Bay County Mosquito Control

Annual Report

2014

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ORGANIZATIONAL HISTORY

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 commenced in 1977 as a bi-county district, Saginaw-Bay Mosquito Control Commission, after an outbreak of St. Louis Encephalitis occurred in Michigan and seeks to protect the health and well-being of county residents from disease and annoyance caused by mosquitoes.

Mosquito "control" does not mean elimination, but rather 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.

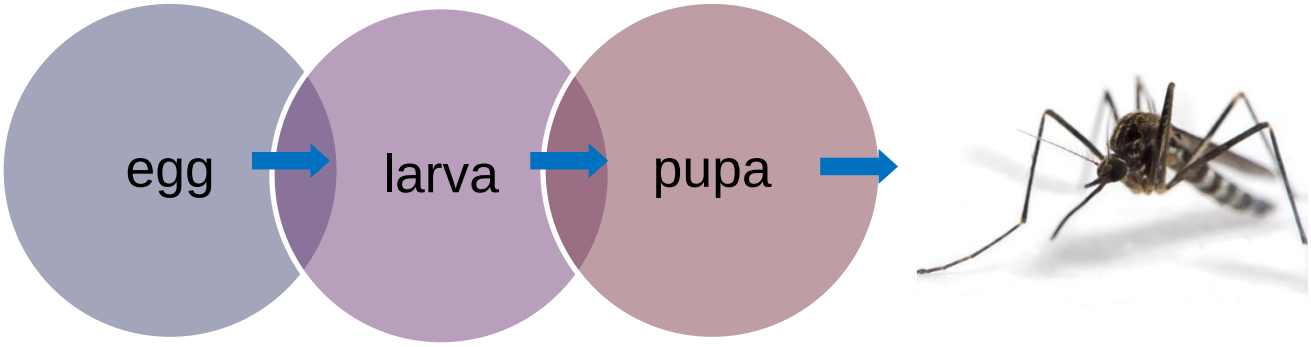
Bay County is one of four Michigan counties with formal, comprehensive mosquito control programs. A Technical Advisory Committee (TAC), composed of local and state professionals, annually reviews program operations for BCMC, Midland County Mosquito Control, Tuscola County Mosquito Abatement, and APM Mosquito Control. Involvement in the TAC allows for interagency cooperation on many levels, but particularly with the coordination of insecticide bids as the three county mosquito districts mentioned above bid jointly to keep costs as low as possible.

Funding is received from a special millage for the control and abatement of mosquitoes and 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 primarily 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 2nd which is about a week later than normal due to cold temperatures creating a slow snowmelt. Records showed that March 2014 officially ranked as the fifth coldest March in the Saginaw area history. Two weeks later on April 14, we received 1-3 inches of rain leading to many new areas flooded and another hatch of Spring *Aedes* larvae. Larval density remained low overall with an average of 2.1 larvae per dip recorded, but woodland pool test sites were set and larvae counted to determine pre-treatment populations. With the April 14 rain, woodlots had above-average water levels at the onset of treatment, but a dry period that followed had pools drying along their edges by the time treatment was complete after seven days. An additional inch of rain fell on April 29, but no other hatch was noted during the next week.

Pre-treatment larval counts were taken between 1-4 days before treatment in 39 woodlots and post counts followed within 2-6 days. Aerial calibration took place on April 21 with treatment beginning immediately and lasting seven days until April 27.

A late-season one-inch snowfall occurred on April 15

Three fixed wing aircraft were calibrated to deliver three pounds of *Bti* per acre. Quality control of the spring aerial campaign was accomplished with the help of three full-time staff and one certified technician. Staff walked through 68 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.

Post counts indicated an overall average 93.3% larval mortality (Table 1), which indicates favorable control was accomplished at the three-pound per acre dosage. 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. Adult emergence of spring *Aedes* mosquitoes from seasonally flooded woodlots took place from approximately May 12-15.

Field technician Jim Hughes checks for the presence of Bti after aerial treatment

Table 1 - BCMC Spring Treatment Bti Evaluation, 2014

		Larval Count		
Location	**Dosage Rate**	**Pre**	**Post**	**Mortality**
Bangor 4 - Bangor Oil Well	3#/acre	2.15	0.075	96.5%
Bangor 33 - Bangor and Zimmer	3#/acre	0.83	0.125	84.9%
Beaver 4 - 1576 Cottage Grove	3#/acre	1.6	0.1	93.8%
Beaver 5 - Carter and Cottage Grove	3#/acre	1.08	0.16	85.2%
Beaver 9 - 1585 Cottage Grove	3#/acre	2.86	0.16	94.4%
Frankenlust 2 - Four Mile and Delta	3#/acre	1.7	0.04	97.6%
Frankenlust 3 - Delta by Automotive Bldg.	3#/acre	4.9	0.28	94.3%
Frankenlust 7 - 259 Amelith Road	3#/acre	2.82	0	100%
Fraser 6 - Townline 16 by 7 Mile Rd.	3#/acre	1.06	0.06	94.3%
Fraser 11 - Camp Fishtales	3#/acre	1.02	0.04	96.1%
Fraser 11 - Deer Acres	3#/acre	1.6	0	100%
Fraser 15 - Fraser Twp. Firebarn	3#/acre	4.93	0.675	86.3%
Fraser 22 - Fraser Twp. Hall	3#/acre	1.02	0.02	98%
Garfield 9 - 11 Mile N. of Erickson	3#/acre	1.6	0.3	81.3%
Garfield 10 - Garfield Twp. Park	3#/acre	3.74	0.96	74.3%
Garfield 15 - Methodist Church	3#/acre	1.17	0	100%
Garfield 26 - Crump Fox Club	3#/acre	3.82	0.72	81.2%
Kawkawlin 2 - 2080 LeBourdais Rd.	3#/acre	3.56	0	100%
Kawkawlin 15 - Kawkawlin Township Hall	3#/acre	2.72	0.22	91.9%
Kawkawlin 30 - White Birch Village	3#/acre	1.02	0	100%
Monitor 9 - 1306 Wheeler	3#/acre	1.24	0.26	79.0%
Monitor 20 - Fraser and N. Union	3#/acre	1.7	0.175	89.7%
Monitor 23 - Rocking Horse Ranch	3#/acre	1.32	0.22	83.3%
Monitor 28 - Mackinaw Road Tech Park	3#/acre	1.6	0.26	83.8%
Monitor 34 - Fremont Cemetery	3#/acre	0.95	0.05	94.7%
Mt. Forest 9 - Sand Rd. Road Commission	3#/acre	1.6	0.04	97.5%
Mt. Forest 17 - Carter N. of Cody-Estey	3#/acre	1.77	0.2	88.7%
Mt. Forest 21 - Daycare	3#/acre	4.06	0.04	99.0%
Mt. Forest 21 - Mt. Forest Hall	3#/acre	2.23	0	100%
Mt. Forest 21 - Mt. Forest Firebarn	3#/acre	1.38	0.02	98.6%
Mt. Forest 30 - Pinconning and County Line	3#/acre	4.52	0.04	99.1%
Pinconning 23 - K C Hall Water Street	3#/acre	1.66	0	100%
Pinconning 30E - Pinconning County Park	3#/acre	1.8	0	100%
Williams 7 - Reder Landscaping	3#/acre	1.28	0.02	98.4%
Williams 16 - Carter and N. Union	3#/acre	2.53	0.2	92.1%
Williams 19 - Victoria Woods Trailer Park	3#/acre	1.34	0.025	98.1%
Williams 20 - Forest School/Daycare	3#/acre	0.92	0	100%
Williams 21 - Forest Edge	3#/acre	0.86	0	100%
Williams 30 - Rockwell and Salzburg	3#/acre	1.8	0.23	87.2%
CONTROL Frankenlust 3 - Delta Mackinaw Road	N/A	2	3.32	0%
CONTROL Mt. Forest 30 - Pinc. Rd. and County Line	N/A	4.52	5.75	0%
AVERAGE TREATED MORTALITY				**93.3%**
AVERAGE TREATED MORTALITY (Corrected)				**93.3%**

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 completed 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. Seventy-five larval samples representing nine species were identified; the majorities were *Culex pipiens* and *Culex restuans* followed by *Aedes vexans*. Seven 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 nine occasions. The basins are a perfect habitat, providing *Culex* mosquitoes with organically-rich standing water and decomposing leaf litter that provides a bacterial food source. Basin surveillance on June 6 showed that 57% of those checked were breeding with larvae and pupae, which prompted the initial treatment using VectoLex® FG and Natular™ XRT. In order to determine efficacy and longevity of the control materials, basins were inspected every three-four weeks or sooner. We expect VectoLex to provide control for about four weeks, which it did. Natular is expected to provide season-long control, but after three months over half of the Natular basins were breeding. The three-month check occurred a few weeks after the 5-6 inch rain event of August 11, which may have flushed the product from the basins. Large rain events like this are certainly a concern.

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 treatment product was performing correctly; no non-target impacts were noted.

AEDES JAPONICUS

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.

Staff continue to provide control efforts as well as habitat reduction (i.e. tire drives) to inhibit the production of *Aedes japonicus*.

