Vector-Borne Disease Report

West Nile Virus, Lyme Disease and Eastern Equine Encephalitis Surveillance and Control Activities for 2011

December 2011

BUREAU DE SANTÉ DE MIDDLESEX-LONDON HEALTH UNIT

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Executive Summary

This season the Middlesex-London Health Unit's (MLHU) Vector-Borne Disease Program (also referred to herein as the VBD Program and/or the VBD Team), focused on facilitating comprehensive services to monitor local mosquito populations for West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE). In addition, the MLHU also focused efforts on Lyme disease (LD) education, tick intake, identification and testing in the MLHU's Strathroy laboratory.

West Nile Virus is an arbovirus from the family *Flaviviridae*, and is transmitted to humans through the bite of an infected mosquito. The transmission cycle begins when mosquitoes bite an infected bird and then transmit WNV through a bird-mosquito-bird cycle, with mosquitoes playing the role of "primary vector" for the virus. Infected humans can develop symptoms anywhere from three to 15 days after being bitten; however, most people (80%) do not acquire enough of the virus in their bloodstream to make them ill. Twenty percent (20%) of those bitten will develop mild symptoms known as West Nile Fever. Less than 1% of people will develop a severe form of West Nile Encephalitis, a serious neurological condition causing acute inflammation of the brain which may cause tremors, disorientation, loss of consciousness, muscle weakness and/or paralysis. Approximately three percent (3%) to 15% of people with these severe encephalitic symptoms will die from the infection. This season saw an increase in WNV activity within Middlesex-London and also throughout the province, as an increased number of WNV-positive mosquito pools and human cases were observed throughout the course of 2011.

Lyme disease—caused by the *Borrelia burgdorferi* bacteria—is the most common tick-borne illness in North America, transmitted to humans through the bite of an infected *Ixodes scapularis*, commonly known as the blacklegged or deer tick. Middlesex-London is not an endemic region for this tick species; however, since blacklegged ticks often feed on migratory birds, they can easily be transported throughout the province. For the second straight season, the MLHU observed an increase in tick submissions from the public and performed tick dragging based on the geographic distribution of submitted tick specimens, to determine the prevalence of LD-carrying ticks in Middlesex-London. In total, 73 ticks were submitted to the MLHU this season. Two ticks were identified as blacklegged, one acquired locally and one acquired from an endemic region within the province. Both ticks were identified as negative for *Borrelia burgdorferi* following submission to the National Microbiology Laboratory in Winnipeg. This season there were two confirmed human cases of Lyme disease reported in Middlesex-London. These cases were acquired from travel to Turkey Point and Rondeau Provincial Park, both endemic regions for black-legged ticks.

Eastern Equine Encephalitis is an arbovirus in the *Alphavirus* genus, from the family *Togaviridae* and is transmitted through the bite of an infected mosquito. The virus circulates through a bird-mosquito-bird transmission cycle, with different mosquito species playing the role of "primary vector" within avian, animal and human populations. Although the incidence of EEE in Canada has historically been low, the 2009 and 2010 seasons marked a significant spike in EEE activity, when more than one province reported EEE for the first time. In 2011, there were no EEE-positive mosquito pools in Ontario, however there were two confirmed equine cases (Chapter 3). The presence of EEE vector species in Middlesex-London indicates that continued monitoring of adult mosquitoes is necessary to reduce the risk of EEE to local populations. Since many mosquito vectors that have the potential to carry and transmit WNV also have the potential to transmit EEE, the VBD control program must continue to identify and control these species of concern. The VBD Team's WNV field activities which include; mosquito identification, control and viral testing of vector specimens, remain an important part of the program, aimed at reducing the number of EEE vectors within Middlesex-London and ultimately the threat of this disease to local populations.

Dead bird surveillance is used as an early indicator of local West Nile Virus activity. The MLHU continued to receive public reports of dead bird sightings and performed preliminary testing for WNV through the use of Rapid Analyte Measurement Platform (RAMP) technology this season. In total, 26 dead birds were submitted to the Strathroy laboratory, nine of which were crows confirmed as WNV-positive. Maintaining the dead bird surveillance program allows the VBD Team to detect WNV and provide advanced warning to residents regarding the presence of WNV in the community. This season, WNV-positive crows confirmed that the presence of WNV was spread throughout the City of London and Middlesex County.

The surveillance and identification of mosquito larvae is an important aspect of the MLHU's Integrated Pest Management (IPM) control strategy, as the identification of vector mosquito larvae prompts the treatment of sites containing WNV and/or EEE-vector species. Throughout 2011, the VBD Team identified 19,804 larvae, of which approximately 68% were vector species. The most abundant vectors identified this season were *Culex pipiens* and *Culex restuans*, they are also the most competent WNV vectors.

The adult mosquito surveillance program offers valuable information to the VBD Program, providing a greater understanding of disease transmission, population densities, species variation, and the distribution of WNV activity. Adult surveillance is performed with the use of terrestrial and canopy traps, through which the VBD Team collects, identifies and with the assistance of Cosray Labs, viral tests are performed on adult mosquitoes. This season, adult mosquito trapping within Middlesex-London identified 11 WNV-positive mosquito pools.

Once again this season the MLHU focused its attention on human surveillance of WNV, EEE and LD. The objective of human surveillance is to better understand the epidemiology of vector-borne diseases within human populations. West Nile Virus, LD, and the encephalitic symptoms caused by EEE are classified as both *Reportable Diseases* and *Communicable Diseases* under the *Health Protection and Promotion Act*. The number of reported cases of WNV-related illness increased this season to a total of 72 cases in Ontario. There was also in increase locally, with two WNV-positive human cases; one confirmed following the death of a London resident and the other probable, pending confirmation. There were two LD-positive human cases reported within Middlesex-London, both acquired from travel to endemic regions within the province.

The control of vector mosquito populations is an important aspect of the VBD Program, protecting human health from diseases vector mosquitoes could potentially transmit, and reducing vector mosquito populations while remaining environmentally sound. The Canadian Centre for Mosquito Management Inc. (CCMM) once again assisted the VBD Program in mosquito control and catch basin larviciding throughout Middlesex-London. The VBD Team and CCMM together employed an IPM approach; a decision-making process that includes planning, identification, monitoring, control and evaluation of the pest management strategy. The VBD control program is unique because mosquitoes must be identified as vector species prior to treatment. This season, 919 treatments were performed at 247 sites monitored by the VBD Team and CCMM. Treatment of municipal catch basins was part of the VBD Program's control strategy once again this year. Approximately 35,000 catch basins were treated three times throughout the course of 2011.

Middlesex-London's 12 Environmentally Sensitive Areas (ESAs) were monitored on a weekly basis by two VBD staff this season. Peripheral standing water pools within ESAs were monitored from April 13, 2011 to September 28, 2011, and were visited over 330 times, an 18% increase in monitoring visits from 2010. Activity in ESAs has been increasing in recent seasons as the MLHU continues to identify a high number of vector mosquito populations in these areas. The health unit noted increased activity in ESAs in both the 2009 and 2010 seasons as well. Westminster Ponds Zone 5 and Zone 3 were the most frequently treated ESAs, followed by Sifton Bog Zone 2. Two VBD staff members were assigned to monitor ESAs for the duration of the season, surveying roughly 300 hectares of land. Once again for the third straight season, 10 of the 12 sites designated as ESAs required treatment.

As the VBD Program has observed an increase in WNV-positive activity over the past two seasons, it is important to monitor the weather trends that favour viral production and disease transmission in local mosquito populations. In an effort to protect residents of Middlesex-London and understand the emergence of WNV in the community, the VBD Team tracks Accumulated Degree Days (ADD) in order to better prepare for the presence of WNV in the community. Through the monitoring of weather trends in 2011, 234 consecutive Accumulated Degree Days were observed prior to the confirmation of five WNV-positive mosquito pools within the same week. This information allowed the VBD Team to heighten surveillance and prepare for the potential of WNV activity. Heightened surveillance confirmed five positive pools. The health unit then issued a press release and conducted several media interviews to inform the public on personal protection measures against mosquito bites.

Public education is an essential component of the VBD Program. The VBD Team distributed Lyme disease brochures, attended several community events, developed a series of advertisements and also worked closely with the public to educate residents on reducing local mosquito populations and tick bites. The VBD Team worked closely with stakeholders this season to address growing mosquito-related concerns in North Middlesex. The MLHU took part in working groups to address resident concerns and educate the public on how to protect against bites and eliminate breeding areas around the home. The VBD Team also participated in several community events throughout Middlesex-London this season, including the Glencoe Fair, the Parkhill Fall Fair and Strathroy's Turkeyfest. In addition, the MLHU hosted the Annual VBD Stakeholders meeting to discuss findings from the 2010 season and outline field initiatives for 2011.

The objectives of the VBD Program are to educate the public, monitor local tick populations, reduce standing water, decrease vector mosquito habitats and ultimately eliminate the transmission and amplification of vector-borne diseases to humans. In an effort to maintain the goals of this program, the VBD Team must continue to partner with local stakeholders and municipal officials in order to address public concerns and further develop public education strategies. The MLHU must also continued to participate in community events to educate the public on preventing tick and mosquito bites.

Chapter 1: West Nile Virus

1.1 Introduction

West Nile Virus (WNV) originated in the Ugandan Province of West Nile in 1937. Since its introduction, outbreaks have occurred worldwide. The first WNV activity in North America was reported from New York City in 1999. West Nile activity in Canada was first reported in 2001. The first human cases in Ontario and, more specifically, Middlesex-London occurred in 2002, when 394 positive human infections were recorded across the province. Since the initial outbreak of WNV in Ontario, regional Health Units have established and maintained mosquito surveillance and control programs in order to monitor vector mosquito populations and prevent the amplification of WNV to humans.

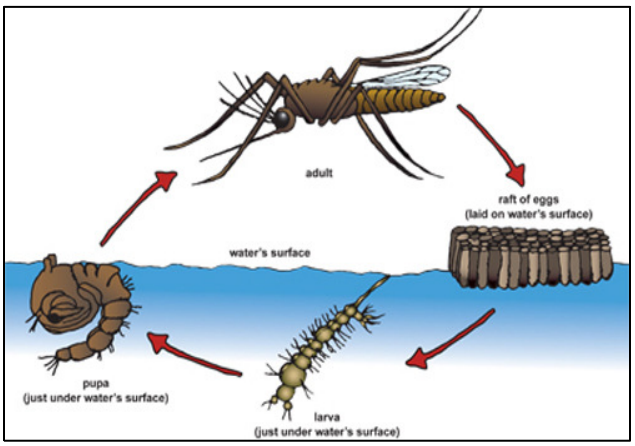

Figure 1-1: Mosquito life cycle. (Sacramento-Yolo Mosquito and Vector Control District, 2010)

1.2 Mosquito Life Cycle

There are four stages in a mosquito's life cycle: egg, larva, pupa and adult [**Figure 1-1**]. Females are the only mosquitoes that bite, as they require a blood meal to nourish their eggs. Most female mosquitoes do not live long after laying eggs; however, in some species, ovulation may be repeated several times before death. Female mosquitoes can lay as few as one or as many as several hundred eggs at a time. Some species lay eggs individually, and others lay multiple eggs that group together as a "raft". It can take as little as two days for the eggs to hatch and for larval and pupal stages to ensue, provided an ideal habitat is maintained. Combined, larval and pupal stages can last anywhere from four to 14 days; increased temperatures accelerate the progression from 1st instar larva to pupa.

When adult mosquitoes emerge, they immediately seek refuge in dense vegetation. Mating usually occurs within the first few days of this adult stage.

The length of a mosquito's life generally depends on temperature and the species' characteristics. For example, many species differ in their preferred blood source, habitat, ability to carry disease, and over-wintering strategies.

1.3 Transmission of West Nile Virus

West Nile Virus is an arbovirus from the family Flaviviridae. The transmission cycle begins when mosquitoes bite an infected bird and then transmit the virus through a bird-mosquito-bird cycle, with mosquitoes playing the role of "primary vector" for infection. This cycle of transmission is called "amplification". Transmission begins in early spring months and by mid-summer an influx of infected birds and mosquitoes can result from this cycle of amplification.

The over-wintering of certain mosquito species plays a large role in the amplification of WNV, as these species can jump-start a cycle of transmission. The cycle begins when mosquitoes emerge in early spring and begin to feed on birds. These species that feed on birds and mammals have the ability to transmit the virus to humans [**Figure 1-2**]. Birds are considered to be the "reservoir" hosts for WNV, while humans (and other mammals) can become incidental end hosts within the viral transmission cycle. (MOHLTC, 2003)

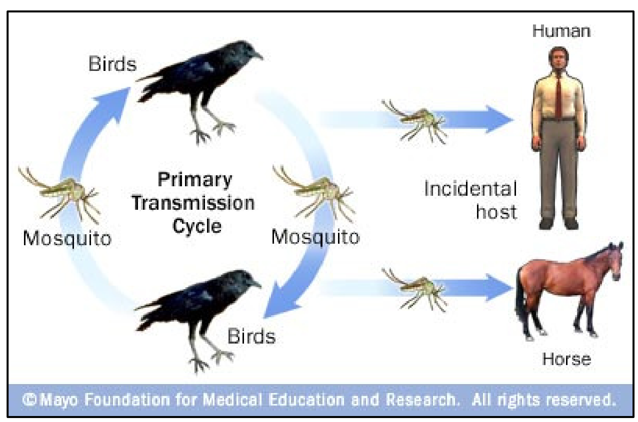

Figure 1-2: WNV transmission cycle.

1.4 Signs and Symptoms

Analysis of WNV has shown that humans will develop symptoms of the illness three to 15 days after being bitten by an infected mosquito. In North America, studies have shown that when bitten, most people (80%) do not acquire enough of the virus in their bloodstream to make them ill. Twenty percent (20%) of those bitten will develop mild symptoms known as West Nile Fever, consisting of general symptoms of fever, headache, muscle aches, nausea, fatigue, rash and/or swollen glands. Less than 1% of people will develop a severe form of West Nile Encephalitis, a serious neurological condition causing acute inflammation of the brain which may cause tremors, disorientation, loss of consciousness, muscle weakness and/or paralysis. These severe symptoms have been found to occur most frequently in adults over 50 and in those with chronic health issues due to weakened immune systems. (MOHLTC, 2006) Approximately three percent (3%) to 15% of people with these severe encephalitic symptoms will die from the infection. Studies indicate that those who survive often continue to experience long-term side effects of: fatigue, memory problems, muscle weakness, difficultly walking and/or depression. (MLHU, 2002)

1.5 West Nile Virus Activities in Middlesex- London

The Middlesex London Health Unit's (MLHU) Vector-Borne Disease (VBD) Program uses an Integrated Pest Management (IPM) approach to monitor and control vector mosquito larvae and test adult mosquitoes, decreasing the threat of vector-borne illness to humans.

In order to reduce and repel mosquito populations, the VBD Program emphasizes:

- Public education
- Adult mosquito trapping and viral testing
- Dead bird surveillance and WNV testing
- Weekly surveillance of standing water and identification of mosquito larvae
- Control of vector mosquito larvae
- Surveillance mapping of adult mosquito trap locations and larval dipping sites

Although WNV is the prevailing vector-borne disease of concern in Middlesex-London, the VBD Team continues to monitor for other vector-borne diseases that could affect local populations in future seasons.

Figure 1-3: The MLHU's 2011 VBD Team.

1.6 Vector-Borne Disease Program

The VBD Team [**Figure 1-3**] has actively monitored sites throughout Middlesex-London since 2002. This season, the Canadian Centre for Mosquito Management (CCMM) was once again contracted as the MLHU's licensed mosquito control provider. CCMM assisted the MLHU with treating catch basins and standing water throughout Middlesex-London.

Both CCMM staff and the VBD Team obtained a Mosquito/Biting Fly Exterminator licence prior to applying larvicide products. In preparation for the 2011 surveillance and control season, the team participated in a series of training sessions provided by CCMM and an Ontario Pesticide Specialist from the University of Guelph. Staff orientation consisted of larval dipping and treatment demonstrations, combined with practical examinations to test the team's ability to understand the safe handling and application of biological pesticides. The VBD Team was also trained to use GPS mapping units so that standing water sites throughout Middlesex-London could be located efficiently.

Chapter 2: Lyme Disease

2.1 Introduction

Lyme disease (LD) is an infection caused by the bacteria, *Borrelia burgdorferi* (Spirochaetes). Lyme disease is a systemic tick-borne illness with many clinical manifestations that occurs over much of the world in temperate zones and has the ability to seriously affect both humans and animals. Although rarely fatal, the disease may be debilitating with side effects that include cardiac, neurologic, and joint involvement. Lyme disease is the most common tick-borne illness in North America, transmitted to humans through the bite of an infected tick, *Ixodes scapularis*, commonly known as the blacklegged or deer tick.

Figure 2-1: Blacklegged tick, *Ixodes scapularis*.

Blacklegged tick populations are most often found along the shores of Lake Erie, Lake Ontario and the St. Lawrence River, coinciding with migratory bird flight routes. Endemic locations with blacklegged ticks include Long Point, Turkey Point, Wainfleet Bog, Rondeau Provincial Park, Point Pelee National Park, Prince Edward Point National Wildlife Area and the St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. It is difficult to establish precise boundaries of tick populations since the species continues to expand into neighbouring areas. Since blacklegged ticks often feed on migratory birds, deer and other animals, they can easily be transported throughout the province. British Columbia, Manitoba, Quebec and Nova Scotia have also reported LD activity in local tick populations. In the United States, LD-carrying ticks have been identified along the Atlantic seaboard and in Ohio, Minnesota and Washington. (MOHLTC, 2011)

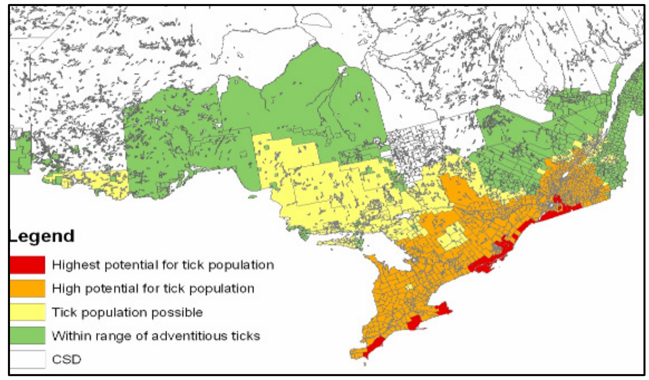

Figure 2-2: North shores of Lake Erie and Lake Ontario where blacklegged tick populations have become established and/or endemic.

It is important in the study of Lyme disease to understand the definitions of an 'adventitious' and 'established' versus 'endemic' blacklegged tick populations. These three terms are used to describe the level of risk within certain geographic regions of Ontario, depending on the number of black-legged ticks and LD cases reported from a jurisdiction. Throughout this Vector-Borne Disease (VBD) Report, the MLHU will discuss established and endemic areas for black-legged ticks, advising residents in public education messages to protect themselves when travelling to these regions. In order to understand why it is important to employ personal protection in these regions, it is important to know the difference between these terms.

Regions with an 'established' blacklegged tick population have identified a number of blacklegged ticks in the same area over multiple years, however these ticks **have not** tested positive for *Borrelia burgdorferi*. Regions with an 'endemic' black-legged tick population have identified blacklegged ticks in the same area over multiple years and both ticks and small mammals in the area **have tested positive** for *Borrelia burgdorferi*. Active tick surveillance is conducted in regions classified as 'established' or 'endemic'. Adventitious tick populations are areas where blacklegged ticks are found only sporadically. Middlesex-London falls within this classification, as tick dragging has not identified any established populations of black-legged ticks, however on occasion; black-legged ticks are submitted to the MLHU from within Middlesex-London. An 'adventitious' tick population means that both passive and active surveillance are conducted within the region, depending on the number and type of ticks that are reported and submitted to the health unit.

The risk of acquiring LD within a region classified as having an 'adventitious' blacklegged tick population also remains low, however it is possible. The risk of acquiring LD increases anywhere that blacklegged ticks are established or endemic.

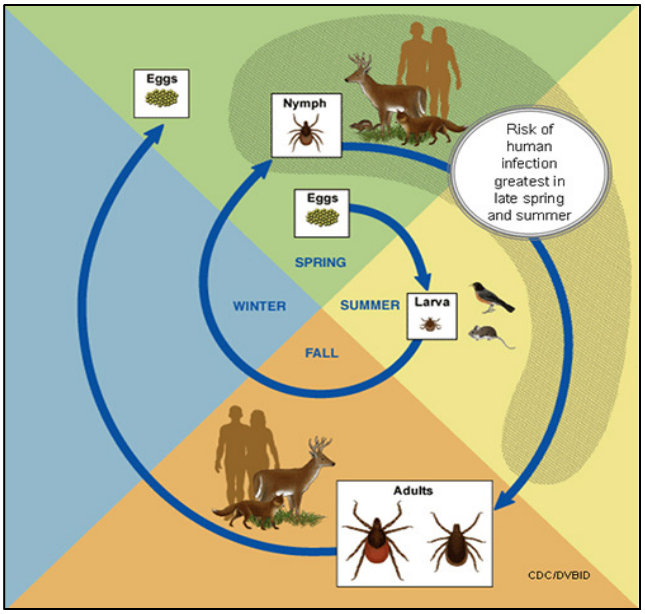

Figure 2-3: Life cycle of black-legged ticks.

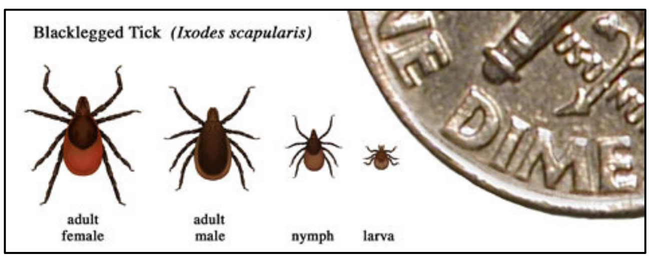

Figure 2-4: Life stages of the blacklegged tick.

2.2 Lyme Disease in Humans

Lyme disease is transmitted to humans after an infected tick feeds on its host for at least 24 hours. It takes this period of time for the bacteria to transfer from the tick's salivary glands into the bloodstream of the host. Due to this delay, rapid detection and removal of ticks is essential in preventing LD. Knowing the complex life cycle of the ticks that transmit LD bacteria can help in understanding the risk in contracting the disease and how to prevent it.

The complete life cycle of blacklegged ticks requires two years. Tick eggs are laid in the spring, and hatch as larvae in the summer. Larvae feed on mice, birds, and other small animals in the summer and early fall. The larvae may become infected with LD bacteria when feeding on these animals. Once a tick becomes infected, it stays infected for the duration of its life and can transmit the bacteria to other hosts. After this initial feeding, the larvae usually become inactive until the following spring, when they develop into nymphs. Nymphs seek blood meals in order to fuel their growth into adults. Nymphs feed on small rodents, birds, and other small mammals in late spring and early summer. Nymphs will also feed on humans, and if infected with the Lyme disease bacterium, they can transmit the disease to humans. Nymphs molt into adult ticks in the fall. In the fall and early spring, adult ticks feed and mate on large animals, such as deer. Adult female ticks will sometimes also feed on humans. In spring, adult female ticks lay their eggs on the ground, completing the two-year life cycle [**Figure 2-3**]. Monitoring tick populations throughout Middlesex-London assists the VBD Team in developing effective screening systems and educational campaigns, which may prevent the public from contracting LD.

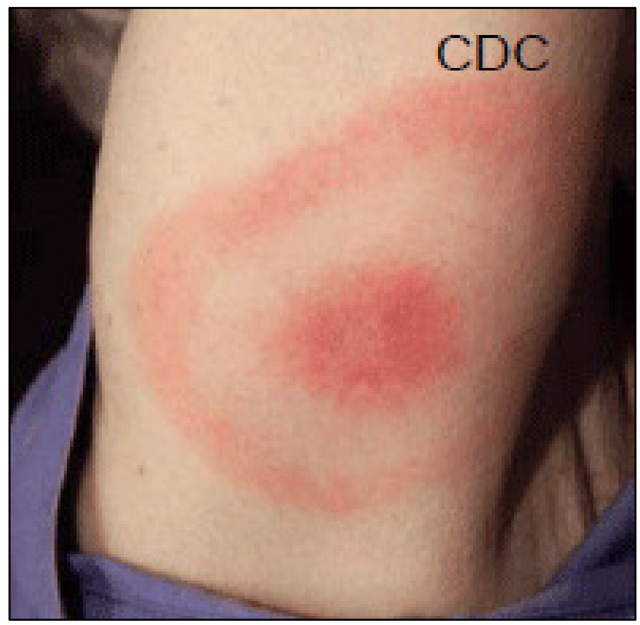

Figure 2-5: "Bull's-eye" rash circulating from tick bite.

2.3 Symptoms and Treatment

Humans infected with LD may have a number of different symptoms. These symptoms often occur in three stages and not all patients show every symptom. Many of the symptoms also occur with other diseases, which may make LD challenging to diagnose. Symptoms usually begin within three days to one month after being bitten by an infected tick. The first sign of infection is usually a circular rash called erythema migrans (EM), commonly known as the "bull's-eye" rash [**Figure 2-5**]. This rash varies in size and typically occurs in 70% to 80% percent of those infected. During the initial stage of infection, symptoms may include: fatigue, chills, fever, headache, muscle and joint pain, and swollen lymph nodes.

If left untreated, the patient may progress to the second stage that can last several months. The symptoms for the second stage may include: multiple skin rashes, heart palpitations, arthritis and arthritic symptoms, extreme fatigue and general weakness, and central and peripheral nervous system disorders. The third stage may last for months or years with recurring neurological problems and arthritis. Most cases of LD can be successfully treated with antibiotics; however, if left untreated, LD can seriously affect the joints, heart and nervous system, resulting in chronic health problems.
(MOHLTC, 2010)

2.4 Incidence of Lyme Disease

The most common tick-borne infection in the Northern hemisphere, LD was first recorded in Canada in 1979, by a biologist who had been working in Long Point, Ontario; a known hot spot for blacklegged ticks. Although 1979 may be the first documented case of LD in Ontario, it is difficult to establish a history of the disease since many early cases of LD have not been well documented in Canada. Lyme disease has become important in recent years as provinces are seeing human cases and blacklegged ticks in higher numbers each season. (Artsob, 2010)

Due to the recent incidence of cases along America's eastern seaboard, and an increasing number of blacklegged tick populations being observed across Canada, Lyme disease is becoming an illness of increasing importance to local health units (Artsob, 2010). In response to these trends, as of 2010, Lyme disease became a nationally reportable disease in Canada, which means that all medical professionals must report cases of LD to the Public Health Agency of Canada. Considering the number of endemic areas in Ontario and the influx of blacklegged tick populations in bordering regions, scientists believe that human LD cases will only worsen in coming years due to the influence of climate change and in effect, the migration patterns of birds. So far, the monitoring of LD cases and blacklegged ticks in Ontario has been effective in detecting the prevalence of LD. (PHAC, 2010)

2.5 Lyme Disease in Middlesex-London

With the inclusion of LD to the VBD Program in 2009, it was determined that Middlesex-London does not have endemic or established blacklegged tick populations; therefore a passive tick surveillance approach has been utilized to monitor local tick populations. Passive surveillance relies on tick submissions from physicians, veterinarians and the public to determine the presence of LD vectors within the community. All submissions are first identified in the MLHU's Strathroy laboratory. If a blacklegged tick is identified it is then sent to the London Public Health Laboratory for species confirmation and then to the National Microbiology Laboratory of Canada to determine if *Borrelia burgdorferi* is present in the tick sample. If a blacklegged tick is submitted and/or identified, follow-up tick dragging is performed [**Figure 2-6**]. When multiple tick submissions are identified from the same neighbourhood, the VBD Team will monitor tick populations more closely within those areas, including occasional tick dragging.

Figure 2-6: VBD staff member dragging for ticks in Westminster Ponds.

The VBD Team's passive tick surveillance approach monitors local tick populations in order to reduce tick bites and increase awareness on LD. This aspect of the VBD Program emphasizes:

- Public education
- Tick submission and identification
- Laboratory testing when blacklegged ticks are identified
- Tick dragging, when increased submissions from similar geographic areas are identified
- Surveillance mapping of areas identified as having a high number of observed ticks

In 2011, a total of 73 ticks were submitted to MLHU for testing. This is an increase from 46 ticks submitted in 2010 and 17 ticks submitted in 2009. Submissions were made from May 10, 2011 to October 28, 2011. Two of the submissions were identified as blacklegged ticks, one was acquired from London, Ontario, and the other submission was acquired in Brockville, Ontario, a known endemic area. Both the tick from Brockville and the tick that was locally acquired tested negative for *Borrelia burgdorferi..* This season the VBD Team also performed tick dragging at six various habitats throughout Middlesex-London.

2.6 Conclusions and Recommendations

In 2011, one blacklegged tick was identified within the City of London. There have been no laboratory-confirmed human cases of Lyme disease contracted from within Middlesex-London, however two residents contracted LD from travel outside the area. Both cases were related to travel to an endemic region of Ontario.

