	0	100%
Williams 30 - Rockwell and Salzburg	3#/acre	1.64	0.04	97.6%
CONTROL Frankenlust 3 - Delta Mackinaw Road	N/A	0.88	0.82	6.8%
CONTROL Mt. Forest 30 - Pinc. Rd. and County Line	N/A	1.82	1.66	8.8%
AVERAGE TREATED MORTALITY				**95.8%**
AVERAGE TREATED MORTALITY (Corrected)				**95.4%**
AVERAGE 3#/ACRE DOSAGE				**94.9%**
AVERAGE 4#/ACRE DOSAGE				**96.9%**
* Not enough larvae could be found to set the woodlot.				

Summer Larval Surveillance

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

Staff conducted routine surveillance of probable mosquito breeding sites using a standard pint-sized dipper. Stagnant water sites included ditches, catch basins, flooded fields, woodlots, and tires. Roadside ditch larval site inspections, termed sequential sampling, occurred weekly throughout the county with larval samples collected and identified to determine the need for control. Two hundred nine larval samples representing eleven species were identified; the majority were *Aedes vexans* followed by *Culex pipiens* and *Culex restuans*. Fifteen larval samples were identified as *Aedes japonicus,* the newest mosquito species to Bay County, which was found breeding primarily in tires and containers.

To assess the activity of *Culex* mosquitoes in city and suburban catch basins, biology staff randomly inspected 30-50 basins on four occasions. The basins are a perfect habitat, providing *Culex* mosquitoes with organically-rich standing water and decomposing leaf litter, which provides a bacterial food source. In the past, egg rafts have been found as early as May 2, but basins weren't sampled until June 7 due to widespread rain during the last two weeks of May. Basin surveillance on June 7 showed that 57% of those checked were breeding with mostly first instar larvae. This prompted the initial treatment using VectoLex CG and Natular XRT. The Natular was used in the more outlying areas of the county. In order to determine efficacy and longevity of the control materials, basins were inspected every four-five weeks. VectoLex provides control through four weeks post-treatment, while Natular-treated basins were hand-treated once this season.

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 and continued through the summer as technicians checked recently-treated habitats. Tires, ornamental ponds, ditches, and retention ponds were some of the habitats that were checked within a few days of treatment to make sure the product was performing correctly; no non-target impacts were noted.

Aedes japonicus is a container-breeding mosquito species native to Asian countries. It was first discovered in Bay County in 2005 in its adult form, but began to crop up in larval samples in 2006. The following two figures show how this invasive species has begun to occupy several habitats including artificial containers (Figure 1) and tires (Figure 2) through the years. Technicians have also sampled *Ae. japonicus* larvae to a lesser extent in ornamental ponds, cross country drains, tree holes, roadside ditches, and ponds.

Figure 1

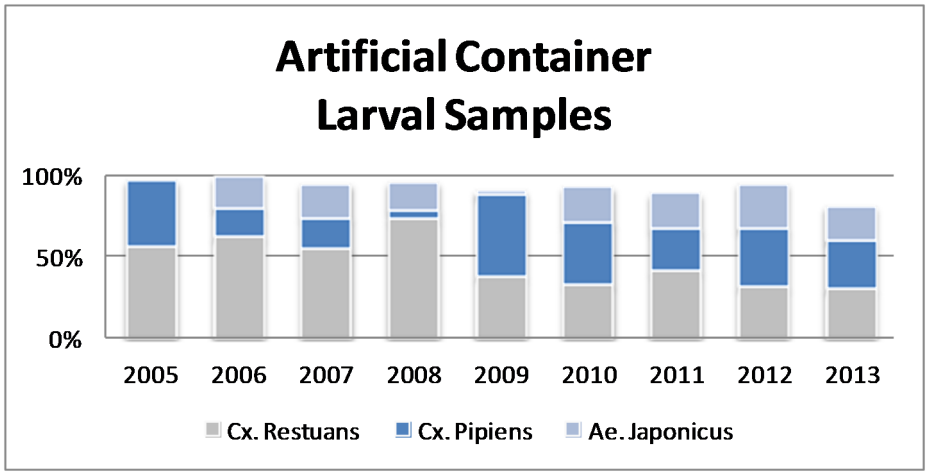
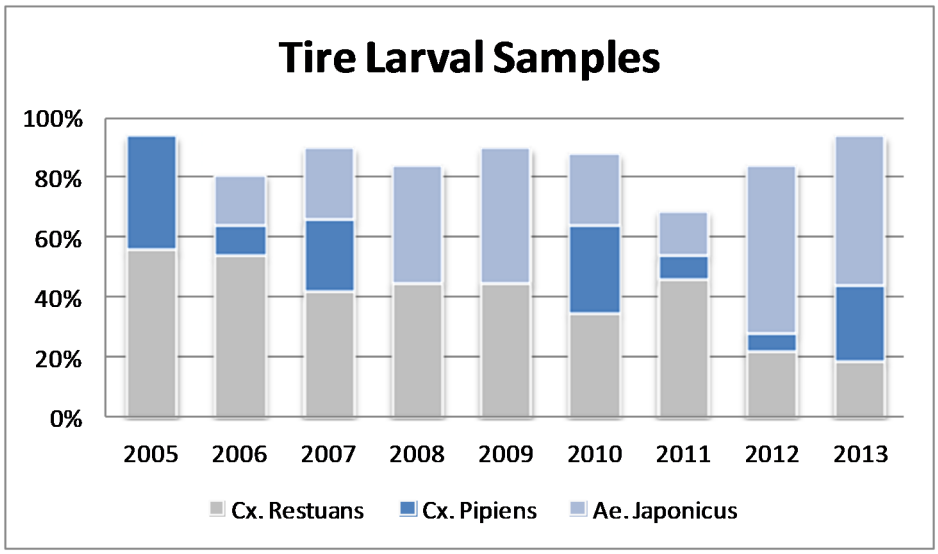


Figure 2



New Jersey Light Traps

As in previous years, BCMC completed regular mosquito trapping throughout the season. Trapping data is critical to the mosquito management program as it helps recognize mosquito numbers, species, location, and potential disease threat. One of the main tools used in adult surveillance is the light trap. From mid-May through mid-September, adult mosquitoes were collected in 14 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 7,603 (Table 2), merely 4% above the 2012 season, but much below (48%) the historical average of 14,536. While May and June had heavy rains, the remainder of the summer was quite dry with few floodwater mosquito hatches; all species were collected in fewer numbers than most years. August trap counts ranked 30 in the 31-year history with 75% fewer mosquitoes than an average year.

Table 2

Species	May	Jun	Jul	Aug	Sep	TOTAL
Ae. vexans	22	2836	1239	218	41	4356
Ae. intrudens	0	5	4	0	0	9
Ae. implicatus	0	1	0	0	0	1
Ae. stim/fitchii	5	19	13	0	0	37
Ae. provocans	0	0	1	0	0	1
Ae. canadensis	1	14	11	0	0	26
Ae. triseriatus	0	50	1	2	0	53
Ae. trivittatus	0	68	43	1	0	112
Ae. sticticus	7	17	2	0	0	26
Ae. japonicus	0	0	3	8	3	14
An. punctipennis	0	24	252	41	5	322
An. quadrimaculatus	22	91	746	424	70	1353
An. walkeri	0	12	43	57	24	136
An. perplexens	0	0	3	4	1	8
Cs. inornata	4	1	0	4	2	11
Cq. perturbans	0	117	220	8	0	345
Cx. pipiens	2	16	206	261	57	542
Cx. restuans	45	82	76	29	5	237
Cx. territans	0	0	0	1	1	2
Ps.ciliata	0	0	0	0	0	0
Ps.ferox	0	0	0	0	0	0
Ur. sapphirina	0	0	0	4	2	6
Damaged	0	1	2	3	0	6
Male Mosquitoes	24	932	851	746	181	2734
Total Females	108	3354	2865	1065	211	7603

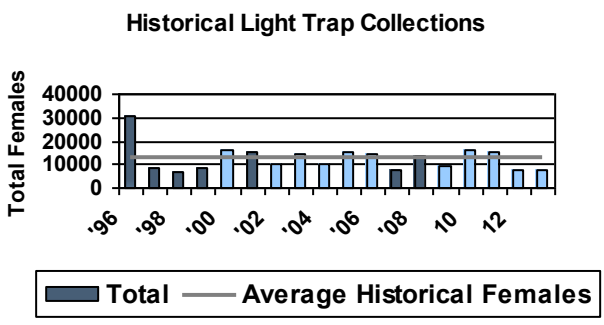
Twenty species were collected during the 2013 season and the most predominant was *Aedes vexans*, representing 57% of the total; this floodwater mosquito usually ranks first because it hatches in great numbers after heavy rains flood ditches, fields, and woodlots. The *Anopheles* species (*quadrimaculatus*, *walkeri*, *punctipennis*, and *perplexens*) represented 24% of the total catch, while the *Culex* mosquitoes, *Cx. pipiens and Cx. restuans,* ranked third with 10%. Emergence of the cattail marsh mosquito, *Coquillettidia perturbans,* adults occurred on time, but the population was about 25% less than an average year when the species represents about 8% of the light trap collection. This year perturbans comprised about 4.5% of the total. Finally, we watched with great interest, our newest mosquito species, *Aedes japonicus,* whose numbers remained virtually unchanged since 2008 with fourteen captured. Average number of *japonicus* collected since 2005, which is the first year they were discovered, is 11. The number of larvae collected, however, indicates more adults must be present.