Figure 1 – Artificial Container Species, 2014

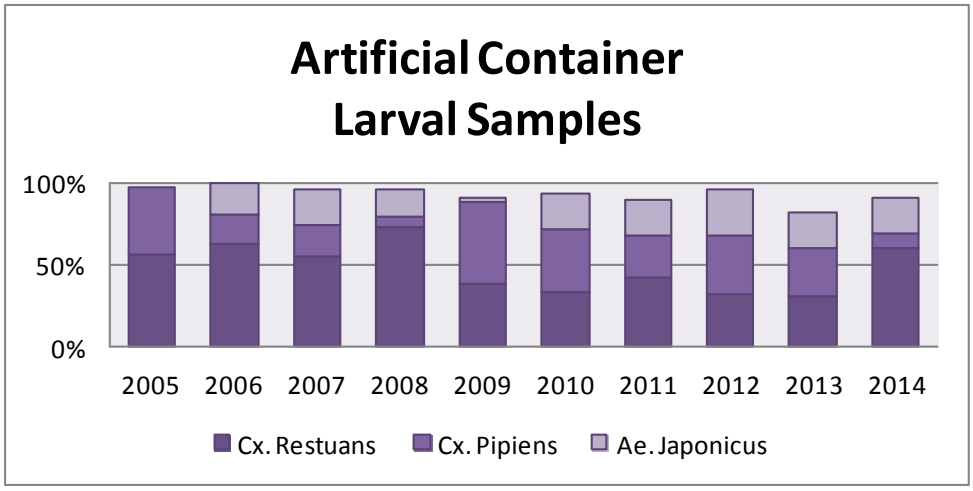
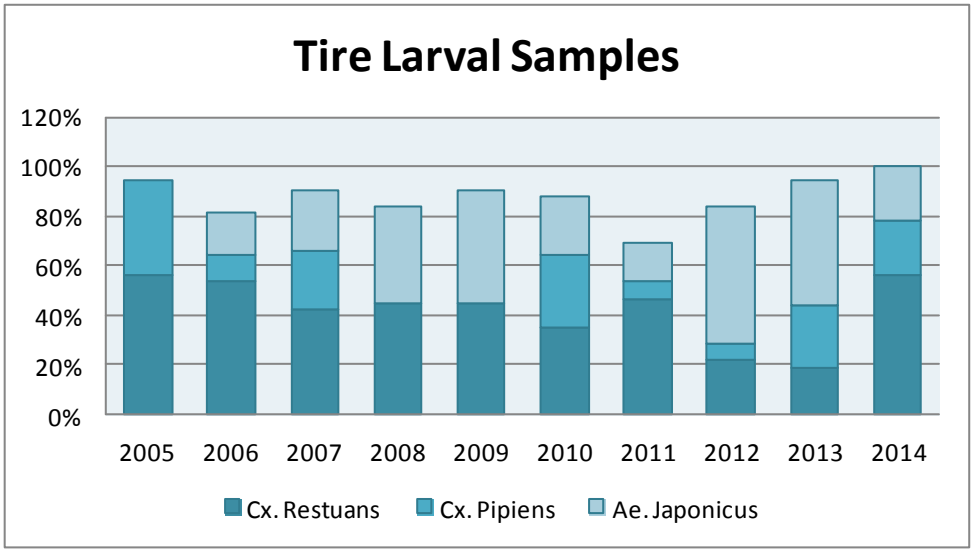


Figure 2 – Tire Species, 2014



NEW JERSEY LIGHT TRAPS (NJLT)

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 threats. One of the main tools used in adult surveillance is the NJLT. From mid-May through mid-September, adult mosquitoes were collected in 14 traps placed throughout the county in backyards with little or no competing light source. Samples were gathered three times each week, followed by counting and species identification. The total capture was 14,285 (Table 2), 88% above the 2013 season and just below (2%) the historical average of 14,529. Heavy rains in August caused a significant floodwater mosquito hatch.

Table 2 - New Jersey Light Trap Data, 2014

Species	May	June	July	August	September	TOTAL
Aedes aurifer	0	3	0	0	0	3
Aedes canadensis	4	13	0	0	0	17
Aedes cinereus	3	32	4	1	0	40
Aedes implicatus	12	9	0	0	0	21
Aedes intrudens	3	27	11	23	12	76
Aedes japonicus	1	9	6	18	4	38
Aedes provocans	3	14	2	1	0	20
Aedes sticticus	0	20	2	0	0	22
Aedes stim/fitchii	36	161	18	6	0	221
Aedes triseriatus	0	1	1	8	2	12
Aedes trivittatus	0	21	17	54	11	103
Aedes vexans	114	685	837	3654	974	6264
Anopheles perplexens	1	8	85	11	2	107
Anopheles punctipennis	3	6	24	98	32	163
Anopheles quadrimaculatus	6	63	199	706	105	1079
Anopheles walkeri	18	1462	1567	823	227	4097
Culiseta inornata/morsitans	4	0	2	12	4	22
Coquillettidia perturbans	0	178	255	65	4	502
Culex restuans	58	184	282	254	28	806
Culex pipiens	0	5	66	340	77	488
Culex tarsalis	0	0	0	2	0	2
Culex territans	0	1	7	26	21	55
Psorophora ciliata	0	0	0	4	0	4
Psorophora ferox	0	0	0	27	7	34
Uranotaenia sapphirina	0	0	4	11	3	18
Damaged	2	24	30	14	1	71
TOTAL FEMALES	**268**	**2926**	**3419**	**6158**	**1514**	**14285**
TOTAL MALES	**180**	**700**	**1401**	**4891**	**703**	**7875**

Twenty-six species were collected during the 2014 season and the most predominant was *Aedes vexans*, representing 44% 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 38% of the total catch, while the *Culex* mosquitoes, *Cx. pipiens and Cx. restuans,* ranked third with 9%. Emergence of the cattail marsh mosquito, *Coquillettidia perturbans,* adults occurred as normal, but the population was about 50% less than an average year when the species represents about 7.5% of the light trap collection. This year *perturbans* comprised about 3.5% of the total. Finally, we watched, with great interest, our newest mosquito species, *Aedes japonicus,* whose numbers increased with 38 captured. The average number of *japonicus* collected since 2005, which is the first year they were discovered, is 14. 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 black line (14,529). As you can see, the number collected in 2014 fell just below the average. Typically, total number of females corresponds with the amount of rainfall received and this year our heaviest rains came in August. Figure 4 (page 12) shows mosquito species collected per trap night throughout the summer. In 2014, summer floodwater *Aedes* levels ran steady before peaking on August 30, which followed the major rain event by approximately two weeks. *Anopheles* species showed three spikes in early June, mid-July, and the end of August and were mostly confined to areas along the Saginaw Bay.

There was one West Nile Virus-positive pool of 17 *Culex* mosquitoes collected from a Light Trap placed in Bangor Township. The sample was collected in mid-August and confirmed positive August 21.

Figure 3 - New Jersey Light Trap Historical Data

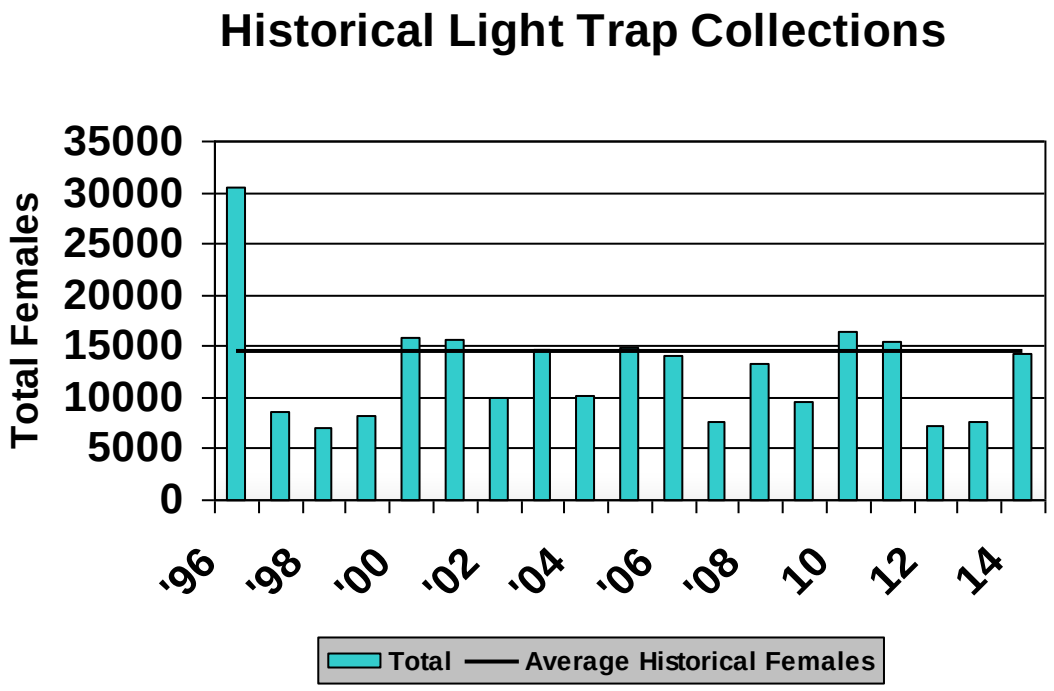
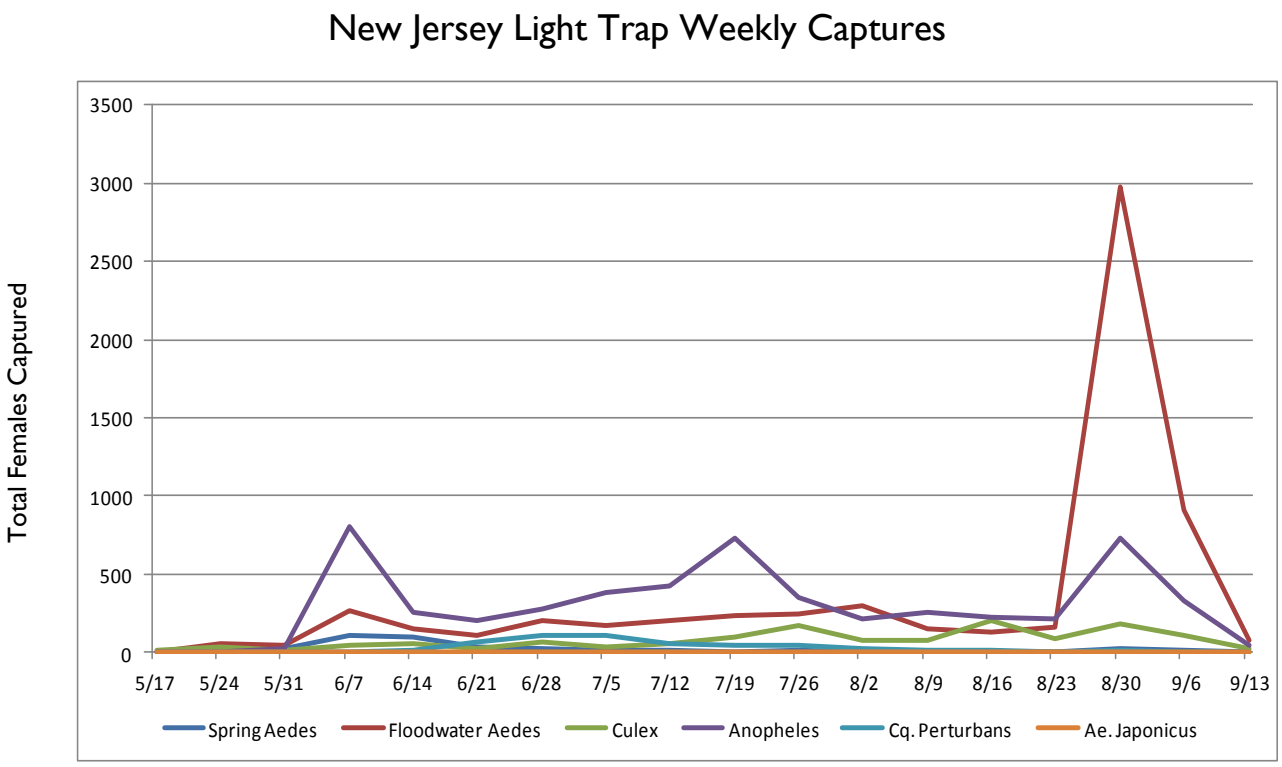