Once again, the VBD Program promoted LD education through various media within Middlesex-London. A Lyme disease television commercial was featured on Rogers TV throughout the 2011 season. The VBD Team also developed an advertisement that was featured in the City of London's 2011 garbage collection calendar, reminding residents to protect themselves with repellent to avoid tick bites. With these advertisements, the VBD Team hopes to continue to educate the public on preventing tick bites and encourage more people to submit ticks when they are found on humans.

The recent increase in LD cases has prompted Public Health Ontario to review and update national LD statistics; therefore for the purposes of this report, Provincial statistics for LD have yet to be released. Public Health Ontario has informed health units that these Provincial statistics will be available in the spring of 2012.

Based on results of tick surveillance in 2011, the following recommendations have been made:

The VBD Team maintained a passive surveillance approach based on public tick submissions and by dragging in areas where a high number of ticks were observed. It is imperative that the VBD Program continue to monitor for blacklegged ticks in order to educate and inform residents of the regional incidence of tick populations and LD-vectors.

Although the incidence of LD-carrying ticks in Middlesex-London remains low, neighbouring regions of the province have been identified as endemic areas for blacklegged tick populations. Ticks are parasites that can migrate by way of host movement; therefore, potential hosts may carry ticks from these neighbouring communities. If blacklegged ticks were to become endemic to Middlesex-London, the VBD Team would heighten its monitoring activities.

The MLHU observed an increase in the number of tick submissions from 2009 to 2011. The MLHU hopes to see an increase once again in 2012.

In 2011, the VBD Team distributed over 1500 Lyme disease brochures educating the public on personal protection when travelling to endemic regions. Education material also encouraged tick submissions to the health unit. The VBD Program should continue to develop and implement educational messages for the public in order to reduce the risk of LD infection to humans and increase awareness on how to submit ticks. The MLHU should also continue to educate residents on how to properly remove a tick and identify the symptoms of LD following exposure to tick bites.

Figure 2-7: Blacklegged tick identified in the Strathroy laboratory.

Chapter 3: Eastern Equine Encephalitis

3.1 Introduction

Isolated in Canada for the first time in 1938, Eastern Equine Encephalitis (EEE) activity has been detected in Ontario, Quebec and most recently, Nova Scotia. The 2011 season saw similar trends, as EEE activity was once again identified in all three provinces. (MOHLTC, 2011)

Eastern Equine Encephalitis is classified as an alphavirus from the family Togaviridae. Eastern Equine Encephalitis most often circulates through a bird-mosquito-bird cycle of transmission, with *Culiseta melanura* as the primary vector for amplification within avian populations. *Coquillettidia perturbans* and species of the genus *Aedes* have been identified as the primary mosquito vectors for the transmission of EEE to animals and humans. *Ochlerotatus sollicitans, Anopholes crucians, Culex restuans,* and *Culex salinarius* have also been identified as vectors for EEE. All of these species have been identified throughout Middlesex-London. It is currently unknown how EEE overwinters in host species; it may endure in birds, mosquitoes or other mammals until it can once again emerge during temperate spring seasons. (CCWHC, 2000; Goddard, 2007)

3.2 Eastern Equine Encephalitis in Humans

In the past, EEE has predominately affected equine populations; however the presence of EEE-positive mosquito pools in recent years has increased the likelihood of human infection in Ontario. Human infection often involves severe symptoms of encephalitis including fever, headache and myalgia. Encephalitis occurs two to ten days from the onset of initial symptoms. Approximately five percent (5%) of humans who acquire EEE will develop severe symptoms of encephalitis, characterized by the abrupt onset of systemic illness. Signs and symptoms in encephalitic patients include fever, headache, irritability, restlessness, drowsiness, anorexia, vomiting, diarrhea, cyanosis, convulsions, and coma. (CDC, 2011)

There is a 70% to 90% mortality rate for those who develop encephalitic symptoms (AMCA, 2010). Approximately one third (33%) of all people with EEE die from the disease. Of those who recover, many are left with disabling and progressive mental and physical side effects, which can include anything from minimal brain dysfunction to severe intellectual impairment, personality disorders, seizures, paralysis, and cranial nerve dysfunction. (CDC, 2011)

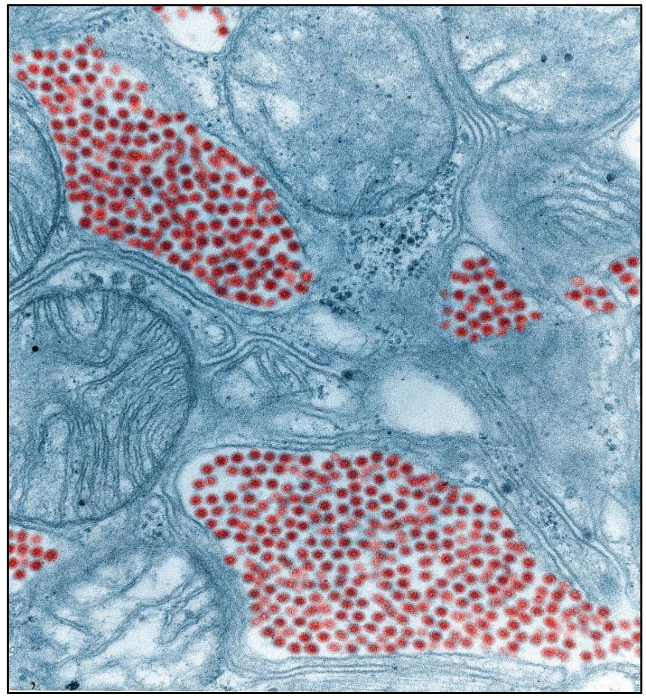

Figure 3-1: Colourized transmission micrograph of a salivary gland extracted from a mosquito infected with EEE virus (virus colourized in red). (PHIL, 2011)

There are currently no anti-viral medications available to humans who become infected with EEE; however a seasonal vaccination for horses is available. (AMCA, 2010)

In Canada, the incidence of human infection has been low in recent decades; however, within the past two years EEE activity has been confirmed in horses, emus, and several EEE-positive mosquito pools in Ontario, Quebec and Nova Scotia. Several bordering American States have also experienced EEE outbreaks in the past three seasons. (CDC, 2011)

3.3 Incidence of EEE

Within Middlesex-London there were no EEE-positive mosquito pools; however, adult mosquito trapping identified the presence of several EEE-vector species. Of the 22,471 adult mosquitoes identified by Cosray Laboratories in 2011, 51% were vector species for EEE, compared to 48% in 2010, and 26% in 2009. The EEE-vectors identified in Middlesex-London include: *Cs. melanura, Cq. perturbans, Ae. vexans, Cx. salinarius, Cx. restuans, Cx. salinarius* and *Oc. canadensis*. Cosray also performed viral testing for viral on several EEE vector species collected from Middlesex-London.

New guidelines set out by Public Health Ontario outlined EEE surveillance protocols for the 2011 season. These new guidelines also introduced a new EEE Adult Mosquito Testing Order of Preference, which recommended priority species for EEE testing to include more species. By testing a variety of potential EEE vectors, the MLHU's service provider, Cosray Laboratories, performed 578 EEE viral tests throughout the course of the 2011 season. The results of these viral tests were all negative. There were also no human or equine cases of EEE reported from Middlesex-London.

Province-wide, there were no EEE-positive mosquito pools identified. However, within the region serviced by the Eastern Ontario Health Unit, there was one EEE-positive equine case and also another EEE-positive equine case within the region serviced by Leeds-Grenville and Lanark District Health Unit. At a national level, Nova Scotia reported EEE-positive equine cases for the second straight season and Quebec has also reported increased EEE activity. (OMAFRA, 2011; MOHLTC, 2011)

In the past several years, the United States (U.S) has reported an increase in EEE cases as well. In 2010, the U.S saw some of its highest numbers of EEE in 30 years. In 2011, three human cases were reported from the U.S; one in New York, one in Massachusetts, and one in Missouri. Michigan reported one positive mosquito pool and three positive veterinary cases. New York State reported 40 positive mosquito pools and 12 positive veterinary cases. (MOHLTC, 2011; USGS, 2011)

Eastern Equine Encephalitis activity has been increasing in the U.S since 2000. From 1963 to 2009, the U.S has reported 40 outbreaks of EEE. An 'outbreak' is issued in the U.S when greater than six EEE-positive cases are identified in one calendar year. The years 2000 to 2006 were all outbreak years in the U.S and this number continued to increase into 2010. The 2010 season marked an outbreak year for the State of Michigan, which not only saw an increase in the number of EEE cases, but also an increase in the severity of symptoms associated with the disease. Other areas reporting increased activity in 2010 also included Massachusetts, New York and Pennsylvania. (Mutebi, 2010; MOHLTC, 2010)

Although Michigan did not report an outbreak year for the 2011 season, the U.S still saw a high number of EEE-positive human, mosquito and veterinary cases. In total, the U.S reported three EEE-positive human cases, 124 EEE-positive mosquito pools and 60 positive veterinary cases.

3.4 Conclusions and Recommendations

Since many mosquito vectors which have the potential to carry and transmit WNV also have the potential to transmit EEE, the MLHU's vector control program must continue to identify and eliminate these species of concern. Regular mosquito identification and viral testing remains an important aspect in controlling the number of EEE vectors within Middlesex-London. Since the number of EEE vector species has doubled since 2009, it is important that the VBD Program maintain regular surveillance and control of these EEE vector species.

There were no confirmed cases of EEE in humans, mosquitoes or horses within Middlesex-London this year. However, the presence of EEE vector species and increased viral activity in the U.S indicates that continued viral testing of adult mosquitoes, in combination with monitoring and control programs, is necessary in order to mitigate the risk of EEE to the local population in future seasons.

Although there were no human cases of EEE reported in Ontario this year, the report of a single human case may signify that an outbreak is developing (ODH, 2010). Four positive equine cases throughout the 2011 season reveal that EEE is present in Ontario; and therefore, the risk of human infection is possible. This information, together with the fact that the prognosis for those infected with EEE is poor due to the virulence of the disease, emphasizes the importance of continued surveillance and control of EEE vector species.

Since EEE is not yet a nationally reportable disease, it is important that the MLHU maintain working relationships with health units across the province as well as with local mosquito control organizations in the U.S in order to effectively monitor emerging trends and positive activity. Forging partnerships with local mosquito control and health organizations is necessary in order to develop uniform protocol and integrated prevention strategies against EEE.

Chapter 4: Dead Bird Surveillance

4.1 Introduction

The objective of dead bird surveillance is to identify WNV activity in an area and to use that information to inform the public and reduce the potential risk of WNV transmission to humans. Information concerning dead birds was received online or by phone, and then recorded and triaged to the appropriate staff. The Vector-Borne Disease (VBD) reporting line was accessed by VBD staff on a daily basis to record dead bird sightings from the public throughout Middlesex-London. Staff were trained to determine if the birds were acceptable for submission to the Canadian Cooperative Wildlife Health Centre (CCWHC) for testing purposes. Although some provinces have discontinued their dead bird surveillance programs, the VBD Team continued to receive public reports of dead birds and performed preliminary laboratory testing for WNV on a discretionary basis. When positive results for WNV were obtained in the health unit's Strathroy laboratory through the use of Rapid Analyte Measurement Platform (RAMP) technology, specimens were forwarded to the CCWHC for confirmation.

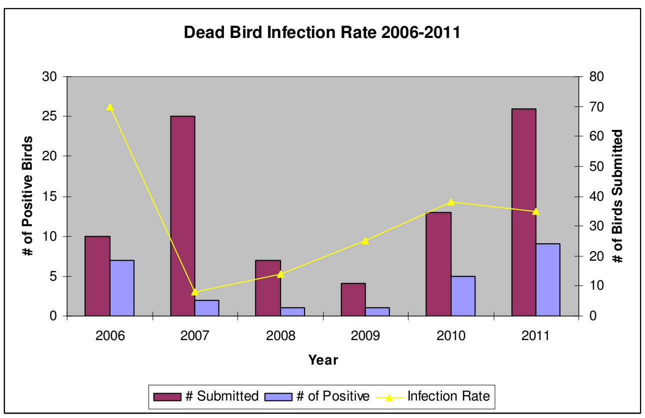

Figure 4-1: Dead bird infection rates, 2006 to 2011.

4.2 Results

Dead bird observations were reported to the MLHU either online or by phone beginning May 6th, 2011. By the end of the 2011 season, a total of 143 dead birds had been observed in Middlesex-London [**Appendix B**]. This is a 101% increase in the number of dead birds observed since 2010. Twenty-six (26) birds were submitted to the Strathroy lab and tested using RAMP technology. A total of nine crows tested positive for WNV in the Strathroy laboratory. The birds were then sent for confirmation, and the positive results were verified by the CCWHC (PHAC, 2011).

Figure 4-2: VBD lab technician performing a RAMP test for WNV.

Ontario submitted the most birds for testing this season, with 134 submissions, followed by British Columbia with a total of 48 submissions, Quebec submitted 16, Saskatchewan submitted 12, and one bird was submitted by each of the following provinces: Manitoba, New Brunswick, and Northwest Territories for WNV confirmation. Fifty-seven (57) of the birds submitted to the CCWHC tested positive for WNV, 43 of which were from Ontario. (CCWHC, 2011)

Although Ontario submitted the largest proportion of dead birds to the CCWHC, with 134 submissions, it was not considered to be conducting active bird surveillance. In 2011, only one Canadian jurisdiction, British Columbia, conducted an active dead bird surveillance program for West Nile Virus, while all other provinces maintained a passive avian surveillance system for the 2011 season. (CCWHC, 2011)

4.3 Discussion

This season's trends indicate that WNV is still present within Middlesex-London and that public submissions are an important aspect in tracking and pin-pointing the geographic distribution of viral activity.

Although positive birds were not detected in all of the areas that the VBD Team confirmed WNV-positive mosquito pools, the positive birds did still help to indicate initial WNV-activity within Middlesex-London this season.

Dead bird submissions served as important warning signs that WNV was present in the community this season. Prior to one of the first WNV-positive mosquito pools confirmed from the Fanshawe Conservation Area adult mosquito Trap F (Upper Thames), two WNV-positive crows were submitted from the surrounding area. Another WNV-positive crow was submitted from West London prior to Warbler Woods Trap Q being confirmed as positive as well. In total, four WNV-positive crows were confirmed prior to the MLHU's first WNV-positive mosquito traps of the season. In week 34, five WNV-positive mosquito pools were confirmed, three of which had been previously identified as areas already having WNV activity, following WNV confirmation in dead birds from those areas. This is significant because the birds served as an early warning that the virus was present in specific areas of the community, prompting the VBD Team to increase surveillance and control efforts, as well as educate residents through media releases.

It is also important to note that three of the nine dead birds confirmed by the VBD Team this season were collected from within the Municipality of North Middlesex. This is significant because the town of Parkhill, located within North Middlesex, experienced increased adult mosquito activity this season. The VBD Team will continue to closely monitor dead birds and mosquito populations within Parkhill to ensure residents are informed when viral activity is detected in their area.

Public education strategies have assisted with the submission and testing of avian specimens to determine the presence of WNV in the community. The VBD Team's comprehensive education strategies have provided the public with contact information for the VBD Team and the Vector-Borne Disease reporting line. This allows the public to take an active role in the program by reporting dead crows and blue jays that are observed in Middlesex London.

4.4 Conclusions and Recommendations

Maintaining aspects of the dead bird surveillance program allows the MLHU to:

- Provide advanced warning to residents regarding the presence of WNV in the community.
- Strengthen knowledge and understanding of WNV trends, both geographical and temporal.
- Increase surveillance and control efforts in areas where WNV activity has been detected.

Increased viral activity in 2011 indicates that an avian surveillance program is still significant in predicting and tracking WNV within the community.

Continuing to accept calls, analyze submissions and perform WNV-testing on a discretionary basis can complement the multi-disciplinary approach of the VBD Program.

It is important that the VBD Team maintain an effective education program to notify residents that dead bird submissions assist in monitoring the prevalence of WNV within the community. Promotional supplies highlighting dead bird submission protocol and the VBD Team's contact information for the reporting line are helpful ways to keep the public involved in the MLHU's efforts to reduce the transmission of West Nile Virus.

Chapter 5: Larval Mosquito Surveillance

5.1 Introduction

The objective of larval surveillance is to monitor the composition of species and the quantity of larval mosquito populations present in Middlesex-London. In 2011, larval monitoring remained an important component of the Vector Borne Disease (VBD) mosquito control program. The VBD Team uses the data collected from larval surveillance to initiate control measures as part of an Integrated Pest Management (IPM) approach to control vector mosquito species.

Figure 5-1: VBD Team members collecting mosquito larvae.

5.2 Larval Identification Results

This season, larval monitoring began on March 17, 2011 (week 11). The mean temperature in these short-term pools caused by snowmelt was 8.5 degrees Celsius (C°). The first larvae collected were *Ochlerotatus stimulans*, found on March 17, 2011. The identification of 25 vector mosquito larvae in the City of London on May 12th prompted VBD staff to perform the first treatment of the season.

Throughout 2011, a total of 19,804 mosquito larvae were identified, of which 13,390 (67.6%) were vectors, and the remaining 6,414 (32.4%) were non-vectors. Although week 29 bred the highest number of vector larvae for the past six years, vector mosquito larvae were observed at peak populations during week 33 of this year.

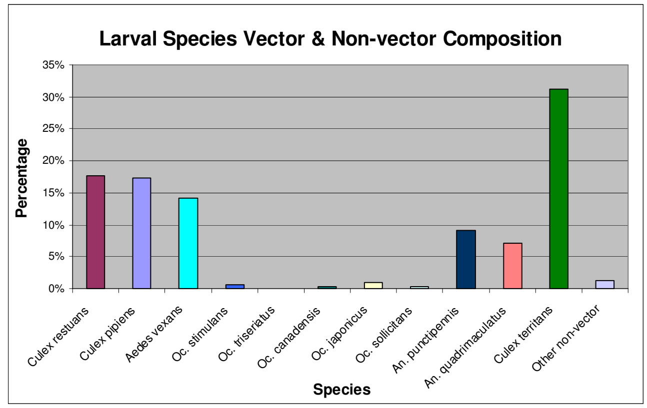

Figure 5-2: Larval Identification of WNV vectors and non-vectors, 2011.

5.3 Vector and Non-Vector Breakdown

Similar to previous years, *Culex restuans* was the most abundant vector species, representing 17.70% of the total larvae identified. C*ulex pipiens* was the second most abundant vector identified at 17.30%, followed by *Aedes vexans* (14.20%), *Anopheles punctipennis* (9.17%) and *An. quadrimaculatus* (7.12%). The species *Ochlerotatus japonicus* (0.91%), *Oc. stimulans* (0.58%), *Oc. canadensis* (0.37%), *Oc. sollicitans* (0.25%), and *Oc. triseriatus* (0.01%) represented the remaining number of vector species identified this season. *Culex territans* was once again the most prevalent non-vector species this season, comprising 31.16% of all larvae identified. [**Figure 5-2**]

5.4 Discussion

Since 2002, larval surveillance has demonstrated a significant increase in the variety of species represented throughout Middlesex-London. The variation of the larval species has increased from only seven species represented in 2002, to over 25 different species identified by 2006. In 2011, 23 different species were represented following the identification of over 19,000 mosquito larvae. Compared to 2010, this season saw a 16% increase in the number of larvae identified. The number of larvae identified in 2011 was also significantly higher than larvae identified in the past five seasons, (up from 17,087 larvae in 2010; 13,270 larvae in 2009; 7,262 larvae in 2008; and 8,441 larvae in 2007).

Vector Discussion

Ochlerotatus stimulans was the first larvae identified this season in mid-March. Although vector mosquito larvae were identified in March this year, larval counts and cooler temperatures in the month of April did not warrant a treatment until May 12, 2011.

Although *Culex restuans* and *Culex pipiens* were the most abundant vectors, accounting for 34.98% of all larvae identified this season, the MLHU has observed a decrease in their population density compared to previous seasons [**Figure 5-3**]. The decrease in *Culex* vector species can be attributed to the MLHU control program specifically targeting these species due to their known WNV virulence. Although the VBD Team focuses its efforts on controlling this primary WNV vector, not all populations can be completely eliminated. This year, 11 WNV-positive adult mosquito pools were identified by Cosray Labs, all of which were comprised of *Cx. pipiens/restuans* specimens. (Cosray, 2011)

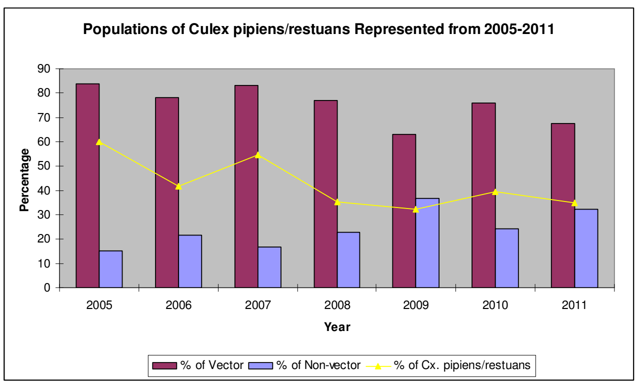

Figure 5-3: Results of vector and non-vector mosquito larvae identified compared to populations of *Culex pipiens/restuans* identified, 2005-2011.

Aedes vexans (14.2%) was the third most abundant vector identified. This species has increased in the past several seasons and proliferate in grassy pools that border wooded areas. In most cases, floodwater habitats will be dominated by this abundant mid-season mosquito. *Aedes vexans* are capable of carrying WNV and are also a secondary vector of Eastern Equine Encephalitis (EEE). Since the population of this species has grown significantly, it is imperative that the MLHU continue to monitor its growth. (Wood *et al.*, 1979)

Anopheles punctipennis and *Anopholes quadrimaculatus* were identified in early May this year and numbers of these species continued to rise for the remainder of the season. Similar to *Culex pipiens/restuans*, *Anopheles* species continue to be a control target due to their significant presence within the county and capability to transmit both WNV and EEE.

Ochlerotatus japonicus, an invasive species, continues to increase throughout Middlesex-London. In 2011, a total of 2,764 larvae were identified. These larvae were observed in various habitats such as field pools, storm water management facilities, ditches, and different artificial containers such as tires and pollution control plants. Special consideration should be given to this vector, as it is a highly competent WNV-vector and has been identified in Ontario in increasing numbers since 2001. The numbers of *Oc. japonicus* have increased significantly in Middlesex-London alone, making it an important WNV-vector to monitor in terms of range and viral activity in future mosquito seasons. (Cosray, 2011)

Culiseta melanura, the primary vector for EEE, was not observed in larval form this season. However, 19 adult specimens of *Cs. melanura* were found within Middlesex-London. Due to this species virus-carrying capabilities and recommendations from Public Health Ontario, *Cs. melanura* continues to be closely monitored within the county. (Cosray, 2011)

The VBD Team should also continue to monitor for the presence of *Aedes albopictus* (Asian tiger mosquito). This is an aggressive mosquito species that has spread through the United States since it was first introduced to North America in 1985. This species has also been detected in states bordering Ontario including Ohio, Pennsylvania and New York. In 2001, two female Asian tiger mosquitoes were collected in the Niagara Region during WNV surveillance. *Aedes albopictus* is a known vector for a variety of diseases including Yellow Fever, Dengue Fever, and numerous types of encephalitis, including LaCrosse encephalitis, EEE, and WNV. It is said that the Asian tiger mosquito is currently the most invasive mosquito in the world. (Wood *et al.*, 1979)

Non-Vector Discussion

Although *Culex territans* are a non-vector species in Ontario they have tested positive for WNV in New York State. The MLHU identified 6,171 *Cx. territans* (31.16%) this season. Since this species represents a large proportion of all larvae identified the MLHU should continue to monitor this species.

5.5 Conclusions and Recommendations

Monitoring mosquitoes in the larval stage is an integral part of the VBD Program. Vector species continue to dominate larval monitoring sites throughout Middlesex-London. Overall, *Cx. restuans* and *Cx. pipiens*, the most competent WNV vectors, were also the most abundant species identified this season. *Aedes vexans*, *An. punctipennis*, and *An. quadrimaculatus* remain the most prevalent vector species identified throughout the seasons. *Culex territans* was the most abundant non-vector species, and should be monitored closely since it has been identified with virus-carrying capabilities in the United States.

Based on larval surveillance and field observations in 2011, the following recommendations have been made:

Continue with earlier larval monitoring. With the increasing number of vector mosquito larvae identified in early spring months, the earlier monitoring of surface water should be continued.

The VBD Team must also monitor the populations of *Cx. restuans* and *Cx. pipiens*. Although their populations have decreased since 2005, they are still the most competent vector and were identified as WNV-positive within Middlesex-London this season. A comprehensive control program targetting these species will aid in the decrease of WNV-transmission to residents of Middlesex-London.

Chapter 6: Adult Mosquito Surveillance

6.1 Introduction

In order to carry out an effective vector-borne disease surveillance program, it is essential to monitor and trap adult mosquitoes. Adult mosquito trapping is performed in order to determine viral activity within the community, study population densities, as well as determine species variation and mosquito biting preferences within Middlesex-London. The information gathered from adult mosquito trapping, identification and viral testing allows the Middlesex-London Health Unit's (MLHU) Vector-Borne Disease (VBD) Team to asses the status of vector-borne diseases and identify areas that require greater larval surveillance and control.

6.2 Adult Mosquito Surveillance Activities in Middlesex-London

Trapping of adult mosquitoes commenced on June 7, 2011 and was completed on September 28, 2011. A total of 22 traps were set up throughout the City of London and Middlesex County. Fourteen terrestrial traps (4 to 6 feet off the ground) at 14 locations were used to collect mosquitoes on a weekly basis. Eight canopy traps (13 to 20 feet off the ground) were also distributed across Middlesex-London to study the variation and biting preferences of adult mosquitoes at heights greater than ten feet. These locations were chosen based on the geography, habitat and proximity to vulnerable populations and/or previous year's viral activity trends.

Once again this season mosquito trapping followed the VBD Program's standard procedures; collecting adult mosquitoes with battery-operated miniature light traps baited with carbon dioxide [**Figure 6-1**]. The traps operated for the duration of one night (15 to 20 hours in total) and samples were collected the following morning, packaged and sent by courier to Cosray Laboratories for identification and viral testing. Cosray received approximately 19 to 26 traps per week, depending on the status of viral activity within Middlesex-London. Following viral testing and mosquito counting, Cosray informed the MLHU of test results and species identifications.

Viral testing and the vector status of each species is determined by Public Health Ontario (PHO). Those mosquito species that are recognized as vectors are outlined in the West Nile Virus and the EEE-Testing Order of Preference Guidelines. The mosquitoes recognized as primary vectors, as outlined by the WNV-Testing Order of Preference are *Cx. pipiens/restuans, Cx. salinarius, Oc. japonicus* and *Cx. tarsalis.*

Figure 6-1: VBD Team member setting up Trap H, located in Parkhill.

The new EEE guidelines introduced by PHO included a new testing order of preference and focused on testing for EEE in the primary enzootic vector *Culiseta melanura*, and three others, *Ochlerotatus canadensis*, *Coquillettidia perturbans*, and *Aedes vexans vexans*. This order rates species that are considered to be 'high-risk' vectors in Ontario by their ability to carry and transmit infection. In total, 578 EEE viral tests were performed, all of which were negative. The most frequently tested species this season were *Ae. vexans vexans*, *Cq. perturbans* and *Oc. canadensis*.

Cosray labs adhered to these new guidelines and tested mosquitoes from Middlesex-London according to the new order of preference. In 2011 Cosray performed 1,101 viral tests for WNV and EEE on samples submitted by the MLHU. Public Health Ontario's new EEE guidelines resulted in a greater number of viral tests performed overall this season, however with the addition of EEE vectors to the Adult Mosquito Viral Testing Order of Preference, this season saw fewer WNV tests performed. In total, 523 WNV tests were conducted in 2011. The most frequently tested species were *Culex pipiens/restuans* and *Ochlerotatus* specimens.

Eleven WNV-positive mosquito pools were identified by Cosray Labs this year, all composed of *Culex pipiens/restuans*, a highly competent vector for WNV. This mosquito species appeared in slightly higher numbers this season, particularly in canopy traps. Nine of the 11 WNV-positive pools were from terrestrial (ground) traps, and two from canopy traps. It should also be noted that the two positive canopy trap pools had correspondingly positive ground traps in the same week. (Cosray, 2011)

6.3 Terrestrial Trap Surveillance

Of the 134,431 mosquitoes collected in 2011, Cosray identified 22,471 female mosquitoes representing over 30 different species. Eighty-six percent (86%) of the adult mosquitoes identified were vectors, and 14% were non-vector. This is a decrease from 2010 when 92% of mosquitoes trapped were vector species, and only 8% were non-vector. A significant increase can be noted in the number of non-vector mosquitoes trapped from 2010 to 2011. In 2010, 1,644 non-vectors were identified, however in 2011, 3,115 non-vectors were identified, a 90% increase between the two seasons [**Table 6-1**].