Figure 3 shows a historical perspective of light trap collections with the average number collected in a given year represented by the solid gray line (12,597). As you can see, the number collected in 2013 was about half as many as the average. Typically, total number of females corresponds with the amount of rainfall received and this year our heaviest rains came in April and May. After this, no significant rainfall occurred throughout the county. Little rain fell in August and September so we ended the year without much fanfare and in drought-like conditions.

Figure 4 (page 14) shows mosquito species collected per trap night throughout the summer. Summer floodwater *Aedes* had a major peak on June 21 as well as a second smaller, but nevertheless noteworthy, brood of both floodwater *Aedes* and *Anopheles* mosquitoes in mid-July. These spikes followed major rain events by about two weeks. Figure 5 (page 15) shows the adult mosquito abundance trend for Bay County's most active species, *Ae. vexans*. You can clearly see the major peak in activity in mid-June. This corresponded to numerous phone calls from Bay County citizens asking for help in reducing mosquito numbers around their homes and neighborhoods.

There were two West Nile Virus-positive pools of *Culex* mosquitoes collected from one NJLT in Williams Township.

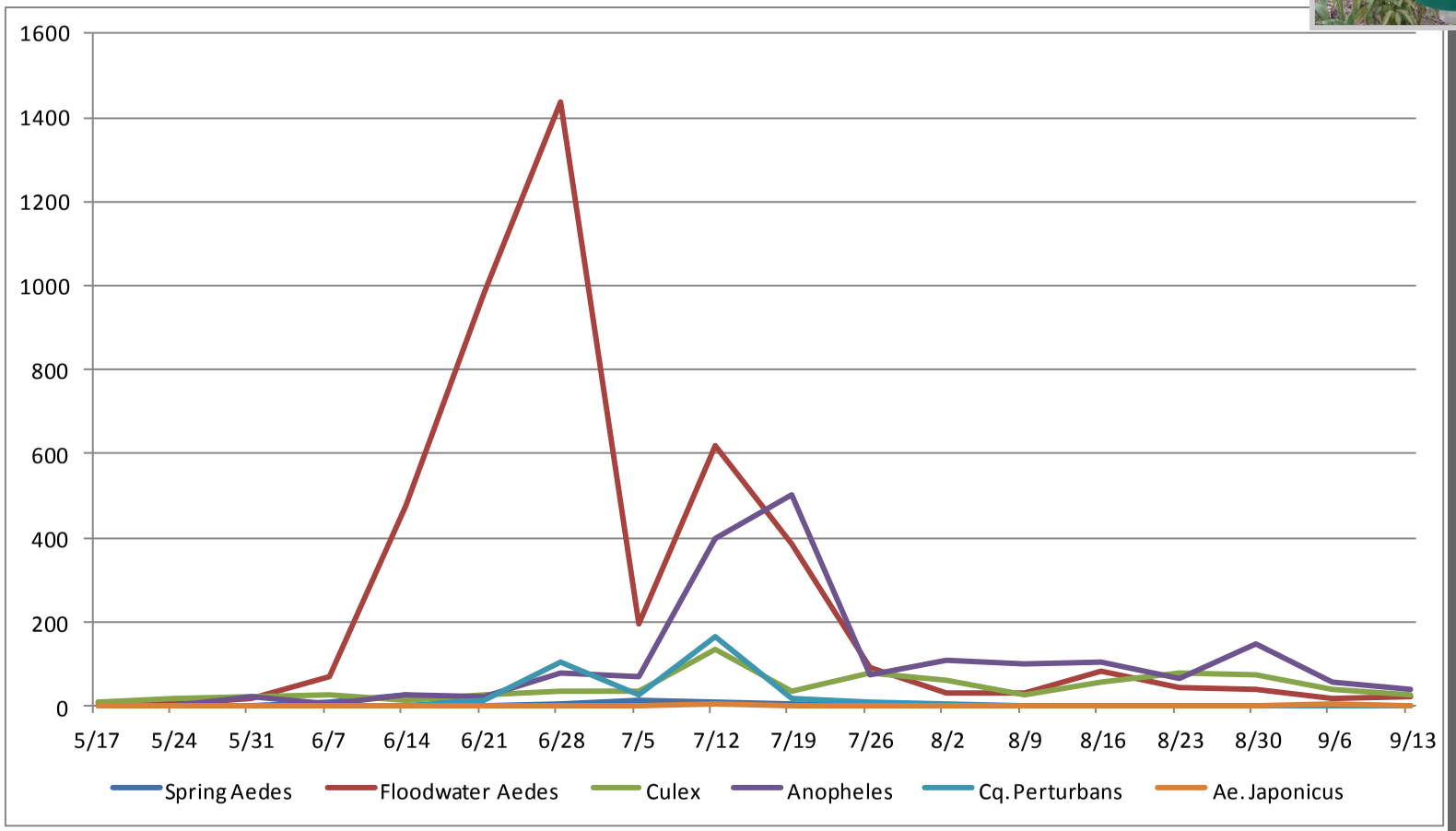
Figure 3



New Jersey Light Traps 2013

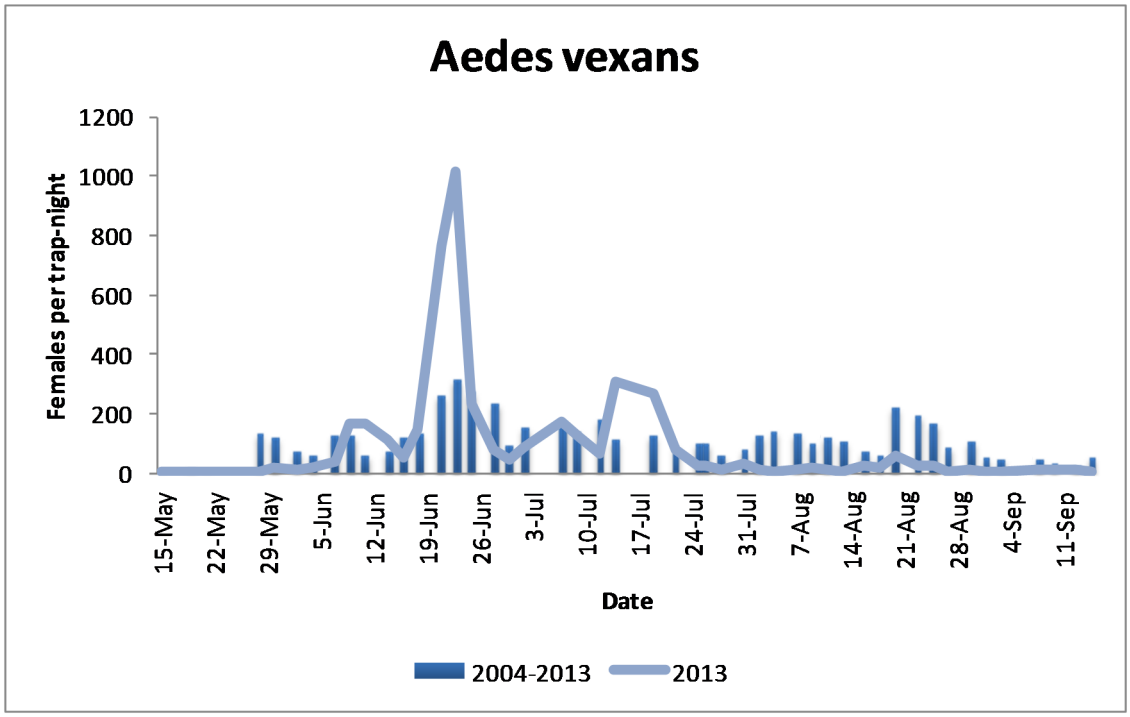
Weekly Captures

Figure 4



New Jersey Light Traps 2013
Adult Mosquito Abundance Trends

Figure 5



The species shown here, *Ae. vexans*, is considered the most significant in Bay County and is widespread and abundant. Its larvae are found in temporary rain-filled fields, woodlots, or ditches with several generations emerging each summer. Adults are bothersome daytime and evening biters and have a long flight range—over five miles.

Heavy rains in April (the wettest on record with 7.33") and May (11th wettest—5.17") caused a major hatch of summer species—especially *Ae. vexans*. One other minor hatch was recorded in mid-July, but the population essentially bottomed out after that.

The spike in adult mosquitoes triggered numerous phone calls from Bay County residents with hundreds of phone calls logged in mid-to-late June. Very few phone calls were logged during the last eight weeks of the season, however.

CDC Traps

CDC Traps are another mechanical trap utilized in BCMC's adult surveillance program. The CDC Trap attracts blood-seeking female mosquitoes with the use of dry ice (carbon dioxide) as bait. Traps are placed overnight within woodlots, summer festival grounds, treatment sites, and personal residences. Usually the traps hold diverse species and larger mosquito numbers compared to New Jersey Light Traps. Traps are also used to assess homeowner complaints, gather arbovirus information, and record changes in abundance of mosquitoes before and after control operations.

These traps are quite good at sampling most of the district's 20+ individual mosquito species, each one being a little different from the other due to where they prefer to breed, their biting habits, flight range, and ability to transmit disease.