Figure 4 - New Jersey Light Trap Weekly Data, 2014



New Jersey Light Trap placed along Three Mile Road in Monitor Township

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 individual mosquito species, each one being slightly 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 289 CDC traps this year was 55,181 (Table 3—page 14). The summer floodwater species, *Ae. vexans* and *Ae. trivittatus,* remained at the top ranking spot, representing 59% of the total with nearly equal numbers of other genera representing the remainder of the trap composition. Most females were collected in September with 22,755 collected; 92% of these were collected in the first nine days of the month. These were floodwater mosquitoes produced from the heavy rains of mid-August.

Twenty-two species in seven genera were collected and identified, averaging 191 females per trap, up considerably compared to 78 in 2013. The average number of females in 2012 and 2011 was 103 and 93, 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. No positive pools were detected from mosquitoes collected in CDC Traps.

Studies have shown that more *Culex* mosquitoes can be collected when a CDC trap is suspended in the tree canopy compared to traps placed at ground level. On four occasions (August 8, 14, 26, and September 11), CDC traps were elevated in woodlots to collect additional *Culex* mosquitoes (that feed on birds as they are roosting in tree canopies) to aid in disease surveillance efforts. In every case, more *Culex* were captured in elevated traps, ranging from 2-32 times more. In total, 291 *Culex* were collected on those four trap nights in elevated traps compared to 16 collected in CDC traps placed at ground level.

Table 3 - CDC Trap Data, 2014

Species	May	June	July	August	September	TOTAL
Aedes aurifer	0	219	0	0	0	219
Aedes canadensis	4142	3577	646	11	0	8376
Aedes cinereus	5	261	40	3	159	468
Aedes dorsalis	0	0	1	0	0	1
Aedes implicatus	39	94	41	2	0	176
Aedes intrudens	76	550	82	54	209	971
Aedes japonicus	0	0	0	0	0	0
Aedes provocans	22	107	26	0	0	155
Aedes sticticus	25	172	52	3	0	252
Aedes stim/fitchii	396	1825	305	33	0	2559
Aedes triseriatus	0	16	23	26	52	117
Aedes trivittatus	0	1165	2054	1717	8701	13637
Aedes vexans	110	2705	1497	2867	11658	18837
Anopheles perplexens	0	8	20	13	9	50
Anopheles punctipennis	2	23	33	26	21	105
Anopheles quadrimaculatus	0	22	150	445	50	667
Anopheles walkeri	0	82	92	462	401	1872
Culiseta inornata	0	0	0	2	0	2
Coquillettidia perturbans	0	626	2358	660	31	3675
Culex restuans	10	45	552	303	233	1143
Culex pipiens	0	0	33	436	272	741
Psorophora ferox	0	0	45	44	917	1006
Uranotaenia sapphirina	0	0	0	2	0	2
Total	**4835**	**11555**	**8926**	**7109**	**22755**	**55181**

SPECIES FOCUS - AEDES AURIFER

Aedes aurifer is a spring species with a single generation of larvae that appear in April and pupate in May. This season, three adult individuals were collected from New Jersey Light Traps with an additional 219 collected in CDC Traps, more than any other year. The eggs of this species hatch fairly early in spring, but development is slow and larvae can be collected for about 6 weeks. The adults are generally on the wing by the second week of May. Eggs laid by females in one season do not hatch until the next season when they are flooded the following spring and the single generation hatches very early in the season to complete the cycle.

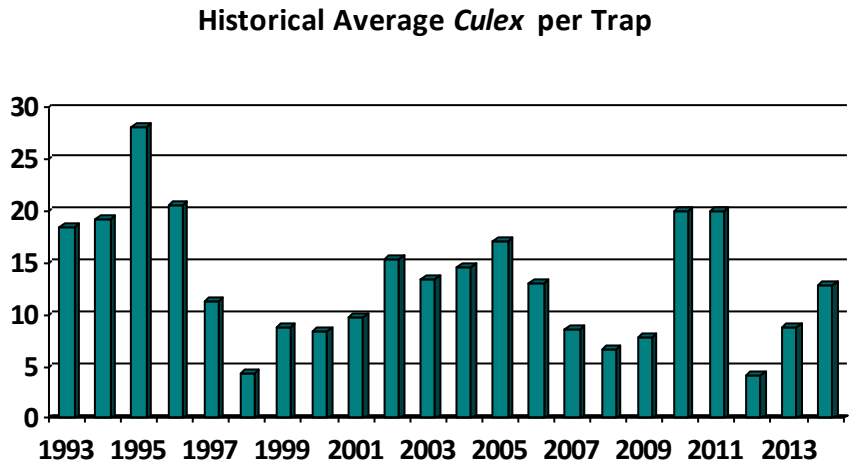
Identifying *Aedes aurifer* was one of the most exciting events in the lab this season because it is always thrilling to find a rare mosquito. A description of this species that helps with identification includes a ventral abdomen that is entirely pale-scaled whereas the dorsal side is dark-scaled; the thorax is marked with a broad median black stripe with sides that are golden. *Aedes aurifer* is a vicious biter, but the mosquito rarely flies far from its breeding habitat.

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. 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.

Gravid trap placement ran from June through September with 76 traps capturing 1,063 mosquitoes (974 C*ulex* species, 5 *Ae. japonicus*, 6 *Ae. vexans*, 2 *Ae. triseriatus*, 1 *Ae. sticticus*, 1 *An. punctipennis, 2 Ae. stimulans/fitchii and* 72 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 (MSU) for WNV-detection. Figure 5 shows a historical perspective of the average number of *Culex* mosquitoes collected per gravid trap. Collections from 2014 increased from the 2013 numbers, with an average of 12.8 female *Culex* mosquitoes per trap.

Figure 5 – Historical Average *Culex* species per Gravid Trap, 2014



DISEASE SURVEILLANCE

Since the inception of BCMC's program, 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. West Nile Virus (WNV) was the only pathogen detected this season.

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. Three hundred thirty-seven (337) pools containing 7,838 females representing a variety of species were tested with the following results:

- *Coquillettidia perturbans* (152 pools/3,875 females/no positives)
- *Culex restuans/pipiens* (180 pools/3,942 females/**1 WNV-positive**)
- *Aedes japonicus* (5 pools/21 females/no positives)

A positive pool indicates local mosquitoes are infected with West Nile Virus and are capable of transmission to humans and other hosts. The positive pool was collected from a New Jersey Light Trap placed along Spruce Ridge Road in Bangor Township (8/15/14; 17 *Culex* mosquitoes).

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 2014 was 0.25; for *Coquillettidia perturbans* the MIR was 0. The MIR for *Culex* in 2013 was 1.6.