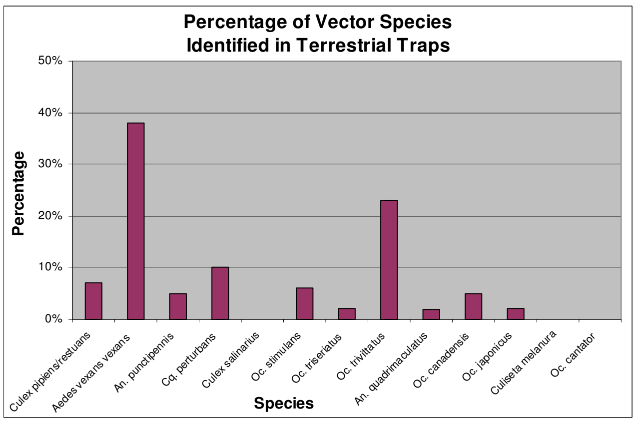

Figure 6-2: Vector species identified from terrestrial traps in 2011.

Although the MLHU trapped a significantly higher number of non-vector mosquitoes this season, there were still increases observed in vector mosquito populations. This season, the relative frequency of each vector species was determined by comparing the total number of vectors identified.

The most abundant adult vectors this year were *Ae. vexans vexans* (38%) and *Oc. trivittatus* (23%). These are the same species that were most prevalent in 2010 and 2009. The number of *Oc. stimulans* and *Oc. canadensis* increased most significantly from 2010 to 2011, with a combined increase of 99%. An increased number of EEE-vector species was also observed this year. Approximately 51% of all mosquitoes identified in 2011 were EEE vector species, compared to 48% in 2010. This is also an increase from 26% in 2009.

[1] Note that Cosray Laboratories is able to identify mosquitoes to the sub-species level (e.g. *Aedes vexans vexans*); however, in subsequent chapters, species are identified by the MLHU to the species level (e.g. *Aedes vexans*). Therefore, the results described in this chapter may be further classified into subspecies since adult mosquito data was attained from Cosray Labs.

Figure 6-3: VBD Coordinator displaying adult mosquitoes collected from Parkhill.

This season 11 WNV-positive mosquito pools were identified in Middlesex-London. Although these positive pools were distributed throughout Middlesex-London, all of the species testing positive were *Cx. pipiens/restuans*. The first specimens were collected in London on August, 24, 2011 (week 34).

This year's first positive came later in the season than the first positive of 2010, which was confirmed in week 32. Seven different terrestrial traps were confirmed positive in 2011. Trap M located in London at Huron Conservation Area, went positive twice, and a hotspot trap set up at Ted Early Sports park tested positive twice as well. Upon confirmation of positive activity, the MLHU issued press releases to notify residents in the area, set up hotspot traps to monitor additional mosquito populations, and also heightened surveillance in those areas identified as having WNV-positive activity. The traps that went positive were distributed across Middlesex-London however the greatest number of positive mosquito pools was identified within the City of London. [**Appendix C**].

The greatest number of adult mosquitoes was once again collected from Trap H, located in Parkhill. Trap H collected a total of 95,997 mosquitoes throughout the course of 2011. This is a significant increase in the number of mosquitoes collected from Trap H in comparison to previous years. In 2011, an increase of approximately 59,000 more adult mosquitoes was observed from 2010. Of the mosquitoes collected from Trap H this season, Cosray identified 26% as vector species and 74% as non-vectors. The traps located in North Middlesex collected the most adult mosquitoes, accounting for 71% of all mosquitoes collected throughout Middlesex-London in 2011. Although Trap H yielded the greatest number of mosquitoes this season, it did not accumulate the greatest number of vector specimens in comparison to other trap locations. In 2011, Trap H was composed of only 26% vector species and no WNV-positive mosquito pools.

The second most populated trap, Trap M, yielded a total of 98.5% vector species and two WNV-positive mosquito pools. In the third most populated trap, Trap J, located in Glencoe, 100% of the mosquitoes identified were vectors and one WNV-positive mosquito pool was detected. [**Appendix D**].

In comparing the number of vector species identified in the second and third most populated adult mosquito traps, it is evident that although Trap H yielded the greatest number of adult mosquitoes, it did not possess the greatest number of vector specimens in comparison to other trap locations. Traps in Middlesex-London collected 80% to 100% vector species, with the exception of traps located in Parkhill; therefore those traps with a higher number of vector species posed a greater threat of viral transmission to humans, as traps with a high number of vector species have the potential to go positive more frequently than those with lower vector counts. **Table 6-2** represents a summary of the vector species identified from terrestrial traps in 2009, 2010 and 2011.

Table 6-2: Vector species composition.

Vector	Number Identified (2011)	Percent	Number Identified (2010)	Percent	Number Identified (2009)	Percent
Culex pipiens/restuans	1339	7%	1284	7%	1137	9%
Aedes vexans vexans	7365	38%	8423	44%	3193	24%
An. punctipennis	891	5%	703	4%	732	6%
Cq. perturbans	1953	10%	1644	8.5%	557	4%
Culex salinarius	3	0.01%	1	0.00%	1	0.00%
Oc. stimulans	1097	6%	680	3.5%	2152	16%
Oc. triseriatus	459	2%	600	3%	258	2%
Oc. trivittatus	4480	23%	4718	24%	3258	24%
An. quadrimaculatus	345	1.95%	239	1.2%	121	1%
An. walkeri	-	-	-	-	5	0.04%
Oc. canadensis	951	5%	348	1.8%	1351	10%
Oc. japonicus	465	2%	656	3%	549	4%
Culiseta melanura	6	0.03%	1	0.00%	6	0.05%
Oc. cantator	2	0.01%	1	0.00%	-	-
Total	**19356**	**100%**	**19298**	**100%**	**13320**	**100%**

Table 6-3: Species composition in terrestrial traps

Total	Number Identified (2011)	Percent	Number Identified (2010)	Percent	Number Identified (2009)	Percent
Vector	19356	86%	19298	92%	13320	90%
Non-vector	3115	14%	1644	8%	1111	10%
Total	**22471**	**100%**	**20942**	**100%**	**14431**	**100%**

6.4 Canopy Trap Surveillance

Canopy trap surveillance is a unique part of the VBD Program, as the MLHU is the only Health Unit in Ontario to integrate these traps as a permanent part of adult mosquito surveillance. The VBD Team continued to trap mosquitoes at canopy heights for the duration of the 2011 season. Canopy traps were used to analyze the species composition and biting preferences of mosquitoes at heights. Samples were collected from eight canopy traps which resulted in the collection of 14,168 mosquitoes. This is an increase of 8,000 mosquitoes from the number of mosquitoes collected in 2010.

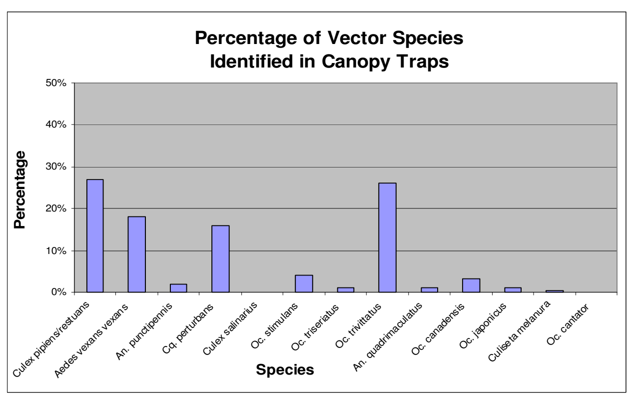

Figure 6-4: Vector species identified from canopy traps in 2011.

Cosray Laboratories identified 4,151 mosquitoes from canopy traps; 72% vector species and 28% non-vectors. This is a slight decrease from 2010 when 79% of mosquitoes were vector species. *Culex pipiens/restuans* (27%) were the most abundant vector species identified in canopy traps this season, followed by *Ochlerotatus trivittatus* (26%) *and Aedes vexans vexans* (18%). Once again, the relative frequency of each vector species was determined by its comparison to the total number of vector species indentified. (Cosray, 2011)

Two pools of *Cx. pipiens/restuans* went positive in canopy traps this season, both of which had corresponding ground traps positive at the same time. This indicates that certain vector mosquito species can be found at both ground and canopy heights; therefore the likeliness of amplifying WNV and/or EEE within avian populations is increased.

Similar to the terrestrial Trap H, Canopy Trap 10 located in Parkhill collected the greatest number of adult mosquitoes at canopy heights this season. Although Can 10 accumulated the most mosquito specimens this season, only 31% were identified as vector species. Compared to Can 8, the second most populated trap, which had a 99.8% vector composition and one WNV-positive pool. All other remaining canopy traps had a vector composition ranging from 82% to 99%. Can 10 yielded one of the lowest counts of vector specimens in comparison to other trap locations and did not have any WNV or EEE-positive mosquito pools.

6.5 Terrestrial Traps versus Canopy Traps

Overall, 148,599 adult mosquitoes were collected from both terrestrial and canopy traps this season. Of all the mosquitoes identified from the traps, 84% were vector species. This is a decline from the composition of vector species observed in 2010, where 90.1% of all adult mosquitoes were vector species, capable of transmitting WNV and/or EEE. In week 35 and 36 canopy traps at Huron Conservation Area and Upper Thames Conservation Area were confirmed WNV-positive along with their corresponding terrestrial traps.

6.6 Discussion

This season the MLHU observed interesting trends in the distribution of vector mosquito specimens identified from traps located throughout Middlesex-London. The number of non-vector species spiked in some areas, whereas other locations experienced increased vector mosquito populations. *Cx. pipiens/restuans* is the most competent WNV vector and it was collected in greater numbers this season, particularly in canopy traps.

Figure 6-5: Canopy Trap 10, with mosquitoes collected from Parkhill in 2011.

Eleven WNV-positive mosquito pools were confirmed by Cosray within Middlesex-London this season, all composed of *Cx. pipiens/restuans* specimens.

This season, Cosray also conducted viral testing for EEE. All EEE viral tests were negative, however this year, 19 specimens of *Culiseta melanura* were found within Middlesex-London. It should be noted that all *Cs. melanura* specimens, including those from 2010 were found at one site; Sifton Bog, located in London. Six *Cs. melanura* specimens were collected from the terrestrial trap located in Sifton Bog, while the other 13 specimens came from the corresponding canopy trap. (Cosray, 2011)

This season 269 pools of *Ae. vexans vexans* were only tested for EEE. In previous years, this species would have been fifth on WNV Testing Order of Preference, however due to changes to EEE surveillance and management guidelines; this species was eliminated from WNV testing this year. Thus, 7,425 *Ae. vexans vexans* specimens from all terrestrial traps and 534 *Ae. vexans vexans* specimens from all canopy traps were not tested for WNV. Species below *Ae. vexans vexans* in WNV Order of Preference list tested WNV-positive this season, therefore it is entirely possible that WNV-positive pools of *Ae. vexans vexans* went undetected this year. (Cosray, 2011)

Throughout the course of 2011, the VBD Team observed significantly higher numbers of adult mosquitoes in traps throughout Middlesex-London. Traps that observed significant increases from previous seasons were Trap H in Parkhill, Trap J in Glencoe, Trap M at Huron Conservation area and Trap I in Strathroy. Adult mosquitoes in traps located outside the City of London experienced the most significant increases, with the number of adults collected in Trap I increasing by over 370%, Trap H increasing by 160% and Trap J increasing by 20%. Trap M also experienced a significant increase of 150% in the number of adult mosquitoes trapped this season. Although significant increases in adult mosquitoes were observed in some traps this season, perhaps the most significant was the vector versus non-vector composition of Trap H.

Although Trap H yielded the largest number of adult mosquitoes caught (95,997), the amount of non-vectors outweighed the number of vectors by nearly 80%. *Ochlerotatus sticticus* (the main member of *Ochlerotatus black-legged* group) were trapped in high numbers in Parkhill. The large number of this nuisance species was so great that it caused serious public concern. This species, a ferocious daytime biter of humans, lays its eggs in ground depressions (flood plains, and woodland pools). The eggs can survive dry spells of up to five years. After any extensive flooding the eggs can hatch. The adults live for up to 85 days. The major generation is in early spring, with only sporadic hatches later in the season. The numbers of this species peaked this year in Traps H and Can 10 and this was noticed in the collections received by Cosray. (Cosray, 2011)

6.7 Conclusions and Recommendations

Adult mosquito surveillance yielded significant results this season as an increased number of adult mosquitoes were collected. An increase of approximately 75,000 mosquitoes was collected in 2011.

Following adult mosquito surveillance this season, the following conclusions have been made:

In 2011 an overall increase in mosquito activity was observed with a total of 148,599 adult mosquitoes collected, an increase of nearly 75,000 mosquitoes and double the number of adult mosquitoes collected in 2010. This increase in mosquito population density can be attributed to environmental factors, such as increased snowfall, which in turn caused water levels to rise with increased snowmelt this spring. Additionally, increased precipitation in the spring, combined with flooding in certain areas and/or higher than usual water levels jumpstarted populations of invasive non-vector species, which created a spike in adult mosquito populations in the late spring to mid-July. The VBD Program observed adult mosquito populations in traps starting to decrease from mid-July to early August, as spring floodwater species began to die off.

The jumpstarting of floodwater species allowed for a significant increase in the number of non-vector *Ochlerotatus sticticus (Ochlerotatus black-legged) Ae. vexans vexans* and *Oc. trivittatus* to be identified in high numbers in both terrestrial and canopy traps. Only 1,083 *Oc. sticticus* were identified in 2010, however 3,368 of these specimens were identified in 2011.

Vector populations of *Oc. japonicus* did not increase for the first time in two seasons. Although the number of *Oc. japonicus* specimens decreased this season, there should still be special consideration given to *Oc. japonicus*, a highly competent WNV-vector species which was confirmed as WNV-positive in previous seasons. Due to its ability to carry and transmit disease, *Oc. japonicus* remains an important WNV-vector to monitor in future mosquito seasons.

In 2011, *Cx. pipiens/restuans* were the most abundant vector species identified in canopy traps, comprising 27% of all vector species identified. The number of adult *Cx. pipiens/restuans* has increased so significantly in the past three seasons that specimen counts at canopy heights are now almost comparable to the number of *Cx. pipiens/restuans* collected in terrestrial traps.

There has also been increased WNV-positive activity in *Cx. pipiens/restuans* trapped at canopy heights. In 2010 a pool of *Cx. pipiens/restuans* trapped in a canopy tested WNV-positive, and in 2011, two WNV-positive pools of *Cx. pipiens/restuans* was confirmed as well. The dominance of *Cx. pipiens/restuans* in canopies, and WNV-positive activity confirmed in this species once again this season indicates that they are still a highly competent vector, not to be overlooked in future surveillance seasons. (Cosray, 2011)

Continuing to collect and identify adult mosquitoes at varying heights is important to determine the frequency of vectors, their biting preferences, and how these preferences may affect human populations. The VBD Team should continue to collect adult mosquitoes from areas that demonstrate high numbers of vector species which may pose a potential threat to human health in future surveillance seasons.

Chapter 7: Human Surveillance of Vector-Borne Diseases

7.1 Introduction

This season, the VBD Team continued to monitor tick and mosquito populations in an effort to reduce the potential risk of vector-borne diseases associated with mosquito and tick bites in Middlesex-London.

7.2 Objective of Human Surveillance

The objective of human surveillance is to understand the epidemiology of vector-borne diseases within the human population. The collection of epidemiological data, which includes the incidence, prevalence, source and cause of the infectious disease, assists in determining biological and environmental risk factors for acquiring the infection.

West Nile Virus, Lyme disease, and the encephalitic symptoms caused by Eastern Equine Encephalitis are classified as both *Reportable Diseases* and *Communicable Diseases* under Ontario's *Health Protection and Promotion Act*. Physicians are required to report suspected, probable, and confirmed cases to the local medical officer of health, who then must report probable and confirmed human cases to the Infectious Diseases Branch of the Ontario Ministry of Health and Long Term Care. (MOHLTC, 2010)

7.3 Human Surveillance of West Nile Virus

Using incidence data from mosquito, bird and human surveillance, risk assessments of local WNV trends can be used to develop comprehensive control efforts and awareness campaigns to protect human health from emerging vector-borne diseases in the community. Human surveillance of reportable diseases such as WNV allows the MLHU to continually develop and update strategies to help aid in the reduction of vector-borne diseases. As WNV continues to pose a threat to residents, it is essential to track the cases on a year-to-year basis to understand the changing dynamics of WNV infection.

Background

The Public Health Agency of Canada's (PHAC) WNV case definition is used by healthcare providers to diagnose WNV in human populations. Case definitions are continually updated to reflect additional information concerning the signs and symptoms of the disease.

West Nile Virus Infections are classified into three infection types: West Nile Virus Neurological Syndrome (WNNS), West Nile Virus Non-Neurological Syndrome (WN Non-NS), and West Nile Virus Asymptomatic Infection (WNAI). WNNS and WN Non-NS cases may be classified as suspect, probable, or confirmed, and WNAI cases as probable or confirmed.

Both clinical symptoms and laboratory findings based on blood work must be interpreted in order to reach a diagnosis, and specific criteria must be met in order to classify a case as suspect, probable, or confirmed. The clinical and laboratory criteria for diagnosis of WNV and case classification criteria based on the Ministry of Health and Long Term Care's (MOHLTC) *Infectious Disease Protocol, 2009* case definitions are outlined in **Appendix D**.

Methods

In the event of a human WNV diagnosis in Middlesex-London, the MLHU has infectious disease staff members who initiate an investigation. Preliminary actions include the notifying the MOHLTC through the Integrated Public Health and Information System (iPHIS). A comprehensive assessment of the case's travel history, recent blood donation/transfusion history, symptoms, and results is conducted. Results of each investigation are forwarded to the MOHLTC where they once again review the blood donation history of the patient. Canadian Blood Services is also notified of human, mosquito, bird, and sometimes equine surveillance, which provide a more complete picture of the presence of WNV in a community.

Results

The number of reported cases of WNV-related illness saw a significant increase from the past two seasons. In 2009 and 2010, WNV illness remained low at the national and provincial levels. This season, the MLHU reported one confirmed WNV positive human case and one probable WNV human case. Both illnesses were acquired locally. Unfortunately, the confirmed case passed away shortly after being diagnosed with WNV. These positive human cases were the first cases in Middlesex-London in two years. The last positive human case reported was in 2009, when one probable case of WNNS whose illness was acquired locally.

In Ontario, the 2011 WNV human surveillance report identified 72 probable and confirmed human cases. Four of these 72 cases were travel-related. This outcome is significantly higher than the cases reported in the past four seasons. The last time Ontario saw greater than 10 cases was in 2006 and 2007, outbreak years for WNV both nationally and provincially. Prior to 2006, positive human cases were reported in high numbers on an annual basis, following the initial outbreak of WNV in 2002.

The national outcome for the 2011 season yielded a total of 110 cases of WNV (PHAC, 2011). Although the 2008, 2009 and 2010 seasons revealed a decline in the incidence of West Nile Virus infections it is evident from the increase in WNV-positive cases this season that trends are starting to reflect years similar to those leading up to 2007. This is problematic as 2007 was the worst year for WNV activity in Canada with 2200 confirmed human cases.

The number of WNV human cases in the USA decreased from the 2010 season. In 2011, only 474 human cases were reported. This is significantly fewer cases than the 981 WNV cases reported in 2010. It is also important to note that although WNV positive cases decreased throughout the U.S as a whole, however there was an increase in cases from the states that border Ontario. In 2011, Michigan's numbers increased from 29 human cases in 2010 to 33 cases in 2011 and in Ohio, where only five cases were reported in 2010, 20 human cases were reported in 2011. Both New York and Pennsylvania observed decreases in the number of confirmed WNV human cases

These WNV human infections in areas just south of our border pose a significant concern for the MLHU, as the identification of WNV human cases confirms that viral activity is active in these regions, and can therefore be extended into Ontario at any time though travel and tourism, the migration of avian specimens, and/or though the displacement of mosquito vectors in artificial and shipping containers moving in and out of the country. (CDC, 2010)

West Nile Virus Case Study

A WNV-positive human case is identified when a person visits a physician and the symptoms of West Nile Virus infection are identified. The health care provider then submits a blood sample to the Public Health Laboratory. The first test performed is the IgM Enzyme-Linked Immunosorbent Assay (ELISA), which, if positive, is run once more to rule out false positive results. These two tests may then be followed by Plaque Reduction Neutralization Test (PRNT) to confirm the diagnosis. If the IgM ELISA tests are positive, the patient is advised that they are a 'Probable' WNV case. The ELISA results are available within 24 hours, while the PRNT confirmation testing takes an additional seven days.

Upon laboratory confirmation of WNV, the health unit conducts interviews with the patient to determine exposure information.

Following the confirmation of the WNV human case this season the health unit contacted the client in order to follow up. During initial follow-up, the health unit learned that the client was an avid gardener who often chose not to wear insect repellent. The client had complained of an increased number of mosquito bites this season, often occurring during her time spent in the garden. Upon contacting the client for a second time, the health unit was informed the patient had passed away. The health unit issued a press release in order to inform the community of the presence of WNV and that the VBD Team heightened its monitoring and surveillance efforts in areas surrounding the client's residence. Two hotspot adult mosquito traps were set up and increased monitoring visits were made to all public parks in the area in order to try and identify additional areas of standing water. The hotspots traps did not yield any positive results. Vector-Borne Disease staff monitored parks in the area thoroughly in order to try and eliminate any vector mosquito larvae which may have been present in those areas.

Discussion

The epidemiology and risk assessment of WNV transmission in Ontario is facilitated through the evaluation of human trends. Although the number of reported WNV clinical cases demonstrated a decline over the past three seasons, the increase of human cases in 2011 both locally, provincially and nationally indicates that the risk of obtaining a WNV infection still exists, despite occasional decreases throughout the years. Many WNV infections go undetected, as 80% of cases are asymptomatic and 20% of cases result in flu-like symptoms. With less than 1% of those infected experiencing life-threatening symptoms, the number of clinically diagnosed infections of WNV may often go unreported for any length of time.

This season WNV monitoring and surveillance indicated that the virus was present in the community, with the identification of 11 WNV-positive mosquito pools, the detection of West Nile Virus in nine dead crows and the identification of two WNV human cases, one of which was followed by the death of a London resident. The recognition of viral activity within the community is indicative of the need for continual monitoring and control of larval and adult mosquito species, reducing the associated risks for human WNV transmission. In order to address the growing number of standing water sites that are added to the VBD Team's monitoring and surveillance schedule each season, the health unit must remain diligent in concentrating its efforts to reduce and repel vector mosquito larvae.

Conclusions and Recommendations

Human infection typically occurs towards the end of a season once the virus has already amplified within avian and mosquito populations. Human surveillance is important for understanding the epidemiology and clinical course of infection of the virus. A comprehensive West Nile Virus monitoring program not only monitors for the human incidence of WNV, but also takes preventative action to reduce the risk of infection before it has the potential to affect humans. A combination of human, mosquito, bird, and equine surveillance provides a thorough understanding of the presence of WNV in a community, serving to protect residents through the use of personal protection, public education campaigns, and additional control measures.

7.4 Human Surveillance of Lyme Disease

Background

Lyme disease (LD) is caused by the bacterium *Borrelia burgdorferi*, it is transmitted through the bite of the *Ixodes scapularis* species, commonly known as the blacklegged or deer tick. LD can have serious symptoms; however, it is a bacterial infection, therefore, it may be treated by anti-biotics. Symptoms become increasingly worse if an infection remains undiagnosed and/or untreated.

The 3 Stages of a Lyme Disease Infection:

Not every person infected with LD experiences symptoms at each stage, and patients typically only experience the latter stages of infection if it remains untreated.

Stage 1: A circular, or "Bulls-Eye", rash called an erythema migrans (EM) is indicative of the initial infection. This occurs in approximately 70-80% of cases 3 days to 1 month after infection at the site of the bite. Flu-like symptoms may also be experienced.

Stage 2: This stage may last up to several months and include: central and peripheral nervous system disorders, multiple skin rashes, arthritis and arthritic symptoms, heart palpitations, and extreme fatigue and general weakness.

Stage 3: This stage may last several months to years, and include chronic arthritis and neurological symptoms or adverse fetal affects in pregnant women.

In order to diagnose LD, a health care practitioner must first evaluate a patient's clinical symptoms and risk of exposure to infected ticks. A blood test may be ordered by a practitioner in order to detect the presence of antibodies for *Borrelia burgdorferi* by means of two IgM/IgG ELISA tests performed simultaneously. (PHAC, 2006)

Results

There were 73 tick submissions from the public to the MLHU in 2011; two of these submissions were identified as *Ixodes scapularis*, known vector species for the LD causing bacterium. One of the blacklegged ticks was collected from within Middlesex-London and the other was acquired from Brockville, Ontario. Brockville is a town located just outside an endemic area, North-east of the St. Lawrence Islands Provincial Park region.

This season there were two confirmed human Lyme disease cases in Middlesex-London, both of which were travel-related. One case was exposed from travel to Turkey Point, Ontario, and the other was exposed from travel to Rondeau Provincial Park. Both of these areas are known endemic regions for blacklegged tick populations. The total number of Lyme disease cases for the province of Ontario has yet to be confirmed.

Discussion

Although the risk of acquiring Lyme disease remains low in Middlesex-London, it is apparent that one can acquire LD from an infected tick anywhere in the province. This is because ticks can travel from region to region on migratory birds or mammals. Although Middlesex-London does not have an established black-legged tick population, there are endemic areas within 100km of the region in Norfolk County and Windsor-Essex County. Therefore, it is essential that the VBD Team continue to implement public education strategies that inform the public of preventative measures and recognizable symptoms in order to prevent and detect early signs of LD. The VBD Team must also continue to perform tick dragging in areas identified as having a high number of tick submissions, or areas where residents reported a high number of tick sightings or tick bites. This season the VBD Team performed tick dragging on several occasions; these drags were either requested by concerned citizens or initiated due to a high number of tick submissions from certain areas within Middlesex-London.

In 2010, Lyme disease became a nationally reportable disease. This now means that all health care providers must report confirmed cases of LD to the Public Health Agency of Canada (PHAC). Now that LD has become nationally reportable, health units will be able to better track cases and understand the epidemiology of the disease and its origins. Since 2011 was the first full season of LD being nationally reportable, there have not yet been national statistics developed on the prevalence of LD within Canada. As cases are reported on an annual basis and the PHAC collects more data on reported human cases throughout the country, the Middlesex-London Health Unit hopes to report on more detailed national statistics relating to black-legged tick populations and human LD cases in future reports.

7.5 Human Surveillance of Eastern Equine Encephalitis

Background

Eastern Equine Encephalitis is a viral infection that causes high mortality rates in humans; approximately 5% of EEE infections advance to include severe encephalitic symptoms and 70% to 90% of those who develop severe encephalitis die from the disease. Those who survive typically experience progressive mental and physical disabilities. (CDC, 2011)

Eastern Equine Encephalitis is a mosquito-borne disease that can be transmitted to humans through *Coquillettidia perturbans*, *Culex salinarius* and *Aedes vexans vexans* species of mosquitoes. *Culiseta melanura* have been identified as the mosquito vectors amplifying EEE within avian populations. Although several EEE vector species were identified this season, no mosquitoes tested positive for the virus, and there were no reported cases of EEE in horses or humans within Middlesex-London. The current risk of human infection in Middlesex-London is low, although positive mosquito pools have been reported in previous years and equine cases were reported in other regions of Ontario and several bordering American states this season. The presence of EEE in neighbouring regions supports the need for continual surveillance and analysis of vector mosquito populations in Middlesex-London. Public awareness of EEE is becoming increasingly important; the high rate of human mortality among those infected coupled with the confirmed presence of EEE within the province necessitates greater focus on developing and implementing public health strategies to reduce the risk of infection.

A lack of positive EEE activity within Middlesex-London this season was not due to a lack of testing or relaxed monitoring efforts. In fact, in response to the 2009 detection of EEE in Ontario mosquitoes, combined with EEE activity confirmed in horses, Public Health Ontario identified a need for enhanced EEE surveillance within the province. Although there have been no reported human cases of EEE in Canada to date, guidelines for the disease were developed and provide a comprehensive overview of EEE and the information needed to do risk assessments and develop EEE contingency plans.

Although the PHAC has not published a nation-wide case definition for the diagnosis of EEE, the Centers for Disease Control and Prevention (CDC) in the United States (U.S) has published case definitions for Arboviral Encephalitides caused by any of the following virus agents: Eastern Equine Encephalitis (EEE), Western Equine Encephalitis (WEE), St. Louis encephalitis (SLE) and La Crosse (LAC) encephalitis which are transmitted by mosquitoes. These case definitions, in conjunction with the new EEE guidelines provide a technical reference for the MLHU to effectively monitor for and manage EEE.

Discussion

Although there were no human cases of EEE reported in Ontario this year, the report of a single human case may signify that an outbreak is developing (ODH, 2010). Positive equine cases within regions serviced by two Ontario health units reveal that the virus is present in the province; therefore, the risk of human infection is possible. This information, coupled with the fact that the prognosis for those infected with EEE is poor due to the virulence of the disease, emphasizes the importance of continued surveillance of EEE vector species. It is imperative that the VBD Program maintain education campaigns to inform the public of measures to protect against mosquito bites, to eliminate mosquito breeding grounds, and to provide information regarding EEE and its human health implications.

