West Nile virus

2000 - 2004

Haldimand & Norfolk
Health Surveillance Report
2005

GIS Mapping Meningitis CDC Light Traps Vectors encephalitis mosquitoes Culex pipiens Dead Birds Larviciding Protection Catch Basins Surveillance Birds WNv Fever infection Deet

Message from the Acting Medical Officer of Health, Dr. Jeff Tschirhart…

The Haldimand and Norfolk West Nile virus Surveillance Report 2005 is the first WNV surveillance report to be completed by the Health Unit. The goal of this report was to summarize the WNV surveillance data (human, bird and mosquito) over the last five years (2000-2004) and to highlight how the WNV program in Haldimand and Norfolk has changed during this time.

West Nile virus was first isolated in 1937 from the blood of a patient living in the province of West Nile in Uganda. In the late summer and early fall of 1999 an outbreak of viral Encephalitis occurred in New York City. Laboratory investigations confirmed that the casual agent was West Nile virus. This was the first recognized West Nile outbreak in North America. The outbreak resulted in 62 confirmed human cases with 17 deaths including a 75 year old Canadian who had visited New York City that September.

Over the last 5 years, the virus has moved across the United States and Canada causing hundreds of human cases and deaths. The negative impact on the avian bird populations has also been significant for specific bird species. Although much has been learned about the epidemiology of WNV infection there are still many unanswered questions.

This WNV Surveillance Report will serve as an important resource document for anyone wanting to better understand the presence of WNV in Haldimand and Norfolk over the last five years and the efforts taken to deal with WNV in both counties.

Sincerely,

Jeff Tschirhart, M.D., C.C.F.P.

Acting Medical Officer of Health

Authors

Wayne Tucker, M.Sc.
Program Coordinator – Communicable Diseases/Epidemiologist
Haldimand-Norfolk Health Unit, (519) 426-6170 Ext. 234
wayne.tucker@haldimand-norfolk.org

Deanna Tries, M.A.
Epidemiologist
Haldimand-Norfolk Health Unit, (519) 426-6170 Ext. 215
deanna.tries@haldimand-norfolk.org

Jerry Khumalo, Dip. P.H.I., B.A.Sc., C.P.H.I. (C)
Public Health Inspector
Haldimand-Norfolk Health Unit, (905) 318-5367 Ext. 306
jerry.khumalo@haldimand-norfolk.org

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Reviewers

Karen Boughner	Manager, Public Health Haldimand-Norfolk Health Unit
Dr. Jeff Tschirhart	Acting Medical Officer of Health Haldimand-Norfolk Health Unit
Patti Moore	General Manager Health and Social Services

Layout and Design

Tracey Austin	Information Developer Haldimand-Norfolk Health Unit

G.I.S. Mapping

Rebecca Dang	Planning Technician Student Norfolk County
Christopher Mazzuca	Mapping and Graphics Technologist Haldimand County
Ryan Boughner	West Nile virus Student Haldimand-Norfolk Health Unit

Cover Design

Janet Pigot	Graphic Designer

EXECUTIVE SUMMARY

The West Nile virus (WNV) Surveillance Report 2005 is the first WNV surveillance report to be completed for Haldimand and Norfolk. It provides a five year perspective of all aspects of the WNV program. This report is an important document for understanding the surveillance activity (human, bird and mosquito) of WNV in Haldimand and Norfolk and the public education efforts by the Health Unit to reduce the likelihood of human infection. The WNV Surveillance Report provides the general public, media, local politicians, physicians and other health care professionals with a comprehensive resource tool for understanding WNV activity in Haldimand and Norfolk over the last five years (2000-2004). This executive summary lists some of the key highlights of the report. The reader is encouraged to review the full report for additional surveillance information on WNV in Haldimand and Norfolk. The complete report can be downloaded from the Health Unit website (www.haldimand-norfolk.org/health/publications).

