Bay County Mosquito Control
2015 Annual Report

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Mosquito Control Staff

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Mary J. McCarry, Biologist

Robert K. Kline, Operations Supervisor

Rebecca J. Brandt, Supervisor

Kristy L. Brandt, Supervisor

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Justin A. Krick, Chief Mechanic

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Kim J. Coonan

Thomas M. Herek

Michael J. Duranczyk

Michael E. Lutz

New Staff Member – In 2015, BCMC welcomed new adulticiding shift supervisor, Kristy Brandt. Kristy filled the position long held by Tom Van Paris who retired in February. Kristy is a 2014 graduate of Central Michigan University majoring in Biology. She was previously employed as a seasonal BCMC employee with experience in both larviciding and adulticiding. Prior to joining Mosquito Control, she was employed at The Andersons, formerly Auburn Bean & Grain, where she worked in agronomy.

Administration

Thomas L. Hickner, County Executive

Laura Ogar, Environmental Affairs & Community Development Director

2015 Mid-Michigan Mosquito Control Technical Advisory Committee

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Roger Allen, Tuscola County Board of Commissioners

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John Hebert, McLaren-Bay Region

John Hill, Michigan Department of Agriculture and Rural Development

Joseph Rivet, Bay County Drain Commissioner

Kent Singer, Tuscola County Health Department

Jerry Somalski, Bay Landscaping

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.

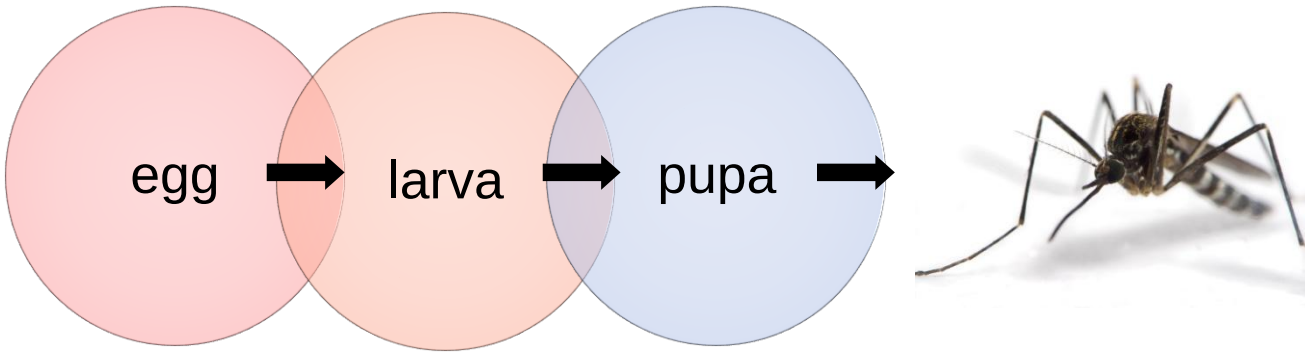
Bay County is one of four Michigan counties with formal, comprehensive mosquito control programs. A Technical Advisory Committee (TAC), composed of local and state professionals, annually reviews program operations for BCMC, Midland County Mosquito Control, Tuscola County Mosquito Abatement, and APM 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 utilizing up to three 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 mid-March with first instars observed in woodland pools on March 19th. The most notable feature of the woodlots at that time was how dry they were – approximately 50-70% drier than a typical year. An inch of rain fell, however, on April 8th, which helped to bring woodland pool levels back to "normal" and caused another hatch of spring *Aedes* larvae and an increase in larval density. From April 19-22, in the midst of the aerial treatment program, an additional 0.75" of rain fell, most falling on April 19. No treatment took place during this time due to inclement weather; therefore, resulting larvae had a chance to grow before treatment took place several days later. A small field trial in Williams Township showed that newly-hatched first instar larvae treated with *Bti* succumbed to its effects within 24 hours.

Pre-treatment larval counts were taken between one and four days before treatment in thirty-nine woodlots and post counts followed within four days of treatment. Aerial calibration took place on April 14 with treatment beginning immediately and lasting twelve days until April 25, although winds were too strong on five days (April 19-23) so no treatment occurred on those dates. Three fixed-wing aircraft were calibrated to deliver 3 pounds of *Bti* per acre. Quality control of the spring aerial campaign was accomplished with the help of three full-time staff. Staff walked through 44 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 94.6% larval mortality (Table 1), which indicates favorable control was accomplished at the 3 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 7-15.

Table 1 – Spring Treat Larval Mortality

Bay County Mosquito Control Spring Treatment 2015 3 lb/acre VectoBac *Bti* Evaluation			
	Larval Count		
Location	**Pre**	**Post**	**Mortality**
Bangor 4 - Bangor Oil Well	1.4	0	100%
Bangor 33 - Bangor and Zimmer	1.27	0.03	97.6%
Beaver 4 - 1576 Cottage Grove	6.5	0	100%
Beaver 5 - Carter and Cottage Grove	2.2	0.04	98.2%
Beaver 9 - 1585 Cottage Grove	6.68	0	100%
Frankenlust 2 - Four Mile and Delta	6.96	0.06	99.1%
Frankenlust 3 - Delta by Automotive Bldg.	7.04	0	100%
Frankenlust 7 - 259 Amelith Road	4.72	0	100%
Fraser 6 - Townline 16 by 7 Mile Rd.	2.06	0.14	93.2%
Fraser 11 - Camp Fishtales	1.34	0	100%
Fraser 11 - Deer Acres	0.63	0.025	96%
Fraser 15 - Fraser Twp. Firebarn	2.43	1.15	52.7%
Fraser 22 - Fraser Twp. Hall	0.84	0.1	88.1%
Garfield 9 - 11 Mile N. of Erickson	6.62	0	100%
Garfield 10 - Garfield Twp. Park	6.79	0	100%
Garfield 15 - Methodist Church	0.87	0	100%
Garfield 26 - Crump Fox Club	2.85	0	100%
Kawkawlin 2 - 2080 LeBourdais Rd.	4.1	0	100%
Kawkawlin 15 - Kawkawlin Township Hall	1.25	0	100%
Kawkawlin 30 - White Birch Village	2.12	0	100%
Monitor 9 - 1306 Wheeler	2.08	0	100%
Monitor 20 - Fraser and N. Union	2.63	0	100%
Monitor 23 - Rocking Horse Ranch	2.16	0	100%
Monitor 28 - Mackinaw Road Tech Park	4	1.32	67%
Monitor 34 - Fremont Cemetery	2.54	0	100%
Mt. Forest 9 - Sand Rd. Road Commission	2.04	0.26	87.3%
Mt. Forest 17 - Carter N. of Cody-Estey	3.12	0.04	98.7%
Mt. Forest 21 - Daycare	6.02	2.6	56.8%
Mt. Forest 21 - Mt. Forest Hall	3.52	0.32	90.9%
Mt. Forest 21 - Mt. Forest Firebarn	1.92	0	100%
Mt. Forest 30 - Pinconning and County Line	8.29	0.18	97.8%
Pinconning 23 - K C Hall Water Street	1.74	0.3	82.8%
Pinconning 30E - Pinconning County Park	1.28	0.1	92.2%
Williams 7 - Reder Landscaping	1.88	0	100%
Williams 16 - Carter and N. Union	3.77	0.025	99.3%
Williams 19 - Victoria Woods Trailer Park	2.44	0.1	95.9%
Williams 20 - Forest School/Daycare	5.04	0	100%
Williams 21 - Forest Edge	4.09	0.04	99%
Williams 30 - Rockwell and Salzburg	1.78	0	100%
CONTROL Pinconning 23 K C Hall Water Street	1.74	1.7	2.3%
AVERAGE TREATED MORTALITY			**94.7%**
AVERAGE TREATED MORTALITY (Corrected)			**94.6%**

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. One hundred fifty-three larval samples representing fourteen species were identified; the majorities were *Culex pipiens* and *Culex restuans* followed by *Aedes vexans*. Ten 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 that provides a bacterial food source. Basin surveillance on May 15 showed that 8% of those checked were breeding with larvae and pupae; however by May 23 the percentage infested jumped to 40%. This prompted the initial treatment (commencing May 26) using VectoLex® FG and Natular™ XRT. In order to determine efficacy and longevity of the control materials, basins were inspected every three-four weeks. We expect VectoLex to provide control for about four weeks, which it did. Natular is expected to provide season-long control and a check on August 27 showed no basins infected of thirty checked.