The total number of mosquitoes captured in 265 CDC traps this year was 22,391 (Table 3—page 17). *Aedes vexans* and *Ae. trivittatus* (floodwater species) remained at the top ranking spot, representing 64% of the total with nearly equal numbers of other genera representing the remainder of the trap composition. Almost 14,000 adults (62% of total catch) were collected in traps between May 15-June 30. Heavy rains in April and May came on the heels of the spring brood, causing the summer species to hatch around the same time as the spring species.

Twenty-two species in seven genera were collected and identified, averaging 84 females per trap, down slightly compared to 103 in 2012. The average number of females in 2011 and 2010 was 93 and 102, respectively. This year we continued to trap twice weekly, placing 20 traps total each week. Some traps sampled the same locations while others were placed based on dead bird reports, mosquito complaints, or other indicators of possible virus or nuisance risk.

Mosquitoes from CDC Traps, like New Jersey Light Traps, were tested for mosquito-borne viruses in batches of between 5-50 individuals of a particular species sampled from the same location. There was one West Nile Virus-positive pool of *Culex* mosquitoes collected from CDC Traps placed in Hampton Township.

Technician Erin Kelly hangs a CDC Trap in a woodlot

CDC Traps

Table 3

Species	May	Jun	Jul	Aug	Sep	TOTAL
Aedes vexans	27	8097	2315	940	250	11629
Aedes intrudens	40	26	66	11	0	143
Aedes implicatus	0	4	6	2	0	12
Aedes stimulans/fitchii	118	199	79	5	0	401
Aedes Canadensis	1485	79	43	0	0	1607
Aedes dorsalis	1	0	0	0	0	1
Aedes provocans	2	55	34	16	0	107
Aedes sticticus	134	280	18	4	0	436
Aedes triseriatus	0	1	29	3	4	37
Aedes trivittatus	0	2238	456	38	4	2736
Aedes japonicus	0	0	0	3	0	3
Anopheles punctipennis	10	20	165	31	2	228
Anopheles quadrimaculatus	7	52	872	212	19	1162
Anopheles walkeri	0	13	31	31	4	79
Culiseta impatiens	0	5	0	0	0	5
Culiseta inornata	0	1	6	1	0	8
Coquillettidia perturbans	0	302	1729	128	0	2159
Culex pipiens	0	21	320	454	39	834
Culex restuans	342	167	145	63	0	717
Psorophora ferox	0	2	7	0	0	9
Psorophora ciliata	0	0	0	0	0	0
Uranotaenia sapphirina	0	0	0	0	0	0
Damaged	1	56	15	6	0	78
Total Females	2167	11618	6336	1948	322	22391

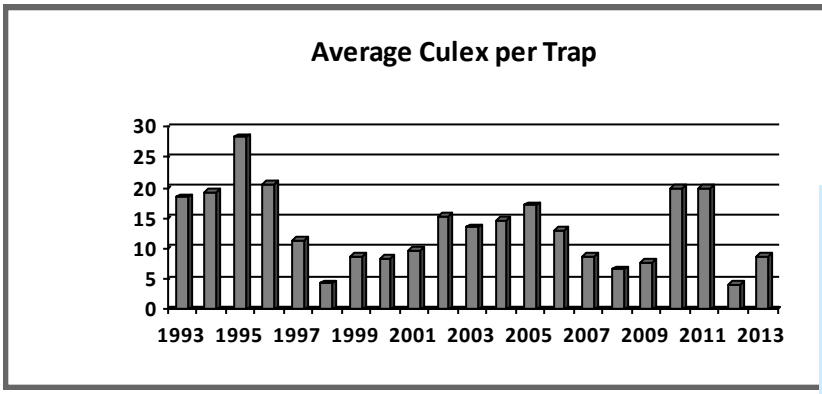
Gravid Traps

Gravid traps offer another method to collect female mosquitoes, primarily *Culex* species that have taken a blood meal and are searching for a suitable place to lay eggs (oviposit). This trap is selective for blood-fed female *Culex* mosquitoes; therefore, the traps provide a good means for early West Nile Virus (WNV) detection. In fact, there were two West Nile Virus-positive pools of *Culex* mosquitoes collected from these traps placed in Bangor and Monitor Townships.

A solution containing water, brewer's yeast, whey, and guinea pig pellets is allowed to ferment for about a week before being poured into a plastic tub, over top of which sits the gravid trap. This organically-rich water is the attractant to gravid (egg-bearing) females. As the females lay or attempt to lay eggs on the surface, they are drawn into the collection chamber and trapped. The fan is located at the top of the trap so the mosquito is not drawn through the fan, thus preserving the specimen. Traps were set out in the afternoon and collected the next day.

Gravid trap placement ran from June through September with 155 traps capturing 1,562 mosquitoes (1,361 *Culex* species, 16 *Ae. japonicus*, 11 *Ae. vexans*, 19 *Anopheles* species, 1 *Ae. trivittatus*, 3 *Cq. perturbans*, 1 *Ae. sticticus, and 1 Cx. territans,* and 149 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 Michigan State University for WNV-detection. Figure 6 shows a historical perspective of the average number of *Culex* mosquitoes collected per gravid trap. Collections from 2013 rebounded from the 2012 numbers, with an average of 8.8 female *Culex* mosquitoes per trap.

Figure 6



Disease Surveillance

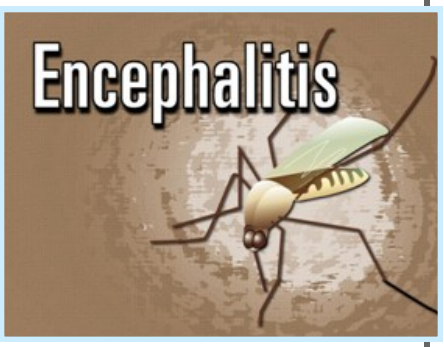
Since the inception of Bay County Mosquito Control, efforts have been targeted at controlling known disease vectors as well as nuisance mosquito species. While reducing annoyance and improving quality of life are important, the primary goal of our program has always been to reduce mosquito numbers in 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.

St. Louis encephalitis, Eastern Equine encephalitis, LaCrosse encephalitis, West Nile Virus, and dog heartworm are all mosquito-borne pathogens found in Michigan. Mosquito pools are submitted to MSU's Microbiology and Molecular Genetics Department to be analyzed for these disease agents.

A mosquito pool is a group of up to 50 mosquitoes of the same species collected from a trap, placed in a vial, and tested for mosquito-borne disease. Two hundred fifty-one (251) pools containing 5,470 females representing a variety of species were tested with the following results:

- *Coquillettidia perturbans* (85 pools/2,347 females/no positives)
- *Culex restuans/pipiens* (165 pools/3,118 females/**5 positives**)
- *Aedes japonicus* (1 pool/5 females/no positives)

A positive pool indicates local mosquitoes are infected with West Nile Virus and are capable of transmitting it to humans and other hosts. One of the positive pools was collected from a CDC trap placed along Weadock Highway in Hampton Township (9/5/13; 6 *Culex* mosquitoes). Two positive pools were collected from gravid traps placed in the following places: Bangor Township's Schumann Road Retention Pond (7/18/13; 50 Culex) and Monitor Township near Michigan Sugar (8/8/13; 12 Culex). The last two positive pools were from a New Jersey Light Trap—Auburn at 204 Grant Street (8/19/13; 12 *Culex) (*9/5/13; 18 *Culex*). In 2012 six pools tested positive from six unique locations.



Mosquito surveillance data are useful in tracking virus activity. The minimum infection rate (MIR) is a calculation of the number of infected mosquitoes per 1,000 of a particular species. The higher the MIR, the higher the level of viral activity and the greater the chance for human infections. A MIR of 4 or above indicates a high level of viral activity. The MIR for *Culex* mosquitoes at BCMC in 2013 was 1.6; for *Coquillettidia perturbans* the MIR was 0. In comparison, the MIR for Culex in 2012 was 2.3.

The dead bird surveillance program was established in 2001 by the Michigan Department of Community Health in collaboration with local agencies. We rely on Bay County citizens reporting dead birds as one method of WNV surveillance. This year we received 61 phone calls reporting dead birds throughout the community, which is down from last year's 95 calls, but still up significantly from the 18 received in 2011. In 2013, 105 dead birds were reported, most of which were American Crows (25), Blue Jays (9), House Sparrows (18), Common Grackles/European Starlings/ other blackbirds (27) and Robins (8). All dead bird sightings were logged onto Michigan's Emerging Diseases website www.michigan.gov/emergingdiseases. After initial screening by staff, a total of 14 crows or jays were tested with **9 testing positive**—two crows from Bay City West (7/25 and 8/20), two crows from Pinconning Twp. (8/16 and 9/23), a crow from Monitor Twp. (9/5), two crows from Bay City East (9/6 and 9/23), a blue jay from Monitor Twp. (9/9), and a crow from Bangor Twp. (9/16). Using the WNV Vector Test™ kit, American Crows and Blue Jays were tested to determine infection rates. The first two samples that tested positive in the lab were confirmed positive by MSU's Diagnostic Center for Population and Animal Health. Compared to 2012, disease activity in 2013 remained at nearly the same level for Bay County.