Introduction

- Human and dead bird surveillance started in Haldimand and Norfolk in 2000. Adult mosquito surveillance did not start until 2002.
- The WNV public education campaign in Haldimand and Norfolk started in 2000 and has evolved each year to become a comprehensive campaign focusing on source reduction and personal protective measures.
- After the occurrence of human cases in Haldimand, Norfolk and surrounding Health Units in 2002, a larviciding program was initiated in 2003.

Public Education

- For the years 2000-2004, the Health Unit used multiple strategies to educate and keep the public informed about WNV activity in the community such as press releases, newspaper and radio ads, pamphlets, posters and fact sheets.
- Public education efforts by the Health Unit targeted the general public with particular emphasis on households, camping grounds and gardening centres.

Human Case Surveillance

- Over the last 5 years, 2002 was the only year that human cases were reported in Haldimand and Norfolk (3 cases).
- Although there were no human cases in Haldimand and Norfolk in 2003 and 2004, there were numerous cases reported in the surrounding Health Units (11 cases in 2003 and 2 cases in 2004).
- In Ontario, the highest number of human cases (probable/confirmed) was reported in 2002 (405 cases). Since then, the number of cases in Ontario has seen a significant decline (89 cases in 2003 and 14 cases in 2004).

Dead Bird Surveillance

- The identification of positive WNV dead birds in Haldimand and Norfolk was an important surveillance tool to alert the community of the presence of WNV in the area.
- Over the last 5 years, 2002, 2003 and 2004 were the only years that the Health Unit received laboratory confirmation of positive WNV crows in Haldimand and Norfolk Counties.
- Over the last 3 years (2002-2004), there were a total of 11 positive crows in Haldimand and a total of 10 positive crows in Norfolk.

Adult Mosquito Surveillance

- There was no mosquito surveillance program in Haldimand and Norfolk during the years 2000 and 2001.
- Mosquito traps were used to help identify the presence of WNV activity in Haldimand and Norfolk over the last 3 years (2002 – 2004).
- Haldimand and Norfolk had 6 positive mosquito pools in 2002, 1 in 2003 and 0 in 2004.
- Surrounding Health Units had 46 positive mosquito pools in 2002, 12 in 2003 and 9 in 2004.
- In 2002, 2003 and 2004, *Ae vexan vexans* (Bridge vectors) was the species of mosquito found most often in both Haldimand and Norfolk. This mosquito specie is known to transmit West Nile virus.

Larval Mosquito Surveillance and Control

- Over the last 5 years, 2003 and 2004 were the only years that Haldimand and Norfolk Counties had a larviciding program.
- A total of 7025 catch basins were larvicided in 2003 (2 applications per county) and 7114 catch basins in 2004 (4 applications per county).
- The Health Unit received 33 environmental concern calls about larviciding in 2002, 69 calls in 2003 and 10 calls in 2004. Over the last couple of years residents of Haldimand and Norfolk appear to have less environmental concerns about larviciding.

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"Surveillance is an integral component of any West Nile virus program."

Wayne Tucker, M.Sc.
Program Coordinator - Communicable Diseases/Epidemiologist
Haldimand-Norfolk Health Unit

Introduction

The goal of the West Nile virus (WNV) Surveillance Report 2005 is to provide residents, physicians, health care professionals, local politicians and media with a detailed summary of WNV surveillance activity for both Haldimand and Norfolk Counties over the last 5 years (2000-2004). It also provides a summary of the steps taken by both counties to prevent the spread of WNV through public education and larviciding programs. To accomplish this goal, the WNV report focuses on the following topics; public education and community outreach, human case surveillance, dead bird surveillance, adult mosquito surveillance and larval mosquito surveillance and control.

WHAT IS WEST NILE VIRUS?