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 *Ae. japonicus*.

Figure 1 – Artificial Container Species, 2015

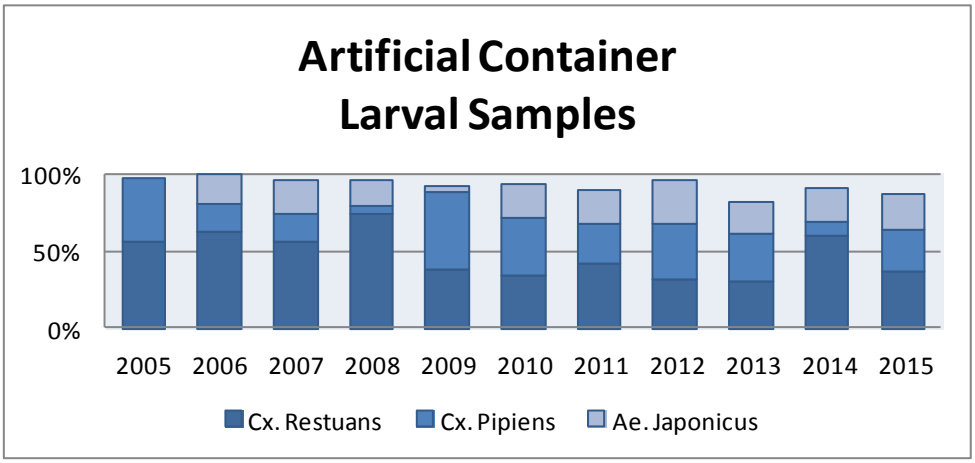
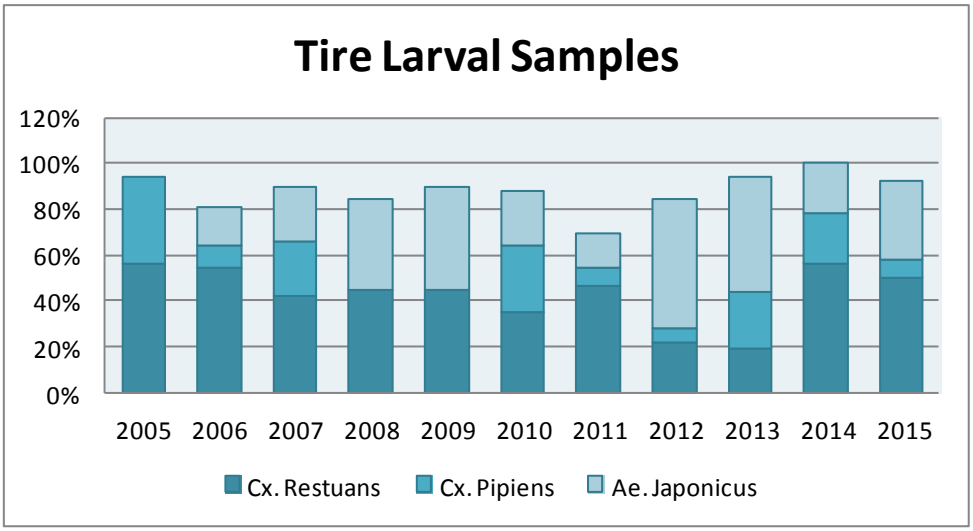


Figure 2 – Tire Species, 2015



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 22,833 (Table 2), 1.6 times greater than the number collected in 2014 and 154% of the historical average of 14,781. Heavy rains in September caused a significant floodwater mosquito hatch; unseasonably warm temperatures during September also created a major nuisance for Bay County residents.

Table 2 - New Jersey Light Trap Data, 2015

2015 LIGHT TRAP DATA						
Species	**May**	**June**	**July**	**August**	**September**	**TOTAL**
Aedes aurifer	6	2	0	0	0	8
Aedes canadensis	2	17	5	0	0	24
Aedes cinereus	3	3	3	0	18	27
Aedes implicatus	6	0	0	14	0	20
Aedes intrudens	6	27	23	3	0	59
Aedes japonicus	0	3	12	12	18	45
Aedes provocans	3	2	4	0	0	9
Aedes sticticus	0	27	25	5	1	58
Aedes stim/fitchii	62	61	25	1	0	149
Aedes triseriatus	0	2	4	3	3	12
Aedes trivittatus	0	22	72	20	38	152
Aedes vexans	41	2128	6999	2578	3397	15143
Anopheles perplexens	6	0	25	31	15	77
Anopheles punctipennis	10	51	126	160	122	469
Anopheles quadrimaculatus	7	89	798	629	169	1692
Anopheles walkeri	40	64	296	143	154	697
Culiseta inornata/morsitans	2	7	8	2	5	24
Coquillettidia perturbans	0	438	794	62	33	1327
Culex restuans	143	401	546	343	10	1443
Culex pipiens	0	52	323	338	248	961
Culex territans	2	15	77	36	84	214
Psorophora ciliata	0	0	3	0	0	3
Psorophora ferox	0	0	11	2	0	13
Uranotaenia sapphirina	0	1	56	56	41	154
Damaged	6	8	23	8	8	53
TOTAL FEMALES	**345**	**3420**	**10258**	**4446**	**4364**	**22833**
TOTAL MALES	243	2757	3889	2371	2489	11749
Historical Female Totals (33 yrs)	**387**	**4236**	**5056**	**3992**	**1109**	**14781**

Twenty-five species were collected during the 2015 season and the most predominant was *Aedes vexans*, representing 66% 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 13% of the total catch, while the *Culex* mosquitoes, *Cx. pipiens and Cx. restuans,* ranked third with 11%. Emergence of the cattail marsh mosquito, *Coquillettidia perturbans,* occurred as normal with the population measuring about 20% more than an average year. Compared to the percentage of total, however, *perturbans* comprised 5.8% this season compared to the historical average of 7.4%. Finally, we watched, with great interest, our newest mosquito species, *Aedes japonicus,* whose numbers increased with 45 captured. The average number of *japonicus* collected since 2005, which is the first year they were discovered, is 17. 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 (14,781). The number collected in 2015 fell above the average. Typically, total number of females corresponds with the amount of rainfall received and this year our heaviest rains came in mid June, late July, and early September. Figure 4 (page 11) shows mosquito species collected per trap night throughout the summer. In 2015, there were three major hatches of summer floodwater *Aedes* with peaks following major rain events by about two weeks (July 5, August 16, and September 13). *Anopheles* species showed three minor spikes in late July, mid August, and early September 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 on the west side of Bay City. The sample was collected on July 27 and confirmed positive in early August.