7.6 Human Surveillance of Vector-Borne Diseases Conclusion

The human surveillance of vector-borne diseases is an important aspect of the VBD Program. Human surveillance information is used in a number of important ways. Knowing that WNV, EEE or LD is in an area puts the general public on alert. This includes doctors and healthcare providers who may also be alerted in order to look for associated signs and symptoms in patients. It also provides more clues to health unit staff about who may be at risk for serious health effects that vector-borne diseases can cause. In addition, human surveillance provides information to help ensure the safety of the blood supply in Canada. Every time a WNV case is confirmed, the patient is interviewed in detail and asked if they have recently given blood. Canadian Blood Services is contacted in order to ensure that the blood supply remains safe and protected.

Chapter 8: Mosquito Control

8.1 Introduction

Controlling vector mosquito populations is a major component of West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) management. The effective control of mosquito populations can help minimize the amplification of vector-borne diseases and can also help to reduce the spread of infection to human populations. Controlling vector mosquito populations before they reach adult and/or biting stages of development has been a key component of the Vector-Borne Disease (VBD) Program for the past ten seasons. The aim of the VBD Team's mosquito control program is to reduce vector mosquito populations while remaining economically and environmentally sound. Staff from both the VBD Team and the Canadian Centre for Mosquito Management (CCMM) employed an Integrated Pest Management (IPM) approach once again this season. IPM is a decision-making process that includes: planning, identification, monitoring, control and evaluation of the pest management strategy (British Columbia Ministry of Agriculture and Lands, 2007). This process ensures that the VBD Team is only controlling mosquitoes that have the potential to transmit vector-borne diseases and harm human health.

8.2 Products and Application

All staff involved in the application of pesticides holds either a Pesticide Technician licence or an Exterminator licence, both of which are provincially regulated by the Ministry of the Environment (MOE) and issued in accordance with the *Pesticides Act* under the Pest Management Regulatory Agency of Canada (PMRA). The VBD Program continued to use larvicides that are applied directly to water; therefore, they are classified as "Class 2" by the Pest Management Regulatory Agency (PMRA) of Canada. The PMRA requires that Class 2 pesticides be applied by trained and licensed personnel.

Bacillus thuringiensis israelensis (*B.t.i.*) and *Bacillus sphaericus* (*B.s.*)

Bacillus thuringiensis israelensis (*B.t.i.*) and *Bacillus sphaericus* (*B.s.*) are biologically safe organic pesticides utilized by the MLHU. Both *B.t.i.* and *B.s.* contain bacteria that create a lethal reaction in the alkaline environment of a mosquito larva's digestive system.

Figure 8-1: MLHU staff member preparing to treat a woodland pool with VectoBac® 200G.

While the modes of action for these two bacteria are similar, *B.t.i.* endures for approximately 48 hours, whereas *B.s.* can remain in a treated body of water for up to seven days.

VectoBac® 200G and VectoBac® 1200L contain *B.t.i.* as the active ingredient; alternatively, Vectolex® products contain *B.s.* as the active ingredient. This season the MLHU and CCMM utilized products containing *B.t.i.* for the treatment of standing water located in ditches, woodland pools, ponds and storm water management facilities. Although the VBD Team utilized *B.t.i.* this season, the MLHU's permits did allow for the use of *B.s. Bacillus sphaericus* is approved for use on the health unit's permits because it can be used as a back-up and/or may be utilized in future surveillance seasons if deemed necessary by the VBD Team and its service provider.

Methoprene

Catch basins are primarily treated with Altosid® pellets or briquettes, which are Methoprene products. Methoprene is an insect growth regulator; which works by disrupting the lifecycle of mosquitoes. Methoprene products prevent development beyond the larval stage. Laboratory tests reveal it is slightly toxic to fish, and can be toxic to some freshwater invertebrates. However, when used according to proper label directions, field research has shown low toxicity levels and no permanent adverse effects on non-target populations of amphibians and mammals, including humans (Health Canada, 2010). This season, CCMM utilized Altosid® products to treat vector mosquitoes located in catch basins and sewage lagoons within the City of London's Pollution Control Plants.

Table 8-1: Surface water sites treated 10 or more times throughout the 2011 season.

18 Treatments	Site Name	Component
HULONESA07	Westminster Ponds (Zone 5)	Woodland Pool
17 Treatments		
HULONESA02	Sifton Bog (Zone 2)	Woodland Pool
HULONESA05	Westminster Ponds (Zone 3)	Woodland Pool
HUSWM008	22478 Dundonald Road	Ditch
16 Treatments		
HULON013	Applegate SWMF-C	SWMF-C
HULON030	Beaver Pond	Woodland Pool
15 Treatments		
HULON001	800 Springbank Drive	Pond
HULON031	Jack Nash	SWMF-F
HULON062	Pond Mills SWMF	SWMF-F
14 Treatments		
HULON002	Frog Pond, Storybook Gardens	Pond
HULON037	Sunningdale Road pond	Pond
HULON038	Pinecourt SWMF	SWMF-F
13 Treatments		
CCMM017	Huron Conservation Area	Woodland Pool
HULON004	Southwest Optimist Park	Ditch
HULON012	Longwoods Road Ditch	Ditch
HULON018	North Lambeth SWMF	SWMF-F
HULON049	Stoney Creek Valley Park	Woodland Pool
HULON052	Kilally SWMF	SWMF-F
HULON061	Pond Mills SWMF	SWMF-CH
HULONESA06	Westminster Ponds (Zone 4)	Woodland Pool
HUMC001	Weldon Park Creek	Field Pool
12 Treatments		
HULON005	Crestwood SWMF	SWMF-F
HULON017	North Lambeth SWMF	SWMF-C
HULON032	Corlon SWMF-F	SWMF-F
11 Treatments		
HULON010	Summercrest SWMF	SWMF-F
HULON024	Sam's Club SWMF	SWMF-C
HUMC002	Weldon Park Ponds	Pond
HUSC011	Thornhead SWMF	SWMF-F
10 Treatments		
HULON014	Applegate SWMF	SWMF-F
HULON022	Manning Dump	SWMF-F
HULON051	Kilally SWMF	SWMF-C
HULON066	Hamilton Road SWMF	SWMF-C
HULON069	Brunswick Ave	Woodland Pool
HUNM018	Craig Street Ditch	Ditch

8.3 Standing Water Treatments

This season, 655 hectares (ha) of potential mosquito habitat was monitored by the VBD Team. These sites were monitored on a weekly basis and treatments were conducted when greater than seven vector mosquito larvae were identified. Throughout the 2011 season, 919 treatments were made at 247 sites monitored by the VBD Team and its service provider [**Appendix F**]. These numbers indicate that 21% of monitoring visits included treatment, and that 56% of sites monitored were treated one or more times. Larvicide was applied to 11.75 ha of standing water located on public property. The scope of surface-water surveillance and control included the municipalities of Adelaide-Metcalfe, London, Lucan Biddulph, Middlesex Centre, Newbury, North Middlesex, Southwest Middlesex, Strathroy-Caradoc and Thames Center. The majority of treatments were made at sites located within the City of London. This can be attributed to the large number of storm water management facilities and naturalized woodlands located within the City.

Figure 8-2: MLHU staff member treating a woodland pool with VectoBac 200G.

The total area of surface water that required treatment this season was smaller than the 13 ha treated in 2009 and 2010, however the number of treatments from 2010 to 2011 increased by 92. This can be attributed to smaller areas of water being treated this season. An increase in treatments without a significant increase in surface area indicates that smaller-scale treatments were performed more frequently than large-scale treatments.

Thirty-four (34) standing water sites were treated ten or more times in 2011 [**Table 8-1**]. This is an increase from only 27 frequently treated sites in 2010. This increase in frequently treated sites also correlates with the overall increase in total treatments made.

An increase in frequently treated sites (ten or more) also indicates the continued naturalization of SWMFs and woodland pools throughout Middlesex-London. As these structures begin to age they develop more vegetation and organic content, becoming an ideal mosquito breeding habitat. Through the analysis of trends over the past ten seasons, the VBD Team has correlated the increase in treatments to the maturity of many naturalized sites located throughout Middlesex-London.

8.4 Canadian Centre for Mosquito Management, (CCMM) Activities

Catch Basin Treatments

In 2011, a 3-round approach to municipal catch basin larviciding was conducted at roadside catch basins using Altosid® pellets. A calculated approach to catch basin treatments was taken in which the three treatment rounds were evenly spaced to achieve optimal mosquito control at the most crucial times for mosquito amplification. Earlier phases of catch basin larviciding are considered essential in order to reduce these early spring species. The elimination of mosquito populations early in the season slows the amplification of WNV throughout the summer months.

Figure 8-3: CCMM staff treating a roadside catch basin.

Throughout the 2011 season 66.1 kg of Altosid® pellets were used to treat urban catch basins. Twenty (20) VectoLex® pouches were used to treat roadside catch basins that had outflows into environmentally sensitive areas. In addition, 1060 Altosid® XR Briquettes were applied to non-roadside catch-basins, including: catch basins located in rear yards of residential properties [146]; catch basins located in municipal green-spaces [260]; and catch basins located on sites such as government buildings, social housing units, and long-term care facilities [654]. These applications were generally made early in the season and were considerate of the extended period of residual activity associated with the briquette formulation. The 2011 Catch Basin Treatment flyer [**Appendix G**] describes catch basin treatment rounds and includes the colour code used to indicate treatment count this season.

Mapping

Standing water sites established as part of the mosquito surveillance schedule are mapped using Global Positioning System (GPS) coordinates. These coordinates represent the exact geographic locations of standing water sites. Standing water sites often exist a considerable distance from roadways or well-established paths; therefore, the specificity of GPS coordinates used to identify sites is helpful for both the MLHU and CCMM staff, allowing team members to easily locate standing water through the direction of GPS coordinates and detailed site descriptions.

8.5 Pollution Control Plants

Larval mosquito populations in pollution control plants (PCPs) were also regularly monitored this season. In partnership with the City of London, CCMM accessed seven PCP's, enabling them to monitor and treat any vector mosquito larvae they identified in the standing water located within these structures. The first identification of mosquito larvae within PCPs was confirmed in the last week of May this season, and these surveillance and treatment visits continued until July 27th, 2011. In total, seven PCPs were monitored and 20 treatments were conducted at five municipal pollution control plants within the City of London. CCMM staff applied 8.92 kg of Altosid® Granules to 0.797 hectares of surface waters located in sewage lagoons. The success of these controls was monitored following treatment and the effectiveness of applied controls this season was considered to be excellent. On no occasion was re-treatment necessary. (CCMM, 2011)

8.6 Source Reduction

While the treatment of standing water with larvicide is effective at temporarily reducing larval mosquito populations, the elimination of standing water through source reduction has greater efficacy, as it results in permanent pest control.

The removal of standing water eliminates suitable environments for mosquitoes to lay eggs; therefore, their lifecycle is halted, and further development is prevented. The removal of standing water sites requires collaboration between the MLHU and local partners.

This season one site located in Parkhill was remediated and the MLHU made recommendations to remediate a second site located at the Parkhill dump in the fall of 2011, in order to reduce the amount of stagnant water that may collect during snowmelt or heavy precipitation in the spring of 2012. Continued collaboration with city and municipal partners is crucial in order to effectively identify areas of concern and reduce artificial or made-made habitats throughout Middlesex-London, that enable vector mosquito larvae to develop in these unmaintained structures.

8.7 Adulticiding

Adulticiding is a method of control that reduces the adult mosquito population through the application of insecticides. The MLHU did not necessitate adulticiding as a component of the VBD control program this year. In the event that WNV and/or EEE posed significant risk to human health, and current control measures did not adequately prevent amplification of the virus, the Medical Officer of Health for Middlesex-London would determine whether adulticiding was a necessary course of action for the MLHU to take. This decision would be based on the results of a local risk assessment. A local risk assessment takes into account: monitoring data; the presence of WNV and or EEE in humans, adult mosquitoes and birds; and the efficacy of control methods already in place. (MOE, 2009)

The application of adulticides usually occurs between dusk and dawn, at which time mosquitoes are more active and honey bees are less active. The MOE requires that residents of neighbourhoods scheduled to undergo insecticide treatment receive notification 48 hours to seven days before application through a minimum of two media outlets. (MOE, 2009)

8.8 Conclusions and Recommendations

In order to improve the quality of the MLHU's mosquito control program, the following recommendations should be considered:

The MLHU's mosquito control program reduces the number of vector mosquito larvae on publicly-owned property in Middlesex-London. In 2011, the MLHU observed an increase in the number of treatments performed, however the total area of surface water that required treatment was less than 2010. This increase in the amount of surface water locations that required control signifies the continued need for a vector mosquito control program in Middlesex-London, as surface area may not necessarily need to increase in order to facilitate the increased development of vector mosquito populations, and ultimately control.

The VBD Team should continue the recording of pre- and post-treatment larval counts and collection of environmental data when monitoring standing water sites. The MLHU's current control program incorporates the recording of larval counts and environmental data both pre- and post-treatment. This data allows for the evaluation of larvicide efficacy and the determination of trends related to the maturity of sites, including monitoring levels of vegetation and organic matter each season.

The VBD Team has noted trends in naturalized bodies of standing water, as sites that mature develop more vegetation along the water's edge, creating an ideal habitat for vector mosquito larvae and therefore increasing the number of required treatments. By monitoring these variables, the VBD Team is able to evaluate the role that the environment and naturalization plays in larval development.

The VBD Program should continue to monitor surface waters from week 20 to week 40, as demonstrated by **Figure 8-4**. The VBD Team should maintain its current monitoring schedule, keeping control programs in place for the duration of these weeks, or until future surveillance data indicates otherwise. This season the MLHU saw an increased number of treatments late into the 2011 season. Although treatments usually begin to decline by the end of August, there were still significant counts of vector mosquito larvae being identified in September and October. It is important that the MLHU maintain its surveillance program in order to identify and control vector mosquito populations late into the season, especially if the weather continues to provide a conducive environment for vector mosquito breeding.

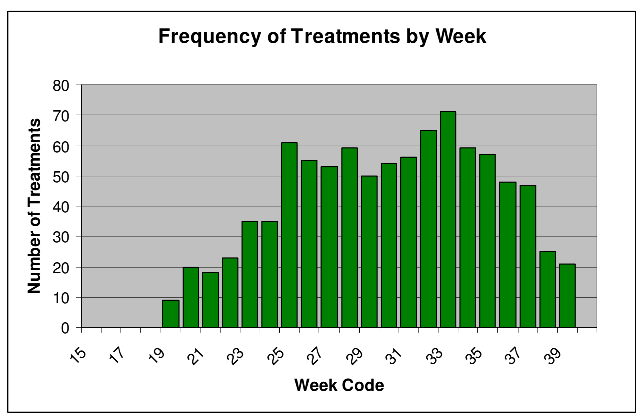

Figure 8-4: Number of treatments made by the MLHU.

Chapter 9: Storm Water Management Facilities

9.1 Introduction

Storm Water Management Facilities (SWMFs) are temporary retention ponds that house water during the final stages of storm water management. The process of managing storm water aims to direct urban rainfall and surface water runoff into a receiving body of water. This process helps to trap sediments, retain pollutants, and prevent erosion and downstream flooding when heavy precipitation overwhelms an urban area. Storm Water Management Facilities have the potential to become an ideal habitat for mosquito larvae, as they retain water for a long period of time to induce further settling before release into a sewer system or a receiving body of water. Emergent vegetation found along the banks of SWMFs provides shelter from wind and predators, further protecting larvae throughout the stages of a mosquito's life cycle. In 2011, three new locations were added to the SWMF monitoring schedule. These new locations were Turnberry SWMF in Dorchester, Parkwood SWMF at Victoria Hospital and a new Forebay at Manning Dump in South London.

Each SWMF may be comprised of several components such as a forebay, cell, channel and/or plunge pool, therefore multiple sites can be present at each SWMF location. During the 2011 season, a total of 77 sites at 42 locations were visited. A complete list of the SWMFs and their associated components that were monitored during the 2011 season has been included in **Appendix H.**

9.2 Results

Overall, 77 sites were monitored 1,559 times over a period of 22 weeks. During this time, 68 of these sites were considered productive, and 16,582 larvae were collected from these locations. This count is lower than the 20,000 larvae observed in 2010, however still higher than the 11,075 larvae observed in 2009. In total, 88% of all SWMFs bred larvae at least once over the course of the season, with 42% of sites requiring treatment five or more times.

This season, eight different species were recognized from 6,700 larvae identified in the Strathroy laboratory. Seven of the eight species recognized in SWMFs this season were vector species. This species breakdown is outlined in **Figure 9-2**. The number of larvae identified in 2011 is only slightly higher than the 6,666 larvae identified in 2010, however still significantly higher than the 3,641 larvae identified in 2009.

Figure 9-1: VBD staff monitoring a SWMF.

This season, as in previous years, there were no more than three distinct species found at any SWMF site on any given visit, with the exception of one surveillance visit in week 33, when four distinct species of larvae were collected from the Pinecourt Forebay. Similar to previous years, the predominant species found in SWMFs were of the *Culex* genus. The three most common species identified in storm waters this season were *Culex territans*, *Culex pipiens* and *Culex restuans*. This year, *Cx. territans*, a non-vector species, increased once again and was the most predominant species identified in SWMFs this season. *Culex territans* represented 37% of all larvae identified in 2011, in comparison to only 25% in 2010.

Culex pipiens and *Cx. restuans*, both established vectors of West Nile Virus, accounted for 21% and 13%, respectively, of all larvae identified from SWMFs. Similar to 2010, larvae belonging to the *Anopheles* genus were the second most prevalent, with *Anopholes punctipennis* accounting for 12% and *Anopholes quadrimaculatus* accounting for 11% of all larvae identified. As the number of non-vector *Cx. territans* increased this season, the composition of vector mosquito larvae identified in turn decreased.

In 2010, 75% of all larvae identified were vector species, however in 2011, this number decreased to only 63% vector species identified. This decreased percentage of vector specimens may be attributed to the overall increase in non-vector species *Cx., territans*, which saw a 49% increase from 2010 to 2011.

Table 9-1: SWMFs treated five or more times.

Site Name	Component	Number of Treatments
Applegate	Cell	16
Pond Mills	Forbay	15
Jack Nash	Forebay	15
Pinecourt	Forebay	14
North Lambeth	Forebay	13
Kilally 2	Forebay	13
Applegate	Cell	13
Kilally 1	Forebay	13
Pond Mills	Channel	13
Crestwood	Forebay	12
Summercrest	Forebay	12
North Lambeth	Cell	12
Corlon	Forbay	12
Sam's Club	Cell	11
Thornhead	Forebay	11
Manning Dump	Forebay 1	10
Kilally 2	Cell	10
Hamilton Road	Cell	10
Fanshawe Ridge North	Forebay	9
Turnberry	Forebay	9
Crestwood	Cell	8
Summercrest	Cell	8
Fanshawe Ridge North	Cell	8
Corlon	Cell	7
Sam's Club	Forebay	7
Meadow Creek	Cell	7
Hunt Club	Cell	6
River Road	Forebay	6
Thornhead	Cell	6
Turnberry	Cell	6
Hunt Club	Forebay	5
Talbot Village	Forbay	5
Mornington	Forebay	5
Ilderton- King Street	Forebay	5

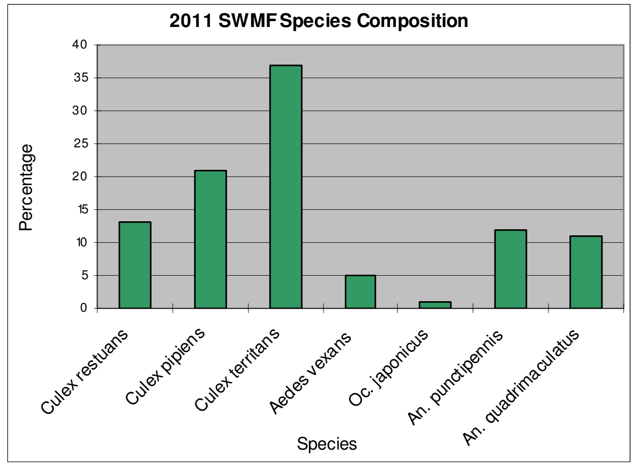

Figure 9-2: 2011 SWMF species composition.

9.3 Treatments

Over the course of 22 weeks, SWMFs were treated 398 times, covering an area of 7.5 hectares. This was an increase from 366 treatments in 2010 and 215 treatments conducted in 2009. **Table 9-1** lists the storm water sites that were treated five or more times in 2011. This season, Applegate was the most frequently treated SWMF requiring 16 treatments. Jack Nash and Pond Mills were the second most frequently treated SWMFs in 2011, both requiring 15 treatments. Both of these sites have been the most frequently treated SWMFs for the past four seasons, with over 10 treatments performed in each component since 2008.

VectoBac 200G® was the main larvicide used at SWMFs this season, with 115 kg used at an application rate of 9.8 kg/ha. This application rate is classified as 'high', and was chosen based on findings of higher larval counts and high levels of organic matter in the water. The number of treatments performed on the individual SWMFs was dependent on the number of larvae found, the temperature, and precipitation levels.

With only three treatments performed in SWMFs in the month of May, the number of treatments performed on SWMFs increased significantly in the month of June, following heavy and consistent rainfall in the last two weeks of May.

The highest number of treatments took place in weeks 28 to 33 (July 10th to August 20th). The number of sites treated five or more times increased once again this season, from 28 frequently treated sites in 2010 to 34 frequently treated sites in 2011.

9.4 Discussion

Data analysis from 2007 to 2011 revealed significant increases in the number of monitoring visits and treatments performed. These increases were observed as the number of site visits increased by approximately 20% each season and in effect, the number of treatments also increased to reflect the changing dynamics of certain SWMFs. These increases were also attributed to the naturalization of mature SWMFs, a process in which the vegetation and organic content of a site increase over time as it ages. This process of naturalization increases the viability of habitat for mosquito larvae, therefore requiring increased monitoring and control efforts.

In 2011, although there were no significant increases in monitoring visits, or treatments, (5% increase in visits from 2010 to 2011), there were significant increases in larval counts observed at SWMFs from 2010 to 2011. Storm waters that had previously bred less than 100 larvae throughout the course of the 2010 and 2009 seasons all saw significant increases in the number of larvae observed in 2011. Examples of this include Manning dump, and Second Street SWMF which both saw a 97% increase in larvae, Parkview Drive in Strathroy, which saw a 73% increase in the number of larvae observed and Meander creek which saw a 54% increase in the number of larvae observed. This increase in the number of larvae observed can be attributed to the naturalization of these SWMFs which bred significantly higher amounts of larvae than previous years. Naturalization is a maturation process that SWMFs go through as they develop vegetation along the water's edge. As a SWMF becomes naturalized, it increases the viable habitat for mosquito larvae, often supporting a diverse range of species, and ultimately increasing the likelihood of vector mosquito proliferation.

Figure 9-3: Turnberry Drive SWMF outfall.

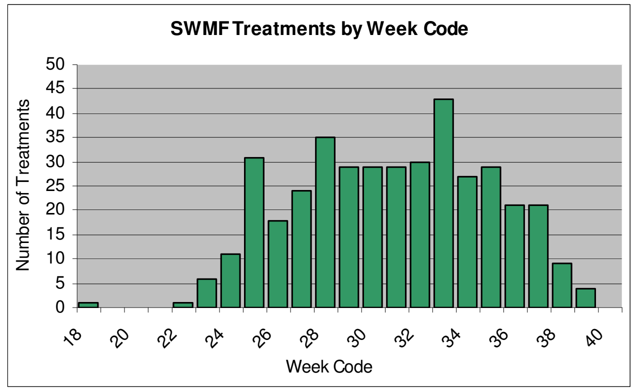

Figure 9-4: Frequency of treatments per week at SWMFs.

9.5 Conclusions and Recommendations

SWMFs should remain the primary area of focus in standing water surveillance due to their natural capacity to favour mosquito larval growth.

Following the analysis of surveillance and treatment activities at SWMFs in 2011, the following recommendations have been made:

The MLHU should continue to monitor the maturity of SWMFs. In 2010, 39% of all larvae identified were collected from SWMF structures and this number grew once again in 2011 as 51% of all larvae identified were collected from SWMFs. As urbanized areas of Middlesex-London continue to expand, the number of SWMFs created through residential development will increase. In combination with precipitation, and warm weather, the naturalization of SWMFs will increase as the site matures. This process was evident from 2010 to 2011 as previously unnaturalized SWMFs which bred very few larvae in 2009 and 2010, bred significantly higher amounts of larvae throughout the 2011 season.

The 2011 season demonstrated the increased production of mosquito larvae at SWMFs that had previously been rated as semi-naturalized in past seasons. The maturity of these SWMFs created a more favourable habitat for larval mosquito production, as these sites had historically seen a lower number of mosquito larvae, coinciding with a classification of 'non-naturalized' or 'semi-naturalized'. As these sites matured, vegetation and organic content flourished, ultimately supporting increased larval production and accounting for the influx in larval identifications and treatments for the 2011 season. The MLHU should maintain community partnerships in order to effectively monitor and/or to resolve SWMF issues. Continued correspondence regarding new and decommissioned storm water management facilities is necessary in order to reduce and eliminate vector mosquito populations within these structures.

Chapter 10: Environmentally Sensitive Areas

10.1 Introduction

Characterized by their unique ecology, Environmentally Sensitive Areas (ESAs) contain diverse natural landscapes which are home to endangered plants, significant wildlife species and also a variety of forests and wetlands. This season, the Middlesex-London Health Unit's (MLHU) Vector-Borne Disease (VBD) Team continued to monitor peripheral pools for vector mosquito larvae contained in ESAs. Environmentally Sensitive Areas located in Middlesex-London are predominantly found near urban, heavily populated areas that are frequently used for recreation during spring and summer seasons. As a result, continued surveillance and treatment of peripheral pools within the ESAs is essential in order to gather data, preserve vulnerable ecosystems, and reduce the risk of contracting mosquito-borne diseases.

10.2 Methods

In addition to larval surveillance and control procedures, which require the identification of vector mosquito larvae prior to treatment, ESAs also require special permits from the Ministry of the Environment (MOE). Mapping of Middlesex-London's existing ESAs was initially performed in 2006. Following an extensive re-inspection of Westminster Ponds and Sifton Bog in 2009, previously concealed ponds were revealed, which remained part of the surveillance schedule for the duration of the 2011 season. Due to the large volume of standing water to be monitored at these sites, two VBD staff were assigned to map the ESA boundaries and maintain larval surveillance and control for the duration of the 2011 season.

10.3 ESA Treatments

Treatments were performed in ESA's when surveillance and identification revealed moderate to high levels of vector mosquito larvae. A 'moderate to high' rating requires at least seven vector mosquito larvae to be identified in a sample in order to conduct a treatment. Treatments occurred 24 to 48 hours following larval identification in the Strathroy laboratory. The monitoring of non-mosquito species also occurred before and after each treatment in order to observe any non-target mortalities which may have resulted from the use of larvicides within ESAs. This season staff did not identify any non-target mortalities in ESAs. If any mortalities were observed, staff would report to the Ministry of Natural Resources and the local conservation authority that maintains ecosystems within ESAs throughout Middlesex-London. [**Table 10-1**]

Figure 10-1: VBD staff dipping for larvae in Westminster Ponds ESA.

10.4 Species Composition

A total of 8,639 mosquito larvae were collected during ESA surveillance in 2011, and 3,320 larvae were identified in the Strathroy and London laboratories. The non-vector species, *Culex territans* (45%) was the most abundant species identified within ESAs this season. *Culex restuans (18%), Anopheles punctipennis* (11%), *Aedes vexans* (8%), and *Culex pipiens* (7%) comprised the largest percentage of vector species found in ESAs.

10.5 Provincially Significant Wetlands

Westminster Ponds Overview

Westminster Ponds is the largest ESA located in London, spanning over 250 hectares of significant wetlands. Increased precipitation near the end of the season, and warmer than usual temperatures into September increased the breeding of vector mosquito larvae later into the month of September, as compared to monitoring and treatment activities from previous seasons. Due to unseasonably warm temperatures combined with increased precipitation into the month of September, treatments increased by 68% in 2011, and three of the five zones were treated more frequently than in both the 2009 and 2010 seasons. **Figure 10-2** demonstrates the composition of species which prompted treatments in the Westminster zones this season.