Table 4

Michigan Human WNV

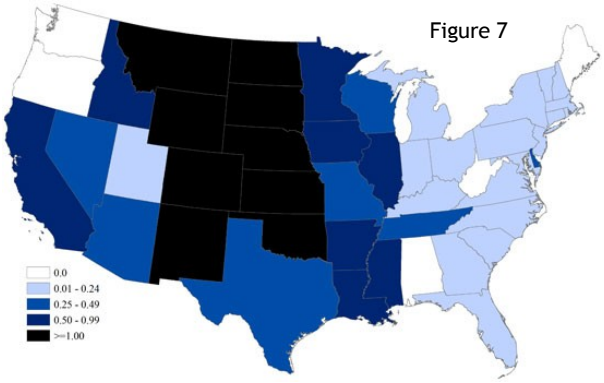
Year	Total Cases	Fatalities
2013	38	2
2012	202	17
2011	33	2
2010	29	3
2009	0	0
2008	17	0
2007	13	2
2006	55	7
2005	62	4
2004	16	0
2003	19	2
2002	614	51

Statewide, there were far fewer cases compared to last year (Table 4). As in previous years, many cases occurred near Detroit communities with most cases located in the City of Detroit (8) and Wayne County (10); each location also had one fatality. Table 4 shows data as of December 2, 2013.

Nationally, there were 2,374 human WNV cases with 114 deaths (as of 1/7/14), which is about 50% fewer cases than were reported in 2012, the second most-active WNV year since 2003. About 60% of the cases were reported from 6 states (California, Colorado, Nebraska, North Dakota, South Dakota, and Texas).

2013 West Nile Virus Neuroinvasive Disease Incidence
per 100,000 (as of 12/3/13)

Figure 7



Product Evaluations

An evaluation of *Bti* Briquets™ was conducted to monitor efficacy and residual of the product in container habitats. *Bti* Briquets are formulated to release effective levels of *Bti* for a period of 30 days or more under typical environmental conditions. The briquets float so the material is released at the surface as well as gradually settling to the bottom. The evaluation was set up to ensure that the product was still performing as expected.

Using a dosage rate of 1 briquet per 10 square feet, a 1/4 briquet was added to two Rubbermaid® containers while a third container was left as an untreated control. The containers were set up on July 17 with 25 *Culex* larvae (second and third instars) each. Little mortality was noted after 24 hours with container #1 showing 12% M and container #2 with 4% while the control recorded 0% M. Mortality went up slightly after 48 hours averaging 12% in both tubs. By Day 4, however, when the briquet had time to release *Bti*, mortality had climbed to an average of 80%; the untreated control mortality remained low at 0%. Increments of 25 *Culex* larvae were added to the tubs on Day 4, Day 18, Day 16, Day 27, and Day 34. After Day 4, mortality remained high averaging 97% until the experiment ended on Day 37.

An operational trial to determine the efficacy and duration of a new granular *Bti* material, AllPro Sustain MBG larvicide was conducted in August. In addition to treating four outdoor mesh-covered containers, a detention pond at Wallinda Court was also treated and monitored.

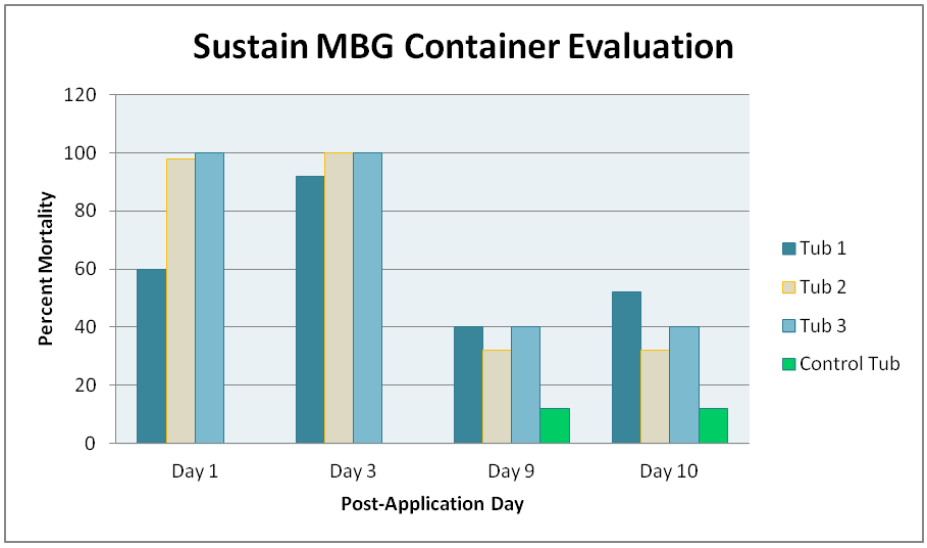
The detention pond had an area of 0.36 acres and was treated August 1 at a 5 lb/ acre dosage rate. Third instar larvae *Aedes vexans* were dipped and counted. The average number of larvae in ten dips was 9.9, while 1.2 larvae/dip were recorded in an untreated control retention pond at Meijer on Pine Road. The 24-hour post-treatment count showed dead larvae in nearly every dip at the Wallinda Court site with mortality averaging 92.9%; control mortality was 0%. On August 5 (Day 4), Wallinda Court pond was dry while the Meijer site averaged 1.3 larvae/dip. Roughly 0.5" of rain fell on August 8, reflooding the Wallinda Court site. Forty-eight hours later, counts showed 2nd instar larvae thriving (21.6/dip). Twenty dips were taken at the Meijer site on that same date and larvae remained unchanged at 1.2/dip. At the 5 lb/acre rate, Sustain MBG was able to effectively control larvae immediately after a hatch, but showed no longevity; larvae that hatched after a successive rain needed to be re-treated.

Containers treated with Sustain MBG were monitored for ten days, beginning August 6. Each container was set up with 30 second or third instar *Culex* larvae and 30 *Aedes vexans* on Day 1. The containers were filled with 5 inches of tap water (about 3 gallons) and with one quart strained gravid bait. Water acclimated 24 hours before larvae were added and each tub was covered with netting. Containers were treated at a 3, 5, and 7 lb/acre dosage with a fourth tub used as an untreated control. After 6 hours of exposure, it was evident that *Ae. vexans* were succumbing to the effects of Sustain MBG more quickly than the *Culex* larvae.

Product Evaluations, continued

Most larvae that were still alive after Day 1 had died by Day 3 (see Figure 8 below). On Day 7, 25 Culex larvae were added to the containers with mortality measured on Day 9 with poor control achieved. Live larvae were returned to the containers and another reading was taken on Day 10. Tub 1 saw an increased mortality from 40% to 52%, but mortality remained the same in the other three tubs. Like the detention pond evaluation, mortality was high initially, but the product did not seem to provide any long-term control. We would like to replicate this experiment in 2014.

Figure 8



Resistance

When insecticides repeatedly fail to achieve an expected level of control when used according to label recommendations, mosquitoes are said to have become resistant to the particular material. Resistance, therefore, is always a concern, so the program relies on using biological insecticides and various chemicals in a variety of habitats and against different developmental stages throughout the season to help reduce the chances resistance will become a problem. In order to monitor for mosquito resistance to control materials, bottle bioassays are run which expose a number of adult mosquitoes to a given amount of insecticide. This resistance testing is a continuous part of the program and this year Kontrol 4-4 adulticide was evaluated with 86% mortality after 15 minutes and 100% mortality achieved after 45 minutes. This is comparable to previous years.

Weather

Monitoring rainfall is especially important in an IPM approach to mosquito control because it allows for estimating mosquito larval activity and to know where to dispatch technicians following significant rain. Average rainfall for the Great Lakes Bay Region from May 1 through September 30, 2013 was 12.73"—3.35" below the average of 16.08" (Figure 9).

While March was cold and dry, April brought with it temperatures just slightly below average, but precipitation significantly higher (7.33") than the monthly average of 2.89". Mean temperature data for May showed the Great Lakes Bay Region running about 4 degrees above normal, at 61.5°F and with above-average precipitation, totaling 5.17".

June and July were characterized as average, both for temperature and rainfall, while August and September had average temperatures, but below-average rainfall (-1.21" and –1.94", respectively). What had been a busy mosquito season early on, slowed significantly with drought-like conditions as the summer wore on.

The eighth driest September on record allowed us to confidently shut down operations just before the end of the month. Figure 10 (page 24) shows the average rainfall amounts that were measured in a rain gauge network placed throughout the county from May to October. Rain events that drop over an inch of rain are typically sufficient to cause a new hatch of mosquitoes. There were really only two such rain events that occurred during the 2013 summer season and those occurred at the end of May and again in early June.

Table 5 (page 24) lists weather data occurring in Bay County during Nov-Dec, 2012 and Jan-Oct, 2013 and the monthly departures from normal for temperature and rainfall.