Figure 3 - New Jersey Light Trap Historical Data

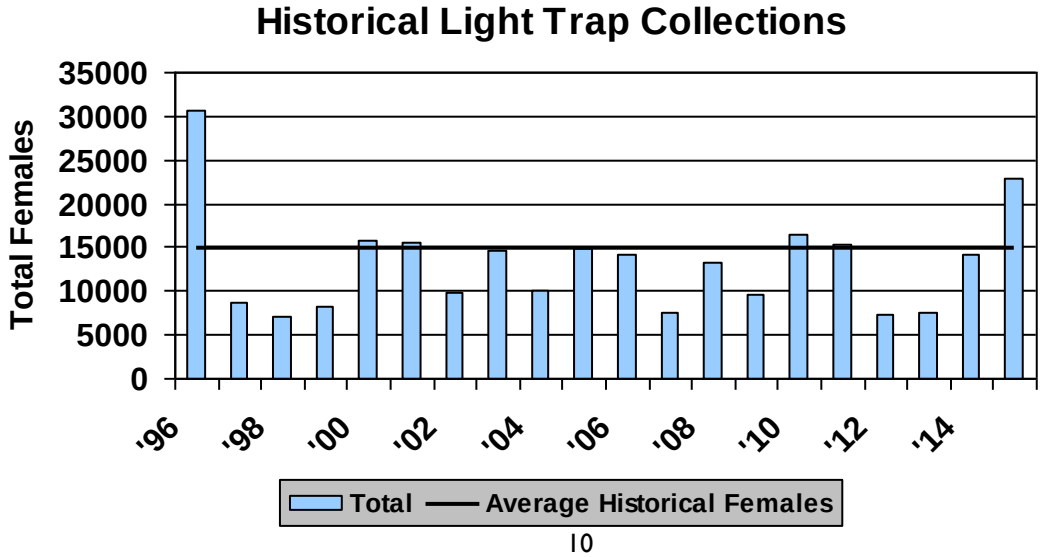
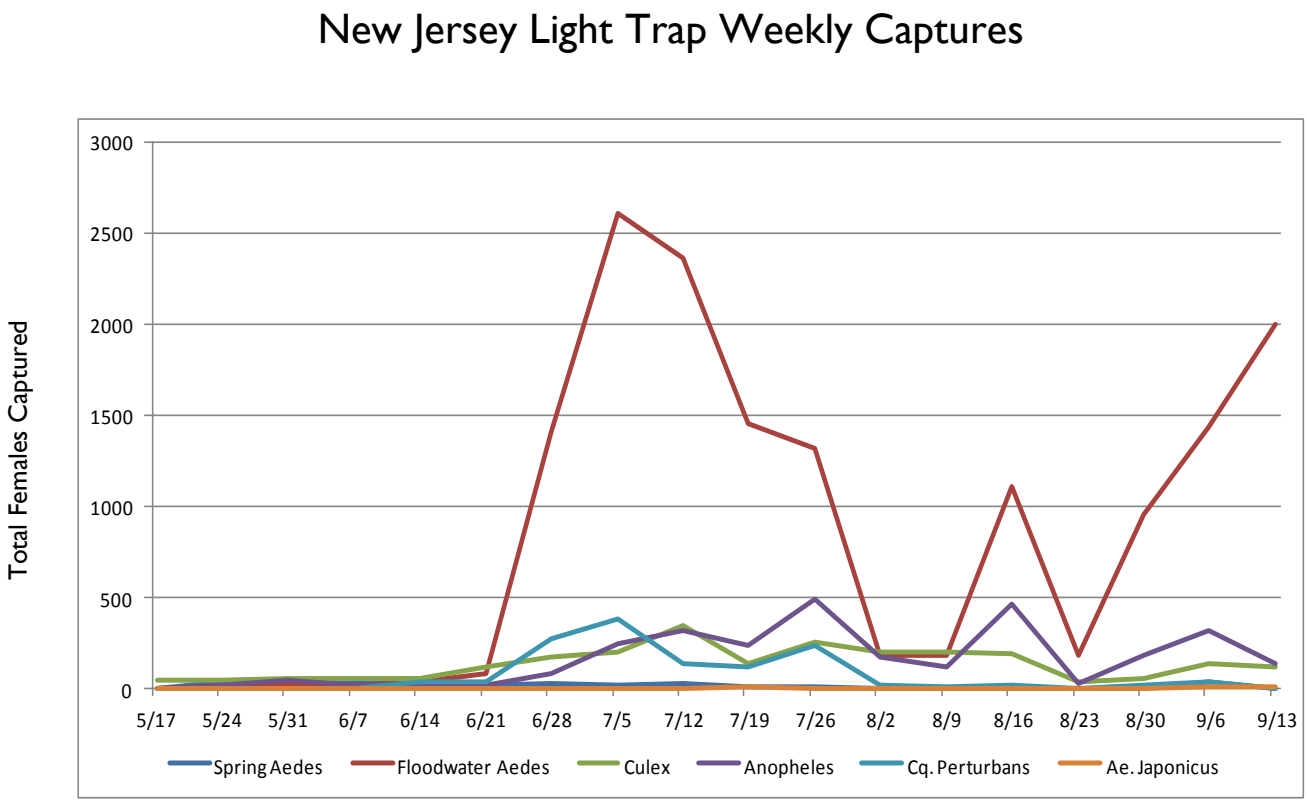


Figure 4 - New Jersey Light Trap Weekly Data, 2015



Unsorted (left) and sorted (right)
light trap collection

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 327 CDC traps this year was 61,358 (Table 3—page 13). The two main summer floodwater species, *Ae. vexans* and *Ae. trivittatus,* remained at the top ranking spot, representing 69% of the total. Spring species (10.6%) and *Coquillettidia perturbans (9.6%)* ranked second and third, respectively. Summer floodwater *Psorophora ferox* comprised 5% of the total catch with nearly three times more collected this year than last. Most were collected in September following the heavy rains that fell early that month. Most females were collected in September (23,385); however, an almost equal number of females were collected in July following mid-June rains.

Twenty-six species in seven genera were collected and identified, averaging 188 females per trap, up considerably compared to 78 in 2013, but essentially the same as the 2014 collection. 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 (July 28, August 4, 18, and 25), 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, *Culex* dominated the species captured in elevated traps; on average 70% of the species collected were *Culex*.

Piles of mosquitoes from September CDC Traps

Table 3 - CDC Trap Data, 2015

2015 CDC TRAP DATA						
Species	**May**	**June**	**July**	**August**	**September**	**TOTAL**
Aedes aurifer	0	5	1	0	0	6
Aedes canadensis	1881	755	650	0	15	3301
Aedes cinereus	28	30	6	15	5	84
Aedes dorsalis	0	0	1	0	0	1
Aedes implicatus	17	4	4	0	0	25
Aedes intrudens	41	96	40	4	24	205
Aedes japonicus	0	0	0	0	0	0
Aedes provocans	43	13	3	0	0	59
Aedes sticticus	4	84	1348	22	80	1538
Aedes stim/fitchii	282	989	78	10	0	1359
Aedes triseriatus	0	0	33	10	22	65
Aedes trivittatus	1	1337	5014	500	5365	12217
Aedes vexans	62	3114	8982	3312	14440	29910
Anopheles perplexens	7	27	23	26	9	92
Anopheles punctipennis	7	43	160	68	17	295
Anopheles quadrimaculatus	4	44	225	160	39	472
Anopheles walkeri	1	112	208	247	108	676
Culiseta inornata	0	1	0	2	0	3
Culiseta morsitans	0	1	0	0	0	1
Coquillettidia perturbans	1	1693	3755	389	59	5897
Culex restuans	101	173	506	353	89	1222
Culex pipiens	0	0	210	206	318	734
Culex tarsalis	0	0	0	0	1	1
Culex territans	0	1	7	0	0	8
Psorophora ciliata	0	1	0	0	1	2
Psorophora ferox	0	15	270	33	2780	3098
Uranotaenia sapphirina	0	0	0	1	0	1
Damaged	5	34	25	9	13	86
Total	**2485**	**8572**	**21549**	**5367**	**23385**	**61358**

SPECIES FOCUS – PSOROPHORA FEROX

Psorophora ferox is a multiple generation summer floodwater species that appears throughout the summer season. This season, 13 adult individuals were collected from New Jersey Light Traps with an additional 3,098 collected in CDC Traps, more than any other year. The larvae of this species occur in temporary rain-filled pools after summer rains. The females are persistent and painful biters, even attacking in the open on cloudy days.

A description of this species that helps with identification includes three notable features - adults have a purple hue on both the abdomen and legs, the last two segments of the hind legs are white-scaled (they appear to be wearing white socks), and the hind legs have erect scales, making them appear rather shaggy.

Female (above) – note white scales on hind legs
Male (below) – note purplish coloration

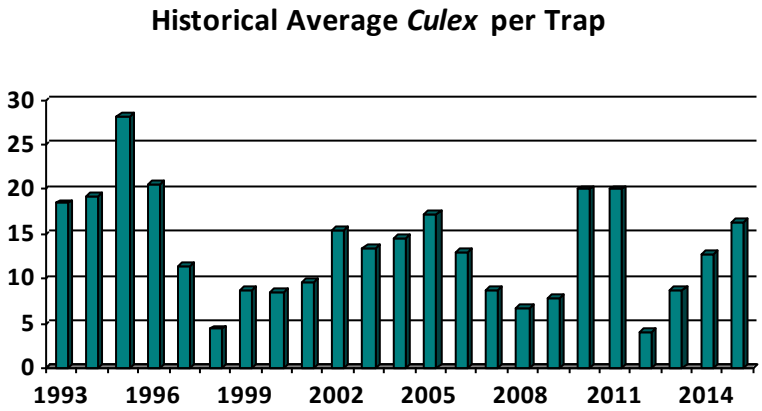
GRAVID TRAPS

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 127 traps capturing 2,290 mosquitoes (2,084 *Culex* species, 27 *Ae. vexans*, 22 *Ae. japonicus*, 13 *Ae. triseriatus*, 8 *Ae. trivittatus*, 7 *An. perplexens,* 4 *An. punctipennis*, 2 *An. quadrimaculatus,* 1 *Cq. perturbans, and* 122 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 2015 increased from the 2014 numbers, with an average of 16.4 female *Culex* mosquitoes per trap.