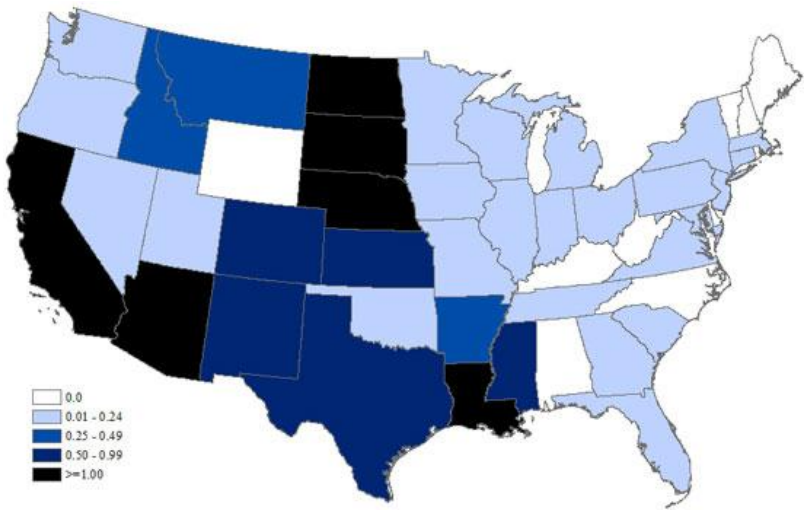
The dead bird surveillance program was established in 2001 by the Michigan Department of Community Health in collaboration with local health agencies. We rely on Bay County citizens reporting dead birds as one method of WNV surveillance. This year we received 21 phone calls reporting dead birds throughout the community, which is down from last year's 61 calls. In 2014, 23 dead birds were reported, most of which were Blue Jays (11), House Sparrows (4), American Crows (3), Common Grackles/European Starlings/other blackbirds (3), Robins (1), and Gulls (1). All dead bird sightings were logged onto Michigan's Emerging Diseases website www.michigan.gov/emergingdiseases. After initial screening by staff, a total of 9 crows or jays were tested with **0 testing positive**. Using the WNV Vector Test™ kit, American Crows and Blue Jays were tested to determine infection rates. Compared to 2013, disease activity dropped dramatically in 2014.

Statewide, there were far fewer cases compared to last year (Table 4, as of October 20, 2014). Human cases are typically clustered around Detroit-metro and Grand Rapids-metro areas, but this year showed a single case in both Kent and Cass Counties. Nationally, there were 2,085 human WNV cases with 84 deaths (as of 12/16/14), which is about 50% fewer cases than were reported in 2012, the second most-active WNV year since 2003. About 70% of the cases were reported from 5 states (California-780, Texas-345, Nebraska-140, Colorado-114, and Louisiana-111).

Table 4 – Michigan's WNV Human Cases

Year	Total Cases	Fatalities	Year	Total Cases	Fatalities
2014	2	0	2007	13	2
2013	36	2	2006	55	7
2012	202	17	2005	62	4
2011	33	2	2004	16	0
2010	29	3	2003	19	2
2009	0	0	2002	614	51
2008	17	0			

Figure 5 – WNV Neuroinvasive Disease Incidence per 100,000, as of December 16, 2014



PRODUCT TRIALS

AQUABAC® 200G BTI, SPRING 2014

A trial was carried out to determine efficacy of Aquabac® 200G B*acillus thuringiensis israelensis* (*Bti*) granules as direct applications to woodland pools for spring *Aedes* species larval control at two dosages - 3 lb/acre and 5 lb/acre. Pre-treatment larval counts were obtained of 2nd and 3rd stage larvae in 5 individual pools in three woodlots (3lb rate, 5lb rate, and controls). Post-counts were taken at the 48- and 72-hour mark. Ten dips were taken per pool with larval numbers recorded on a data sheet and pools were marked and mapped using orange flags.

The *Bti* granules provided effective control for both dosages. The higher dosage provided greater larval mortality at the 48-hour post count; however, after 72 hours both rates were essentially the same. The table below shows the average percent mortality for each pool while the last row shows the average mortality for each dosage rate and post-treatment time.

Table 5 – Aquabac 200G Average Percent Mortality Treated Pools, 2014

Pool Number	3 lb/acre 48-Hour	5 lb/acre 48-Hour	3 lb/acre 72-Hour	5 lb/acre 72-Hour
1	92.3%	100%	100%	100%
2	42.3%	100%	96.2%	100%
3	89.2%	98.1%	100%	100%
4	93%	96.9%	99%	100%
5	92.4%	100%	100%	100%
6	90.9%	88.9%	100%	100%
7	90.9%	100%	100%	100%
8	100%	100%	100%	100%
9	100%	87.5%	100%	100%
10	90%	100%	100%	100%
AVERAGE	88.1%	97.1%	99.5%	100%

Pools 1-5 were located in a flooded woodlot in Mt. Forest Township, Section 30, while pools 6-10 were located in a flooded woodlot at Delta College, Frankenlust Township, Section 3. Five control (non-treated) pools were also established with larval counts taken during this same time period. At the 48-hour post count, control mortality in pools 1-4 was 0%, while pool 5 was 12.5%; at the 72-hour mark, pools 1,2,3, and 5 showed 0% mortality with pool 4 recording 11.1%. The following weather conditions were observed during the April 22-25, 2014 study: outside temperatures ranged from 35-55°F and 0.07 inches of rain fell on Day 3 just before the 72-hour counts were taken. Overall, Aquabac® 200G provided exceptional control of our spring *Aedes* mosquito larvae and would be considered as a viable product when looking at control material bids in the future.

TRAPTECH® MOSQUITO LURE, SUMMER 2014

For ten years (since 2005), *Aedes japonicus* mosquitoes have been collected in Bay County, mainly as larvae. Few adults have been collected in either NJ Light Traps or CDC Miniature Light Traps so whether using light or CO_2 to attract this species, neither has proven very successful.

A study was conducted in Windsor, CT in 2010 and 2011 looking at 12 attractants and 3 different types of traps for their attractiveness to host-seeking and ovipositional-seeking female *Aedes japonicus* and associated woodland species (J Am Mosq Control Assoc 28 (3): 184-191, 2012) They found that CDC miniature light traps baited with a TrapTech® Lure caught significantly more *Ae. japonicus* individuals than did the traps baited with other lures and without bait. The TrapTech® Lure is a proprietary blend of Bedoukian Research, Inc. containing 250 mg of R-1-octen-3-ol and 1900 mg ammonium bicarbonate, which are used in combination with carbon dioxide to collect woodland *Aedes* female mosquitoes. The numbers collected (of *Ae. japonicus*) in the CDC trap baited with CO_2 and the TrapTech® Lure were 28 times greater than the numbers collected in the CDC trap baited with CO_2 alone. In 2013, Saginaw County Mosquito Abatement Commission (SCMAC) ran a similar study by deploying CDC traps in a wooded floodplain. Two traps were hung baited with CO_2, one with the TrapTech® Lure. During a 17-week study, 970 *Ae. japonicus* were collected in traps baited with the TrapTech® Lure while only 12 were collected without the lure. In 2014, BCMC sought to duplicate the SCMAC study.

In BCMC's 17-week study that took place from May 30-September 17, a total of 15,826 mosquitoes representing 23 species were collected. Fifty-three percent of those came from traps baited with the TrapTech® Lure. Like the study conducted by SCMAC, Bay County collected significantly more *Anopheles species, Aedes japonicus*, and *Aedes triseriatus* with the lure. Unfortunately, in our study, the sample size of both *japonicus* and *triseriatus* was small compared to other collected species. Traps were always hung in either floodplains, woodlots, or a wildlife refuge. The summer was also characterized as dry until week 14 of the study (August 26) when numbers of floodwater species rose. In our study, the TrapTech® Lure used in combination with CO_2 in a CDC miniature light trap did not prove to be a significantly better method for *Aedes japonicus* surveillance. We would like to try again in 2015.

Table 6 – TrapTech® Lure Results for Nuisance and Vector Species, 2014

Species	TrapTech (TT) Totals	CDC Trap Totals	TT % Total
Aedes canadensis	1886	1185	61.4%
Aedes japonicus	1	0	100%
Aedes stim/fitchii	366	317	53.6%
Aedes triseriatus	19	1	95%
Aedes trivittatus	2462	3052	44.6%
Aedes vexans	1107	1907	36.7%
Anopheles quadrimaculatus	47	25	65.3%
Anopheles walkeri	1678	211	88.8%
Coquillettidia perturbans	221	355	38.4%
Culex restuans	17	15	53.1%
Culex pipiens	10	28	26.3%
Psorophora ferox	37	65	36.3%
Total 23 species	**8446**	**7380**	**53.4%**

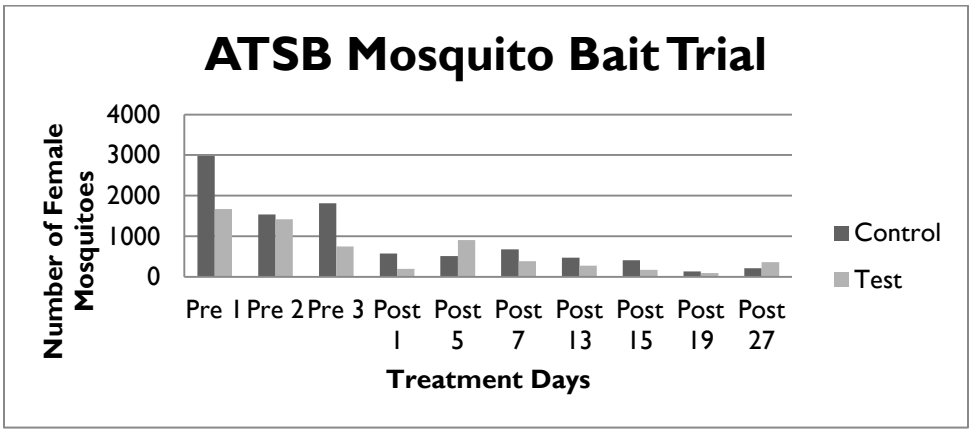
ATSB® MOSQUITO BAIT TRIAL, SUMMER 2014

Terminix® Attractive Toxic Sugar Bait (ATSB) Mosquito Bait Concentrate is composed of 0.4% garlic oil and is applied to outdoor areas frequented by adult mosquitoes. Male and female mosquitoes are attracted to the bait, feed on it, and die. BCMC used the liquid bait as a perimeter treatment and expected to have control up to four weeks. It was applied to foliage with a standard Hudson® pressure sprayer using 1 part concentrate to 3 parts water. The mixture was applied in a band about 5 feet wide to the point of runoff, as the label suggested.