Figure 9

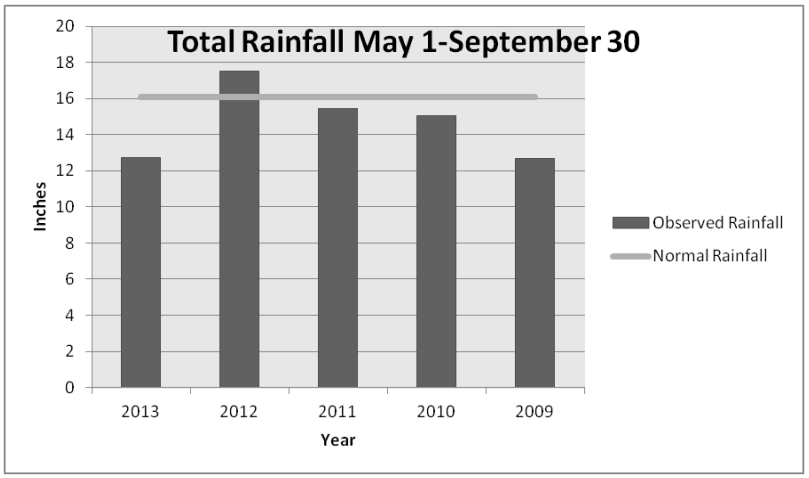


Figure 10

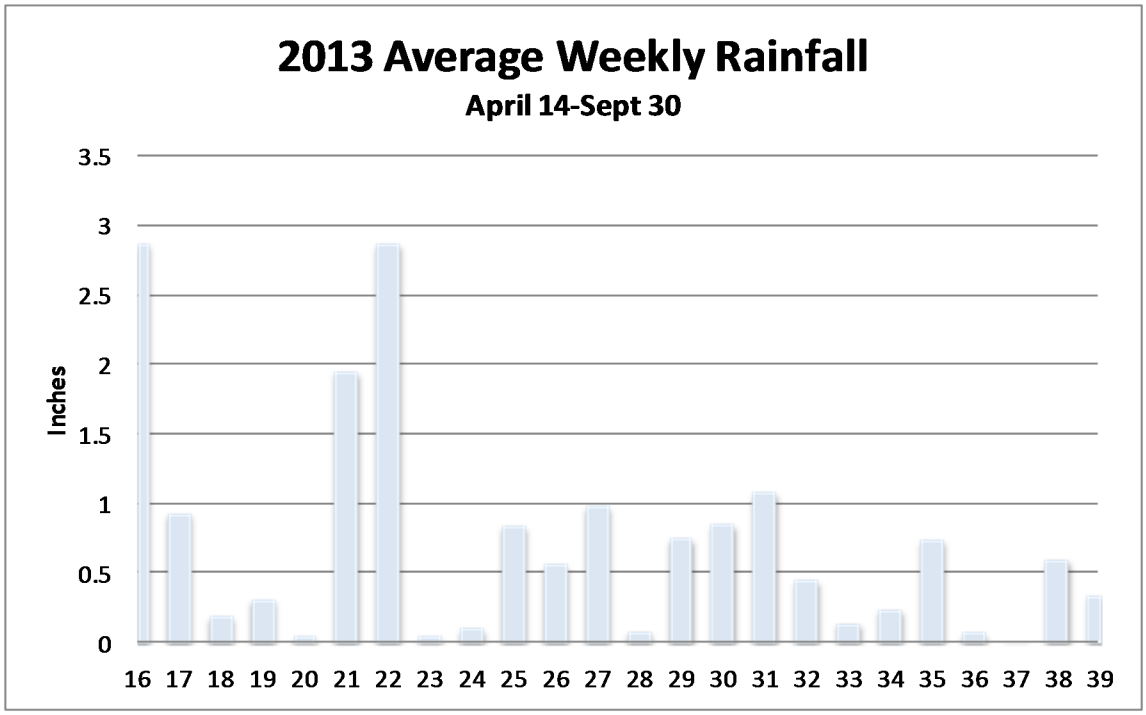


Table 5

Month	Normal Rainfall	2012/2013 Rainfall	Departure from Normal	Normal Average Mean Temp.	2012/2013 Average Mean Temp.	Departure from Normal
November	2.7”	0.41”	- 2.29”	38.5°	38.6°	+0.1°
December	1.86”	1.89”	+0.03”	27.3°	34.1°	+6.8°
January	1.71”	3.26”	+1.55”	22.2°	26.8°	+4.6°
February	1.61”	1.99”	+0.38”	24.5°	24.0°	-0.5°
March	2.06”	0.6”	-1.46”	33.7°	31.3°	-2.4°
April	2.89”	7.33”	+4.44”	46.1°	43.7°	-2.4°
May	3.38”	5.17”	+1.79”	57.3°	61.5°	+4.2°
June	2.98”	2.54”	-0.44”	67.2°	67.6°	+0.4°
July	2.58”	2.9”	+0.32”	71°	71.7°	+0.7°
August	3.31”	2.1”	-1.21”	68.8°	69.7°	+0.9°
September	3.83”	1.89”	-1.94”	61.3°	62.0°	+0.7°
October	2.63”	3.59”	+0.96”	49.7°	52.0°	+2.3°

Spring Aerial Campaign

Weather patterns for spring 2013 returned closer to "normal" compared with the extreme warmth the area had experienced in 2012. The mosquito control season, which typically begins in early- to mid-April with aerial larviciding to control spring woodland mosquitoes, instead began on April 26. March temperatures were slightly colder than normal, but rainfall/snowfall levels were among the driest (5th driest), while April remained cooler than normal, but was among the wettest on record, actually claiming the wettest April since recording began for our area in 1912.

The operation targets vulnerable larvae before they reach the adult, biting stage. The aerial program has gone on for over three decades in the Saginaw Valley and remains the best way to dramatically decrease numbers of spring *Aedes* mosquitoes. The preferred control method uses a bacterial product known as *Bti* (*Bacillus thuringiensis israelensis*) to control the spring larval species.

Earl's Spray Service, Inc. of Breckenridge, Michigan used two aircraft to apply *Bti* to 40,563 woodland acres in the following townships: Bangor (3,221), Beaver (5,603), Frankenlust (895), Fraser (4,216), Garfield (5,229), Gibson (1,375), Hampton (833), Kawkawlin (1,704), Merritt (394), Monitor (1,777), Mt. Forest (5,282), Pinconning (6,657), Portsmouth (297), and Williams (3,080).

Calibration, loading, and fueling of the fixed wing aircraft took place at Barstow Airport in Midland. Sites were treated with VectoBac® *G 5/8 mesh Bti* corncob granules at a dosage rate of three to four pounds per acre. 2013 was the first year in many that the helicopter application was eliminated from the treatment program in order to see a cost savings.

Loading the plane with *Bti*

Bti larvicide product

Spring Ground Surveillance/Larviciding

One certified technician and two full-time staff helped with aerial quality control, conducting post-treatment surveys in 76 woodlots to assess *Bti* application. After the completion of the aerial treatment program, several more technicians were brought on board to begin inspections and subsequent ground treatment using primarily BVA2 larvicide oil to manage the larvae or pupae. Field technicians began to treat woodland pools with larvicide oils, concentrating on smaller woodlots not feasibly treated by aircraft.

Table 6 lists the number of acres treated by foot crews and material used in smaller tracts of woodlots during the 2013 spring season. Ground crews checked 334 sites, dipping each one, to determine the need for treatment. A total of 153 sites were treated; untreated sites were either dry or wet but not breeding. A total of 37.84 pounds of *Bti* and 153.1 gallons of BVA-2 larvicide oil were dispensed at a dosage rate of 5 pounds/acre and 1 gallon/acre, respectively. In addition, 4 *Bti* briquets were used. Just over 160 acres were treated.

Pupae, which are usually noted between May 2-6, were found on schedule May 5 this season and significant emergence of spring *Aedes* adults occurred between May 7-15, which is typical. Adult emergence initiated adulticiding, control of adult mosquitoes through fogging operations.

Table 6

Spring Ground Treatment

Township	Acres Treated	BVA2 (gal)	Bti (lb)	Bti Briquets
Bay City East	4.1	4.1		
Bay City West	1.1	1.1		
Bangor	1.3	1.2	0.57	
Essexville	0.7	0.5	0.85	
Frankenlust	6.9	6.9		
Fraser	3.1	3.1		
Garfield	66.6	66.6	0.44	
Gibson	0.3	0.3		
Hampton	11.1	10.9	1.01	3
Kawkawlin	14.6	7.6	34.98	
Merritt	0	0		
Monitor	6.2	6.2		1
Mt. Forest	40.4	40.4		
Pinconning	1.1	1.1		
Portsmouth	0	0		
Williams	3.2	3.2		
Total	**160.7**	**153.2**	**37.85**	4

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 while also reducing vector mosquitoes.

Our comprehensive mosquito control program focuses on routine surveillance and control of potential breeding sites to prevent adults from emerging. The program involves MDARD-certified technicians applying insecticides to stagnant water throughout the county. During the breeding season, a team of 17 technicians (20% reduction in staff compared to 2012 due to budget concerns) inspect water habitats guided by a database of known breeding sites, citizen complaints, and high trap numbers. Homeowners are notified of property inspections either in person or through the use of a door hanger.

Efforts directed at larval control are accomplished by using bacterial, chemical, or sanitary (dumping water from containers) methods. The district uses several natural bacterial products for control of larval mosquitoes. These include VectoBac®G (*Bti*), *Bti* Briquets™, VectoLex® FG (*Bacillus sphaericus*) and Natular® XRT and 2EC (*Saccharopolyspora spinosa*). Chemical insecticides routinely used include temephos (Allpro® ProVect 1G and Abate® 4-E), alcohol-based monomolecular surface films (Agnique® MMF and Agnique® MMFG WSP) and petroleum-based oil (BVA2). The Agnique MMF was used near the Saginaw Bay beachfront as well as sensitive wetland areas.