There was one West Nile Virus-positive pool of 15 *Culex* mosquitoes collected from a Gravid Trap placed in Bangor Township. The sample was collected on August 4 and confirmed positive in mid August.

Figure 5 – Historical Average *Culex* species per Gravid Trap, 2015



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 disease transmission. 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 several of these disease agents. West Nile virus 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. Four hundred thirty (430) pools containing 11,211 females representing a variety of species were tested with the following results:

- *Coquillettidia perturbans* (195 pools/5,889 females/no positives)
- *Culex restuans/pipiens* (234 pools/5,318 females/**2 WNV-positives**)
- *Aedes japonicus* (1 pool/4 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 pools were collected from a New Jersey Light Trap placed on Columbian Road on the West Side of Bay City (7/27/15; 17 *Culex* mosquitoes) and from a Gravid Trap placed at the Water Treatment Plant on Patterson Road in Bangor Township (8/4/15; 15 *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 more elevated 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 2015 was 0.04; for *Coquillettidia perturbans* the MIR was 0. The MIR for *Culex* in 2014 was 0.25.

BCMC was notified by the Michigan Department of Health and Human Services in late October that a **wild turkey** collected from Pinconning Township on October 20, tested **WNV-positive** at the MDNR Wildlife Disease Laboratory.

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 47 phone calls reporting dead birds throughout the community, which increased from last year's 21 calls. In 2015, 58 dead birds were reported, most of which were American Crows (23), Blue Jays (8), and blackbirds (Common Grackles/European Starlings) (8). Other species reported were House Sparrows (7), Robins (6), House Wrens (2), Finches (2), Woodpecker (1), and Cedar Waxwing (1).

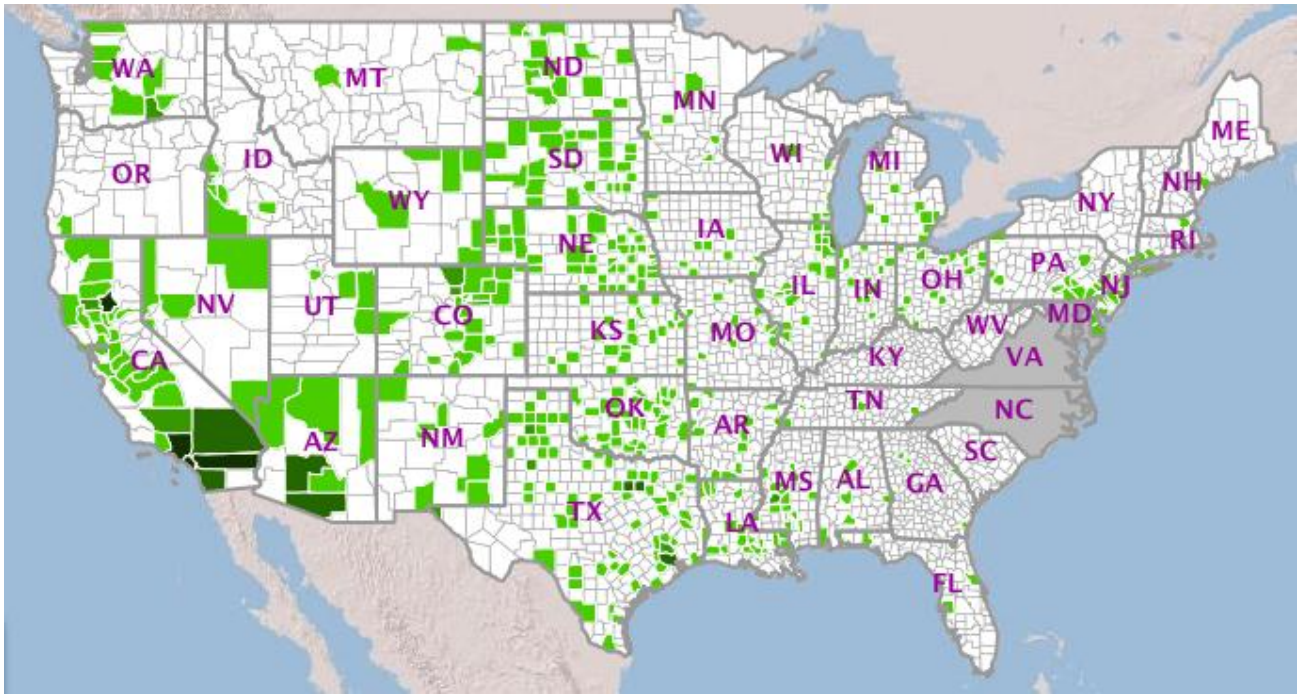
All dead bird sightings were logged onto Michigan's Emerging Diseases website www.michigan.gov/emergingdiseases. After initial screening by staff, a total of 14 crows or jays were tested (using the WNV Vector Test™ kit) to determine infection rates; **7 tested positive**. Compared to 2014, disease activity increased slightly for Bay County.

Statewide, there were 18 human cases compared to only two last year (Table 4, as of November 24, 2015). Human cases were clustered around Detroit-metro and Grand Rapids-metro areas, but this year two cases occurred in more rural areas – Wexford and Isabella Counties. As of November 17, 2015, a total of 48 states and the District of Columbia have reported West Nile virus infections in people, birds, or mosquitoes in 2015. Overall, 1,812 human WNV cases with 98 deaths have been reported to CDC, which is 18% fewer cases than were reported in 2014. About 60% of the cases were reported from five states (California-570, Texas-241, Colorado-90, Arizona-85, and Oklahoma-82) (Figure 6).

Table 4 – Michigan's WNV Human Cases

Year	Total Cases	Fatalities	Year	Total Cases	Fatalities
2015	18	2	2008	17	0
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

Figure 6 – WNV Human Disease Cases, as of November 17, 2015



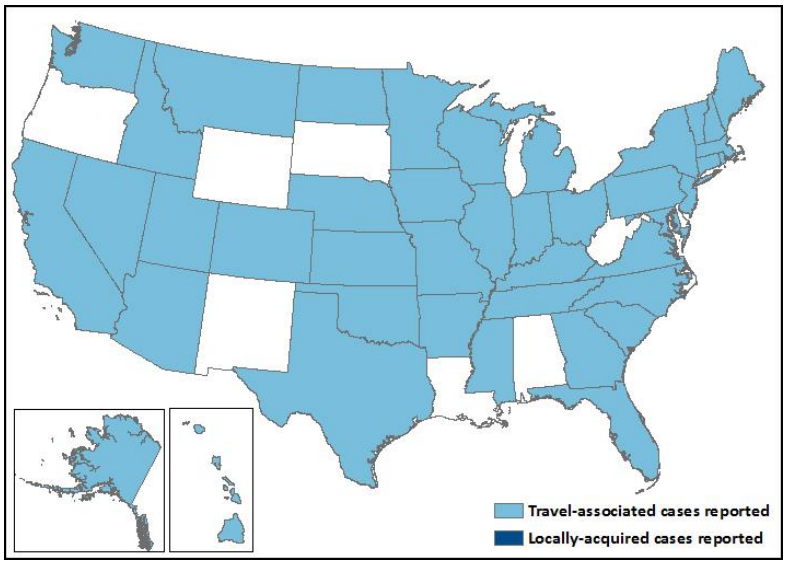
CHIKUNGUNYA VIRUS

According to the Centers for Disease Control and Prevention, Chikungunya virus (CHIKV) is a pathogen transmitted by mosquitoes, and has established itself in the Caribbean (approximately 350,000 suspected cases in the Western Hemisphere since December 2013). There were 567 cases of imported Chikungunya reported in the U.S. in 2015, with five reported from Michigan. Florida is the only state that has reported locally-transmitted Chikungunya virus. The occurrence of locally-transmitted cases causes public health officials fear as to its spread and establishment in states bordering the Caribbean. The name "Chikungunya" is attributed to the Kimakonde (a Mozambique dialect) word meaning "that which bends up", which describes the primary symptom – excruciating joint pain. Although rarely fatal, the symptoms are debilitating and may persist for several weeks. There is no vaccine and primary treatment is limited to pain medication.