West Nile virus was first discovered in 1937 and named after the West Nile region of Uganda.[1, 6] West Nile virus is an infection that people can acquire after being bitten by an infected mosquito.[1, 8] Mosquitoes obtain WNV from biting an infected bird carrying the virus.[1, 6, 8] Transmission of the virus from one person to another is not possible.[6] Although the risk is low, research in 2002 indicated that people could become infected with WNV via blood transfusions and organ/tissue transplants.[1, 6] There is also evidence that pregnant women can transmit the virus to their unborn babies and the virus may also be passed through breast milk.[2] The first confirmed human cases of WNV in Canada were recorded in 2002 in the provinces of Ontario and Quebec.[15] It is estimated that 4 out of 5 people infected with WNV do not exhibit any symptoms.[8, 9] If there is an illness resulting from being infected with WNV, symptoms usually appear within 2 to 15 days.[3] Of those who do develop an illness, the severity of the illness can range from a mild illness, such as 'West Nile Fever', to serious neurological illness such as encephalitis (inflammation of the brain).[7, 9] For those who are infected with WNV, there are a number of symptoms that are possible early signs of WNV disease such as fever, muscle weakness, stiff neck, confusion, severe headache, and sudden sensitivity to light.[13, 14] There is no WNV vaccine that exists to date.[3, 7]

WEST NILE VIRUS – PROTECTION/PUBLIC EDUCATION

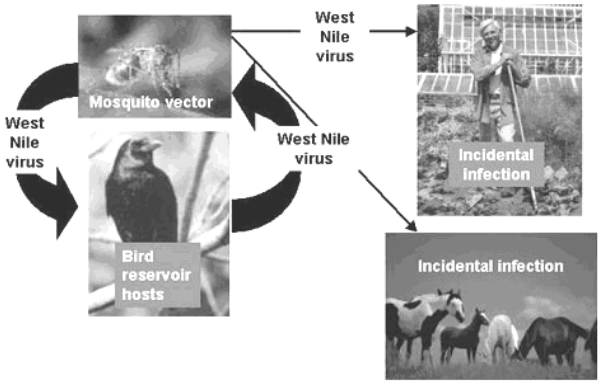
Public education is an important component of protection against WNV. There are a number of things that people can do to either protect themselves or reduce the number of mosquito breeding grounds. Individuals should use an insect repellent that contains DEET to reduce the likelihood of getting bitten by an infected mosquito.[4] The concentration of DEET should be no greater than 30% for adults and 10% for children.[6, 8]

This information can be found on the insect repellent bottle. The percentage of DEET reflects the duration of protection, i.e., 30% DEET provides approximately 6 hours of protection, whereas 5% DEET provides approximately 2 hours of protection.[6, 8] Other means of protection include covering up by wearing long-sleeved shirts/jackets and long pants when outdoors.[4, 6, 8, 10] Standing water areas are breeding grounds for mosquitoes.[6, 8, 11] The general public should take every preventive measure to eliminate standing water areas around their homes.[4] Common standing water areas include bird baths, old tires, wheelbarrows, barrels, small containers, flower pots, swimming/wading pools, and eaves/drains.[4]

WEST NILE VIRUS – TRANSMISSION CYCLE

The WNV transmission cycle to people involves being bitten by an infected mosquito.[5] The mosquito becomes infected when it feeds on the blood of a bird that is infected with the virus.[5] Once the mosquito is infected with WNV, it takes about two weeks before the mosquito is capable of passing the virus to people and animals by biting them.[5] According to the Ministry of Health and Long-Term Care (MOHLTC), WNV is not spread by person-to-person contact including touching, coughing, sneezing, or drinking from the same cup.[8, 9] There is no evidence to suggest that WNV can be transmitted from infected animals to people.[5, 9] WNV has been found in approximately 10 species of mosquitoes in Canada and is most common in the *Culex* species that feed on birds.[1] The different species of mosquitoes can be divided into either "bridge" vectors or "enzootic" vectors.[12] Bridge vectors and sometimes Enzootic vectors are mosquito species that impose a risk to humans.[12] Enzootic vectors feed mainly on birds, although they may occasionally feed on humans.[12] See Figure 1 for an illustration of the West Nile virus Transmission Cycle.