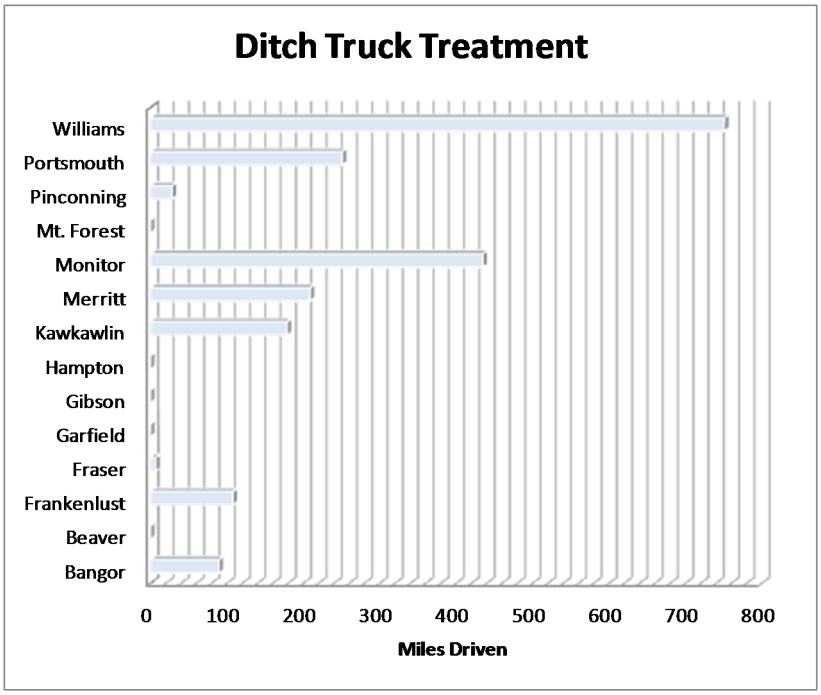
Larval Sites: The total number of breeding sites changes each year as new sites are added to the database and others are deleted. A total of 12,810 larval site inspections were conducted this season; only 21% (2,635) of those were actually treated with a larvicide material. This percentage was slightly higher than the previous years' average of 16-17%. Some of these sites were permanent breeding habitats while others were temporary and included ditches, containers, fields, woodlots, tires, idle pools, ornamental ponds, and Saginaw Bay beachfront. Larvae are sampled by quickly skimming the water's surface with a dipper; some are collected and returned to the lab for identification. Technicians also control mosquitoes by dumping water from buckets, pails and other man-made containers (one method of source reduction) on a regular basis. This is the preferred method to eliminate mosquitoes from breeding in containers.

Events: In addition to surveillance and control in neighborhoods throughout the county, special attention is given to summertime outdoor recreational events, such as the Auburn Cornfest, Munger Potato Festival, and River of Time, to name a few. According to the Bay Area Convention and Visitors Bureau, over a half million people attend these types of festivals. Controlling larvae prevents adults from emerging and interfering with outdoor recreational activities.

Ditch Treatments: Bay County's topography is very flat and most roadways are flanked by ditches, which divert water from the county's 1,400 linear miles of roads. In addition, ditches serve as breeding grounds for mosquitoes, so attention is given to monitoring their mosquito activity. In fact, surveys are made by lab personnel once each week. Most problems with breeding occur after major rainfall events, which stimulate mosquito eggs to hatch.

This year, ditch trucks logged 2,058.6 miles driven, which was 66% fewer than the 2012 treatment season, dispensing 1,193.3 gallons of Abate 4E mix (6.5 gallons of Abate 4E) and 49 gal of BVA2. Figure 11 shows in which townships the ditch trucks logged treatment miles. Monitor and Williams Townships received the most treatment due to higher levels of mosquito larval activity, with a combined 1,186.2 miles.

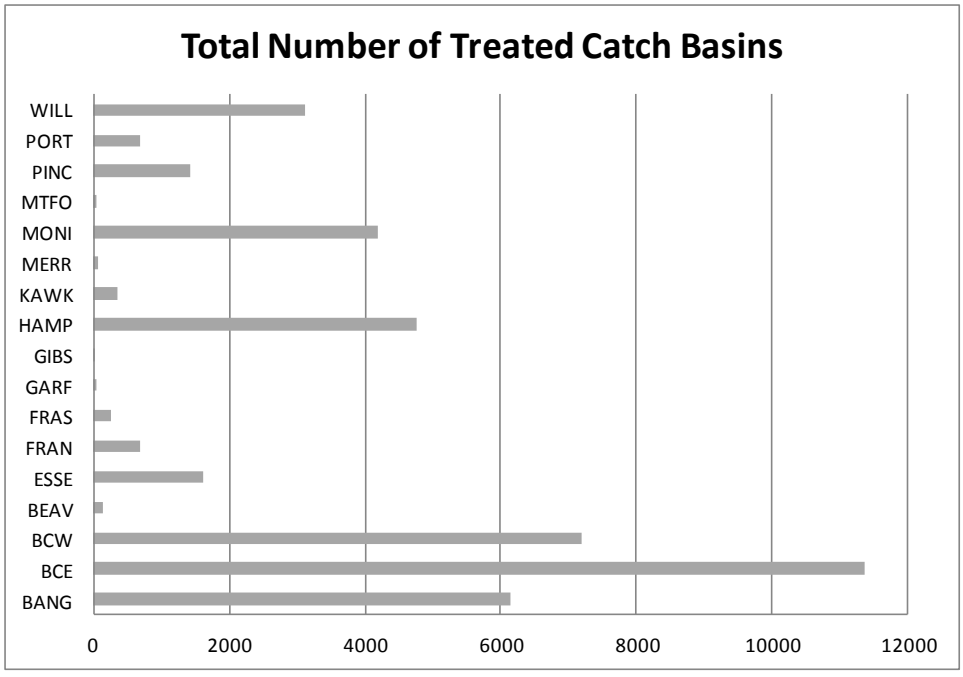
Figure 11



Catch Basins: Treatment of catch basins will control *Culex restuans* and *Culex pipiens* mosquitoes, known vectors of both St. Louis encephalitis and West Nile Virus. These species are not considered nuisance mosquitoes, as they feed primarily on birds; however, controlling disease vectors is extremely important in our efforts to decrease disease potential and maintain public health. Staff monitored mosquito breeding in catch basins and treated a total of 42,042 individual habitats. Figure 12 shows the number of catch basins treated in each township or city. The bulk of treatment took place in Bay City, Bangor Township, Hampton Township, and Monitor Township, the most urban areas of the county.

Mainly, catch basins were treated using either Natular® XRT (2,176 individual tablets) or VectoLex® FG bacterial larvicide (1,042.2 pounds). In addition, 445 basins were treated with 4.81 gallons of BVA2 oil due to the presence of mosquito pupae. Basins treated with VectoLex were primarily in BCE, BCW, and Essexville and these were treated three times—each treatment lasted about one month. Treatments began in early June with the last VectoLex treatment occurring in late August.

Figure 12



Retention & Detention Ponds: Bay County is home to 128 retention ponds or detention basins that are designed to manage storm water runoff to prevent flooding. Retention ponds usually include a permanent pool of water in their design, while a detention pond holds storm water for a limited time or until the water either percolates or evaporates, which returns the area to its normally dry state.

Floodwater mosquitoes are usually the first to appear in detention ponds, but *Culex* and *Anopheles* mosquitoes can also be found. Certified technicians surveyed the ponds, making 410 individual visits throughout the summer. Of those 410 surveys, no treatment was needed 68% of the time, which is essentially the same trend seen in the search and destroy operation. However, on the days when treatment was necessary, the following larvicides were used to control either larvae or pupae: *Bti* Briquets (43), *Bti G* (352.62 lb), BVA2 (80.94 gal), Agnique MMF (0.08 oz), Agnique Packets (11), Abate 4E (56.44 gal), and ProVect (3.45 lb).

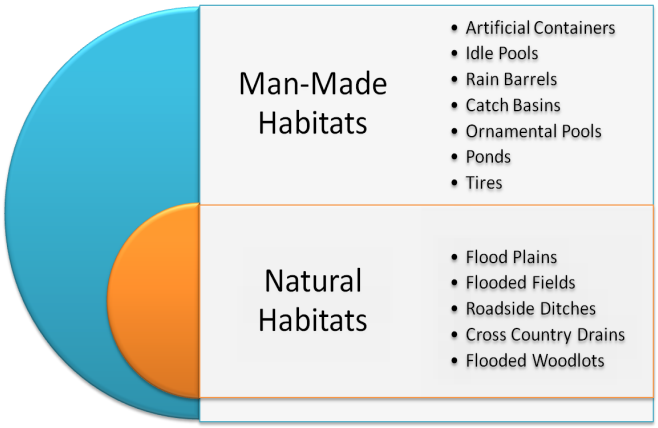
When conducting surveys and/or larviciding of these ponds, technicians utilized aerial maps that detailed the location and size of each pond. This gave technicians a way to quickly locate the ponds allowing for more efficient surveillance and treatment.

Field technician Arin Shupert dips a retention pond

Sewage Lagoons: Sewage lagoons are perfect breeding zones for *Culex* mosquitoes as they are filled with polluted, highly organic water all summer long. Two sewage lagoons were monitored this season—White Birch Village and Pinconning McDonalds—resulting in 28 treatments, 89% of which were done at White Birch Village. In order to treat sewage lagoons, a Michigan DEQ Water Treatment Additive form was first approved. The following products were dispensed: 27.5 *Bti* Briquets, 85 gallons of Abate 4E mix (0.34 gal Abate 4E), 14.15 gal of BVA2, and 34.61 lb Natular G30.