The mosquito species that transmit this disease are the Asian Tiger Mosquito (*Aedes albopictus*) and the Yellow Fever Mosquito (*Aedes aegypti*). Genetically, it appears that viral strain currently spreading throughout the Americas is more easily transmitted by *Ae. aegypti*. Both species lay their eggs in containers such as cans, discarded tires and other items that hold water close to human habitation, but *Ae. aegypti* is more geographically confined to the southeastern United States. Traditional mosquito methods of truck-mounted and aerial sprays are ineffective in controlling these mosquitoes. Removal of water-bearing containers and sanitation are key preventive strategies.

Figure 7 - States reporting Chikungunya virus disease cases – United States, 2015 *(as of November 17, 2015)*

2015 Chikungunya Disease Cases in the United States



WEATHER

The relationship between weather and mosquito activity is especially important in an IPM approach to mosquito control. Monitoring both rainfall and temperature are paramount in estimating mosquito larval and adult activity. Flooding rain creates ideal breeding conditions for mosquitoes, but what also matters is how long the water remains on the ground after a storm. Average rainfall for Bay County from May 1 through September 30, 2015 was 18.55 inches-2.5 inches above the average of 16.08 (Figure 8).

With the exception of December whose average mean temperature measured 4.8˚above normal, the remaining winter months were colder than average. This was especially true for February, whose average mean temperature ran 13 degrees below normal, coming in at 11.5˚ F. For the Great Lakes Bay Region, February 2015 ranked as the coldest February since record-keeping began in 1912. Mean temperatures during the remainder of the season averaged above normal. May and September deviated from the historic averages coming in at 5.3˚ and 6.9˚above normal, respectively.

Figure 9 (page 20) 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 seven such rain events that occurred, although some were affiliated with the same hatch due to how closely they occurred. The most significant rain events occurred in mid-June and again in early-September. The June 12-15 rainfall dropped 4.5" of rain while September rains averaged 3.3" (ranging from 1.9-4.6"), with the heaviest rains occurring in Pinconning and Portsmouth Townships. In both cases, mosquito counts and complaint calls followed two weeks later.

Table 5 (page 20) lists weather data occurring in Bay County from Nov, 2014-Oct, 2015 and the monthly departures from normal for temperature and rainfall.

Figure 8 – Bay County Total Rainfall May 1 – September 30 (Observed vs. Historical), 2015

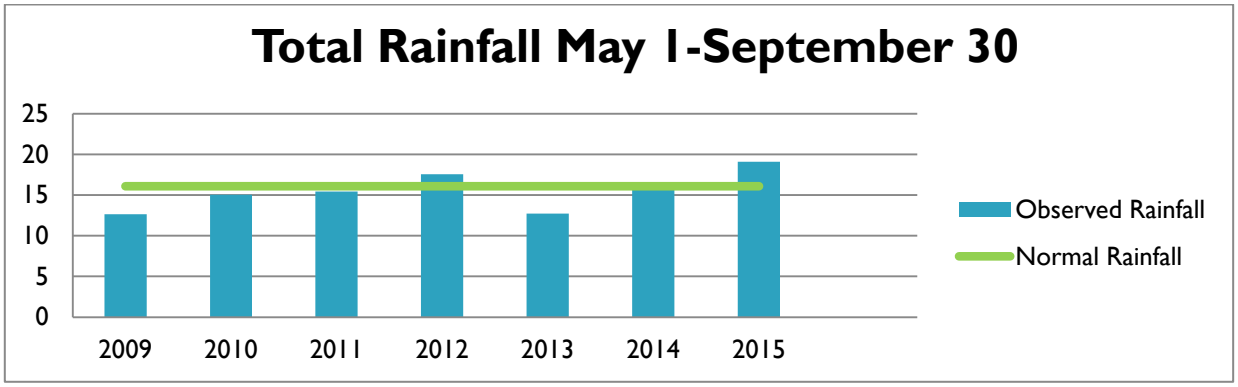


Figure 9 – Average Weekly Rainfall, 2015

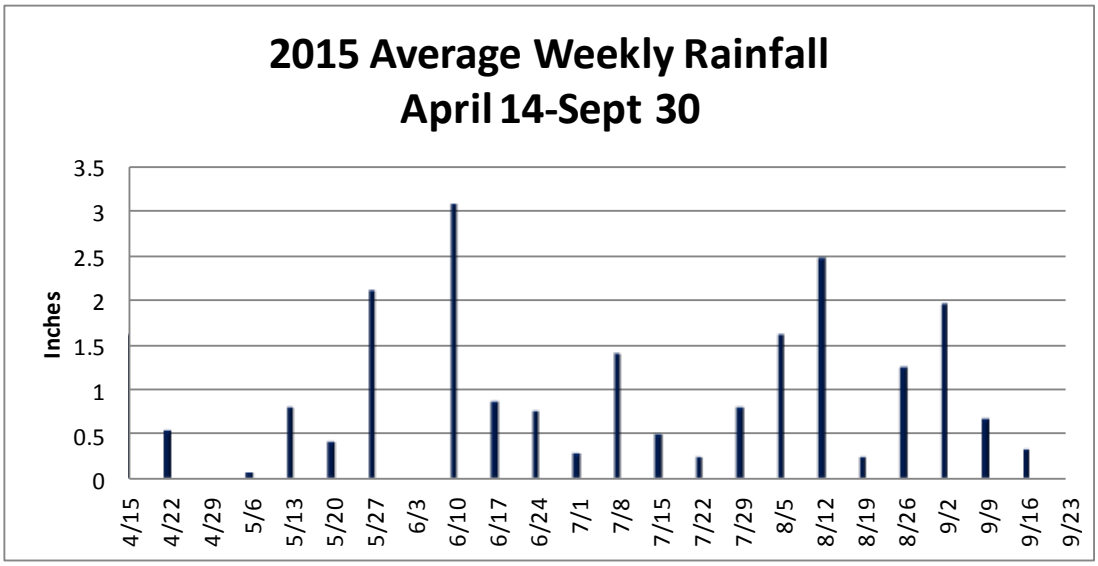


Table 5 – Rainfall and Temperature Data, 2015

Month	Normal Rainfall	2014/15 Rainfall	Departure from Normal	Normal Avg Mean Temp.	2014/15 Avg Mean Temp	Departure from Normal
November	2.7"	2.18"	-0.52"	38.5°	34.6°	-3.9°
December	1.86"	1.47"	-0.39"	27.3°	32.1°	+4.8°
January	1.71"	1.02"	-0.69"	22.2°	20.8°	-1.4°
February	1.61"	1.09"	-0.52"	24.5°	11.5°	-13.0°
March	2.06"	0.8"	-1.26"	33.7°	32.3°	-1.4°
April	2.89"	2.04"	-0.85"	46.1°	46.4°	+0.3°
May	3.38"	3.36"	-0.02"	57.3°	62.6°	+5.3°
June	2.98"	4.68"	+1.7"	67.2°	68.0°	+0.8°
July	2.58"	2.28"	-0.3"	71°	72.8°	+1.8°
August	3.31"	5.5"	+2.19"	68.8°	70.2°	+1.4°
September	3.83"	2.73"	-1.1"	61.3°	68.2°	+6.9°
October	2.63"	2.62"	-0.01"	49.7°	52.9°	+3.2°

SPRING AERIAL LARVICIDING

Aerial larviciding of seasonally flooded woodlots signals the beginning of our mosquito control season and approximately 43,000 acres are treated throughout Bay County. Historically, treatment begins in mid-April, but the actual date is dictated by larval development and weather. Mean temperatures for March and April were average, but precipitation ran 60% and 30% below normal, respectively.

The spring aerial campaign began on April 14 and lasted twelve days until April 25; however, weather conditions on five days during that period were not conducive to treatment. The operation targets 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 up to three aircraft to apply *Bti* to 43,364 woodland acres in the following townships: Bangor (4,357), Beaver (4,819.8), Frankenlust (1,003.3), Fraser (5,035.9), Garfield (6,217.2), Gibson (1,757.2), Hampton (1,476.4), Kawkawlin (2,080), Merritt (426), Monitor (2,203), Mt. Forest (4,433), Pinconning (5,320.6), Portsmouth (685.9), and Williams (3,548.7).