Figure 1- West Nile Virus Transmission Cycle

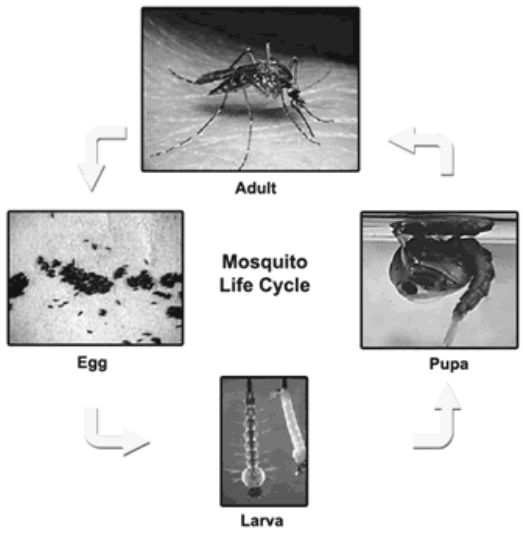


Source: Centres for Disease Control and Prevention (CDC)
http://www.cdc.gov/ncidod/dvbid/westnile/cycle.htm

WEST NILE VIRUS – MOSQUITO LIFE CYCLE

There are four stages in the development of a mosquito – egg, larva, pupa and adult.[6, 10] See Figure 2 for an illustration of the Mosquito Life Cycle. The female mosquito requires a blood meal to develop the eggs.[10] The female mosquitoes find surface water areas to lay their eggs.[6] A mosquito may take two or three blood meals during its life and develop several hundred eggs each time.[10] The stages of larva and pupa are dependent on water.[2] Weather conditions such as temperature and rainfall can affect the mosquito population.[1] The entire cycle (egg to adult) can be completed in less than ten days.[11] Mosquitoes can live four to eight weeks.[10]

Figure 2 - Mosquito Life Cycle



Source: York University
http://resources.yesican.yorku.ca/west_nile/trans_life_cycle.html

HALDIMAND AND NORFOLK WEST NILE VIRUS SURVEILLANCE PROGRAM

The 2004 season concludes 5 years of WNV surveillance in Haldimand and Norfolk and significant changes have been noted.

2000 – WNV Surveillance

In 2000, the WNV surveillance program in Haldimand and Norfolk included human and dead bird (crows and blue jays) surveillance and public education. There were no adult mosquito surveillance or larviciding programs.

2001 – WNV Surveillance

In 2001, the WNV surveillance program in Haldimand and Norfolk focused on human and dead bird (crows and blue jays) surveillance and public education. The public education component focused on source reduction and the use of personal protective measures. This information was provided to camping areas and the general public through fact sheets and newspaper ads. There were no adult mosquito surveillance or larviciding programs.

2002 – WNV Surveillance

In 2002, the WNV surveillance program in Haldimand and Norfolk focused on human, dead bird (crows only), and adult mosquito surveillance (Norfolk only). There was no larviciding surveillance program. The Health Unit set up five mosquito traps from spring to fall in the Simcoe area. The traps were sent via courier to Brock University for testing. Some of the testing was conducted at Health Canada's National Microbiology Lab in Winnipeg.

In 2002, the public education program utilized several communication channels including newspapers, radio and information sheets. The Health Unit targeted students, campers, garden centre employees and the general public. Source reduction and personal protection measures continued to be the Health Unit's primary focus.

2003 – WNV Surveillance

In 2003, the WNV surveillance program in Haldimand and Norfolk focused on human, dead bird (crows only), adult mosquito and larviciding. Mosquito surveillance involved using Centers for Disease Control and Prevention (CDC) light traps every week. In 2003, five traps were put out every other week at seven different sites within Haldimand and Norfolk Counties. Five locations were regular sites and two traps were used to coincide with 'hot spots". Hot spots were defined as areas where there was increased WNV activity, i.e., positive WNV mosquito pools. All traps were sent to Brock University for testing. As well, two WNV students were hired to conduct WNV public education activities through newspapers, radio, schools, work places, camping grounds, and households and garden centres.