The trial was conducted over a 37-day period, using CDC light traps to monitor mosquito populations. Three pre-counts were taken on June 16, 18, and 23. Most of the mosquitoes captured during the study were spring *Aedes* (mostly *Aedes canadensis*), which naturally peak in early June and begin to decline thereafter. On day 11, the ATSB solution was sprayed on vegetation in the treatment site. Immediately after, the relative abundance of female mosquitoes declined about 75% from the average pre-treatment level, but by day 5, trap counts rebounded slightly (Table 7). They then remained low until post-treatment day 27 when they began to climb. Although control trap numbers were higher than test traps throughout most of the study, the trend was the same, falling numbers through post-treatment day 19 after which the trap numbers began to rise and the trial ended. With control numbers declining in equal fashion to the treatment numbers, it was impossible to attribute the treatment population decline to the product. There were also five rain events during the trial – two that recorded just over one inch of rain.

Studies done by others have shown that the sugar baits seem to work well, however, so we may try the product again in the future.

Table 7 – ATSB® Bait Results, 2014



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 Bay County from May 1 through September 30, 2014 was 16.57 inches—0.49 inches above the average of 16.08 (Figure 6).

Temperatures this winter finished below normal every month, with the December through March timeframe finishing at least 4 degrees below normal. The greatest monthly departure from normal this winter came in February when temperatures averaged 9 degrees below normal. Only in April, where we experience the big transition from winter to spring did a month finish just a hair above normal. The November through March time frame across the Great Lakes region was one of the coldest in recent memory.

May and June were characterized as close to average for temperature, but just below average for rainfall. July was below average for temperature while August and September were less than one degree above the normal with no 90 degree days occurring this summer. August was the only month that had significant rainfall, averaging about an inch above the normal. One significant rainfall (August 11-12) recorded an average rainfall of 3.45 inches, ranging from 0.4-5.6 inches. Heavier rains fell in Bay City, Bangor Township, and Monitor Township.

Figure 7 (page 22) 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 three such rain events that occurred—mid-May, mid-August, and again in mid-to-late September.

Table 8 (page 22) lists weather data occurring in Bay County from Nov, 2013-Oct, 2014 and the monthly departures from normal for temperature and rainfall.

Figure 6 – Bay County Total Rainfall May 1 – September 30 (Observed vs. Historical), 2014

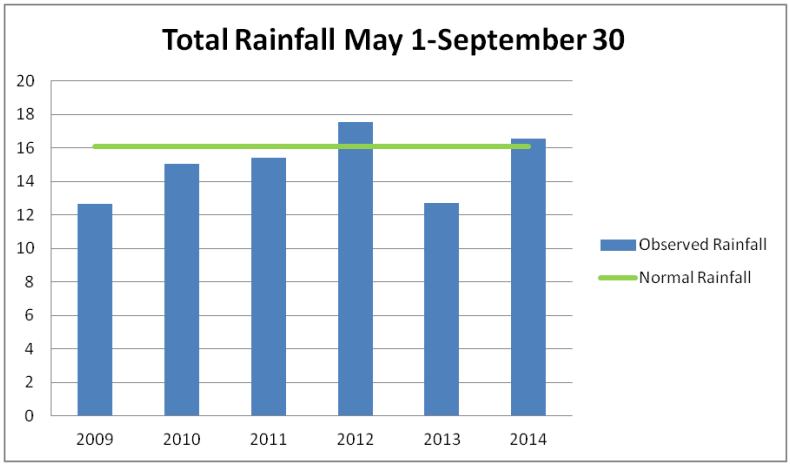


Figure 7 – Average Weekly Rainfall, 2014

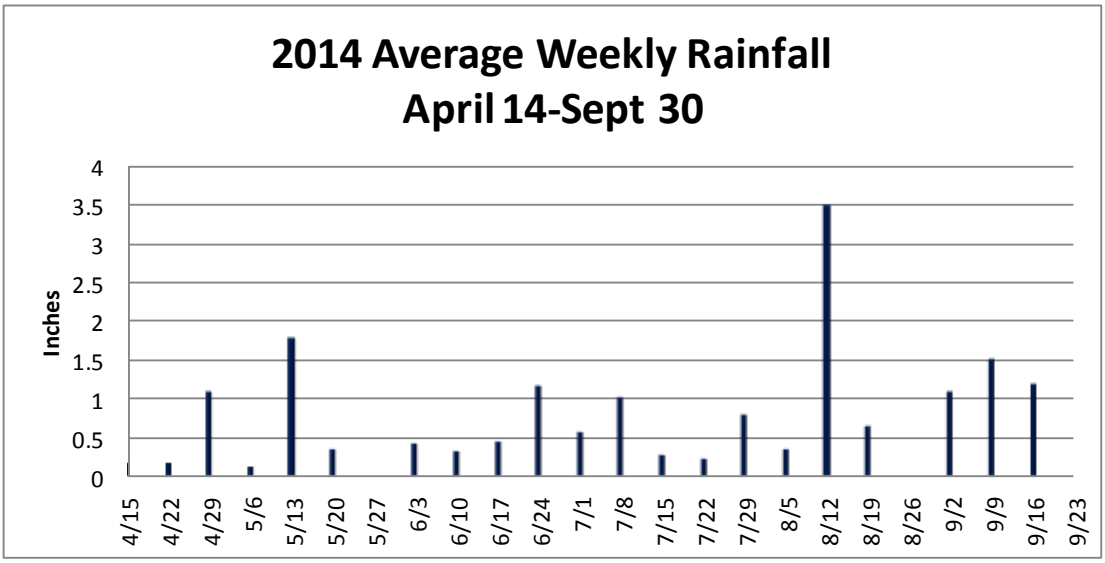


Table 8 – Rainfall and Temperature Data, 2014

Month	Normal Rainfall	2013/14 Rainfall	Departure from Normal	Normal Avg Mean Temp.	2013/14 Avg Mean Temp	Departure from Normal
November	2.7"	1.78"	-0.92"	38.5°	36.5°	-2.0°
December	1.86"	1.83"	-0.03"	27.3°	22.8°	-4.5°
January	1.71"	1.9"	+0.19"	22.2°	16.0°	-6.2°
February	1.61"	1.88"	+0.27"	24.5°	15.5°	-9.0°
March	2.06"	1.03"	-1.03"	33.7°	25.4°	-8.3°
April	2.89"	3.55"	+0.66"	46.1°	46.6°	+0.5°
May	3.38"	3.23"	-0.15"	57.3°	58.8°	+1.5°
June	2.98"	2.37"	-0.61"	67.2°	69.7°	+2.5°
July	2.58"	2.94"	+0.36"	71°	68.4°	-2.6°
August	3.31"	4.34"	+1.03"	68.8°	69.4°	+0.6°
September	3.83"	3.69"	-0.14"	61.3°	61.8°	+0.5°
October	2.63"	2.39"	-0.24"	49.7°	51.1°	+1.4°

SPRING AERIAL CAMPAIGN

Weather patterns for spring 2014 were cold and snowy. March had 5.8 inches of snowfall recorded, but with the cold temperatures, snow remained on the ground for much of the month. March temperatures were much-below normal, but April temperatures ran closer to normal. April was among the snowiest on record, ranking as the 15th snowiest since recording began for our area in 1912.

The mosquito control season, which typically begins in early-to-mid April with aerial larviciding to control spring woodland mosquitoes, began about a week late on April 21. 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*) applied to seasonally flooded woodlots to control mosquito larvae.

Earl's Spray Service, Inc. of Wheeler, Michigan used three aircraft to apply *Bti* to 42,793 woodland acres in the following townships: Bangor (4,433), Beaver (5,001), Frankenlust (1,167), Fraser (4,502), Garfield (5,643), Gibson (1,858), Hampton (1,893), Kawkawlin (1,979), Merritt (468), Monitor (2,513), Mt. Forest (4,479), Pinconning (4,988), Portsmouth (630), and Williams (3,239).

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 3 pounds per acre. This was the first season Bay County Mosquito Control treated all aerial acres at the 3 pound rate, compared to the 4-5 pound rates used previously. This provided a more expansive treatment area while still achieving a high mortality rate.

Supervisor Rebecca Brandt speaks with pilot Jake Baker during spring aerial treatment

SPRING GROUND SURVEILLANCE/TREATMENT

One certified technician and three full-time staff helped with aerial quality control, conducting post-treatment surveys in 68 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 to manage the larvae or pupae. Field technicians began to treat woodland pools with larvicide oil, *Bti*, or temephos, concentrating on smaller woodlots not feasibly treatable by aircraft.