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 second 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.

Pilot Jake Baker during spring aerial treatment

SPRING GROUND TREATMENT

Three full-time staff helped with aerial quality control, conducting post-treatment surveys in 44 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. Ground crews concentrate on sensitive woodlots such as those near eagles' nests, no spray zones, and towers. In the past few years, heavily vegetated woodlots previously treated by ground crews have been re-assigned to the aerial applicators, which increases efficiency.

Table 6 lists the number of acres treated by foot crews and material used in smaller tracts of woodlots during the 2015 spring season. Just over 148 acres received larval treatment by ground crews to control the emergence of pestiferous spring *Aedes* mosquitoes. The crews checked 203 sites, dipping each one, to determine the need for treatment. A total of 121 sites were treated; untreated sites were either dry or wet with no larval activity. A total of 4.72 pounds of *Bti*, 3 *Bti* Briquets, and 147.56 gallons of BVA2 larvicide oil were dispensed at a dosage rate of five pounds/acre, one briqet/100 square feet, and one gallon/acre, respectively.

Pupae were first noted on April 27, but were found en masse on May 1. Significant emergence of spring *Aedes* adults occurred May 7-15. Adult emergence initiated adulticiding, control of adult mosquitoes through fogging operations.

Table 6 – Spring Ground Treatment, 2015

Township	Acres Treated	BVA2 (gallons)	*Bti* (pounds)	Bti Briquets (number)
Bangor	7.64	7.64		
Bay City East	5.91	5.91		
Bay City West	4.09	4.09		
Frankenlust	4.24	4.24		
Fraser	8.28	8.28		
Garfield	15.48	15.48		3
Gibson	9.48	9.48		
Hampton	16.87	16.87		
Kawkawlin	1.79	1.79		
Merritt	1.24	1.24		
Monitor	3.65	3.65		
Mt. Forest	54.9	54	4.72	
Pinconning	10.24	10.24		
Portsmouth	3.55	3.55		
Williams	1.1	1.1		
TOTAL	**148.46**	**147.56**	**4.72**	**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 and/or dumping water from man-made containers (i.e., buckets, pails) that act as breeding habitats. During the breeding season, a team of 16 technicians inspect 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 (source reduction component – to eliminate the breeding source) 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 11,203 larval site inspections were conducted this season; only 18% (2,017) 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 (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 that 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 5,813 miles treated, which was 6% greater than the historical average (Figure 10). Control materials dispensed included 1,786.5 gallons of Abate 4E mix (7 gallons of Abate 4E concentrate), 179 gallons of BVA2, and 1,130.5 gallons of Natular 2EC mix (7.4 gallons of Natular 2EC concentrate). Figure 11 depicts product usage for each township. Most of the treatment occurred in Monitor, Williams, and Pinconning Townships with 987, 875, and 709 miles treated, respectively. As a combined total for these three townships, 2,571 miles were treated or 44% of the total.

Figure 10 – Historical Ditch Truck Miles

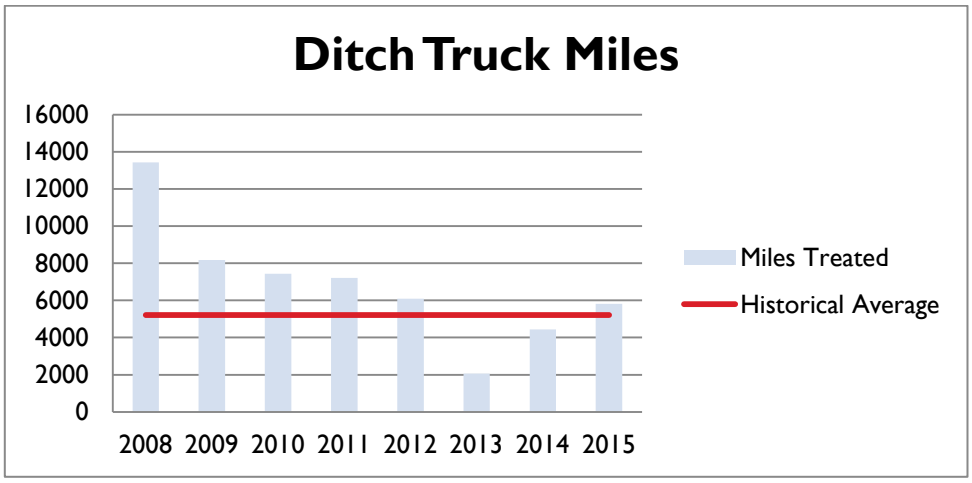
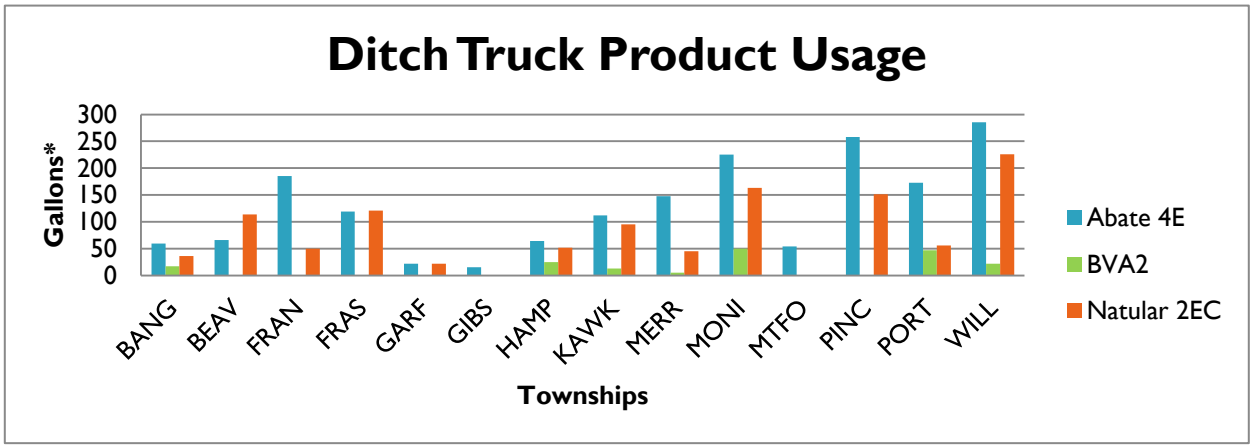


Figure 11 – Ditch Truck Product Usage, 2015



*Unit of measure is gallons for BVA2 and gallons of final mix for Abate 4E and Natular 2EC.

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 32,415 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 and Bangor, Hampton, and Monitor 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 (2,567 individual tablets) or VectoLex® FG bacterial larvicide (760.12 pounds). Basins primarily in BCE, BCW, and Essexville, were all treated three times with VectoLex, with the first treatment commencing in late May. Figure 13 shows catch basin treatment data for each township.