Search and Destroy: Besides the larviciding activities previously discussed (ditch trucks, sewage lagoons, retention ponds, and catch basins), technicians also spent most days engaged in what is known as Search and Destroy. This simply means that technicians search for and control immature mosquitoes in various breeding habitats, most of which are shown in the table below.

Table 7



It is important to select the appropriate control material and formulation based on what mosquito life stage is encountered in the water habitat. Timing of the application is also crucial as is the amount of product applied. As technicians search for mosquito breeding, they also educate Bay County citizens about how to prevent mosquitoes from breeding in containers around residents' backyards. Technicians leave door hangers when they encounter tires, reminding citizens about the residential scrap tire drives and the need to recycle tires in order to prevent mosquitoes from breeding there.

Table 8 illustrates the control materials dispensed during Search and Destroy activities.

Table 8

Search and Destroy Operations	
Control Material	**Amount Dispensed**
Abate 4E	155.52 gal of mix
Agnique MMF Paks	109
Agnique MMF	6.3 gal
Bti	1,886.96 lb
BVA2	217.97 gal
Bti Briquets	846.5
Natular 2E	0.25 gal of mix
ProVect 1%	185.91 lb
VectoLex	11.18 lb

Field technicians Nate LeCronier and Mike Collins gather a larval sample

Adulticiding

While larval control is the preferred method of treatment, it is virtually impossible to find and treat all breeding sites, so adulticiding (fogging to kill adult mosquitoes in flight) is also carried out to control mosquitoes. Mosquito numbers vary between seasons and years and a major contributing factor to this is the amount of rainfall received. While it is not possible to eliminate mosquitoes, it is important to take measures to reduce the risk of being bitten by nuisance or infected mosquitoes. Adult mosquito activity will increase following periods of heavy rains that cause new mosquito broods to hatch. Fogging adult mosquitoes includes the use of Ultra Low Volume (ULV) equipment that allows a relatively small amount of material to be dispensed from the spray equipment. Application rates are adhered to by using GPS units with SmartFlow technology in each truck. Label recommendations are strictly followed to assure proper dosage rates and droplet sizes during adulticide applications. To accomplish the latter, droplet measurements are taken several times throughout the season. The first droplet characterization took place May 13 using the Teflon® slide method to measure aerosol droplets; a subsequent check took place in late July.

When weather conditions are conducive to fogging (temperatures above 50°F and winds below 10 mph), eight certified technicians fog cities and townships that have either the highest mosquito populations or noted disease activity. This year saw the routine use of the permethrin products Masterline® Kontrol 4-4 and AllPro® Evoluer 4-4 ULV. Mosquitoes must come in contact with the droplets in order for the insecticide to be effective so adulticiding activities take place after sunset when most mosquito species are active and bees have returned to their hives.

For management purposes, Bay County utilizes route maps during adulticiding operations. These road maps of each township show the most efficient route to follow when adulticiding so all roads are treated and no roads are re-treated or missed during a nightly operation. The maps also highlight addresses of medical and no spray residences. Medical residences, of which there are 69 (an increase of 23% over 2012), are homes that qualify to be a part of our Medical Needs Program because at least one resident is allergic to mosquito bites or has verifiable medical needs. The medical condition must be confirmed by a medical doctor. No spray residences are homes that prefer not to be treated for mosquitoes; there are 92 such addresses, which is a 5% decrease compared to 2012 numbers.

Technicians Nick Paige and Nate Brown load permethrin into a tank for the fogging operation

Adulticiding Treatment

Table 9

Township	Kontrol 4-4 (gal)	Evoluer 4-4 ULV(gal)	Envion 4-4 (gal)	Miles Treated
BANG	113.46	236.6	5.13	1654.1
BCE	58.49	60.56	1.37	568.5
BCW	37.35	60.71	0.29	452.7
BEAV	74.9	91.01	0	780.7
ESSE	10.45	8.17	1.53	89.5
FRAN	29.78	52.25	10.12	435.8
FRAS	62.82	108.2	5.26	790.8
GARF	38.5	71.39	0	513.1
GIBS	59.96	38.6	0	477.9
HAMP	74.34	126.04	11.24	980.1
KAWK	48.7	96.69	16.21	956.2
MERR	33.46	54.45	0.72	443.3
MONI	156.64	264.38	20.27	1993.3
MTFO	86.49	34.88	0	542.9
PINC	75.70	108.34	7.82	892.1
PORT	36.45	85.2	18.58	637.8
WILL	116.87	162.05	20.28	1399.7
TOTAL	**1114.36**	**1659.52**	**118.82**	**13608.5**

During the 2013 season, the "Long Driveway Program" continued. This program is designed to fog inhabited properties that sit a considerable distance off the main road and that do not receive adequate adult mosquito control during normal fogging operations. Ninety such addresses were placed on route maps to be fogged on a regular basis, an increase of 11% from 2012.

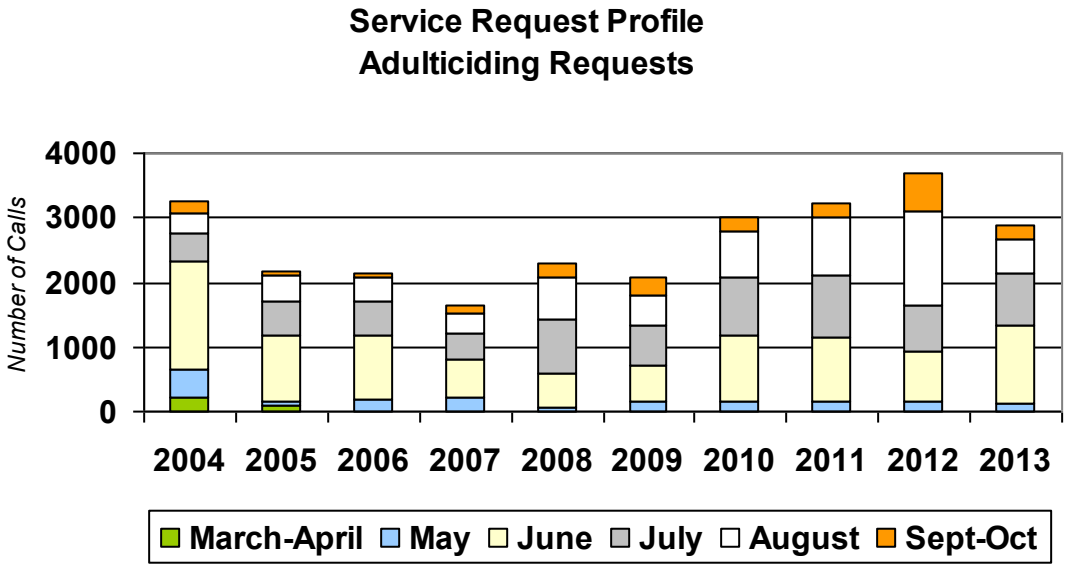
Table 9 reveals that 13,608.5 miles were logged during adulticiding operations and 2,892.7 gallons of adulticide were dispensed, with the majority being Evoluer 4-4 ULV (1,659.52 gallons). Compared to 2012, this is 1,030 fewer gallons of control materials and 24% fewer miles treated.

Customer Calls

Traps are the primary indicator of mosquito activity, but customer calls are also used as a means to indicate where adult populations are problematic. Office staff answered and technicians responded to 2,887 adult mosquito service requests received from Bay County citizens. Most (2,234) of the calls were regular service requests for adulticide treatment due to nuisance mosquitoes with 870 of those calls logged between June 11-26, peaking approximately two weeks after the major May rain events. An additional 653 calls represented special event spray requests. In comparison to 2012, the level of adulticide service requests decreased by 22%.

One hundred forty-two calls were also received reporting standing water with potential mosquito breeding. Most of those were received in our wettest months of May and June with 54 and 44 calls received, respectively. Regardless of the type of service request, all were responded to in a professional, courteous, and prompt fashion. Figure 13 represents a historical profile of adulticide requests.

Figure 13



Scrap Tire Drives

Scrap tire drives are 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 season. The first was held on May 18 with drop-off locations set up at both the BCMC field station and Fraser Township Hall; the hall location was chosen to decrease travel time for residents in the northern portion of the county. There were 2,600 tires collected during this Spring collection. A second tire drive was held September 7 at the field station and 1,071 tires were dropped off. So, a total of 3,671 tires were recycled—3.5% more than was collected in 2012.

Semi-trailers are filled at the drop-off location; trailers are then hauled back to Environmental Rubber Recycling where tires are recycled at the Flint facility. Tires are ground into chips and shipped to Michigan power plants to be burned as tire-derived fuel (TDF).

In 2013, BCMC applied for and received a Scrap Tire Cleanup Grant for $2,700 from the Michigan Department of Environmental Quality. The purpose of the grant was to assist property owners and local units of government with the proper removal of abandoned scrap tires and scrap tires at collection sites. The goal of the program is to use available funding to maximize reduction of the public health and environmental concerns associated with scrap tire collection sites, while improving the urban renewal and economic development opportunities.