Table 9 lists the number of acres treated by foot crews and material used in smaller tracts of woodlots during the 2014 spring season. Just over 136 acres received larval treatment by ground crews to control the emergence of pestiferous spring *Aedes* mosquitoes. The crews checked 210 sites, dipping each one, to determine the need for treatment. A total of 78 sites were treated; untreated sites were either dry or wet but not breeding. A total of 49.08 pounds of *Bti* and 123.9 gallons of BVA2 larvicide oil were dispensed at a dosage rate of 5 pounds/acre and 1 gallon/acre, respectively. In addition, 3.3 pounds of granular temephos was used.

Pupae were first noted on April 28, but were found en masse on May 4. Significant emergence of spring *Aedes* adults occurred May 7-15. Adult emergence initiated adulticiding, control of adult mosquitoes through fogging operations.

Table 9 – Spring Ground Treatment, 2014

Township	Acres Treated	BVA2 (gallons)	*Bti* (pounds)	Temephos (pounds)
Bay City East	3	3		
Bay City West	12.15	12.15		
Bangor	23.2	19	16.52	0.75
Beaver	2.73	2.73		
Essexville	0.5	0.5		
Frankenlust	3.14	3.14		
Fraser	1.51	1.47		0.43
Garfield	3.65	2.6	4.18	
Gibson	15.31	15.31		
Hampton	9.43	8.18	4.92	0.2
Kawkawlin	1	1		
Monitor	7.82	3.87	15.8	
Mt. Forest	41.81	41.81		
Pinconning	5.52	5.5		1.92
Williams	5.52	3.6	7.66	
TOTAL	**136.29**	**123.86**	**49.08**	**3.3**

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 16 technicians 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 film (Agnique® MMF) and petroleum-based oil (BVA2 Mosquito Larvicide Oil). The Agnique MMF was used near the Lake Huron 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 11,561 larval site inspections were conducted this season; only 12% (1,392) of those required treatment with a larvicide material. 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, which contribute significantly to local economies.

Residents participate in a variety of outdoor activities including gardening, biking, walking, golfing, and barbecuing. As activities like these grow in popularity, more and more people spend time outdoors and BCMC strives to control mosquito larvae in order to prevent the emergence of large adult mosquito populations. It is always BCMC's goal to decrease mosquito populations to decrease mosquito annoyance and disease threats.

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. Many ditches breed mosquitoes because they hold water for extended periods of time. Culverts are often dug deeper than the ditch itself so even if a ditch dries, areas near the driveway culverts often still hold water. So attention is given to monitoring mosquito activity in ditches throughout the county. 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 4,445.3 miles treated, which was 14% fewer than the historical average (Figure 8). Control materials dispensed included 988.1 gallons of Abate 4E mix (5.4 gallons of Abate 4E) and 1,256.25 gallons of Natular 2EC mix (17.5 gallons of Natular 2EC). Figure 9 depicts miles treated per township. Most of the treatment occurred in Mt. Forest, Bangor, and Monitor Townships with a combined total of 1,607.8 miles or 36% of the total.

Figure 8 – Historical Ditch Truck Miles

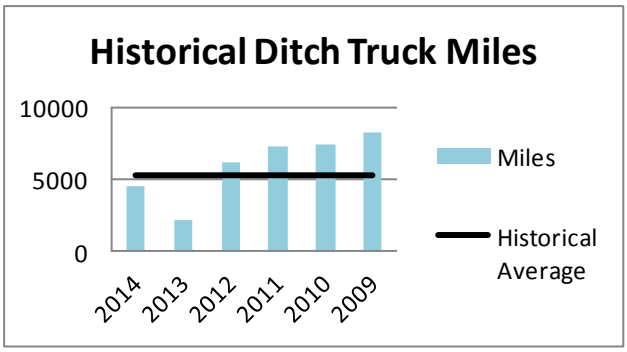
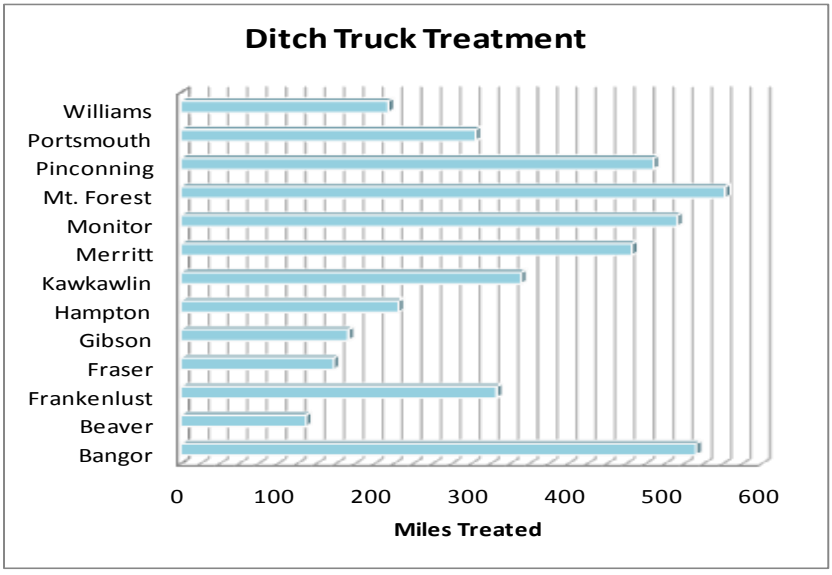


Figure 9 – Ditch Truck Treatment Miles, 2014

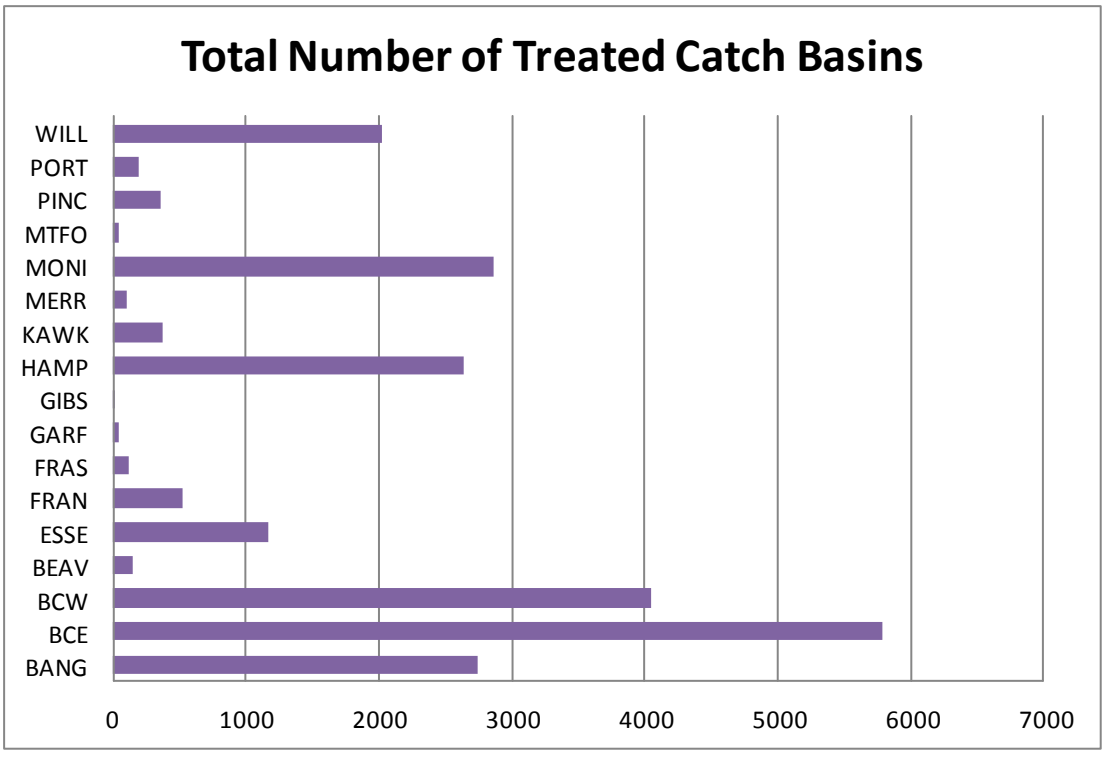


Catch Basins: Treatment of catch basins, or storm drains, will control *Culex restuans* and *Culex pipiens* mosquitoes, known vectors of both St. Louis encephalitis and West Nile virus. These species are not considered nuisance mosquitoes, as they feed primarily on birds; however, controlling disease vectors is extremely important in our efforts to decrease disease potential and maintain public health.

Catch basins may be found along streets, in parking lots, and sometimes in backyards. Staff monitored mosquito breeding in catch basins and treated a total of 23,140 individual habitats. Figure 10 shows the number of catch basins treated in each township or city. The bulk of treatment took place in Bay City and Bangor, Monitor, and Hampton Townships, the most urban areas of the county. Treatments reduce the number of vector mosquitoes during late summer, the period of time of greatest disease risk to humans.

Catch basins were primarily treated with either Natular® XRT (2,306 individual tablets) or VectoLex® FG bacterial larvicide (533.7 pounds). Basins primarily in BCE, BCW, and Essexville, were all treated twice with VectoLex, with the first treatment commencing in early June.

Figure 10 – Catch Basin Data, 2014



Retention & Detention Ponds: Bay County is home to 150 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.

All mosquitoes need water to complete their life cycle, but some species live in permanent and semi-permanent waters while others live in temporary waters. Permanent and semi-permanent waters are found in retention ponds, where it's present except during drought periods. Pools of water that accumulate in low-lying areas during and immediately following a flood, like those seen in detention basins, are examples of temporary waters and these waters can produce large populations of floodwater mosquito species. Mosquitoes need a minimum of four consecutive days of stagnant water for larvae to grow to adulthood.