Figure 12 – Catch Basin Treatment Data, 2015

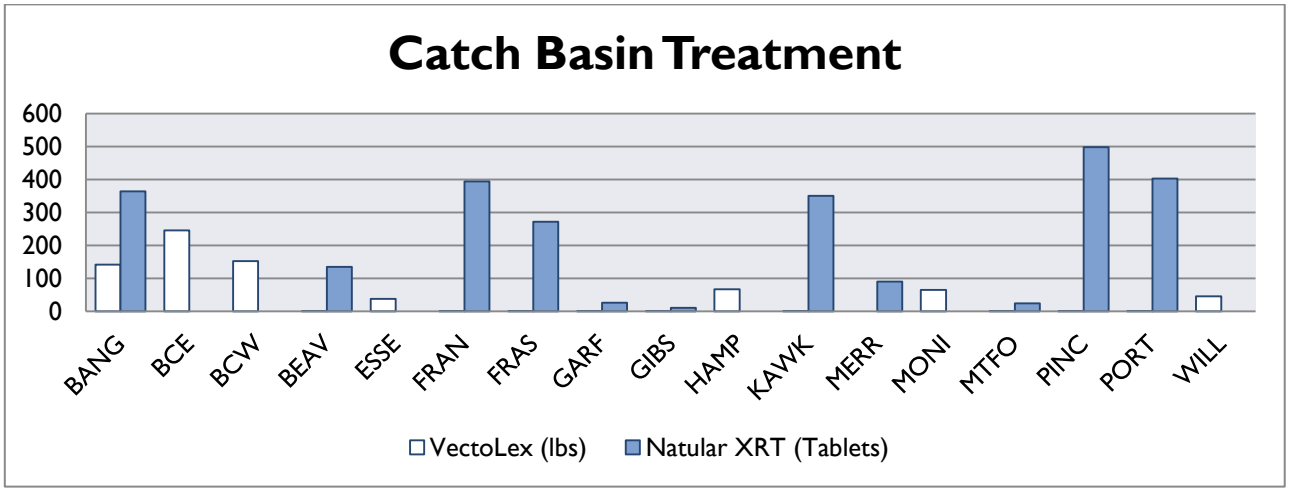
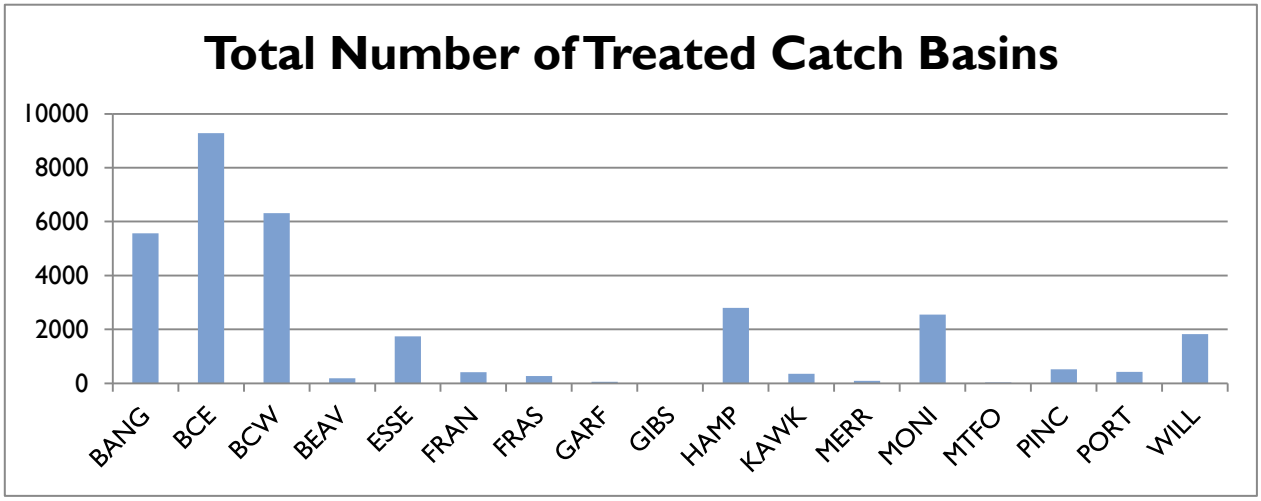


Figure 13-Total Catch Basins Treated Per Township



Retention & Detention Ponds: Bay County is home to approximately 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 369 individual visits throughout the summer, 78% of which did not result in treatment. This is a trend often seen in "search and destroy" operations.

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 shelter 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 21 times this season—White Birch Village Mobile Home Park and Pinconning McDonalds— resulting in 17 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.

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 to reduce mosquito breeding.

Man-Made Habitats

- Artificial Containers
- Idle Pools
- Rain Barrels
- Catch Basins
- Ornamental Ponds
- Ponds
- Retention/Detention Ponds
- Sewage Lagoons
- 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.

Table 7 – Larvicides Dispensed During Search and Destroy Operations, 2015

2015 Larvicide Usage								
Twp.	*Bti*	VectoLex	Briquets	AB4E	1% AB	Nat XRT	Agnique	BVA2
BANG	289.48	2.6	67.5	11.38	73.18	5	35.80	80.68
BCE	15.57	0	20	2.04	33.66	0	14.46	24.51
BCW	17.63	0	11	5.58	57.74	0	58.87	45.72
BEAV	12.13	0	24	0.10	2.55	0	15.35	0.37
ESSE	6.41	0	6	0.26	5.76	0	0	2.54
FRAN	41.97	0	5	0.75	113.86	0	25.87	25.10
FRAS	1.86	2.48	84.75	2.17	9.68	0	8.44	21.84
GARF	14.29	0	30.5	0.26	0	0	3.60	27.94
GIBS	0.12	0	17	8.28	1.12	0	0.09	20.22
HAMP	52.25	0	22	0.91	93.35	0	34.38	73.25
KAWK	46.29	0.06	30	26.64	4.00	0	21.17	5.82
MERR	51.25	0.10	24	7.86	8.50	8	0.71	14.47
MONI	314.64	0.64	180	0.82	157.12	46	50.04	78.66
MTFO	8.26	0	18	0.74	5.63	0	0.18	85.09
PINC	46.87	0	75	17.80	21.44	0	1.91	39.85
PORT	39.30	0	23	0.50	57.91	0	2.04	47.41
WILL	229.39	0.61	81	3.08	103.86	0	8.64	52.98
TOTALS	**1187.71**	**6.49**	**718.75**	**89.17**	**749.36**	**59**	**281.55**	**646.45**

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 a part of the control program. 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 5 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 Pursuit™ 4-4 ULV and Masterline® Kontrol 4-4. 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 without skips or re-treatment during a nightly operation. The maps also highlight addresses of medical and no spray residences. Medical residences, of which there are 68 (a 6% decrease from 2014), 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 were 96 in 2015.

During the 2015 season, the "Long Driveway Program" continued. This program is designed to treat inhabited properties that sit a considerable distance off the main road and do not receive adequate adult mosquito control during normal fogging operations. One hundred fifteen such addresses were placed on route maps to be fogged during routine sweeps, an increase of 17% from 2014.

Table 8 reveals that 19,471 miles were logged during adulticiding operations and 4,091.36 gallons of control materials were dispensed, with the majority being Masterline® Kontrol 4-4 (2,595.56 gallons). Compared to 2014, this is 925 more gallons of control materials and 37% more miles treated. In mid-September, the flow rate of adulticide material was increased from 6.1 to 12.3 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 8 – Adulticiding Treatment, 2015

Adulticiding Treatment Totals			
Township	**Kontrol 4-4 (gallons)**	**Pursuit™ 4-4 ULV (gallons)**	**Miles Treated**
Bangor	308.90	155.12	2194.36
Bay City East	104.59	39.09	662.88
Bay City West	64.73	34.76	461.71
Beaver	127.18	97.24	1237.05
Essexville	15.48	8.65	127.53
Frankenlust	133.04	62.58	1001.91
Fraser	158.05	95.3	1236.13
Garfield	89.6	80.95	890.06
Gibson	62.59	69.50	688.55
Hampton	191.51	113.79	1406.04
Kawkawlin	145.96	99.11	1208.15
Merritt	135.77	68.81	986.58
Monitor	403.28	161	2443.71
Mt. Forest	69.83	79.56	739.81
Pinconning	175.17	107.09	1282.25
Portsmouth	106.46	72.86	841.23
Williams	303.42	150.39	2062.91
Total	**2595.56**	**1495.8**	**19470.86**

SERVICE 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 4,513 adult mosquito service requests received from Bay County citizens. Most of the calls (3,590) were regular service requests for adulticide treatment due to nuisance mosquitoes with the remainder (923) logged as event requests. Regular service calls peaked in July with 1,418 received, followed by 1,005 calls logged in September, with most of those calls coming in between September 18-24. On September 21 alone, 176 phone calls were received. In comparison to 2014, the level of adulticide service requests increased by 38%. Figure 14 represents a historical profile of adulticide requests.

Office staff also logged 883 calls reporting standing water with potential mosquito breeding. Most of those were received in June and July with 258 and 223 calls received, respectively. Regardless of the type of service request, all were responded to in a professional, courteous, and prompt fashion. Figure 15 shows historical larvicide service requests.