Table 10-1: ESA site descriptions and treatment count by zone

Name	Description	Subsection	Treatments 2011	Treatments 2010	Treatments 2009	First Treatment	Last Treatment
Kilworth Pond	Near banks of Thames River just west of London. Varying size throughout the season.	N/A	2	6	8	June 17	July 15
Kilworth Treehouse	Low-lying area in woods along Thames River west of London. Floods early in the spring but dries up midseason.	N/A	0	0	1	N/A	N/A
Mill Pond, Strathroy	Swampy woodland pools near river. Remains wet throughout the season. Mainly the peripheral areas require treatment.	N/A	6	3	0	July 22	September 28
Sunningdale Pond	Shallow pond and marshy area. Dries up at various points throughout the season.	N/A	14	12	0	June 29	September 20
Sifton Bog	Canada's most southerly acidic bog. Consists of the bog wetlands as well as peripheral pools. MOE permits allow treatment of solely the peripheral pools, not the bog itself.	Zone 1	8	1	8	June 3	September 13
		Zone 2	17	7	11	May 20	September 28
Victoria St., Strathroy	Combination of several ponds, a marsh and a large woodlot that may fill with water following precipitation.	N/A	0	0	3	N/A	N/A
Westminster Ponds	250 Hectares of significant wetlands. The largest protected area in London, a combination of swamp and bog habitats.	Zone 1	6	5	8	May 19	August 31
		Zone 2	8	13	7	June 10	September 13
		Zone 3	17	10	8	May 20	September 13
		Zone 4	13	7	6	May 20	September 28
		Zone 5	18	2	4	May 12	September 27

Sifton Bog Overview

Compared to 2010, Sifton Bog experienced a considerable increase in the amount of standing water contained within its periphery this season, contributing to the increased larval count observed this year, in comparison to past seasons. In 2011, peripheral pools within Sifton Bog were some of the most frequently treated areas of water within ESAs. The 40-hectare site is known to accumulate large amounts of standing water following rainfall and snow-melt since its original formation was the result of colonized glaciations. This season, wetter than normal conditions caused many of the bog's peripheral pools to hold water late into the season, producing significantly numbers of mosquito larvae, and an increased number of treatments for the 2011 season. **Figure 10-3** illustrates the species composition that was observed at Sifton Bog this season.

10.6 Results and Discussion

Between April 13, 2011 and September 28, 2011, ESAs were visited a total of 336 times, an increase of 19% in the number of visits made to ESAs from the 2010 season. These visits included a combination of regular larval surveillance and control as well as pre- and post-treatment dips.

In 2011, 10 of the 12 sites designated as ESAs required treatment and nine of the 12 sites were treated five times or more. Westminster Ponds Zone 5 was the most frequently treated ESA (18 treatments), followed by Westminster Ponds Zone 3 (17 treatments) and Sifton Bog Zone 2 (17 treatments). In 2010, Westminster Ponds Zone 2 was the most frequently treated ESA (13 treatments), followed closely by Sunningdale Pond with 12 treatments.

Typically the woodland pools and ponds within ESAs begin to dry up by mid-season, however due to a spike of precipitation in August, areas that have typically dried up in previous seasons remained active late into September, prompting increased larval breeding and in turn increased monitoring visits by the VBD Team.

10.7 Conclusions and Recommendations

Environmentally Sensitive Areas play a crucial role in the proliferation of vector mosquitoes within Middlesex-London. These areas are ideal mosquito breeding grounds that are important to monitor because they are located in areas where previous seasons have demonstrated the presence of WNV activity and are also in close proximity to high risk populations.

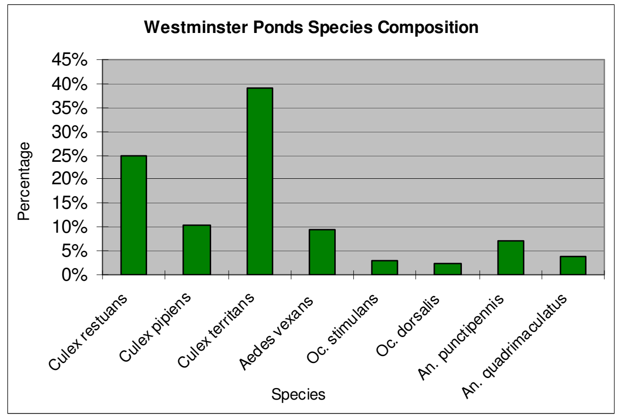

Figure 10-2: Westminster species composition.

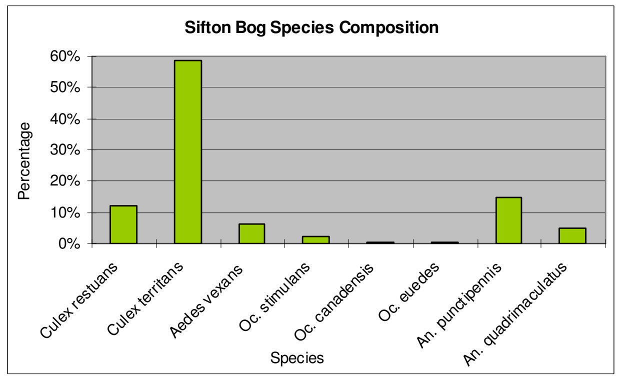

Figure 10-3: Sifton Bog species composition.

It is important that the VBD Program maintain consistent surveillance in order to reduce the amount of vector mosquito larvae that emerge and have the potential to infect local vulnerable populations that reside nearby these significant areas.

The results obtained from surveillance and control activities within ESAs have lead to the following recommendations:

Continue ongoing surveillance and treatment of ESAs as they provide the ideal habitat for larval mosquito breeding. It is essential to continue monitoring for vector mosquito larvae within these areas in order to reduce the threat of transmission and amplification of known vector-borne diseases to local populations.

Chapter 11: Complaints, Comments, Concerns

11.1 Introduction

Once again this season the Vector-Borne Disease (VBD) Team continued to monitor, record and respond to all complaints, comments and concerns (CCCs) received from the public. The initial intake of inquiries was handled by the VBD field technician and then triaged to seasonal VBD staff according to the location and complexity of the concern. In the event of a complaint, appropriate actions were taken to resolve and eliminate the area of concern. Concerns were received by phone, email, or in person, and following an initial dialogue with the complainant, the concern was documented in the VBD Team's complaints database. In some cases, the assistance of Public Health Inspectors (PHIs) and/or local community partners was required to assist the VBD Team in resolving issues on public and/or private property.

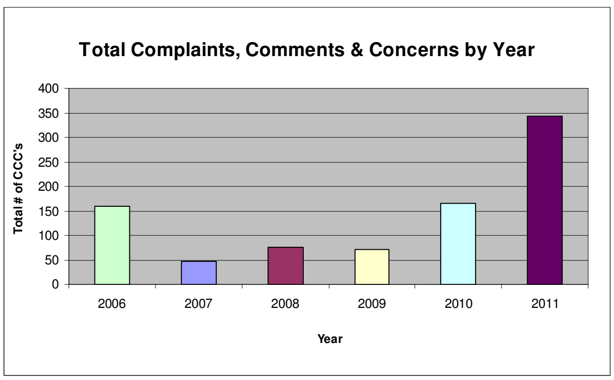

Figure 11-1: Total number of Complaints, Comments and Concerns by year.

11.2 Results

In 2011, the VBD Team received and responded to a total of 373 complaints (including dead bird and tick reporting). This is a 108% increase in the number of reported CCCs from the 2010 season [**Figure 11-1**]. Increased CCCs in the past two seasons indicates that the VBD Team's public education campaigns and promotional brochures have been effective in encouraging residents to call and report any West Nile Virus (WNV) or tick-related concerns, in addition to calling to inquire about personal protection methods and/or advice on how to reduce mosquito or tick bites.

11.3 Overview of Complaints

Dead bird reporting once again represented the greatest proportion of concerns; comprising 41% of all CCCs for the 2011 season. This was significant to the VBD Program's CCC intake, as dead bird reporting assisted with the identification of nine WNV-positive birds, which aided the VBD Team in notifying the public of the presence of WNV in the community.

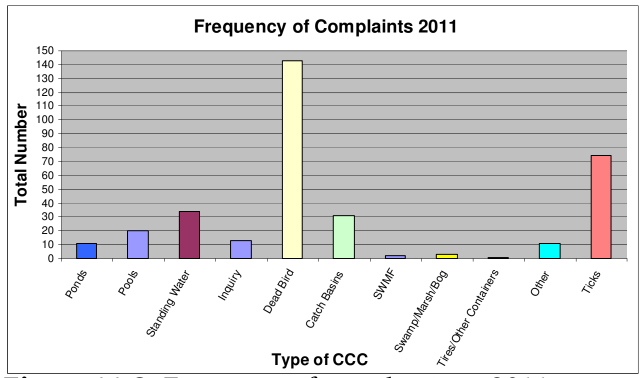

Figure 11-2: Frequency of complaints in 2011.

In past years standing water complaints have represented the greatest number of concerns, however, in the past two seasons, dead bird and tick reporting has increased to become the most frequent types of concerns identified throughout the course of a VBD season.

The MLHU has also observed an increase in the diversity of complaints received throughout the course of a season. From 2006 to 2009 most CCCs reported to the MLHU were regarding standing water and/or catch basins, however in the past two seasons there has been greater diversity represented in the type of concerns reported by the public. In 2011, the MLHU received concerns regarding ponds, Storm Water Management Facilities, swamps, bogs, tires and other containers. In the past the public has called in about general areas of standing water, however this season the public became more specific in identifying types of standing water that posed a concern [**Figure 11-2**]. Although the reporting of specific structures, such as ponds and swamps, was not observed in high numbers, it is still significant that the public has identified a greater variety of standing water concerns, and is taking steps to address a potential risk to human health. In addition to an increased diversity of complaints, the VBD Team observed an increase in standing water concerns.

It is important to note that the number of standing water concerns often fluctuates from season to season depending on the amount of precipitation recorded following snowmelt and during rainy spring months. Although some standing water concerns received this season were certainly the result of snowmelt and spring rainfall, the reporting of standing water concerns observed overall can also be attributed to the VBD Team's public education efforts, encouraging residents to reduce areas of standing water around the home in order to eliminate mosquito breeding. Additionally, the increased number of tick submissions observed in the past three seasons can also be attributed to increased Lyme disease (LD) education efforts to inform the public on how to prevent tick bites and submit ticks to the health unit.

The number of both roadside and non-roadside catch basin concerns and inquiries has increased over the past five seasons. This increase can be attributed to several factors. First, ongoing residential developments throughout Middlesex-London have created new catch basins to add to the catch basin treatment schedule. Second, the MLHU hired a new service provider for mosquito control and an increased number of inquiries were received regarding the new service provider's process of treating catch basins. Lastly, the increase can also be attributed to the growing awareness of the catch basin treatment program, which is promoted by the VBD Team and local media at the beginning of each season. The VBD Team also observed an increased in catch basin inquiries and treatments from the Parkhill area this season. As a result of increased education efforts in Parkhill this year the VBD Team encouraged residents to identify if they had back yard catch basins and call the health unit to have the basins treated. In 2011, forty-three (43%) percent of all CB inquiries were received from Parkhill; a majority of which were received directly following a Parkhill town meeting on July 19, 2011.

11.4 Discussion

Once again this season, the VBD Team observed an increase in dead bird and tick-related concerns. Dead bird and tick reporting has increased in the past two seasons and is significant because both areas require the submission of specimens and allow the VBD Team to identify areas of viral activity and/or establish the presence of vector species in Middlesex-London.

Another new trend observed in 2011 was an increase in the diversity of complaints received by the MLHU. The MLHU observed an increase in the reporting of concerns related to specific types of standing water, which included; ponds, Storm Water Management Facilities, swamps, bogs, marshes, tires and/or other containers. This is significant to the MLHU because it demonstrates that the public is able to identify a variety of structures that have the potential to breed mosquito larvae, rather than just reporting on standing water in general.

Figure 11-3: Pond complaint addressed by VBD staff this season.

The MLHU also observed an increase in the number of general inquiries made to the VBD Team in 2011. In previous seasons there were very few general questions or inquiries made regarding vector-borne diseases and/or protection methods, however this season there were 13 inquiries made to the health unit. Although these inquiries only represent 4% of the total number of CCCs received in 2011, it is still significant because it demonstrates that residents are asking questions, and the MLHU is given the opportunity to educate citizens according to the nature of their inquiry. A majority of the inquiries made this season were regarding ticks and alternative insect repellents. The VBD Team addressed all inquiries thoroughly and hopes to see an even greater number represented in the upcoming 2012 season.

It is important to note in this discussion the increase in mosquito, catch basin and standing water-related concerns received from the Municipality of North Middlesex this season. Located within the Municipality of North Middlesex, the town of Parkhill, experienced an increased number of mosquito bites. This increase was observed by the VBD Team through weekly trapping and identification of adult mosquitoes. This influx of mosquitoes created difficult and uncomfortable living conditions for the residents of Parkhill and the MLHU worked diligently with local community partners to try to address these concerns and inquiries. The influx of adult mosquitoes observed in Parkhill was also represented by the increased number of concerns received from residents in this area. In past seasons, the MLHU has received very few concerns from the Parkhill area, however this season the MLHU received a total of 19 concerns from Parkhill. This accounts for approximately 6% of all concerns received throughout the 2011 season.

The VBD Team responded to several concerns immediately following the Parkhill town meeting on July 19, 2011, and these concerns led to the identification of two new sites and the treatment of 11 catch basins in the week following this town meeting. Concerns voiced at the town meeting also led to two thorough inspections of areas located in Parkhill, led by local residents. During these two inspections, the VBD Team did not identify any vector mosquito larvae, however areas of potential mosquito breeding in future seasons were identified. Additional areas identified by concerned residents were already part of the VBD Team's weekly surveillance schedule, and were monitored on a weekly basis by two staff members.

In order to address the increased amount of resident concerns in Parkhill, the MLHU closely monitored larval and adult mosquito populations throughout the course of the 2011 season. By the end of the season, the VBD Team had identified four new standing water sites in Parkhill, treated an additional 14 roadside and non-roadside catch basins and added a third adult mosquito trap location. The MLHU also collaborated with the Municipality in order to develop a mosquito reporting page on North Middlesex's website, which will be discussed further in Chapter 13, Public Education.

Due to increased public concerns regarding mosquito breeding and mosquito bites in Parkhill this season, the MLHU focused attention on resident concerns and promptly addressed CCCs in a timely fashion in order to reduce vector mosquito larvae and test dead birds for WNV. With the assistance of Parkhill residents calling to report concerns, the VBD Team was able to identify three WNV-positive crows, resolve several standing water concerns, and treat an increased number of non-roadside catch basins throughout the course of 2011. Although the VBD Team monitored mosquito populations closely this season, there were no positive mosquito pools were confirmed in Parkhill.

Figure 11-4: A new site identified by VBD staff in Parkhill this season.

Figure 11-5: Parkhill dump, an additional new site identified by residents following the Parkhill town meeting.

Figure 11-6: VBD staff members investigating an area of concern in Parkhill.

Once again this season, the MLHU distributed letters to homeowners outlining what could be done with unopened or unmaintained pools. This letter assisted the VBD Team in resolving unmaintained pool concerns, as it educated residents on the risks associated with standing water within unopened or unmaintained pools. The goal of this letter was to educate homeowners on eliminating standing water and to encourage homeowners to initiate pool maintenance before water has the chance to collect, attempting to reduce the number of pool complaints the VBD Team receives throughout the course of a season. This letter was distributed to residents in early spring to encourage homeowners to open swimming pools earlier in the season and to avoid accumulating stagnant water on top of pool covers.

A product called Mosquito Dunks® also assisted the VBD Team in resolving many unmaintained pool and standing water concerns this season. Mosquito Dunks® contain the biological larvicide, *Bacillus thuringiensis israelensis* (*B.t.i.*), which is the same ingredient found in products used by the MLHU for seasonal vector mosquito larval control. This product eliminates mosquito larvae by applying one 'dunk' to the water. One 'dunk' lasts about one month; therefore with the purchase of one package, homeowners are provided with enough dunks to last the duration of a season. This product was very helpful to the VBD Team in resolving unmaintained pool concerns and as a last resort for the resolution of standing water concerns. In 2009 there were no commercial products available for residents to purchase at local stores to control mosquito larvae. The VBD Team had to emphasize natural practices to eliminate standing water and mosquito breeding, such as changing water in bird baths, drilling holes in outdoor containers and pumping out water from backyard pool covers. Due to the difficulty in monitoring the status of these practices, the VBD Team could not verify if homeowners maintained these practices beyond the initial and follow-up visits of the complaint. The use of Mosquito Dunks® has assisted in the elimination of larval mosquito breeding at complaint sites, as it provides a straightforward solution to eliminate larvae for approximately one month. Overall, Mosquito Dunks® were an important product that helped to resolve several standing water and unmaintained pool complaints this season.

11.5 Distribution of Complaints

The VBD Team's public education campaign encourages residents to identify, inquire, report standing water concerns and submit dead bird or tick samples in order to better protect human health from vector-borne diseases. Upon review of **Appendix I**, the VBD Team analyzed the geographic distribution of complaints and is pleased to report that there was an even distribution of complaints throughout Middlesex-London this season. This even distribution tells the VBD Team that residents understand how to identify a potential mosquito breeding habitat and report VBD-related concerns. The VBD Program strives to educate residents to identify potential breeding areas and report or eliminate these habitats so as not to support the growth of vector mosquito populations. The VBD Team is also pleased to see increased participation in the reporting of concerns from the Municipality of North Middlesex. Increased calls from concerned residents allowed the VBD Team to identify new areas of standing water to monitor and add additional catch basins to the treatment schedule. Resident participation in dead bird reporting also allowed the VBD Team to confirm three WNV-positive crows within this region. The VBD Team hopes to once again see high resident participation in the VBD Program in upcoming seasons.

11.6 Community Partnership

The MLHU maintained effective community relations this season, as the VBD Team worked closely with City staff on several occasions to reconcile standing water concerns. The MLHU also worked with the Municipality of North Middlesex and the Ausable-Bayfield Conservation Authority (ABCA) to address mosquito concerns in Parkhill this season.

The MLHU collaborated with municipal and City officials to consult on the presence of vector mosquito populations at several sites of public concern this year. Of particular importance was the MLHU's work with the Municipality of North Middlesex, to conduct additional monitoring of adult and larval mosquito populations in Parkhill. Due to the large number of concerns received from Parkhill this season, the VBD Team worked closely with residents and staff from the Municipality in order to address resident concerns. Mosquito concerns have existed in Parkhill for several years, however this season was of particular discomfort to residents, as an influx of non-vector adult specimens, known to be ferocious biters was observed in much higher numbers than previous years.

By the end of the 2011 season, the VBD Team had addressed 19 public concerns in Parkhill and had monitored all areas of standing water on publicly-owned property. Although residents are still concerned with some areas of standing water, the VBD Team can only monitor areas located on public property. Resident concerns are still expressed over wooded areas and areas of standing water located on ABCA property, however the MLHU does not have authority to monitor and control larvae on these areas of land. The ABCA has informed the community and local partners that it is continuing to assess the areas deemed wetlands and will address the concerns once the assessment has been completed. The MLHU will continue to update residents into the 2012 season on mosquito activity and WNV positive trends identified in North Middlesex. The MLHU will continue to work with North Middlesex to report on mosquito identifications and vector mosquito control efforts. **Figure 11-7** and **11-8** are examples of the documents developed to report larval and adult mosquito findings to residents of Parkhill.

Figure 11-7: Twitter page developed to update residents on mosquito information and activities in Parkhill this year.

WEST NILE VIRUS SUMMARY UPDATE FOR PARKHILL 2011										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Birds	0	0	0	0	0	0	0	0	0	3 WNV Pos. Crows
Mosquito Pools	0	1	0	1	0	0	0	0	0	0
Human Cases	0	0	0	0	0	0	0	0	0	0
Adults Collected	945	2900	19990	13435	1260	8900	32318	5339	36130	108489
Vectors	31%	15%	29%	35%	95%	56%	89%	49%	66%	33%
Non-Vectors	69%	85%	71%	65%	5%	44%	11%	51%	34%	67%
Larvae Collected	141		18	276	251	306	485	319	1036	1213
Vectors	61%	*	55%	89%	94%	82%	96%	82%	93%	90%
Non-Vectors	39%	*	45%	11%	6%	18%	4%	18%	7%	10%
Treatments Performed									50	72

Figure 11-8: WNV summary for Parkhill, featured on the mosquito statistics page of the North Middlesex Website, www.northmiddlesex.on.ca.

The VBD Team would like to extend a special thanks to Dan Flaherty and the MLHU Communications department for assistance in creating all of the web-based reporting tools used to update and inform residents of North Middlesex throughout the course of the season. The VBD Team looks forward to working with Dan in upcoming seasons to regularly update residents and develop effective communication strategies.

11.7 Conclusions and Recommendations

The VBD Program should continue to promote public education strategies. Continuing to educate the public on issues regarding vector-borne diseases is an important step in reducing the overall risk posed to residents in the Middlesex-London area. It is also important to maintain public messaging to educate homeowners on eliminating breeding areas and reporting potential concerns, so that the VBD Team can continue to identify and mitigate the risk of vector-borne diseases to local populations.

The investigation into the Melbourne Tire Dump has prompted the MLHU to continually investigate complaints regarding, not only standing water, but any location that poses an immediate or potential threat to human health. The VBD Program should continue to develop strong community partnerships, including professional relationships with local and provincial agencies, as well as city developers and public health inspectors. These community partnerships will assist local officials in reducing mosquito breeding in areas investigated for additional environmental concerns. Working closely with these groups may also help to address resident concerns and alleviate some of the time required to address complaints and eliminate potential breeding areas.

Collaboration with North Middlesex is ongoing as residents of Parkhill still have many concerns regarding the high number of adult mosquitoes and bites experienced each year. The MLHU will continue to work with the North Middlesex as residents still remain concerned with what the 2012 spring and summer months will bring.

The VBD Program has worked extensively to address mosquito-related concerns and inquiries in the town of Parkhill this season. Working with the municipality, the MLHU remains a dedicated member of the committee to address resident and mosquito concerns in the town of Parkhill. The MLHU will maintain its relationship with the Municipality of North Middlesex in future seasons and will continue to work with residents and other local agencies in order to address ongoing concerns.

The MLHU strives to collaborate with all community partners in order to better develop public education strategies and ultimately manage the transmission of vector-borne diseases throughout Middlesex-London. This season's larval monitoring, mosquito control, public education and community relations with local stakeholders are a great example of the VBD Team's dedication to protecting public health and wellbeing.

Chapter 12: Weather Trends and Special Projects

12.1 Introduction

The Vector-Borne Disease (VBD) Team has established an annual review of weather trends, OviPool and Catch Basin analysis in order to better understand the habitat preferences and generational longevity of mosquito larvae, in addition to the influence that climate has on the development of mosquito larvae in a variety of structures.

12.2 2011 Weather Trends in Middlesex-London

This season the Middlesex-London Health Unit (MLHU) reported 11 West Nile Virus (WNV) positive mosquito pools, following three years of low viral activity. Similarly, the province of Ontario also saw a dramatic increase in the number of WNV-positive mosquito pools compared to previous year's results. In 2009 the province reported only 14 positive pools and in 2010, 56 positive pools. This season viral activity increased to 278 WNV-positive mosquito pools. Since temperature and precipitation can have a great effect on mosquito abundance and viral replication, it is important to consider this season's weather as a factor in this season's increased mosquito abundance and viral activity. Additionally, an increased number of mosquito breeding habitats can be supported by certain weather conditions, such as heavy precipitation, flooding, humidity and drought, all of which can create ideal ecological environments for the proliferation of larval mosquito populations.

The relationship between weather and mosquito abundance can also be explained through the Accumulated Degree Day (ADD) model. External temperature plays a key role in the development rate of many organisms, including viruses. In the case of WNV, a certain amount of heat and time are required before the viral titre in an infected mosquito is high enough for human infection risk. The combination of time and temperature needed for an organism's development is expressed in units called degree days. The amount of heat required to raise the viral infectivity rate is taken as temperature measured above the threshold of 18 degrees Celsius. Degree days are those with the mean temperature above 18 degrees Celsius.

The degree days observed this summer in Middlesex-London was the second highest observed in five years. This ADD model accounts for the stimulated viral replication observed in Middlesex-London this season, in addition to the MLHU's first positive mosquito pools of the season.

Ultimately, ADD can help to explain the greater number of weather-accelerated mosquito populations and WNV-positive pools observed this year. (Cosray, 2011)

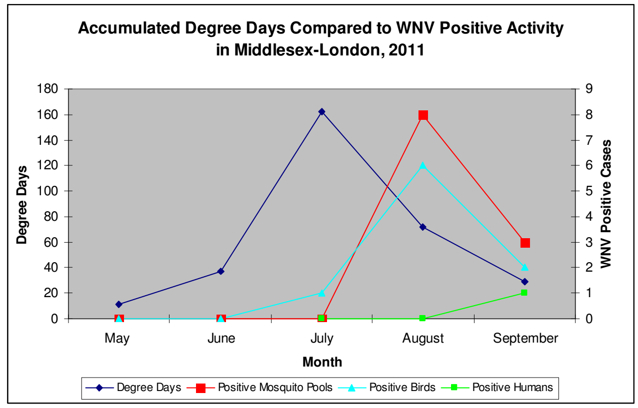

Figure 12-1: Accumulated degree days in Middlesex-London compared to WNV-positive bird, mosquito and human cases.

12.3 Weather Trends and West Nile Virus

Meteorological monitoring is important in the study of vector-borne diseases, as many types of weather conditions can give way to outbreaks of mosquito related diseases. For example, after the outbreak of WNV in 1999, everyone was concerned with hot, dry climate conditions and many began to monitor this type of weather to prepare for future outbreaks when these types of environmental conditions may once again present themselves. (Mutebi, 2010)

Traditionally hot, humid weather has been known to favour WNV viral production. Following the initial outbreak of WNV in 1999, meteorological data was studied in detail in order to better predict and prepare for future outbreaks of vector-borne diseases. This season, Middlesex-London experienced increased precipitation from March to May and then a decline in late June and July. Although the region did experience several days with unseasonably warm temperatures, the Middlesex-London's viral activity can also be associated with the high temperatures recorded in 2010. It is often understood that several very hot seasons are required in order to begin to see WNV activity. The above-average temperatures from July and August of 2010, the unseasonably warm temperatures in late July of this year (2011) and the 234 consecutive degree days recorded by the MLHU prior to WNV-positive mosquito pools, can account for increased WNV-activity in 2011. West Nile Virus-positive mosquito pools and birds identified within Middlesex-London this season can be attributed to the accumulated warmer temperatures from the 2010 and 2011 seasons, which amplified viral transmission throughout Middlesex-London.

12.4 Weather Trends and Eastern Equine Encephalitis

As Eastern Equine Encephalitis (EEE) activity increases across North America, many have begun to monitor the environmental conditions that have been associated with this emerging vector-borne disease. Rainfall has been highly associated with Eastern Equine Encephalitis, as significant correlations in the USA have been drawn between the occurrence of EEE-positive human cases and the excess of rainfall present at the time of infection. Eastern Equine Encephalitis was associated with rainfall when more than 20 centimetres above average precipitation was observed for two years in Massachusetts, correlating with the outbreak of three human cases at that same time (AMCA, 2010 Mutebi, 2010).

It is imperative that the VBD Team monitor weather trends and precipitation in order to better understand viral trends in future surveillance seasons. Although Middlesex-London did experience high levels of precipitation in the early spring this season, there were no EEE-positive human cases, or EEE-positive mosquito pools confirmed in 2011. A season that presents itself with consistent rainfall may in turn increase the capacity for EEE transmission within Middlesex-London; therefore it is imperative that the VBD Program maintain its weather trend analysis, in addition to monitoring for EEE in adult mosquito populations.

12.5 Weather Trends and Larval Surveillance

This season larval monitoring began on March 17, 2011 (week 11). The average temperature in these short-term pools caused by snowmelt was 8.5 degrees Celsius (8.5°C). For the past three seasons, the first day of larval monitoring has occurred earlier in March each year, and the temperature of these temporary pools has increased by several degrees; however this season, due to heavy snowfall in early March, the VBD Team did not begin monitoring for larvae until mid-March. The temperature of the snowmelt pools sampled on March 17th this season did increase by 5°C from 2010, however the water was sampled later into the month than previous years.

Oftentimes unseasonably warm spring temperatures play an important role in larval production, jumpstarting populations in the early weeks of March. This was the case for the past two seasons (2009 and 2010), however on average, spring temperatures in 2011 were cooler than usual. Since Middlesex-London did not experience a warmer spring this season, it was in fact the increased levels of precipitation, following a winter with heavy snowfall that jumpstarted this season's spring mosquito populations. The VBD Program observed a spike in spring floodwater species from June to late July. Heavy runoff from increased snowmelt created extensive flooding in some areas of Middlesex-London, hatching the eggs from several generations of the floodwater species *Ochlerotatus sticticus* (the main member of *Ochlerotatus black-legged*). Other spring floodwater species that increased this season due to heavy spring flooding were *Ochlerotatus stimulans*, *Oc. canadensis* and *Aedes vexans.*

Warm temperatures also play a significant role in larval production. Warmer than usual temperatures observed in Middlesex-London from July to September of 2011 can account for the increased number of larvae identified later into the 2011 season. These higher temperatures accelerated the lifecycle of mosquitoes, allowing them to reach the biting age sooner and also increase the amplification of WNV within mosquito and avian populations (Kramer, 2010).