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 204 individual visits throughout the summer, 83% of which did not result in treatment. This is a trend often seen in "search and destroy" operations. However, on the days when treatment was necessary, the following larvicides were used to control either larvae or pupae: *Bti* Briquets (4), Bti G (24.2 lb), BVA2 (12.8 gal), Agnique MMF (11.7 oz), Abate 4E (1.5 gal of mix/0.01gal active), Natular 2EC (3 gal of mix/0.04 gal active), and ProVect (0.2 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.

Sewage Lagoons: Sewage lagoons are a prolific source of mosquitoes, especially *Culex* mosquitoes that prefer permanent, polluted, highly organic water in which to lay eggs. Surface and emergent vegetation along a lagoon's shoreline provide both hiding places and food for the developing larvae. This is where most mosquito breeding occurs – in a zone about 10 feet wide from the shoreline outward. Populations of mosquito larvae and pupae in lagoons may become high from time to time in spite of the best prevention efforts, but treatment will quickly bring an infestation under control.

Two sewage lagoons were monitored this season—White Birch Village and Pinconning McDonalds—resulting in 11 treatments, all 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: 12 gallons of Abate 4E mix (0.07 gal Abate 4E), 2 gal of BVA2, and 9 gal of Natular 2EC mix (0.13 gal Natular 2EC).

Search and Destroy: Through data gathered during field surveillance, BCMC technicians conduct daily mosquito surveillance in a variety of habitats in a procedure known as Search and Destroy. This simply means that technicians search for and control immature mosquitoes in various breeding habitats, such as those listed below. In the case of man-made containers, staff enlists the help of homeowners who are encouraged to dump water from containers or cover them tightly to reduce mosquito breeding.

Man-Made Habitats

- Artificial Containers
- Idle Pools
- Rain Barrels
- Catch Basins
- Ornamental Ponds
- Ponds
- Tires

Natural Habitats

- Flood Plains
- Flooded Fields
- Roadside Ditches
- Cross Country Drains
- Flooded Woodlots

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 10 illustrates the control materials dispensed during Search and Destroy activities this season.

Table 10 – Control Materials Dispensed During Search and Destroy Operations, 2014

CONTROL MATERIAL	AMOUNT DISPENSED	UNIT OF MEASURE
Abate® 4E	52.3	Gallons of mix
Agnique® MMF	2.4	Gallons
VectoBac® G	973.2	Pounds
BVA2 Mosquito Larvicide Oil	622.3	Gallons
Bactimos *Bti* Briquets™	501.5	Each
Natular™ 2EC	20.5	Gallons of mix
Natular™ XRT	38	Each
AllPro® ProVect 1G	42.1	Pounds
VectoLex® FG	0.75	Pounds

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 20 when Chris Novak, Mosquito Control Sales Consultant at Clarke, analyzed the droplet size distribution for BCMC's ULV machines using the Army Insecticide Measurement System (AIMS). A subsequent check took place in late July using the Teflon® slide method to measure aerosol droplets.

When weather conditions are conducive to fogging (temperatures above 50°F and winds below 10 mph), eight certified technicians treat cities and townships that have either the highest mosquito populations or noted disease activity. This year saw the routine use of the permethrin products AllPro® Evoluer 4-4 ULV and Pursuit™ 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 72 (a 4% increase from 2013), 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 97 such addresses, which is a 5% increase compared to 2013 numbers.

Technician Nate Brown weighs permethrin into a tank for nighttime adulticiding operations

During the 2014 season, the "Long Driveway Program" continued. This program is designed to treat 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-eight such addresses were placed on route maps to be fogged on a regular basis, an increase of 8% from 2013.

Table 11 reveals that 14,155.55 miles were logged during adulticiding operations and 3,165.94 gallons of control materials were dispensed, with the majority being Pursuit™ 4-4 ULV (2,433.49 gallons). Compared to 2013, this is 273 more gallons of control materials and 3.5% more miles treated. From mid-August through early September, the flow rate of adulticide material was increased from 6.1 to 12 fluid ounces per minute in several townships where mechanical traps indicated the adult mosquito populations had spiked coupled with increased levels of service requests.

Table 11 – Adulticiding Treatment, 2014

Adulticiding Treatment			
Township	**Evoluer™ 4-4 ULV (gallons)**	**Pursuit™ 4-4 ULV (gallons)**	**Miles Treated**
Bangor	78.08	455.14	2373.4
Bay City East	17.91	102.92	476.8
Bay City West	2.55	87.39	343.4
Beaver	45.63	83.08	691.3
Essexville	6.59	20.63	102.6
Frankenlust	8.83	112.87	575.6
Fraser	31.95	114.21	709.7
Garfield	67.04	58.97	626.93
Gibson	92.27	66.14	749.75
Hampton	33.72	196.15	908.6
Kawkawlin	22.49	210.45	951.19
Merritt	19.48	36.54	276.1
Monitor	109.72	445.47	2293.8
Mt. Forest	94.36	76.16	831.58
Pinconning	47.6	97.88	728.2
Portsmouth	16.57	124.75	591.5
Williams	37.66	144.74	925.10
Total	**732.45**	**2433.49**	**14155.55**

ELECTRIC ULV

Bay County Mosquito Control introduced the use of a new truck-mounted electric ULV machine into the adulticiding fleet during the 2014 treatment season. The electric machine was incorporated into the program initially for the relative quietness of the sprayer, under 80db. Adulticiding with this unit was prioritized to noise-sensitive areas in Bay County, including the campground at Bay City State Recreation Area, where the quieter machine would cause less distraction to campers at night. The response from the Recreation Area staff was favorable.

The quieter machine had its "drawbacks" as residents mentioned they did not hear the expected sound of the fogger in their neighborhood during routine township sweeps, therefore didn't realize they were receiving treatment. However, the unit included an illuminated spray head to highlight the fog to verify to onlookers that the machine was operational and material being applied.

Other advantages Bay County noted with this machine included the little-to-no-maintenance associated with the electric unit. The absence of a small engine and components such as couplers, head gaskets, and blowers eliminated maintenance on parts that easily wear out over time. The machine also came in at a light weight of 140 lbs versus the nearly 500 lbs of gas-powered machines.

Expected maintenance includes the simple replacement of a spray sleeve about once a year, and periodic cleaning of a single in-line filter. Bay County Mosquito Control has 17 total truck-mounted ULV foggers in its fleet including Grizzly®, Leco, and Micro-Gen gas-powered foggers. The electric machine, the ProMist Dura®, is marketed as a high performance electric ULV sprayer focusing on flexibility and durability. The battery-powered machine is also touted as eco-friendly as it eliminates the emissions released by gas-powered machines.

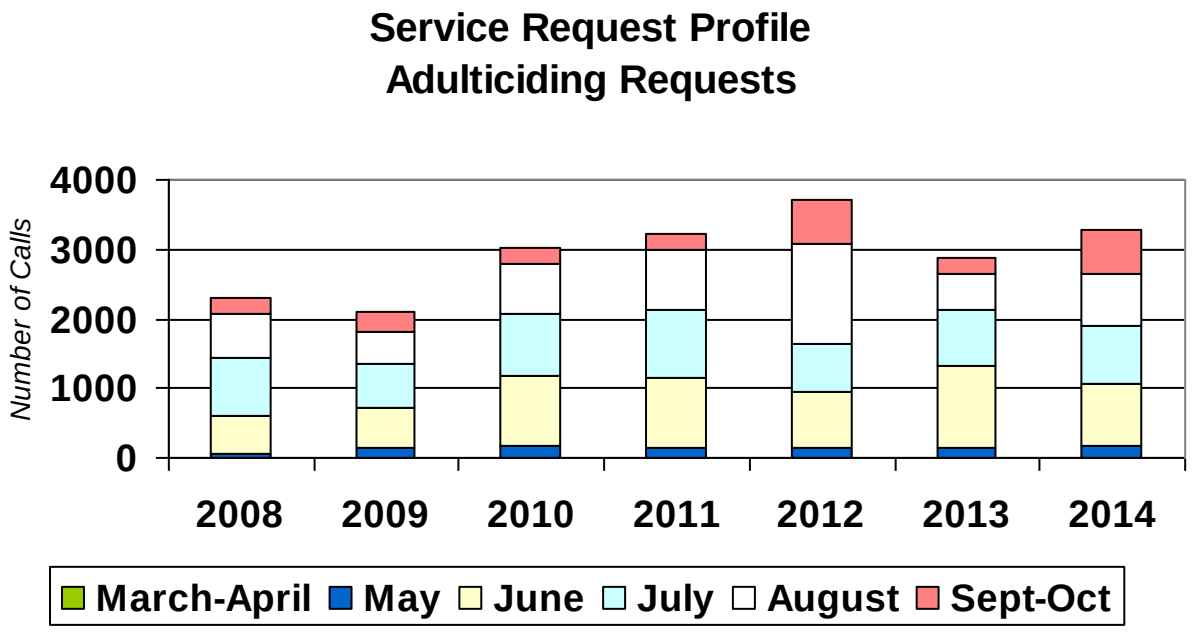
ProMist Dura® electric ULV machine mounted on BCMC vehicle

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 3,270 adult mosquito service requests received from Bay County citizens. Most of the calls (2,544) were regular service requests for adulticide treatment due to nuisance mosquitoes with 445 of those calls logged between September 2-8, peaking approximately three weeks after the major August rain event. On September 3 alone, 129 phone calls were received. An additional 726 calls represented special event spray requests. In comparison to 2013, the level of adulticide service requests increased by almost 12%.