Figure 14 – Historical Number of Adulticiding Requests from Bay County Citizens

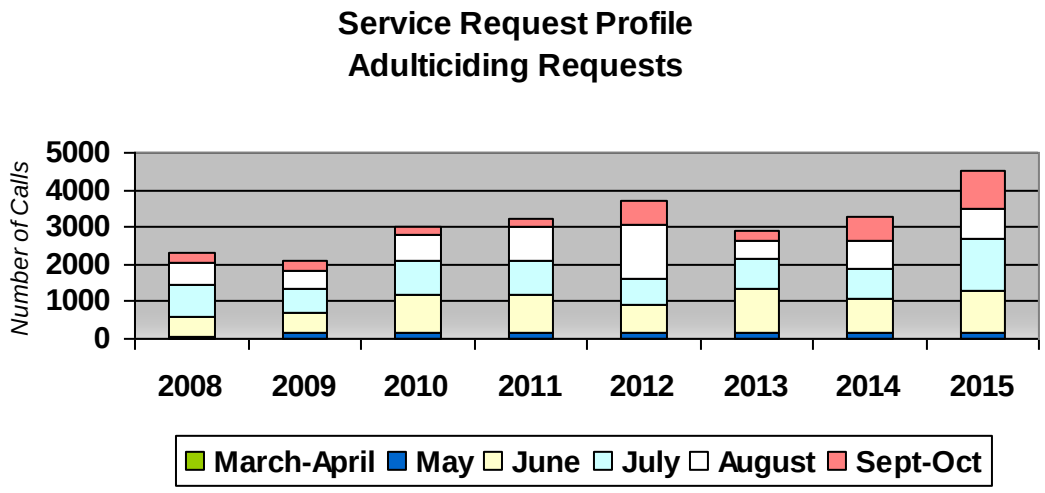
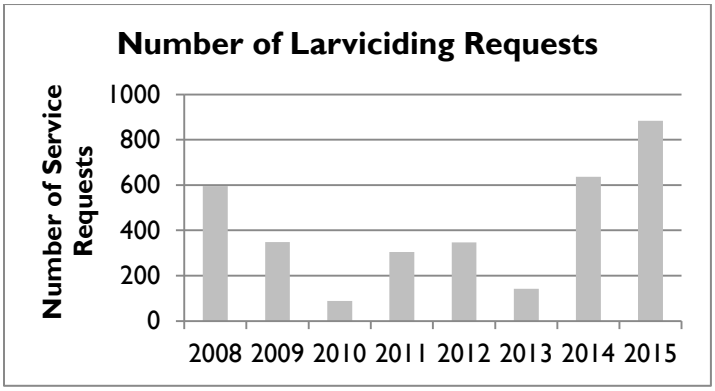


Figure 15 – Historical Larviciding Requests from Bay County Citizens



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 2015 season, as Figure 16 shows, 150,195 miles were driven, which is much below the 24-year average of 185,188 miles and represents 21% more miles driven than in 2014. Vehicle and equipment maintenance included the following:

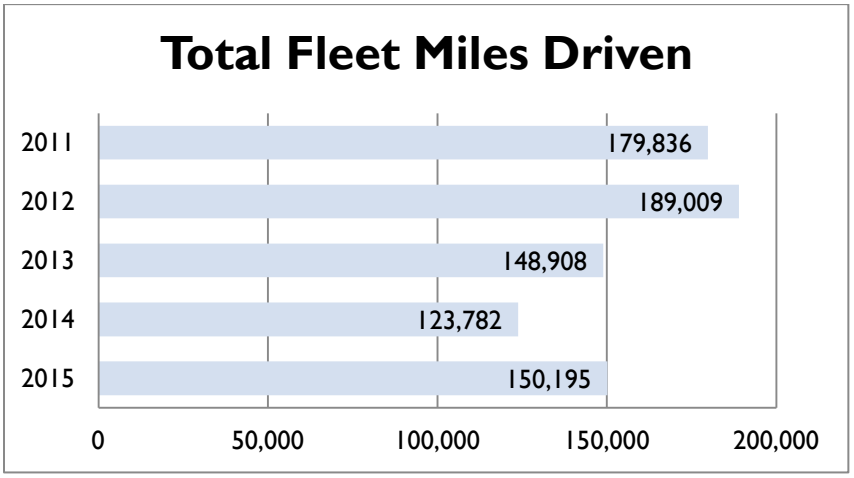
Vehicle Repairs

- Brake systems - 22
- Fuel systems - 5
- Front end repairs - 40
- Truck oil changes - 56
- Electrical systems - 67
- Drive lines - 7
- New tires - 16
- Used tire repair - 10

Equipment Repairs

- ULV oil changes - 22
- ULV repairs - 30
- Ditch trucks - 27
- Hudson® sprayers - 42
- Spreaders - 7
- CDC Traps - 7
- New Jersey Light Traps - 1
- Gravid Traps - 0

Figure 16 – Historical Vehicle Mileage



FLEET TRACKING

Velocity Systems, LLC of Big Rapids, MI met with BCMC and Bay County Information Systems Department staff to discuss implementing a fleet tracking system in 2015. Velocity set up a sample unit in September and visited on several occasions to test the unit's performance. In the off-season, BCMC's mechanic is installing 10 MqTrack™ systems in nine ULV trucks and one ditch truck with the intention of running the units beginning in the 2016 season. The MqTrack™ system provides guidance throughout the application process handles automatic no-spray control, monitors and maps application positioning, collects detailed rate and volume measurements, and produces informative, statistical reports of coverage areas. The system uses an on-board computer and GPS to track position and rate information as application operations are performed. Reports are presented in detail over aerial maps and live tracking is provided for up-to-the-minute location of vehicles and progress monitoring.

Phase 2 (2016 and beyond) involves purchasing 10 more GPS units for larviciding vehicles as well as tablets and software installed in all trucks. The tablets will be used by staff to load work orders, locate treatment sites, and enter treatment data.

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 30 at the BCMC field station and staff recycled 1,356 tires; an additional 557 tires were recycled during the second late-summer tire drive on August 15. Therefore, a total of 1,913 tires were recycled, only a 1% reduction from 2014.

In 2015, BCMC applied for and received a Scrap Tire Cleanup Grant for $4,500 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).

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. This year we visited three Bay County elementary schools - Auburn, Kolb, and MacGregor. Brochures and handouts are developed and distributed at various locations and our website is updated regularly.

MEMBERSHIP/CERTIFICATION/MEETINGS

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. In addition to two training sessions that were held May 8 and 29 with new and returning technicians in attendance, four staff meetings were scheduled during the summer for the entire BCMC staff. Full-time staff members were also present for MMCA's 29th annual meeting at Shanty Creek on February 4-5, 2015 and the MMCA 2015 Mosquito Control Training Session October 19, 2015 in Bay City, both of which offered continuing education credits. Staff listened to several webinars offered by the AMCA and ESA this season: Evaluation of Mosquito Repellents on Skin and Clothing (January 22, 2015) and How to Conduct a Great Scientific Presentation (October 14, 2015).

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 was held March 4, 2015 where the 2014 annual report and 2015 program plan were presented for review and approval.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

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 2015 included the chemical storage, cold storage, wash bay, garage, and parking lot. Four indoor and three outdoor catch basins were also 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. This year was the third year BCMC was mandated to file a NPDES Annual Report, which was completed and submitted on November 25, 2015 via the newly created MIWaters website.

Table 9 – Control Material List, 2015

Control Materials		
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	0.047 lb temephos/acre
Agnique® MMF	0.2-1 gal/acre	0.2-1 gal alcohol-based surface film/acre
BVA2 Mosquito Larvicide Oil	1-3 gal/acre	0.987-2.96 gal petroleum distillates/acre
Bactimos Bti Briquets™	1briquet/100 sq ft	7000 *Aedes aegypti (AA*) Bti ITU/mg
VectoBac® G	3-5 lb/acre	0.273-4555 billion Bti ITU/acre
VectoLex® FG	5-80 lb/acre	0.115-1.84 billion Bs ITU/acre
Natular™ 2EC	1.1-2.8 fl oz/acre	0.018-0.045 lb spinosad/acre
Natular™ XRT	1 tablet/CB	6.25% spinosad/tablet
Masterline® Kontrol 4-4	0.67 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
Saginaw County
Tuscola County
Gibson Twp
Mt Forest Twp
Pinconning Twp
City of Pinconning
Garfield Twp
Fraser Twp
Beaver Twp
Kawkawlin Twp
Bangor Twp
City of Essexville
Hampton Twp
Williams Twp
City of Auburn
Monitor Twp
City of Bay City
Portsmouth Twp
Frankenlust Twp
Merritt Twp
Bay County
State Highways
Local Primary Roads
Townships
Cities
Saginaw Bay
County Boundaries