12.6 Weather Trends and Adult Mosquito Surveillance

The weather played a significant role in the results of the VBD Team's adult mosquito surveillance this season. Increased precipitation and heavy snowmelt in early spring months jump-started populations of *Oc. sticticus, Ae. vexans vexans*, *Oc. trivittatus*, *Oc. canadensis and Oc. stimulans.* Warmer temperatures from July to September also accounted for an increase in the number of container species such as *Culex pipiens* and *Cx. restuans* this season. Additionally, a greater percentage of non-vector species were observed this season, as a result of heavy spring precipitation and flooding which hatched several generations of non-vector spring floodwater species. This spike in non-vector floodwater species created a huge increase in the number of non-vector adult mosquito specimens collected by the VBD Team this season (approximately 86% more non-vectors collected in 2011 than in 2010). An early start to the WNV season with high populations of non-vector species can be attributed to the heavy precipitation which caused these species to peak in June and July.

Precipitation also caused *Oc. trivittatus* to peak three times throughout the season, following 62 millimeters (mm) of rain in June, a relatively dry July, and then another spike in precipitation in August, with 122mm of precipitation. *Culex* species were present throughout the course of the season, with no clear peaks related to weather trends or precipitation. (Cosray, 2011)

The ADD model observed by the VBD Team helped to prepare for WNV-positive activity that was confirmed in five WNV-positive mosquito pools on August 24th (week 34) this season. Typically, greater than 100 accumulated degree days is associated with an increased risk of WNV activity and greater than 200 with an increased risk of human infection. Prior to week 34 when the VBD Team confirmed its first positive mosquitoes, 234 consecutive Accumulated Degree Days were observed [**Figure 12-1**]. Following three weeks of WNV-positive mosquito activity, the VBD Team also confirmed a positive test for WNV in an elderly London resident who had passed away.

12.7 Weather Trends and Environmentally Sensitive Areas

Compared to 2009 and 2010, Middlesex-London experienced peaks of precipitation throughout the course of 2011. Environmentally Sensitive Areas (ESAs) typically begin to dry up mid-July to early August, decreasing larval mosquito activity. However in 2011, a spike of precipitation in late July maintained pools of standing water, producing increased amounts of vector mosquito larvae later into the season. Referencing **Figure 12-2**; where precipitation has typically decreased in 2009 and 2010, it increased significantly in 2011. This increased the total number of vector mosquito larvae collected in ESAs and as a result, prompted an increased number of standing water treatments.

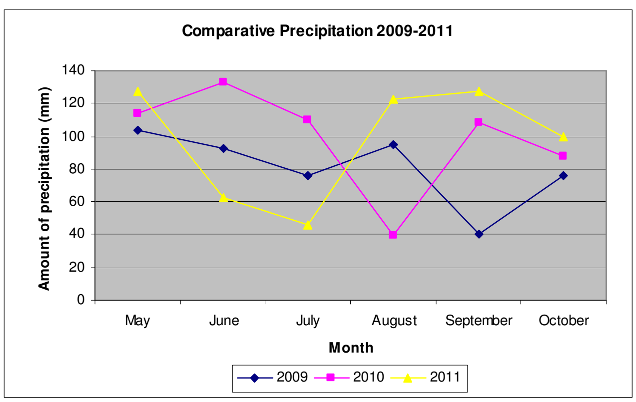

Figure 12-2: Comparison of 2009 to 2011 precipitation levels.

Although the VBD Team collected fewer mosquito larvae than in 2010 (approximately 2,000 fewer larvae), the vector composition of the larvae collected in 2011 did increase. Increased vector mosquito larvae required VBD staff to visit ESAs more frequently this season. Compared to 2010, monitoring visits increased by 20% in 2011 and can be attributed to a spike of precipitation late in the season, which maintained woodland pools and ideal larval habitats, increasing the amount of vector mosquito larvae collected within ESAs this season.

Weather trends also played a significant role in the changes observed at Sifton Bog in 2011. In the past two seasons Sifton Bog has been uncharacteristically dry throughout the course of the seasons (2009 and 2010). As a result, Sifton has produced very few mosquito larvae for an area of its natural history. Sifton has historically retained water for the duration of a season due to its original formation which was the result of colonized glaciations. In the past two seasons, decreased precipitation has resulted in Sifton retaining very little standing water and therefore producing lower levels of mosquito larvae. This season however, Middlesex-London saw increased precipitation in late July, which allowed Sifton to retain water throughout the course of the season, and in turn produce increased amounts of mosquito larvae. Although 59% of all larvae identified in Sifton this season were non-vectors, an increased amount of standing water and mosquito larvae were a significant change identified due to changing weather patterns in Middlesex-London season.

12.8 Weather Trends and Seasonal Complaints

Weather and precipitation often play a role in the nature of public concerns represented each season. This year however, the weather did not affect the overall composition of seasonal complaints as a whole. Due to heavy snowfall this winter, and as an effect, increased standing water due to snowmelt, the VBD Team received standing water concerns in early April of this year. Various climates can play a role in the type of complaints the MLHU receives throughout the course of the surveillance season. For example, standing water complaints often comprise the largest portion of all complaints received by the VBD Team each season, however this season standing water was not the most significant public concern. In a season that experiences high amounts of rainfall throughout the season, the VBD Team often receives a greater number of standing water concerns and/or stagnant swimming pool concerns. This season only experienced spikes in precipitation, and therefore weather patterns did not affect the overall composition of seasonal complaints.

12.9 Weather Trends and Mosquito Control

Weather often plays a significant role in the VBD Team's control activities each year. There are several types of weather which may affect the MLHU's control program. First, if a season brings warmer temperatures, it can accelerate the development of mosquito larvae, increasing vector mosquito populations and therefore increased efficiency in treatments to control specimens before they emerge into adults; whereas a season with cooler temperatures can prolong the maturation of certain larval mosquito species, therefore necessitating fewer treatments.

Mosquito larvae require certain amounts of precipitation to jump-start their life cycle in the spring months and/or maintain their populations throughout summer months and into the fall. Precipitation played a significant role in larval mosquito development this season as increased snowmelt caused flooding and high water levels throughout Middlesex-London, hatching several generations' worth of mosquito larvae. With increased larval development due to snowmelt in early spring this season, monitoring visits and standing water treatments increased in order to control the emergence of vector specimens in June and July. As demonstrated by **Figure 12-3**, increased precipitation in the spring and peak temperatures in July accelerated larval production and ultimately increasing the number of treatments required in 2011.

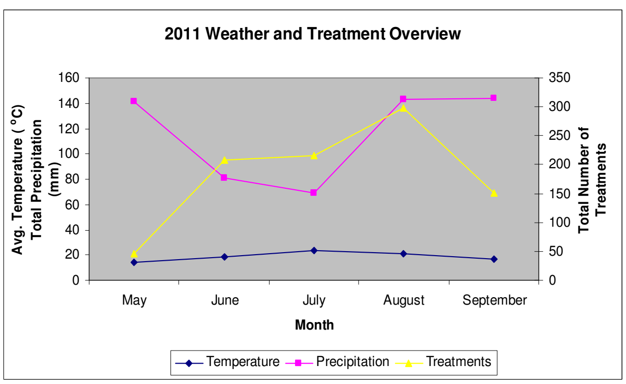

Figure 12-3: Comparison of 2011's temperature, and total number of treatments.

12.10 Weather Trends Conclusion

Due to the variability of weather throughout the seasons and the ability for vector mosquitoes to proliferate in different environmental conditions, it is important to monitor the weather following each surveillance season in order to understand the conditions necessary for mosquito development and viral production.

There are many different climates and conditions that favour larval mosquito production, therefore it is important to understand and review all of the conditions that may foster these ideal larval habitats. In order to better understand the conditions that foster larval mosquito growth, and prepare for future surveillance seasons, the VBD Team must continue to monitor temperatures, precipitation and drought conditions.

12.11 OviPool Analysis

In 2011, the VBD Team continued OviPool analysis as part of a special project within the larval monitoring and surveillance program. Ovipools are a system of trapping and collecting mosquito eggs and larvae in artificial containers located in wooded areas. OviPool analysis involves the identification of mosquito eggs and larvae from gravid female mosquitoes. The information obtained allows the VBD Team to understand the population dynamics of new and emerging mosquito species. OviPool surveillance began on June 6, 2011. OviPools were set up at eight different sites; two sites located in London, and one site in each of the following communities: Strathroy, Glencoe, Parkhill, Dorchester, Arva, and Kilworth.

Figure 12-4: VBD Team member setting up OviPools at Westminster Ponds.

In total, 25,161 eggs were observed in OviPools this season. Of this total, 24,161 (96%) eggs were *Ochlerotatus* species and approximately 1,000 (4%) eggs were *Culex* species. A total of 5,877 larvae were identified, representing six different species. *Ochlerotatus japonicus* was the most abundant species representing 47.03% of all larvae identified, followed by *Culex restuans* (35.43%). The remaining species included *Culex pipiens* (9.05%), *Ochlerotatus triseriatus* (5.44%), *Culex territans* (2.20%), and *Anopheles punctipennis* (0.85%). **Figure 12-5** displays the composition of larval mosquito species identified in OviPools this season.

It is important to monitor mosquito larvae using Ovipools because not only does it allow the VBD Team to monitor various species that prefer artificial containers, but it also attracts new and possibly invasive mosquito species that may not otherwise be collected in regular site surveillance. Invasive species, such as *Oc. japonicus* and *Aedes albopictus*, are not often found in common bodies of standing water. For example, *Oc. japonicus* are not found in high densities in SWMFs or the woodland pools that the VBD Team regularly monitors. The VBD Program does however collect and identify a high number of *Oc. japonicus* from OviPools. Since this species can be found in high densities in OviPools it is significant because the VBD Team would not otherwise be able to detect this species in other containers. Maintaining OviPool surveillance also allows the VBD Team to monitor for other new species that may be introduced in the Middlesex-London area. OviPools may provide an early habitat for new or invasive species before they begin to breed in the more common areas of standing water among other species and predators. By providing this habitat and controlling its development, the VBD Team will have a better understanding of generational periods of new and invasive species.

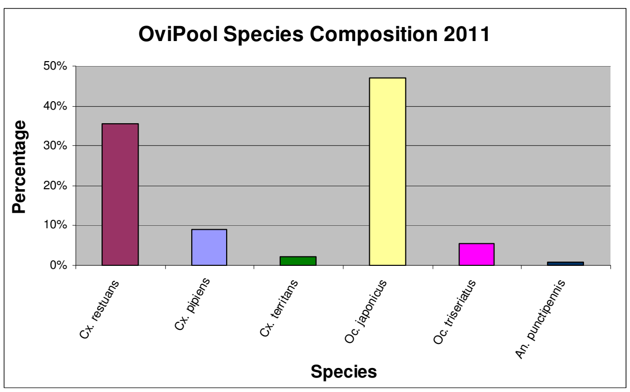

Figure 12-5: OviPool species composition 2011.

12.12 Catch Basin Analysis

Catch basins are known to be ideal habitats for mosquitoes because they provide a source of warm, shallow water, with low oxygen, suitable pH levels and high amounts of organic matter, creating ecological environments for the proliferation of larval mosquito populations.

Through catch basin analysis, the MLHU hopes to identify the species distribution of mosquito larvae in different geographic settings, tracking the generation periods and analyzing the presence of invasive mosquito species within catch basins. The VBD Team monitors catch basins that are located in different parks possessing different environmental surroundings, in order to identify the composition of larval species and the generations of various species throughout the seasons. Understanding the larval composition of municipal catch basins will assist in the development of new ideas and techniques for controlling larval mosquito populations within these structures.

For the duration of the 2011 season, eight catch basins located within the City of London were selected for the purpose of this study. All of the catch basins were chosen based on organic matter and vegetation levels present surrounding the structures. Using a standard 350 millilitre (mL) long handled dip sampler [**Figure 12-6**], a total of five dips were conducted from different areas within each catch basin. The mosquito larvae were then counted, and the catch basin was given a low, moderate or high pool rating, depending on the amount of larvae collected. A site was rated as "low" if the number of larvae collected was between one and six, "moderate" if between seven and 30 and a site was rated as “high” if the number of larvae collected was 31 or more. A rating of “nil” was assigned if no larvae were collected from the catch basin. All larvae collected were identified to the species level in the Strathroy laboratory. The VBD Team began monitoring for larvae in catch basins on June 6, 2011 (week 23), when temperatures began to increase; creating a viable habitat for the initial emergence of mosquito larvae. The study continued for the duration of the VBD surveillance season (weeks 23 through 39). Catch basins were monitored bi-weekly until September 29, 2011 (week 39).

Figure 12-6: VBD Team member monitoring mosquito larvae in a catch basin at Scenic View Park in London.

Table 12-1: Catch basin sites selected for the study.

Address	Park Name	Area
27 Chalet Crescent	Scenic View Park	West
40-47 Quinella Drive	Rosecliffe Park	Southwest
70 Riverside Drive	Harris Park	Central
34 Locust Crescent	White Oaks Optimist Pk.	South
42 Danielle Crescent	East Optimist Park	East
1375 Clarke Road	Ted Early Sport Complex	Northeast
18 Repton Avenue	Virginia Park	North
1852 Aldersbrook Road	Jaycee Park	Northwest

In 2011 the most abundant mosquito species found in catch basins was *Culex restuans* accounting for 54% of the all larvae identified and coinciding with previous studies and the habitat preferences of species of the genus *Culex*. *Culex pipiens* was the second most abundant species identified at 34%, followed by *Ochlerotatus japonicus* (6%) and *Anopheles punctipennis* (6%). [**Figure 12-7**].

It is important to note that for second consecutive year the presence of *Ochlerotatus japonicus* was observed in catch basin structures. This invasive species has been observed in other various habitats and its presence has increased since 2006 in both larval and adult mosquito populations.

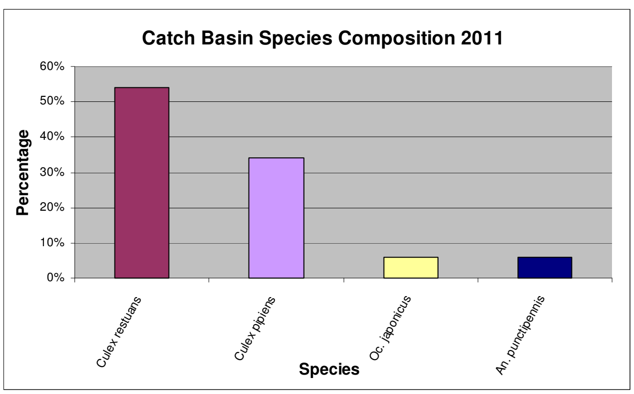

Figure 12-7: Catch basin species composition 2011.

12.13 Weather Trends and Special Projects Conclusion

Monitoring local mosquito populations in OviPools and catch basins is an important tool used by the VBD Program to track species composition and generational longevity of certain species. Vector mosquito species continue to dominate OviPool and catch basin sites throughout Middlesex-London. Overall, *Ochlerotatus japonicus* and *Culex restuans* remained the most abundant vector species identified in OviPools. *Culex restuans* and *Culex pipiens* remained the most abundant vector species identified in catch basins.

Following the review of weather, OviPools, and catch basins for the 2011 season, the following recommendations have been made:

This season the weather observed in Middlesex-London was hot and humid, which likely contributed to the increase in mosquito abundance and viral activity. Heavy rainfall and snowmelt this spring also jump-started populations of floodwater species in early June. It is recommended that the VBD Program continue to monitor weather trends throughout the season in order to better plan for the next season's surveillance and viral trends.
It is recommended that the VBD Team continue to use OviPools to track the generation periods of vector mosquito species. OviPools are an effective tool used to analyze mosquito population dynamics, to monitor for the presence of new and emerging vectors, as well as understand the ideal habitats that are conducive to specific mosquito species. One of the primary vector species to monitor in future seasons is *Aedes albopictus* (Asian tiger mosquito). This is a known vector for a variety of diseases including Yellow Fever, Dengue Fever, and numerous types of encephalitis, including LaCrosse encephalitis, EEE, and WNV. The Asian tiger mosquito is currently the most invasive mosquito in the world and it is recommended that the VBD Team continue to be aware of its presence in neighbouring regions of the province. (Wood *et al.*, 1979)

It is recommended that the VBD Team continue monitoring selected catch basins throughout the 2012 season in order to track the generation periods, competition of different vector-mosquito species and analyze the presence of invasive larval mosquito species within these structures. It is also important to monitor the presence of additional organisms in catch basins, as these organisms have the potential to be a natural control agent for mosquito larvae.
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Chapter 13: Public Education

13.1 Introduction

In 2011, the Vector-Borne Disease (VBD) Team continued a comprehensive public education campaign, focused on community relations and teaching residents to protect themselves against West Nile Virus (WNV), Lyme disease (LD) and Eastern Equine Encephalitis (EEE). Educational and promotional materials were distributed to stakeholders and the community at local events throughout the season. Advertising, educational brochures and participation in a range of community events were essential elements of the VBD Team's public education strategy.

13.2 Printed Resources

To initiate the 2011 season, Reduce and Repel brochures were distributed to all elementary schools within the London District Catholic School Board and to residents of North Middlesex. The central message of the VBD education campaign remained to 'Reduce and Repel' mosquito and tick bites. This was also the message in brochures distributed to residents, which contained basic information about WNV, preventing mosquito breeding and protecting against mosquito bites. The VBD Program Lyme disease brochure was also distributed to increase awareness about LD and to educate the public on how to submit a tick, how to protect against tick bites and how to take precautions when travelling to endemic regions in the spring and summer months.

The Ministry of Health and Long-Term Care (MOHLTC) distributed their Vector Borne Disease Tool Kits to all health units to assist staff in preparing for the 2011 season. This season the tool kit contained information on WNV, LD and EEE, which outlined the key public health implications of these diseases and the proper planning and management strategies in the event of an outbreak or positive activity. The kit also provided information on larval and adult mosquito monitoring techniques and various tick surveillance strategies. This season the VBD Team also distributed fact sheets on additional areas of public interest. In the 2010 season, residents expressed interest in using alternative forms of insect repellents. In order to address this need, an Insect Repellent fact sheet was developed to educate the public on how to properly apply repellents with Health Canada's recommended amounts of DEET and also to inform the public of alternative repellents not containing DEET. This fact sheet was developed based on Health Canada's recommendations and general use information for all personal insect repellents.

Figure 13-1: Lyme disease bus shelter ad.

A fact sheet was also developed for Mosquito Dunks®, a product that has assisted the MLHU in resolving many standing water and unmaintained pool concerns in the past two seasons. Mosquito Dunks® contain a biological larvicide, *Bacillus thuringiensis israelensis* (*B.t.i.*), which is the same ingredient found in the products used by the MLHU for seasonal mosquito larval control. The use of Mosquito Dunks® has assisted the MLHU in addressing larval mosquito breeding concerns at complaint sites, as it has provided a straightforward solution for homeowners to eliminate larvae for approximately one month. The Mosquito Dunks® fact sheet has assisted the VBD Team in encouraging homeowners to purchase this product as a last resort when regular maintenance cannot be kept on an area of standing water.

13.3 Media

This season the VBD Program commenced its 2011 surveillance season with a press release that prompted a series of media interviews. These interviews answered questions and educated the public on how to prevent tick and mosquito bites for the upcoming spring and summer months. One interview with A-Channel news in London gave reporters a guided tour of the Strathroy laboratory and discussed the larval monitoring process, including the identification of vector mosquito larvae, which when found in enough quantity, initiates a treatment to standing water.

The VBD Team spent an extensive amount of time promoting Lyme disease education throughout Middlesex-London this year. Advertisements promoting tick submissions and protection against tick bites were featured in London's garbage collection calendar and also on the local Rogers Cable 14 channel. These ads were run for the second consecutive year, encouraging LD awareness among Middlesex-London residents. Two VBD staff were also interviewed on a feature episode for a short summer series titled 'Inside Strathroy' on Rogers cable 14. During this interview, staff discussed seasonal activities and the VBD Program's focus on monitoring local tick populations in order to protect residents from acquiring bites and educating on personal protection when travelling to endemic regions in the spring and summer months.

Some key educational messages that the VBD Team's LD campaign focused on this season were encouraging the public to be aware of Lyme disease and use protection when travelling to endemic areas, wear insect repellent to avoid tick bites, check for ticks after outdoor exposure, learn how to remove ticks when they are found on a person and know how to submit ticks to the health unit for identification and testing [**Figure 13-1**].

The VBD Team received considerable attention this season due to increased adult mosquito populations and WNV-positive activity throughout the province. Following the confirmation of the first WNV-positive birds and mosquito pools, the MLHU issued media releases to inform the public of WNV activity, and remind citizens to protect against mosquito bites when spending time outdoors. These media releases were intended to educate the public, encouraging residents to 'Reduce and Repel' mosquitoes during known breeding seasons. Local media coverage following this positive activity was also beneficial as it informed the public of the VBD Team's continued efforts to actively monitor and control mosquito larvae throughout Middlesex-London.

The VBD Team also received media attention due to an increased number of adult mosquitoes observed in the town of Parkhill. Although traps in Parkhill often yield the highest numbers of mosquitoes trapped each season, the number of mosquitoes trapped in Parkhill in 2011 was significantly higher than in previous seasons. Residents experienced considerably more mosquito bites and nuisance activity. This influx of nuisance mosquitoes received national media attention, and the VBD Team worked diligently with community partners to address these mosquito-related concerns. Some of the media that featured stories on the MLHU and Parkhill included MacLean's Magazine, CBC, The London Free Press, the Parkhill Gazette, the Western Gazette and various local radio stations [**Figure 13-2**].

Figure 13-2: VBD Coordinator, Jeremy Hogeveen, featured in a MacLean's article on Parkhill. August, 2011.

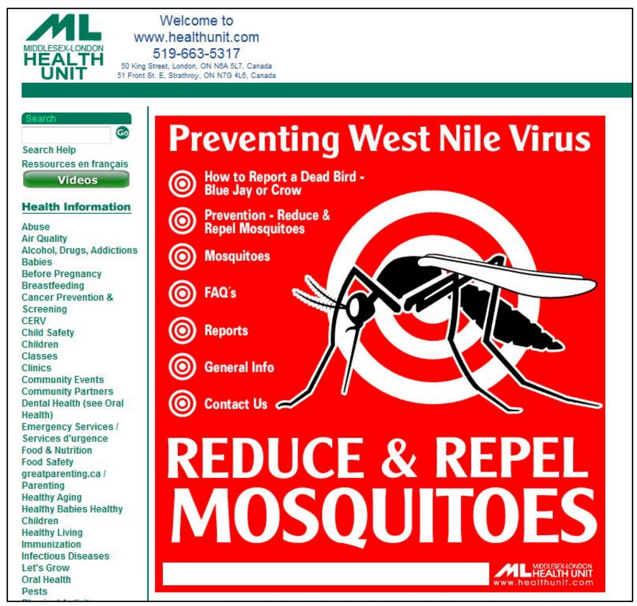

Figure 13-3: WNV splash page on the MLHU website.

13.4 Online Education

The Vector-Borne Disease page on the MLHU's website works to address public inquiries and concerns by posting updated and relevant information on WNV and LD monitoring and treatment activities within Middlesex-London. Frequently asked questions regarding WNV, as well as treatment reports, standing water status reports, and final reports from previous seasons may all be accessed through the MLHU's webpage [**Figure 13-3**].

The bright 'Reduce and Repel' logo featured on the main page, provides the public with a variety of subject headings in order to navigate more easily through the information. The webpage is also an effective tool for the public to report dead crows or blue jays. Forms for dead bird reporting can be easily accessed at www.healthunit.com/westnilevirus. The MLHU also provided facts and information on Facebook this season, in an effort to reach a younger audience in Middlesex-London.

The MLHU also liaised with the Municipality of North Middlesex this season to develop a mosquito reporting page on the North Middlesex website and a Twitter page to quickly update residents on mosquito activity in the area. This webpage featured general information on protecting against mosquito bites, reducing potential mosquito breeding habitats, and reporting the number of treatments made by the VBD Team when vector mosquito larvae were identified in standing water. The webpage also featured a weekly update on the number of adult mosquitoes identified in Parkhill, and any positive activity that may have been confirmed in the area in order to keep residents informed.

13.5 Community Events

The VBD Team participated in various community events this season in order to enhance public education and network with community partners. In the spring, the VBD Team attended 'Get Into Spring Day' at Novack's outdoor living store in downtown London and information sessions at the MLHU's Well-Baby clinics and SmartStart Programs [**Figure 13-4**]. Throughout the summer months, the VBD Team set up information booths at Strathroy Turkeyfest and attended both Car-free Festivals in downtown London. The VBD Team also donated promotional materials and Lyme disease brochures to the annual Children's Make a Wish Foundation Golf Tournament. In September, the VBD Team concluded its public education efforts for 2011 at both the Glencoe and Parkhill Fall Fairs [**Figure 13-5**].

At these events, the public was given an opportunity to inquire about WNV, LD, EEE and the VBD Program. A display case containing preserved adult mosquitoes, insects commonly confused as mosquitoes, and ticks was featured in order to teach residents how to identify ticks on family members and submit them to the MLHU for identification. A breeding chamber containing live mosquito larvae and pupae was also on display.

In addition to distributing brochures, promotional material such as frisbees, "skeeter" swatters, temporary tattoos, and pens were distributed to the public. All promotional materials featured the 'Reduce and Repel' logo as the VBD Team encouraged the community to reduce standing water and repel tick and mosquito bites. Information shared with parents at the Well-Baby and SmartStart clinics focused on answering questions regarding insect repellents and alternative methods of avoiding mosquito and tick bites on babies and children under five years old. Many parents were interested in alternative methods or techniques to use instead of applying DEET to babies and/or young children.

Figure 13-4: Display at Novack's in downtown London

Figure 13-5: VBD booth at the Parkhill Fall Fair.

13.6 Stakeholders

Stakeholders are any group or person who has a vested interest or could be affected by the VBD Program. This year, the VBD Stakeholders meeting was held on June 23, 2011 [**Figure 13-6**].

Since this was the 10th operational year of the VBD Program, staff presented a summary of findings from 2005 to 2011. Staff also presented a summary of 2010 field and laboratory findings, including an overview of the MLHU's 2011 VBD Program plans. The Stakeholders meeting also featured presentations from The Canadian Centre for Mosquito Management Inc. and the Ministry of Health and Long Term Care.

Once again the MOHLTC distributed weekly updates to staff and stakeholders on the provincial status of WNV and EEE. The reports were helpful in keeping track of viral activity within the province and allowed the MLHU to stay up-to-date on the activities of other health units. These reports were also important in 2011 as Ontario experienced increased adult mosquito viral activity. These weekly vector surveillance updates assisted the VBD Team in reporting results to residents and provided strategies in conducting local risk assessments based on the positive activity reported by neighbouring health units.

Figure 13-6: The MLHU's 2011 VBD Stakeholders meeting.

13.7 Professional Development

This season Vector-Borne Disease staff had the opportunity to attend the Annual Zoonotics and Vector-Borne Diseases Wrap-Up Meeting, hosted by Public Health Ontario. At this event VBD staff liaised with other health units, sharing research initiatives, new public education strategies and field surveillance activities.

13.8 Conclusions and Recommendations

The VBD Program will continue to work on developing a fact sheet to educate the public on Eastern Equine Encephalitis. As EEE viral activity within the U.S continues to increase, Ontario has begun to monitor the disease more closely in mosquitoes, adapting its viral testing order of preference to reflect this new focus. Since the province has seen an increase in EEE mosquito vectors and several equine cases in the past few seasons, new EEE surveillance and management guidelines were developed to manage and assess the status of EEE in the province. Based on these new guidelines, the VBD Team is working to develop educational materials to better inform the residents of Middlesex-London on vector-borne diseases of growing importance in the province. As more data is collected on EEE each season, the VBD Program hopes to develop a fact sheet containing the key public health messages and implications of EEE by the end of the 2012 season.

The VBD Team also hopes to continue passive surveillance for ticks in Middlesex-London, and begin active surveillance and regular tick dragging if increased activity indicates that it is necessary. The VBD Team will maintain an effective LD education campaign, with the support of the Board of Health. Following a meeting on November 17, 2011, it was recommended that the Vector-Borne Disease Team continue its ongoing Lyme disease surveillance and promotional activities within Middlesex-London. The VBD Team will adhere to this recommendation in the coming 2012 season and will continue to implement LD educational strategies to engage the public and promote tick safety and proper removal techniques.

Based on the analysis of public education strategies this season, the following recommendations have been made:

It is important that the MLHU continue to expand its public education efforts and resources to include the most recent information on emerging vector-borne diseases, such as EEE, in order to reduce any threat it may have to local residents in future seasons.

It is also imperative that the VBD Team maintain and develop effective community relations in order to ease public concern and maintain correspondence with regional partners.

The VBD Team must also, with the support of the Board of Health, continue an effective Lyme disease campaign to educate residents and promote proper protection against tick bites.

Chapter 14: Conclusions and Program Evaluation

14.1 Conclusions and Recommendations

Vector-borne diseases can be transmitted through the bite of an infected mosquito or tick. Over the past 10 seasons the MLHU has employed comprehensive education, surveillance and control strategies to 'Reduce and Repel' the amplification of West Nile Virus (WNV), Eastern Equine Encephalitis (EEE) and Lyme disease (LD), within Middlesex-London.