BCMC received 637 calls reporting standing water with potential mosquito breeding. Most of those were received in June and August with 175 and 164 calls received, respectively. Regardless of the type of service request, all were responded to in a professional, courteous, and prompt fashion. Figure 11 represents a historical profile of adulticide requests.

Figure 11 – Historical Number of Adulticiding Requests from Bay County Citizens



VEHICLE MAINTENANCE AND 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 2014 season, as Figure 12 shows, 123,782 miles were driven, which is much below the 23-year average of 186,709 miles and represents 17% fewer miles than were driven in 2013. Vehicle and equipment maintenance included the following:

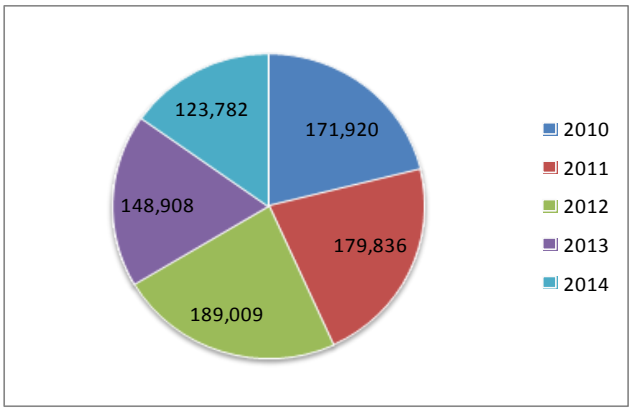
Vehicle Repairs

- Brake systems - 25
- Fuel systems - 10
- Front end repairs - 42
- Truck oil changes - 54
- Electrical systems - 57
- Drive lines - 8
- New tires - 24
- Used tire repair - 12

Equipment Repairs

- ULV oil changes - 40
- ULV repairs - 26
- Ditch trucks - 32
- Hudson® sprayers - 48
- Spreaders - 4
- CDC Traps - 6
- New Jersey Light Traps - 4
- Gravid Traps - 18

Figure 12 – Historical Vehicle Mileage



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 31 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. Staff recycled 1,269 tires during the Spring collection and an additional 666 during the second late-summer tire drive. A total of 1,935 tires were recycled, a 47% reduction from 2013.

In 2014, BCMC applied for and received a Scrap Tire Cleanup Grant for $2,400 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 was 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.

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

Scrap tire pile located in Beaver Township, Bay County, MI

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 allow 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 2 and June 18 with new and returning technicians in attendance. Jim Iaquinta from Saginaw Bay Cooperative Weed Management was on hand to provide training on identifying phragmites throughout the county. Staff also attended Bay County Drain Commission's "Spotting Illicit Discharges" training on May 28. Lastly, staff were present for MMCA's 28th annual meeting at the Lansing Radisson on February 19, 2014 and the MMCA 2014 Mosquito Control Training Session October 20, 2014 in Bay City, both of which offered continuing education credits. Full-time staff listened to several webinars offered by the AMCA this season: Surveillance and Control of Dengue Vectors (January 16, 2014), Introduction of Chikungunya Virus into the Western Hemisphere (April 10, 2014), and PESP is not a PEST: A Continuing Opportunity to Reduce Pesticide Risk (September 12, 2014).

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

The Technical Advisory Committee (TAC) annual meeting March 5, 2014 where the 2013 annual report and 2014 program plan were presented for review and approval.

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 2014 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 Floor-Dry™ granular absorbent or soap, water, and paper towel.

NPDES

The Michigan Department of Environmental Quality has issued BCMC 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. 2014 was the second year BCMC was mandated to file a NPDES Annual Report, which was completed and submitted on November 21, 2014.

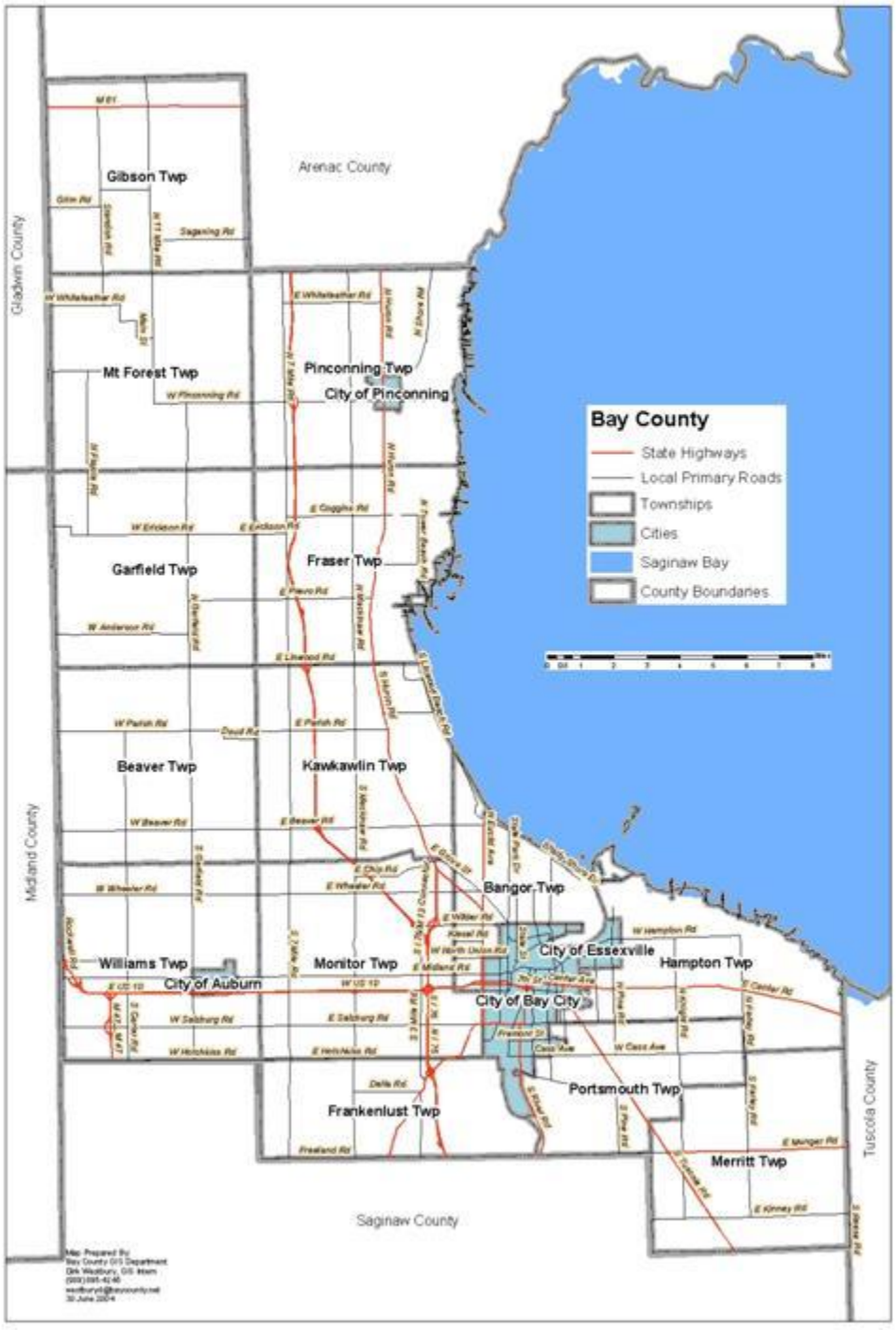
640 BULK STORAGE

The Michigan Department of Agriculture and Rural Development inspected BCMC's bulk chemical storage facility on October 15, 2014. The MDARD recently discovered that BCMC and other county mosquito abatement programs were subject to pesticide bulk storage regulations as they store mini bulk containers of liquid pesticides and bulk dry pesticide products for mosquito control. The containment facility was found to be in compliance with Regulation 640.

Table 12 – Control Material List, 2014

Trade Name	Application Rate	Active Ingredient Dosage
AllPro® ProVect 1G	10 lb/acre	0.1 lb temephos/acre
Abate® 4E	1.5 fl oz/acre	0.0468 lb temephos/acre
Agnique® MMF	0.2-1 gal/acre	0.2-1 gal alcohol-based surface film/acre
BVA2 Mosquito Larvicide Oil	1-5 gal/acre	0.987-2.96 gal petroleum distillates/acre
Bactimos Bti Briquets™	1/100 sq ft	7000 AA (*Aedes aegypti*) Bti ITU/mg
VectoBac® G	3-5 lb/acre	0.4555 billion Bti ITU/acre
VectoLex® FG	5-80 lb/acre	0.115-1.84 billion Bs ITU/acre
Natular™ 2EC	5-20 lb/acre	0.125-0.5 lb spinosad/acre
Natular™ XRT	1 tablet/CB	6.25% spinosad/tablet
Evoluer™ 4-4 ULV	0.78 fl oz/acre	0.00175 lb permethrin/acre 0.00175 lb PBO/acre
Pursuit™ 4-4 ULV	0.67 fl oz/acre	0.00175 lb permethrin/acre 0.00175 lb PBO/acre

BAY COUNTY


Arenac County
Gladwin County
Midland County
Tuscola County
Saginaw County
Gibson Twp
Mt Forest Twp
Pinconning Twp
City of Pinconning
Garfield Twp
Fraser Twp
Beaver Twp
Kawkawlin Twp
Bangor Twp
Williams Twp
City of Auburn
Monitor Twp
City of Essexville
Hampton Twp
City of Bay City
Portsmouth Twp
Frankenlust Twp
Merritt Twp
Bay County
State Highways
Local Primary Roads
Townships
Cities
Saginaw Bay
County Boundaries