Technician Cullen Kwapiszewski unloads a scrap tire during the 2013 BCMC Scrap Tire Drive

New Scrap Tire Site Controlled in Bay County

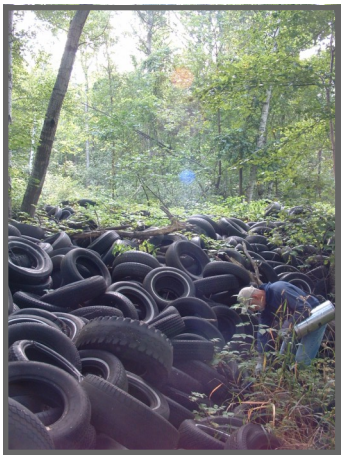
In early August, BCMC was informed by the MDEQ of a large scrap tire pile located in a woodlot in Beaver Township. Operations Supervisor Bob Kline was unaware of the massive pile and went to the site to verify it. Using old aerial maps from the Bay County GIS department, he verified that the tire piles have been in existence for many years.

Bob received permission from the present landowner to go back through the woods to get an idea of how large the pile was and to see if the tires were breeding. Upon locating the area in the woodlot, Bob confirmed the existence of "thousands upon thousands" of tires in a heap and noted that the tires were not on BCMC's listing of known tire sites.

Larviciding technicians were dispatched to the tire site on August 12 to check for mosquito larvae. Six technicians spent 2 hours treating the tires which were breeding high density larvae, stages 2-4. Liquid Abate 4E was used at the site, with tires being an ideal habitat to use the temephos product, applied via a Hudson hand pump sprayer.

A re-check was done on the tires 15 days later with no breeding found, showing the effectiveness of the active ingredient temephos. Another check done on September 10 revealed only a few tires breeding again which were re-treated by hand using a small amount of Provect 1G Larvicide, the granular temephos formulation.

For 2014, BCMC will regularly check the tire pile and it has been added to the listing of regular larviciding sites. The property owner stated he was working with the DEQ to get a scrap tire grant to aid in the clean-up of the site left by a previous owner over 20 years ago.



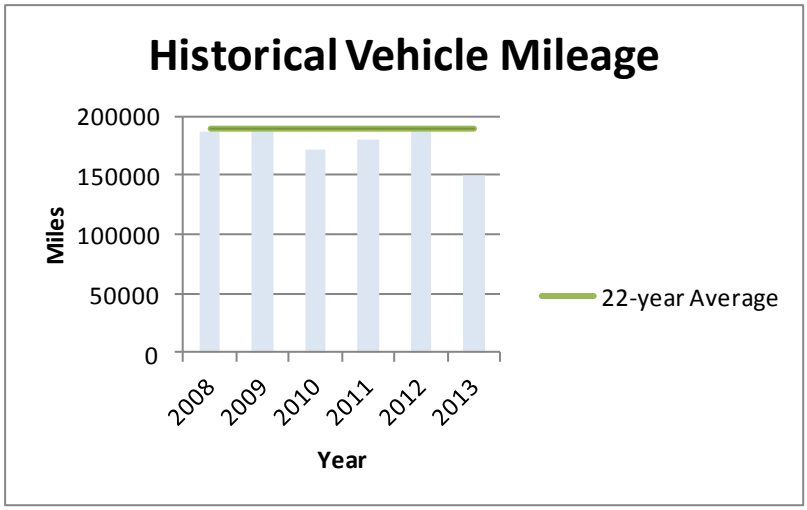
Vehicle Maintenance/Mileage

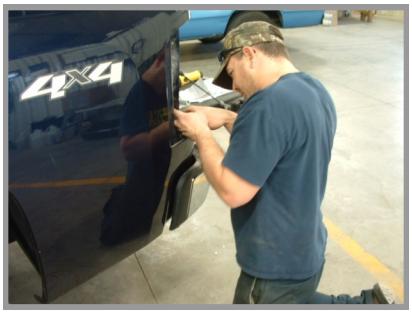
Bay County Mosquito Control's state-certified mechanic maintains the 33-vehicle fleet as well as four Bay County Animal Control vehicles, which are billed for parts and labor. Besides vehicles, the shop maintains forklifts, ULV foggers, ditch truck sprayers, and various types of equipment. From time to time, specialized equipment is designed and fabricated.

During the 2013 season, as Figure 14 shows, 148,908 miles were driven, which is much below the 22-year average of 189,570 miles and represents 21% fewer miles than were driven in 2012. Vehicle maintenance repairs included the following: brake systems (20), fuel systems (16), front end repairs (22), truck oil changes (53), electrical systems (63), drive lines (12), new tires (32), and used tire repair (16).

In addition to maintaining the vehicles, the mechanic was responsible for repairing and maintaining equipment used by mosquito control staff. Equipment repairs included: ULV oil changes (40), ULV repairs (22), ditch truck repairs (26), Hudson® pressure sprayer repairs (56), spreader repairs (7), CDC Trap repairs (3), New Jersey Light Trap repairs (6), and Gravid Traps (3).

Figure 14





Chief mechanic Justin Krick positions strobes into truck tail lights

Storm Water Pollution Prevention Plan

To comply with state and federal regulations on storm water runoff from urban and suburban areas, many communities have implemented new programs to reduce the adverse impact of storm water runoff on streams, rivers, lakes, and estuaries. Compliance at BCMC is achieved by following a Storm Water Pollution Prevention Plan (SWPPP) that began in July of 2010.

According to permit guidelines, in addition to routine monthly inspections, comprehensive inspections are completed once every six months by a certified storm water operator. The overall objective is to ensure continued use of Best Management Practices (BMPs) and good housekeeping practices as defined by the MDNR. Any leaks, spills or other exposure of significant materials shall be addressed immediately to achieve compliance with permit standards. Additionally, it is imperative to identify any potential sources of storm water contamination and reduce that potential by the greatest extent possible.

The areas inspected in 2013 included the chemical storage, cold storage, wash bay, garage, and parking lot. There were also four indoor and three outdoor catch basins monitored. Minor vehicle leaks were the main issue observed during inspections. These were cleaned up with either Floor-Dry granular absorbent or soap, water, and paper towel.

NPDES

The Michigan Department of Environmental Quality has issued Bay County Mosquito Control a Certificate of Coverage (COC) under the National Pollution Discharge Elimination System (NPDES) General Permit No. MIG030000. The COC authorizes BCMC to discharge biological pesticides and pesticide residues resulting from the application of chemical pesticides to control mosquito and other flying insect pests, in, over, or near to surface waters of the State of Michigan. The permit expires February 1, 2017.

2013 was the first year BCMC was mandated to file a NPDES Annual Report, which was completed and submitted on November 22.

Education

Efforts are made to inform and educate Bay County residents about mosquito control methods and mosquito-borne diseases. A great deal of education takes place every day through hundreds of personal contacts in the field and calls to the office. Periodic interviews by newspaper, television, and radio allows 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. Press releases are also issued, as needed, if a mosquito-borne disease is detected in the county. Staff training is also held on a regular basis to update staff on various topics including safety, disease activity, and policies and procedures.

Presentations are also given to various groups, including school-based programs. Brochures and handouts are developed and distributed at various locations and our website is updated regularly.

Membership/Certification

Membership in professional organizations remains 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 (ESA) are maintained. All are beneficial due to conferences, publications, networking, and legislative advocacy.

All staff members maintain certification with the Michigan Department of Agriculture and Rural Development (MDARD) in both the Core and 7F (Mosquito Control) categories. Two training sessions were held May 10 and May 20 with 27 new and returning technicians in attendance. Staff also attended MMCA's 27th annual meeting at the Double Tree Hotel in Bay City, Michigan in February and the MMCA 2013 Mosquito Control Training Session October 22, 2013 in Bay City, both of which offered continuing education credits.

BCMC's program plan was reviewed and approved in January by the MDARD as part of the Comprehensive Community Outreach as mandated in Regulation 637.

Staff attended the Technical Advisory Committee (TAC) annual meeting March 6, 2013 where the 2012 annual report and 2013 program plan were presented for review and approval.

Table 10

2013 Insecticide Use Summary

Trade Name	Application Rate	Active Ingredient Dosage	Amount Used
Temephos 1%	10 lbs/acre	0.1 lb temephos/acre	316.19 lb
Abate® 4E concentrate	1.5 fl oz/acre	0.0468 lb temephos/acre	6.05 gal
Bactimos Bti Briquets™	1/100 square feet	7000 AA (Aedes aegypti) Bti ITU/mg	991 briquets
VectoBac® G	5 lbs/acre	0.4555 billion Bti ITU/acre	150,325 lb
Agnique® MMF-G Pak 35	1/160-350 square feet	2.24-6.88 lb alcohol-based surface film/acre	154 ea
Agnique® MMF	0.2—1.0 gal/acre	0.2—1.0 gal alcohol-based surface film/acre	10.1 gal
All Pro® Envion 4-4	0.78 fl oz/acre	0.00175 lb permethrin/acre 0.00175 lb PBO/acre	30 gal
BVA2 Mosquito Larvicide Oil	1—5 gal/acre	0.987-2.96 gal petroleum distillates/acre	610 gal
VectoLex® FG	5-80 lbs/acre	0.115-1.84 billion BsITU/acre	995.14 lb
Masterline® Kontrol 4-4	0.676 fl oz/acre	0.00176 lb permethrin/acre 0.00176 lb PBO/acre	1,100gal
Evoluer™ 4-4 ULV	0.78 fl oz/acre	0.00175 lb permethrin/acre 0.00175 lb PBO/acre	2,017 gal
Natular™ XRT	1 XRT tablet/catch basin	6.25% spinosad/tablet	2,200 tablets
Natular™ 2EC	5-20 lb/acre	0.125-0.5 lb spinosad/acre	34.58 lb

Map of Bay County, Michigan