Following an active 2011 season, the following conclusions and recommendations have been made:

West Nile Virus:

- This season, Middlesex-London experienced increased viral activity for the second straight season, with 11 WNV-positive mosquito pools, and nine WNV-positive crows.

- West Nile Virus activity also increased across the province with a total of 281 WNV-positive mosquito pools for the 2011 season, compared to 56 positive pools in 2010 and only 14 WNV-positive mosquito pools in 2009.

The VBD Team will continue to monitor for the presence of WNV in vector mosquito populations in order to protect human health in Middlesex-London from mosquito bites and the risk of acquiring these vector-borne diseases.

Lyme Disease:

- A total of 73 ticks were submitted to MLHU this year from May 10, 2011 to October 28, 2011.

- Two tick submissions were identified as blacklegged ticks; one was acquired from Brockville, Ontario, and the other from within Middlesex-London.

- Two LD-positive human cases were reported from travel to Turkey Point, Ontario and Rondeau Provincial Park, both known endemic regions for blacklegged tick populations.

This season the province of Ontario noted an increase in human LD cases acquired from endemic regions, and a decline in LD human cases from non-endemic regions. Although the incidence of LD and blacklegged ticks in Middlesex-London remains low, neighbouring regions within the province have been identified as endemic areas.

The VBD Team observed an increased number of tick submissions in the past two seasons and hopes to see that further increase in the 2012 season. Through increased public education strategies, engaging residents in prevention methods and tick removal strategies, the VBD Team hopes to better prepare residents that travel to endemic regions, which are often popular vacation spots in the spring and summer months. This season the VBD Team distributed over 1500 LD brochures, educating the public on protection in endemic areas, and encouraging tick submissions to the health unit. The VBD Program should continue to develop informative material to make the public aware of LD, its signs and symptoms and how to properly remove a tick.

Eastern Equine Encephalitis:

- Eastern Equine Encephalitis is one of the most severe vector-borne diseases with a mortality rate of approximately 33% for all of those infected with EEE.

- An estimated 5% of EEE infections advance to include severe encephalitic symptoms. There is a 70% to 90% mortality rate for those who develop encephalitic symptoms.

- The recovery rate for those who develop severe symptoms of encephalitis is only 3%. Those who recover are left with disabling and progressive mental and physical side effects, which can include minimal brain dysfunction to severe intellectual impairment, personality disorders, seizures, paralysis and cranial nerve dysfunction.

- In 2011, 51% of all mosquitoes collected in adult traps were vectors for EEE.

- This season 19 *Culiseta melanura* specimens were identified from the same location (Sifton Bog). All of these specimens tested negative when subjected to Cosray's standardized testing for EEE.

Viral testing on adult mosquito samples remains an important aspect of the VBD Program. Although the incidence of EEE remains low in Middlesex-London, new viral testing protocols introduced at the beginning of the 2011 season focused on testing a preferred order of adult mosquitoes for EEE. This new Viral Testing Order of Preference did not identify any EEE-positive pools, however EEE activity was confirmed elsewhere in the province. The VBD Program should continue to monitor and test vector specimens for the presence of EEE within the community, as increased EEE viral activity throughout Ontario in the past three seasons warrants close attention.

Dead Bird Surveillance:

- A total of 134 dead birds were observed in Middlesex-London throughout the 2011 season.
- Twenty-six (26) dead birds were collected and/or submitted to the MLHU this season, where RAMP testing in the Strathroy laboratory identified nine WNV-positive crows.
- Four of the nine WNV-positive crows served as important early indicators of WNV activity in North, Central-east, Central-west and South London this season. Public notice was issued following the confirmation of the positive crows, one week prior to five adult mosquito traps being confirmed WNV-positive.

The VBD Team should continue to accept dead bird submissions and perform RAMP testing, as the confirmation of WNV-positive birds may provide an early indicator of WNV and/or EEE activity within the community. In the past two seasons, dead bird surveillance has revealed the presence of WNV in the community one week prior to adult mosquito traps being confirmed positive.

Larval Mosquito Surveillance:

- Vector species continue to dominate larval monitoring sites throughout Middlesex-London. *Culex restuans* and *Culex pipiens* were the most abundant vector species identified once again this season.
- In addition to *Cx. pipiens* and *Cx. restuans*, *Ae. vexans* and An. *punctipennis* were the most prevalent vector species identified in larval form throughout the course of 2011.
- *Culex territans* were the most abundant non-vector species once again this season and should be monitored closely since they have been identified with virus-carrying capabilities throughout North America.

Monitoring larval mosquito species is an important aspect of the VBD Program. As the vector mosquito populations continue to increase each season, the VBD Team should maintain its current larval surveillance schedule and begin monitoring for vector species in the early spring.

The VBD Team should also continue to monitor the vector composition of larvae collected from London's Environmentally Significant Areas, as the composition of vector specimens collected from these areas increased from the 2010 to the 2011 season.

Adult Mosquito Surveillance:

- Overall there were 148,599 adult mosquitoes collected by Cosray from both terrestrial and canopy traps in 2011.
- Eighty-six (86%) percent of all adult mosquitoes trapped were vector species capable of transmitting WNV and/or EEE. This is a decrease from 92% in 2010; however the decrease can be attributed to the high number of non-vector specimens trapped in North Middlesex this season.
- Approximately 71% of all adult mosquitoes identified this season were collected from North Middlesex. Of the total number of mosquitoes collected from North Middlesex this season, 26% were vector species, and 74% were non-vectors. This is the highest number of non-vector mosquitoes the MLHU has ever observed in an adult mosquito trap.
- Eleven (11) WNV-positive mosquito pools were confirmed in London this year. Nine positive pools were from terrestrial traps, and two positive pools were from canopy traps.
- The number of *Ochlerotatus japonicus*, a vector species for WNV, did not increase this season for the first time in five seasons. Although it was believed this species would become an established vector, it was not identified as WNV positive this season and was collected in much fewer numbers.

This season 11 WNV-positive mosquito pools were confirmed throughout Middlesex-London. In 2011, there was a vast distribution of positive activity, with WNV-positive pools identified in Glencoe, Strathroy, North-west London, Central-east London and South London. Since WNV positive activity was identified throughout the County and in both canopy and terrestrial traps, the VBD Team should continue to monitor adult mosquito populations in order to track viral trends and report positive activity to residents within Middlesex-London.

Human Surveillance:

- This season WNV was present in the community, as indicated by 11 WNV-positive mosquito pools and nine WNV-positive crows. There were also two human WNV-cases reported. One case was confirmed following the death of a London resident and the other remains probable at this point in time.

- This season there were two confirmed human cases of LD from residents of Middlesex-London. Both cases were travel-related.

- Although the risk of acquiring Lyme disease is low in Middlesex-London, it is possible to acquire LD from an infected tick anywhere in Canada. The number of ticks observed this season increased significantly for the second straight season, therefore the presence of tick species is on the rise.

- Greater than 50% of all adult mosquitoes identified this season were potential vectors for EEE, therefore, with increased viral activity in regions surrounding Middlesex-London, it is imperative that the VBD Program monitor for EEE-vector species in order to protect human health from this emerging vector-borne disease.

Human surveillance is important for understanding the clinical course of infection that vector-borne diseases can take. The combination of human, mosquito, bird, and equine surveillance provides a thorough understanding of the presence of WNV, EEE and LD in a community. The VBD Program will continue to closely monitor emerging LD trends in nearby regions. It is imperative that the VBD Team continue to educate residents on how to protect against tick bites in order to better prepare those who travel to endemic regions in spring and summer months. The VBD Program will continue to make Lyme disease education a priority in order to emphasize personal protection and tick removal as important LD prevention strategies.

Mosquito Control:

- In 2011, 21% of monitoring visits included treatment, and 56% of all sites were treated one or more times, for a total of 919 treatments encompassing a total of 11.75 hectares of standing water.

- Thirty-four sites were frequently treated ten or more times this season, an increase from both the 2009 and 2010 seasons.

- Storm water management facilities were once again the most frequently treated site type this season, followed closely by woodland pools.

- This season, 20 treatments using Altosid® granules were performed at five municipal pollution control plants within Middlesex-London.

The VBD Team should continue recording pre- and post- treatment larval counts and also monitor environmental data in order to evaluate larvicide efficacy, and the environmental impact of larvicide use on non-target populations. This season staff did not observe any adverse effects on local aquatic invertebrates or mammal populations within peripheral pools regularly monitored by the VBD Team.

The VBD Team should continue to monitor standing water sites during the weeks when the greatest numbers of vector mosquito larvae have been observed. For the 2011 season, weeks 20 to 40 possessed the greatest larval presence. Therefore, the VBD Team should maintain its current larval surveillance schedule, which encompasses the weeks of greatest larval activity, in order to identify and treat vector specimens during this time and better protect human health.

Catch Basin Treatment:

- This season, approximately 90,000 catch basins were treated throughout Middlesex-London.

- An increased number of backyard catch basin treatments were also made in the municipality of North Middlesex.

- Catch basins were primarily treated with Altosid® pellets or briquettes, which are Methoprene products and/or VectoLex® pouches.

Catch basin treatment remains an important aspect of the VBD Program. Monitoring and treatment of catch basins should remain a fundamental control strategy in future seasons in order to eliminate vector mosquito larvae which proliferate in these highly ideal and organic environments.

It is also important that residents contact the VBD Team if they identify a catch basin in their backyard, since these structures are ideal environments for larval development. Public education efforts in North Middlesex this season assisted with the identification of additional backyard catch basin locations that the VBD Program added to its treatment schedule.

Treating catch basins at these new locations assisted with efforts to address mosquito concerns in North Middlesex this season.

Storm Water Management Facilities:

- In 2011, 77 Storm Water Management Facility (SWMF) sites were monitored at 42 locations. Sixty-eight (68) of these sites were considered productive and over 16,000 larvae were identified from within SWMF structures this season.

- There were 398 treatments conducted at SWMFs this year, a slight increase from the 366 treatments conducted in 2010, and 215 conducted in 2009.

- Eighty-eight (88%) of all SWMF sites bred larvae at least once throughout the course of the 2011 season and 42% percent of productive SWMF sites required treatment 5 or more times.

- Thirty-four percent (34%) of all mosquito larvae identified in 2011 were collected from SWMFs.

The VBD Program should continue to monitor new SWMFs, as the number of SWMFs continues to rise with ongoing residential development. Mature sites should also be actively monitored as the maturity of many sites creates a more favourable habitat for larval mosquito production. As SWMF sites mature, increased levels of vegetation can support and create ideal mosquito larval habitat, rich in organic content, and providing protection from water disruption and inclement weather. The maturation and naturalization of SWMFs this season contributed to the increased number of vector mosquito larvae being identified in previously non-naturalized SWMF locations.

Environmentally Sensitive Areas:

- This season, approximately 300 hectares of environmentally sensitive areas were monitored by VBD staff.

- Once again, ten of the 12 ESA sites monitored this season required treatment and nine sites were treated five or more times.

- Peripheral pools within Westminster Ponds Zone 2 were the most frequently treated (13 treatments), followed by Sunningdale Road Pond (12 treatments).

- This season, the number of vector species identified in ESAs increased. The most abundant vector species identified in ESAs this season were *Cx. restuans, An. punctipennis, Ae. vexans* and *Cx. pipiens*. *Culex territans* represented the greatest proportion of non-vector species identified in ESAs.

The VBD Program should maintain ongoing surveillance and treatment of vector mosquito species within ESAs. Continued monitoring of vector mosquito populations within ESAs is imperative in order to alleviate the transmission and amplification of vector-borne diseases to local populations. It is also important to monitor mosquitoes in these areas because the two largest ESAs, Sifton Bog, and Westminster Ponds, within the City of London are located close to vulnerable populations, long-term care facilities and hospitals.

Complaints, Comments and Concerns:

- In 2011, the MLHU received and responded to a total of 373 complaints, a 108% increase from the 165 complaints received in 2010.

- Dead bird reporting represented the greatest concern, comprising 41% of all CCCs, followed by tick inquiries, which comprised 22% of all CCCs. Dead bird reporting was a significant aspect of the VBD program this year as it helped to identify nine WNV-positive crows.

- An increased number of tick submissions were observed once again this season, directly attributed to the MLHU's increased efforts to educate the public on LD this season. The MLHU encouraged residents to protect themselves when travelling to endemic regions and check themselves for ticks following any time spent in long grasses or wooded areas. Key messages and educational brochures outlined how to properly remove a tick and to submit ticks to the health unit for identification.

- This season a greater diversity of standing water complaints were expressed. Rather than general standing water concerns and inquiries, many specific structures were reported to the MLHU this season. This was a significant finding, and it tells the health unit that past education campaigns have been effective in teaching residents to identify the structures that have a potential to breed vector mosquito larvae, and potential WNV infection.

The MLHU should continue to emphasize all public education efforts put forth to protect against West Nile Virus, Eastern Equine Encephalitis and Lyme disease. Continuing to educate the public on how to identify circumstances that favour larval breeding and the transmission of vector-borne diseases is an important step in reducing the risk of VBD infection to local populations. The VBD Program will continue to encourage tick submissions and educate residents on how to properly remove ticks and submit them to the health unit. It is important that the public know the most common places to look for ticks and how to protect themselves against acquiring a tick when spending time in wooded areas or when travelling to endemic regions.

2011 Weather Trends:

- This season snowmelt from the heavy snowfall this winter and increased precipitation from April to mid-June created a spike in populations of spring floodwater mosquitoes. High floodwaters throughout Middlesex-London hatched several generations' worth of the spring species; *Ochlerotatus blacklegged,* a non-vector known to be a ferocious biter. These populations were observed in several traps throughout Middlesex-London; however they caused the most discomfort to residents of North Middlesex where their populations were observed in very high numbers this season.

- A second spike in precipitation at the end of July also helped to maintain vector mosquito populations in Environmentally Sensitive Areas throughout the course of the season. In past seasons decreased precipitation has allowed woodland pools within ESAs to dry up by mid-July; however this season precipitation extended larval mosquito activity in many low-lying woodland pools throughout the ESAs. Sifton Bog experienced some of the most activity, as this ESA usually dries up by July each season; it bred increased amounts of vector mosquito larvae due to maintaining higher levels of water in peripheral pools located throughout its two zones.

- In monitoring Accumulated Degree Days (ADD), it is understood that greater than 100 consecutive degree days is an indicator of WNV-positive mosquito activity, and greater than 200 degree days is an indicator of human WNV-positive cases. This season prior to the first five traps of the season being confirmed as WNV-positive, the MLHU observed 234 consecutive degree days.

It is important to monitor weather trends and environmental conditions in Middlesex-London to better understand viral trends and generational periods of larval and adult mosquito populations. It is typically known that one very hot season is required in order to see a year with positive activity, and that was indicated to the MLHU with very high temperatures recorded in 2010, which led to increased WNV-positive activity in 2011. If high temperatures are once again observed in 2012, Middlesex-London may once again see increased WNV activity. In order to best prepare for this activity and develop effective methods to educate the public, the VBD Team must continue to monitor weather trends in order to anticipate environmental conditions that are favourable to viral production.

Public Education:

- This season the VBD Team distributed educational Lyme disease materials and ran a television commercial on Rogers to further enhance LD awareness. Some key messages the LD campaign focused on were encouraging the public to protect themselves when travelling to endemic areas, wear insect repellent to avoid tick bites, check for ticks after outdoor exposure, and know how to remove and submit ticks to the health unit.

- The VBD Team participated in various community events throughout Middlesex-London this season, including the Strathroy Turkeyfest, the Glencoe Fair and the Parkhill Fall Fair.

- The Annual Vector-Borne Disease Stakeholders meeting was held again this year, celebrating the 10th operational year of West Nile Virus surveillance, and presenting 2010 findings to local community partners.

- The VBD Team worked closely with the public and local officials this season to address several concerns in the Parkhill area. Some of the steps taken to address these concerns included; adding a third adult mosquito trap in Parkhill, identifying several new areas of standing water, monitoring and treating new areas on a weekly basis, and adding several new backyard catch basins to the treatment schedule.

It is imperative that the VBD Program continue to enhance public education strategies to inform the public of personal protection methods against vector-borne diseases. The VBD Team must continue to educate the community on preventative measures required to protect against mosquito and tick bites. The VBD Program will maintain its comprehensive Lyme disease education campaign in the 2012 season, with the support of the Board of Health.

14.2 Program Evaluation

This season although not as hot and humid as the 2010 season, saw increased viral activity throughout Middlesex-London. In 2011, eleven WNV-positive mosquito pools were identified and nine WNV-positive crows were confirmed within Middlesex-London. There were also two WNV human cases; one confirmed and one probable. Two black-legged ticks were submitted to the MLHU, and two travel-related human LD cases were reported. Although there was no positive EEE activity in humans, mosquito or horses within Middlesex-London, once again a significant proportion (51%) of all adult mosquitoes collected were vectors for EEE. The VBD Program also observed an increase in *Culiseta melanura* specimens collected this season, one of the most competent vectors for EEE. Only four *Cs. melanura* were collected in 2010, compared to 19 specimens collected in 2011.

Following an analysis of vector-borne disease activity each season, the VBD Team re-evaluates its program plans to carefully outline the following season's surveillance, control and education strategies. After carefully reviewing all of the sites visited, larva collected, adult mosquitoes identified, treatments conducted, education strategies implemented and local viral trends, the VBD Team will decide the best course of action to take in order to ensure the successful delivery of next year's VBD Program.

The following is an assessment of the VBD Program following 2011 monitoring, control and education activities:

- With the recent emergence of LD-positive human cases acquired in endemic regions throughout Ontario, the MLHU should continue to focus efforts on Lyme disease promotion to residents of Middlesex-London. Although this region is not endemic for black-legged tick populations, it is important to educate residents on personal protection so they are informed when travelling to these endemic regions, which are often popular family vacation destinations in the spring and summer months.

- The VBD Team would also benefit from including more information on EEE in its public education campaign. Since a new Adult Mosquito Viral Testing Order of Preference has been implemented to monitor EEE activity in Ontario, the MLHU should look into developing more educational materials on this emerging vector-borne disease of importance.

- Although the VBD Program does have a website featuring reports and information regarding WNV, the VBD Team should include more detailed educational content regarding LD and EEE and how residents can assess levels of risk in their area, or at least be informed on the endemic regions prior to travelling in the summer months. Improved web design and greater information on Lyme disease and EEE is a necessary component for an enhanced VBD educational campaign in the 2012 season.

- An effective VBD Program includes a multi-faceted public education campaign, with the ability to engage local residents who, in turn, contribute to the prevention of vector-borne diseases and understand how to protect themselves from tick and mosquito bites. Although the MLHU does a thorough job at educating the public on vector-borne diseases in the area by participating in community events and interacting with residents to distribute promotional and informational materials throughout the season, the VBD Team would like to further enhance these promotional efforts in the 2012 season. Residents of Middlesex-London participate in the program by calling in dead bird sightings, submitting ticks, reporting standing water concerns and/or calling with questions or inquiries related to preventing tick and mosquito bites. The VBD Program will maintain its LD promotion efforts and hope to see greater tick submissions in 2012.

The 2011 season was the 10th operational year of West Nile Virus surveillance, and the program has come a long way since its early beginnings in 2001 with few staff. Since 2001, the West Nile Virus Team has undergone many enhancements, including adding hundreds of additional standing water sites to its surveillance schedule, adding an additional six seasonal staff to the team each summer season, and most importantly, taking on the monitoring of additional vector-borne diseases of importance in Ontario, which include Lyme disease and Eastern Equine Encephalitis.

Over the past ten years the program has grown to efficiently monitor large areas of standing water and recent successes of the VBD Team can be attributed to the progress the program has made as a whole in the past 10 years of operations. Over the past 10 years, the VBD Program has grown to understand the complexities of vector-borne diseases, effectively monitor tick and mosquito populations and detect viral activity within the community. When the VBD Program speaks of recent successes, this includes increased monitoring and surveillance visits in comparison to past years, increased treatments, increased areas of water being monitored on an annual basis and increased efficacy of public education messages in encouraging residents to participate in the VBD Program.

The VBD Program has mapped areas of standing water for many years, identifying specific areas of increased concern. Through effective monitoring for larval mosquito specimens, the VBD Team has developed a great understanding of mosquito habitat preference, including the ability to identify and locate larval mosquito species in specific habitats and site types. By understanding the characteristics of vector mosquito specimens, the VBD Team can better control the populations of these species and reduce the ability of these specimens to transmit disease.

The VBD Program has also developed an extensive adult mosquito surveillance system, setting up traps throughout Middlesex-London and identifying viral trends through the advanced research and study of adult mosquito specimens trapped at canopy heights. The MLHU's laboratories have also advanced and have become efficient in identifying mosquitoes and ticks, and performing viral tests on dead bird specimens. Increased vector mosquito activity observed each season can be attributed to weather trends, however at the same time; the number of mosquito identifications, treatments and monitoring visits has increased each year due to the advancements that the VBD Program has made as a whole. Staff have become efficient in identifying vector mosquito habitat, and are better be able to identify and control vector mosquito populations as each season passes.

The VBD Program would like to thank David White for his efforts in beginning the initial West Nile Virus Prevention Program in 2001, with fieldwork and monitoring activities commencing in 2002. The MLHU would like to recognize David for maintaining a commitment to protecting human health by developing a comprehensive VBD Program to monitor for all vector-borne disease of importance in Ontario. David provided the VBD Team with great management and support throughout the past 10 years and the Vector-Borne Disease Team would like to sincerely thank him for his efforts in building this program to be successful in 'Reducing and Repelling' WNV, EEE and LD, in protecting human health and in promoting personal protection and education to residents.

The Vector-Borne Disease Team will now be managed by Iqbal Kalsi, Manager of Environmental Health. Iqbal's portfolio includes work in the areas of Health Hazards Prevention and Management, Toxicology and Risk Assessment, Bed Bugs, Vector Borne Diseases and Emergency Response. The VBD Team would like to welcome Iqbal and look forward to working with him in future seasons.

14.3 Final Comment

The Vector-Borne Disease Program is based on local risk assessment, minimizing the risk of vector-borne diseases to human populations within Middlesex-London. It is important to adjust surveillance, control and education strategies based on the changing dynamics of local mosquito and tick populations, species variation and the emergence of new tick or mosquito populations into Middlesex-London's local environment. The VBD Team hopes to once again promote a successful Lyme disease education program in 2012. The VBD Program will continue to focus on preventing tick bites and educating residents who travel to endemic regions in spring and summer months. This season the VBD Team established a strong community presence in Middlesex-London; through interaction with local media, participation at several community events and by developing relationships with Municipal officials, stakeholders and local partners. The VBD Program hopes to maintain effective relationships with local partners in order to improve education strategies and address any ongoing public concerns or inquiries.

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Appendix A - Vector and Non-vector Mosquito Species Found in Middlesex-London and Ontario

Vector Mosquito Species Identified in Middlesex-London:

Culex pipiens
Culex restuans
Culex quinquefasciatus
*Culex salinarius**
Culex tarsalis
Aedes vexans
*Coquillettidia perturbans**
*Culiseta melanura**
*Ochlerotatus canadensis**
Ochlerotatus cantator
Ochlerotatus hendersoni
Ochlerotatus trivittatus
Ochlerotatus triseriatus
Ochlerotatus stimulans
Ochlerotatus japonicus
Anopheles walkeri
Anopheles punctipennis
Anopheles quadrimaculatus

Vector Mosquito Species Identified in Ontario:

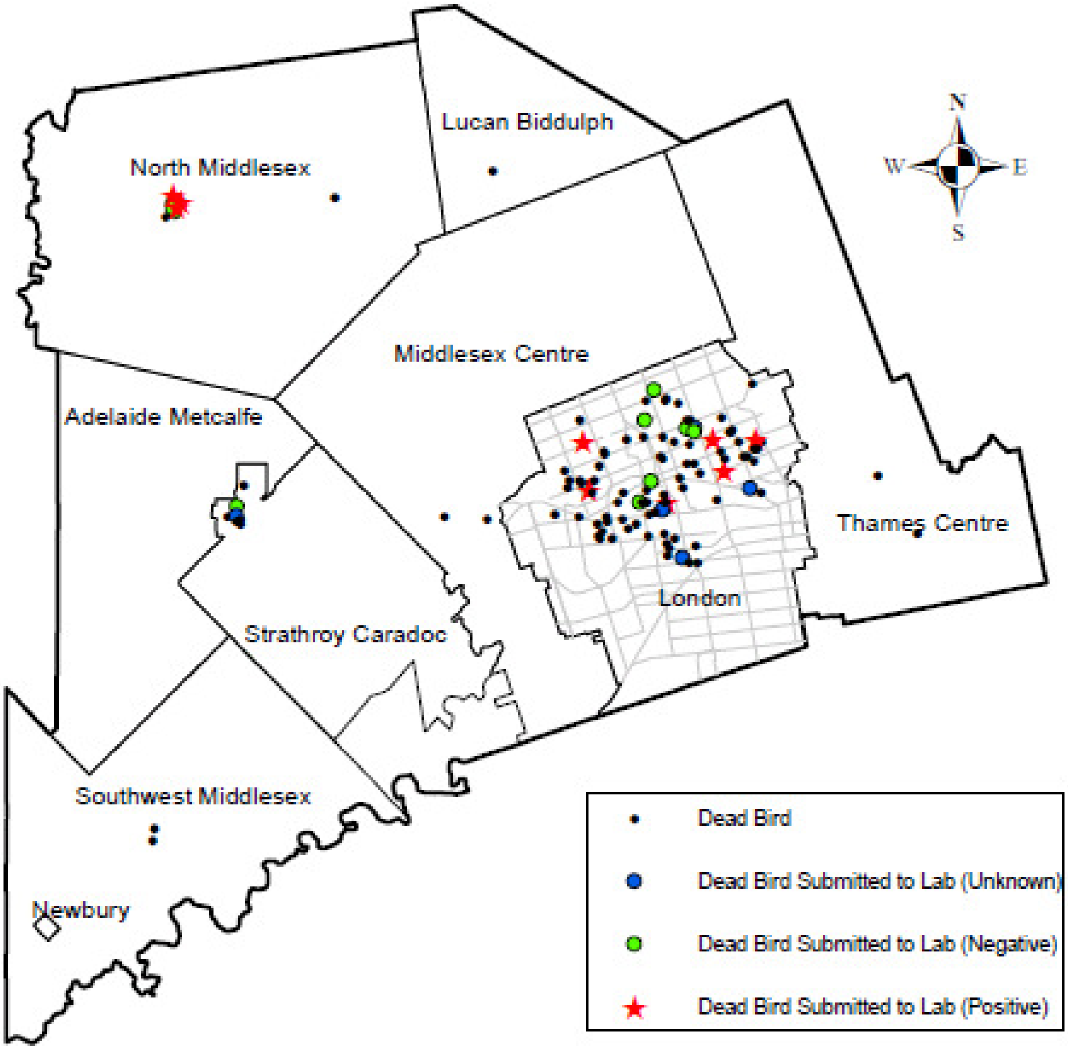
Culex pipiens
Culex restuans
Culex quinquefasciatus
*Culex salinarius**
Culex tarsalis
*Aedes albopictus (Stegomyia albopicta)**
*Aedes vexans vexans**
Aedes vexans nipponii
*Coquillettidia perturbans**
*Culiseta melanura**
*Ochlerotatus canadensis**
Ochlerotatus cantator
Ochlerotatus hendersoni
Ochlerotatus trivittatus
Ochlerotatus triseriatus
Ochlerotatus stimulans
Ochlerotatus japonicus
Ochlerotatus sollicitans
Anopheles walkeri
Anopheles punctipennis
Anopheles quadrimaculatus

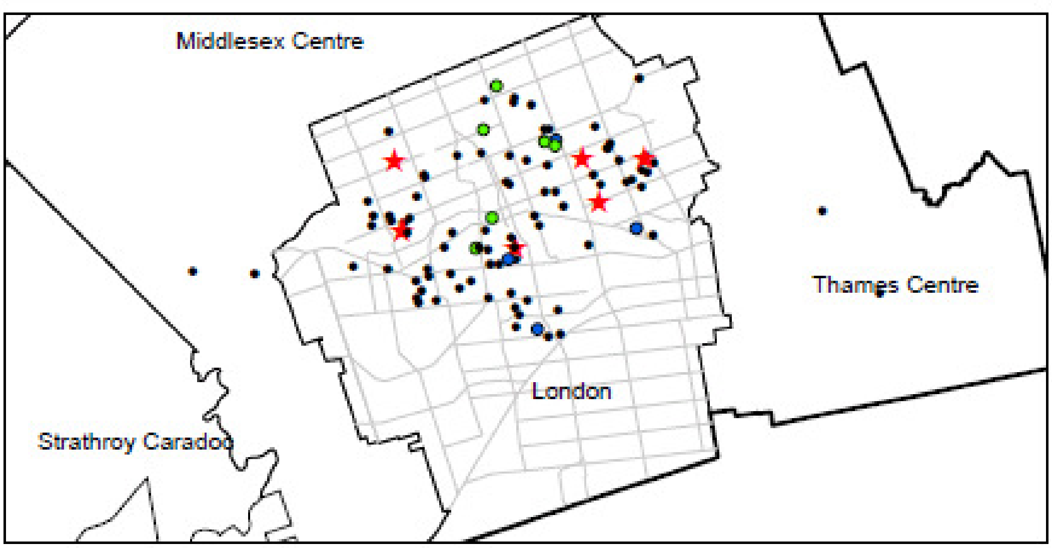
Non-vector Mosquito Species in Ontario:

Aedes cinereus
Anopheles barberi
Anopheles earlei
Anopheles perplexans
Culiseta impatiens
Culiseta inornata
Culiseta minnesotae
Culiseta morsitans
Culex erraticus
Culex territans
Ochlerotatus abserratus
Ochlerotatus aurifer
Ochlerotatus churchillensis
Ochlerotatus communis
Ochlerotatus diantaeus
Ochlerotatus dorsalis
Ochlerotatus eudes
Ochlerotatus excrucians
Ochlerotatus fitchii
Ochlerotatus flavescens
Ochlerotatus grossbecki
Ochlerotatus hexodontus
Ochlerotatus impiger
Ochlerotatus intrudens
Ochlerotatus mercurator
Ochlerotatus provocans
Ochlerotatus punctor
Ochlerotatus riparius
Ochlerotatus spencerii
Ochlerotatus sticticus
Orthopodomyia alba
Orthopodomyia signifera
Psorophora ciliata
Psorophora columbiae
Psorophora ferox
Toxorhynchites rutilus
Uranotaenia sapphirina

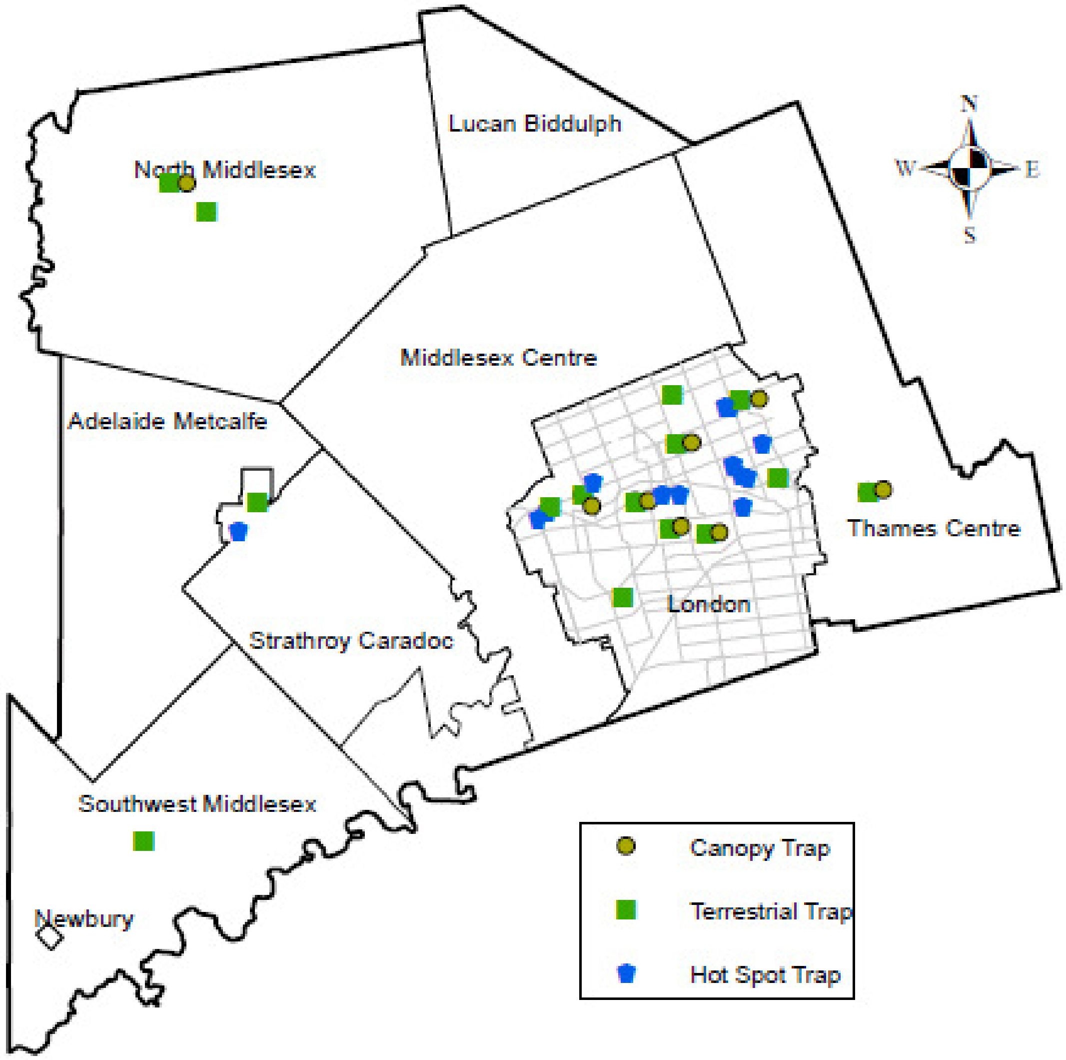
***Vectors of WNV *and* EEE**
** Since 2001, adult mosquito trapping and larval monitoring has resulted in the identification of 55 species of mosquitoes in London and Middlesex County. 37 of these species have been identified in the larval stage.

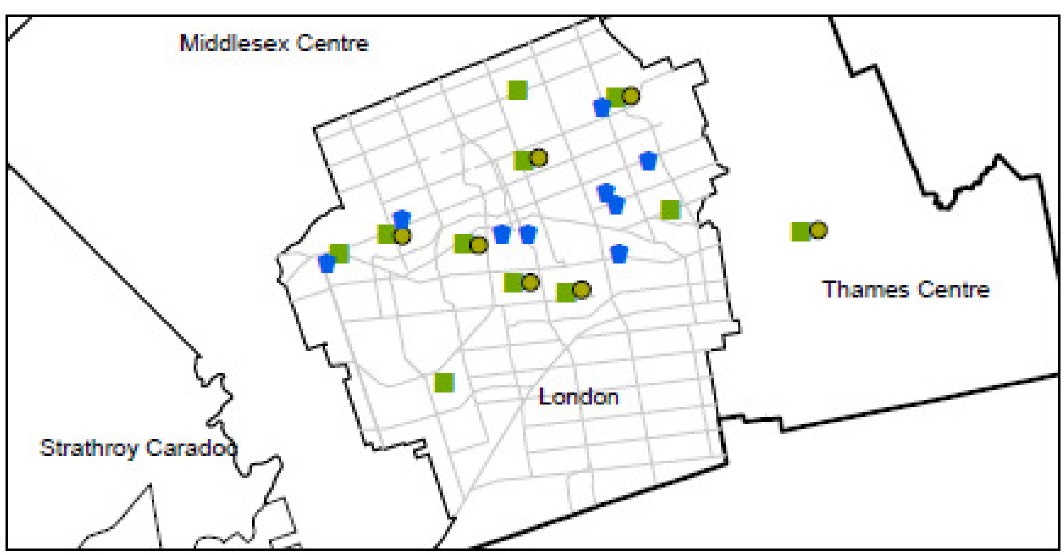
Appendix B - Middlesex-London Dead Bird Surveillance Results, 2011





Appendix C - Middlesex-London Adult Mosquito Trapping Sites, 2011





Appendix D - Adult Mosquito Trap Names and Locations

Trap Name	Trap Type	Location	Total mosquitoes collected	Number of Positive Mosquito Pools (PMP)
Trap A (Dorchester)	Terrestrial	Dorchester	796	-
Can 5 (Dorchester)	Canopy	Dorchester	222	-
Trap J (Glencoe)	Terrestrial	Glencoe	3736	*1 PMP*
Trap H (Parkhill)	Terrestrial	Parkhill	95,997	-
Trap H-A (Parkhill 2)	Terrestrial	Parkhill	998	-
Can 10 (Parkhill)	Canopy	Parkhill	11,494	-
Trap I (Strathroy)	Terrestrial	Strathroy	3303	*1 PMP*
Trap G (Lambeth)	Terrestrial	London	2312	-
Trap O (Exmouth)	Terrestrial	London	651	*1 PMP*
Trap L (Glenora)	Terrestrial	London	560	-
Trap D (Greenway)	Terrestrial	London	1328	-
Can 3 (Greenway)	Canopy	London	230	-
Trap F (Upper Thames)	Terrestrial	London	4658	*1 PMP*
Can 6 (Upper Thames)	Canopy	London	382	*1 PMP*
Trap N (CC Mews)	Terrestrial	London	1717	-
Can 7 (CC Mews)	Canopy	London	382	-
Trap C (Dearness)	Terrestrial	London	2244	-
Can 2 (Dearness)	Canopy	London	322	-
Trap Q (Warbler Woods)	Terrestrial	London	397	*1 PMP*
Trap S (Sifton)	Terrestrial	London	814	-
Can 12 (Sifton)	Canopy	London	450	-
ZZ-11	Hotspot	London	91	-
YY-11	Hotspot	London	67	-
XX-11	Hotspot	London	40	-
WW-11	Hotspot	London	37	-
VV-11	Hotspot	London	111	*2 PMP*
UU-11	Hotspot	Strathroy	110	-
TT-11	Hotspot	London	7	-
SS-11	Hotspot	London	86	-

Appendix E: Criteria for Diagnosis and Classification of West Nile Virus (WNV) Cases

Clinical Criteria for Diagnosis of WNV

(with excerpts from the Ministry of Health and Long Term Care's Infectious Disease Protocol, 2009)

West Nile Virus Neurological Syndrome (WNNS) Diagnostic Criteria

- History of exposure in an area where WNV activity is occurring **OR**
- History of exposure to an alternative mode of transmission (i.e. lab-acquired, in utero; receipt of blood components, organ/tissue donation; possibly via breastmilk)

AND

- Onset of fever

AND recent onset of at least **one** of the following:

- Encephalitis, viral meningitis, acute flaccid paralysis, movement disorder, Parkinsomism or Parkinsomism-like disorders, or other neurological symptoms (as defined by the PHAC)

West Nile Non-Neurological Syndrome (WN Non-NS) Diagnostic Criteria

- History of exposure in an area where WNV activity is occurring **OR**
- History of exposure to an alternative mode of transmission
- **AND** at least **two** of the following:
- Fever, myalgia, arthralgia, headache, fatigue, lymphadenopathy, or maculopapular rash

West Nile Virus Asymptomatic Infection (WNAI) Diagnostic Criteria

- **There is an absence of clinical criteria in WNAI

Laboratory Criteria for Diagnosis of WNV

(with excerpts from the Ministry of Health and Long Term Care's Infectious Disease Protocol, 2009)

Probable Case Laboratory Criteria:

At least **one** of the following:

- Detection of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA without confirmatory neutralization serology (e.g. Plaque Reduction Neutralization Test -PRNT) **OR**
- A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA **OR**
- A titre of > 1:320 in a single WN virus HI test, or an elevated titre in a WN virus IgG ELISA, with a confirmatory PRNT result **OR**
  [Note: A confirmatory PRNT or other kind of neutralization assay is not required in a health jurisdiction/authority where cases have already been confirmed in the current year]
- Demonstration of Japanese encephalitis (JE) serocomplex-specific genomic sequences in blood by NAT screening on donor blood, by Blood Operators in Canada.

Confirmed Case Laboratory Criteria:

At least **one** of the following:

- A 4-fold or greater change in WN virus neutralizing antibody titres (using a PRNT or other kind of neutralization assay) in paired acute and convalescent sera, or CSF **OR**
- Isolation of WN virus from, or demonstration of WN virus antigen or WN virus-specific genomic sequences in tissue, blood, CSF or other body fluids **OR**
- Demonstration of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA, confirmed by the detection of WN virus specific antibodies using a PRNT (acute or convalescent specimen) **OR**
- A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA AND the detection of WN specific antibodies using a PRNT (acute or convalescent serum sample).

Case Classification of WNV

(with excerpts from the Ministry of Health and Long Term Care's Infectious Disease Protocol, 2009)

WNNS and WN Non-NS Case Classification Criteria

Suspect

- Clinical criteria AND absence or pending laboratory criteria AND absence of any other obvious cause

Probable

- Clinical Criteria AND at least one of the probable case laboratory criteria

Confirmed:

- Clinical criteria AND at least one of the confirmed case laboratory criteria

WNAI Case Classification Criteria

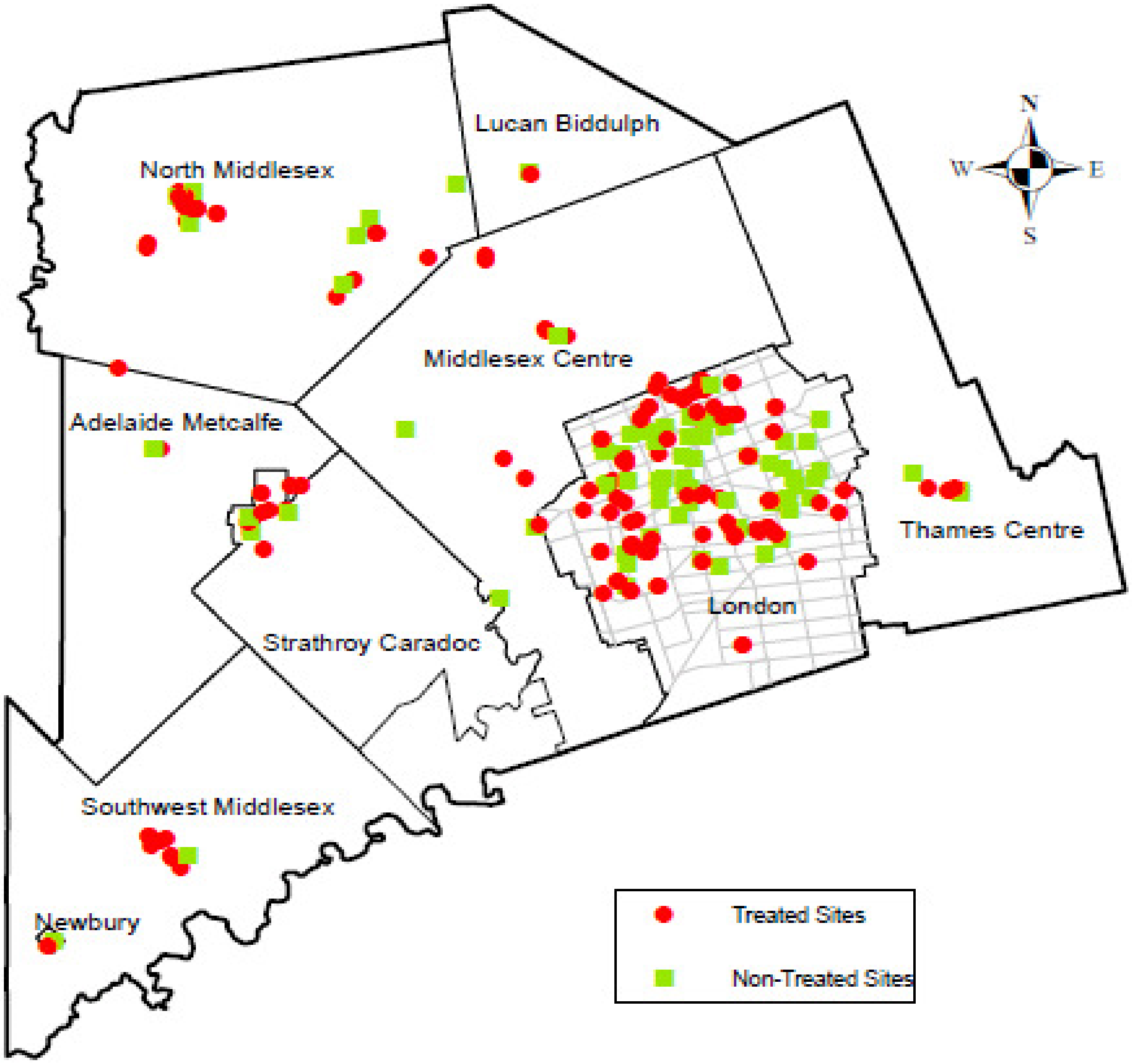
Probable:

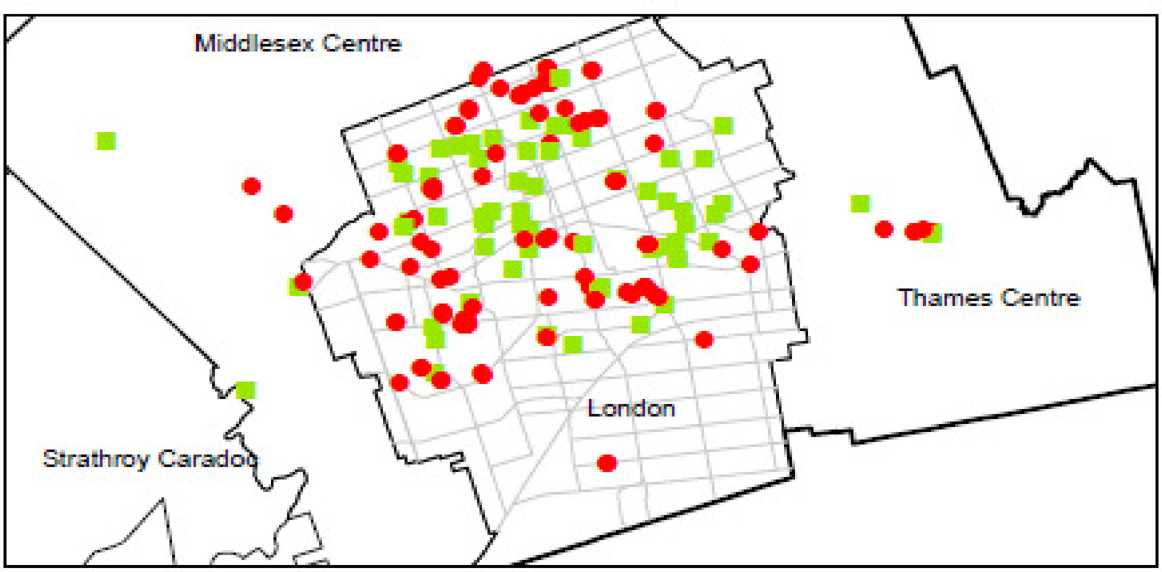
- Probable case laboratory criteria AND absence of clinical criteria

Confirmed:

- Confirmed case laboratory criteria AND absence of clinical criteria
-

Appendix F - Middlesex-London Surface Water Sites, 2011





Appendix G - 2011 Catch Basin Flyer

MIDDLESEX-LONDON HEALTH UNIT

CATCH BASIN TREATMENT 2011

Why treat catch basins?

Catch basins are a significant breeding site for mosquitoes including *Culex pipiens*, a West Nile Virus mosquito vector (a species known to carry the virus). Treating catch basins will prevent larvae from maturing into adult mosquitoes and will reduce the risk of amplification and spread of the virus into the human population.

How will I know if the catch basins in my area have been treated?

Each catch basin will be assigned a colour based on the treatment status (see table below). Canadian Centre for Mosquito Management Inc. will treat catch basins in every urban centre in the Middlesex-London region approximately 3-4 times between June and September. The method of control used will depend on the area. Catch basins within 50m of an outfall to water bodies such as streams, lakes and wetlands are considered sensitive and will be treated with the biological larvicide, *bacillus sphaericus* water soluble pouches. If the catch basin is not near an outfall, the pesticide methoprene will be used for treatment. Treatment will involve the use of 30-day methoprene pellets for most public catch basins. A 120-day methoprene briquette will be used in rear yard catch basins, park catch basins and other areas that may be difficult to access. Dry catch basins will not be treated. For further information, please contact the Middlesex-London Health Unit Strathroy office at (519) 245-3230.

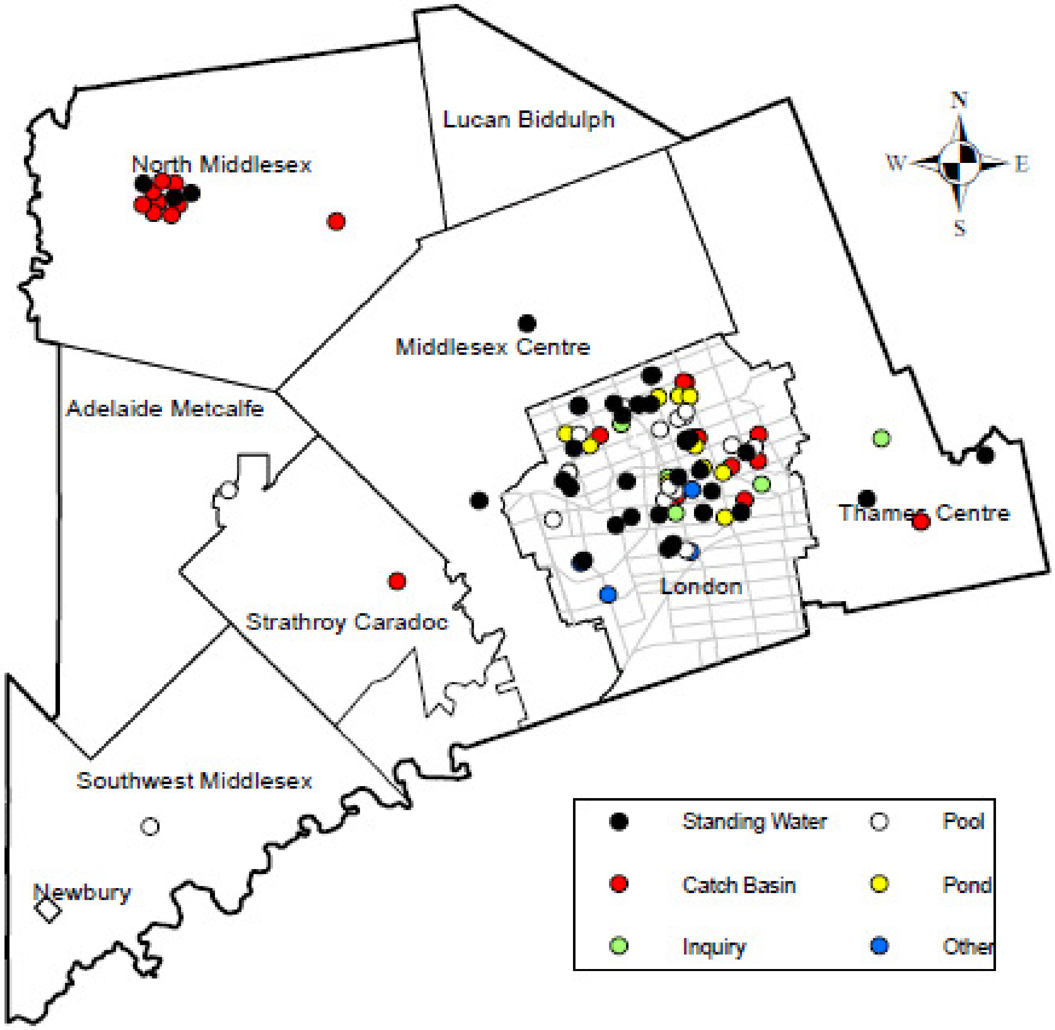
TREATMENT COLOUR CODES	
Purple	Treatment #1
White	Treatment #2
Orange	Treatment #3
Pink	Sensitive Area
Brown	Methoprene Briquette

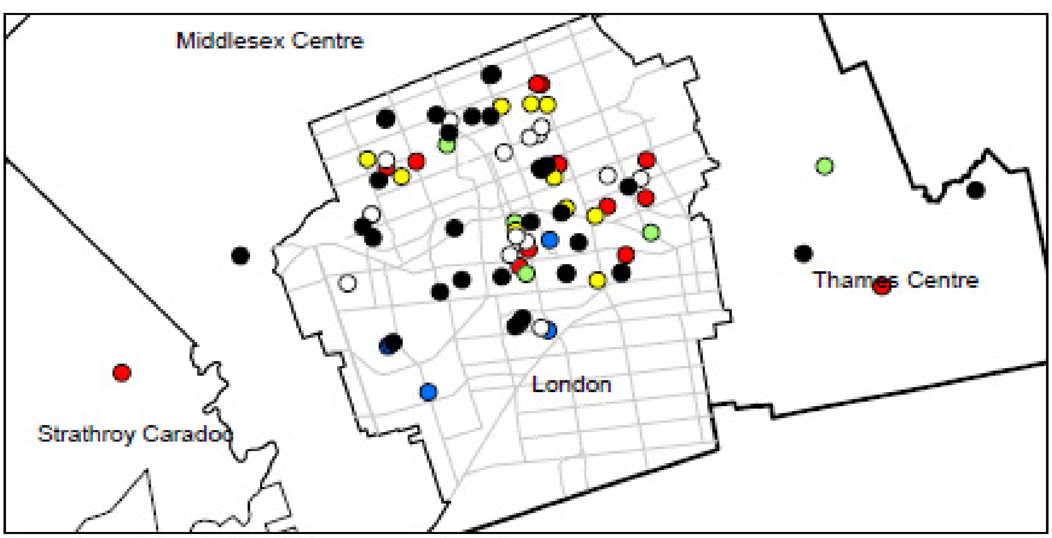
Appendix H - Storm Water Management Facilities Monitored

Site Name	Component	Larval Count	Most Common Vector Species Identified
Adelaide North	F	58	*An.punctinpennis, An. quadrimaculatus*
Applegate	F, C	174,152	*An. punctipennis, Cx. pipiens*
Beattie Street	Ch, C	33,34	*Cx. territans, An. quadrimaculatus*
Corlon	F, C	190,101	*Cx. territans, Cx. pipiens*
Cranbrook	F, C	14, 41	*An. punctipennis, Cx. restuans*
Crestwood	F, C	188,132	*Cx. pipiens, Ae.vexans*
Commissioner's Road	C	52	*An. punctipennis, Cx. territans*
Dorchester	F1, F2, C	17,0,4	*Oc. japonicus*
Duncairn	F, C	41,64	*An. punctipennis, Cx. pipiens*
Evans Boulevard	F, C	8,4	*Cx. pipiens, Ae. vexans*
Fanshawe Ridge North	F, C	188,117	*Cx. territans, An.quadrimaculatus*
Ilderton - Meredith Drive	F	65	*Cx. pipiens, Cx. restuans*
Ilderton - Meadowcreek	F, C	98,84	*An. punctipennis, An. quadrimaculatus*
Ilderton- King Street	F	105	*Cx. pipiens, Cx. restuans*
Hamilton Road	C	129	*An. punctipennis, Cx. territans*
Hunt Club	F, Ch, C	51,0,102	*Cx. territans, An. punctipennis*
Killaly I	F	108	*Cx. territans, An. punctipennis*
Killaly II	F, C	192,151	*Cx. territans, An. punctipennis*
Manning Dump	F1, F2	116,10	*An. punctipennis, An. quadrimaculatus*
Meadowlilly Woods	F,C	23,0	*An. punctipennis, Cx.territans*
Meander Creek	F	61	*An. punctipennis*
Mornington	F, C	124,66	*Cx. pipiens, Cx. restuans*
North Lambeth	F, C	115,146	*An. punctipennis, An. quadrimaculatus*
Parkview	F1, F2	257,0	*Cx. pipiens, An. punctipennis*
Parkwood	F, C	0,0	*** No mosquito larvae identified*
Pinecourt	F, C	214,27	*Cx. pipiens, An.punctipennis*
Pond Mills	F, Ch	225,234	*Cx. pipiens, Cx. restuans*
River Road	F	67	*An. punctipennis, An. quadrimaculatus*
Jack Nash	F	434	*Cx. pipiens, Cx. restuans*
Saintsbury	F	18	*An. quadrimaculatus, Cx. restuans*
Sam's Club	F, C	136,186	*Cx. pipiens, Cx. restuans*
Second Street	F	72	*Ae. vexans, An. quadrimaculatus*
South River	F, C	55,53	*Cx. pipiens, Cx. territans*
South Wenige	F,C	33,27	*An. punctipennis, An. quadrimaculatus*
South Wenige 2	F, C	33,2	*An. punctipennis, An. quadrimaculatus*
Summercrest	F, C	108,88	*An. punctipennis, An. quadrimaculatus*
Talbot Village	F, C	81,42	*An. quadrimaculatus, Cx.territans*
Ted Earley Park	Ch, C	66,42	*Ae. vexans, An. punctipennis*
Thornhead	F, C	289,86	*Cx. pipiens, Cx. restuans*
Turnberry	F,C	99,115	*An. punctipennis, An. quadrimaculatus*
Upland Hills	F1, F2, C	47,51,29	*An. quadrimaculatus Ae. vexans, Cx. pipiens*
White Oak	F,C	27,61	*Cx. pipiens, An. punctipennis*
Wilton Grove Road	F	63	*Cx. pipiens*

F= forebay C= cell Ch= channel

Appendix I - Middlesex-London Complaints, Comments and Concerns, 2011





REDUCE & REPEL MOSQUITOES

10 Years of Surveillance