In 2003, the Health Unit expanded the public education campaign on source reduction and personal protective measures. The Health Unit did investigate standing water complaints related to increased risk for mosquito breeding and established a WNV hot line to answer any public calls regarding WNV.

2004 – WNV Surveillance

The WNV surveillance program in 2004 was very similar to 2003. Larviciding began earlier in the season with a total of 8 applications (4 in Haldimand and 4 in Norfolk). In addition, mosquito surveillance was expanded to set up mosquito CDC light traps at designated sites every week reserving some mobile traps for identified 'hot spots'. Hot spots were defined as areas where there was increased WNV activity, i.e., positive WNV mosquito pools. In 2004, 20 traps were set up every week (10 in Haldimand and 10 in Norfolk) between June and October. Of these 20 traps, there were 10 fixed traps in Haldimand and 8 fixed traps in Norfolk. Norfolk had 2 traps that were rotated among 7 different flexible sites on a weekly basis. Hot spots were taken into consideration when moving the mosquito traps.

In 2004, public education was still an important component of the WNV program for Haldimand and Norfolk Counties. The Health Unit continued to provide a WNV hot line to answer any public calls about WNV. Three WNV students were hired in 2004 to help implement components of the WNV program in Haldimand and Norfolk. To date, there is no standing water by-law in effect for either Haldimand or Norfolk Counties. Residents of Haldimand and Norfolk were encouraged to reduce mosquito breeding grounds by reducing standing water areas. The Health Unit investigated standing water complaints, dipped standing water areas and applied larviciding if required.

CONCLUSION

The last 5 years has seen some significant developments in the WNV program in Haldimand and Norfolk. See Table 1 for a summary of the WNV program in Haldimand and Norfolk over the last 5 years. Ongoing efforts on promoting and educating the public on WNV helped to monitor and control WNV in Haldimand and Norfolk.

Table 1 – Summary of WNV Program in Haldimand and Norfolk 2000-2004

	2000	2001	2002	2003	2004
Human Surveillance	Yes	Yes	Yes	Yes	Yes
Bird Surveillance	Yes	Yes	Yes	Yes	Yes
Mosquito Surveillance	No	No	Yes	Yes	Yes
Public Education	Yes	Yes	Yes	Yes	Yes
Larviciding	No	No	No	Yes	Yes

The chapters that follow provide detailed summaries on public education and community outreach, human surveillance, dead bird surveillance, adult mosquito surveillance and larval mosquito surveillance and control.

"Personal protective measures and reducing mosquito breeding sites are key public efforts in reducing WNV."

Karen Boughner, R.N., B.Sc.N.
Manager, Public Health
Haldimand-Norfolk Health Unit

Public Education and Community Outreach

Over the last five years public education has been an important factor in the prevention and control of West Nile virus. Education efforts in Ontario have focused on providing the public with information about the disease such as what it is, symptoms, how it spreads and what the public can do to control it.[17, 18, 19] The public was educated about how to reduce possible breeding sites for mosquitoes, the importance of personal protection measures such as wearing appropriate clothing and the use of repellents containing DEET.[16, 17, 20, 21, 22, 23] The purpose of this chapter is to outline the public education efforts of the Haldimand-Norfolk Health Unit over the last five years in keeping the public informed and educated about WNV activity in the community.

2000 Public Education and Community Outreach

In 2000, public education efforts focused on WNV surveillance activities. Newspaper advertisements provided the general public with information on the WNV dead bird surveillance program and promoted basic personal protection measures.

2001 Public Education and Community Outreach

The Ministry of Health and Long-Term Care (MOHLTC) set up an Ontario West Nile virus Working Group in 2001 to provide information and guidance to local Health Units. Public education efforts focused on the WNV surveillance activities in both Haldimand and Norfolk Counties. Information was provided to physicians and other health care providers on human surveillance. Pamphlets were developed for areas where outside activities were the focus (camping grounds and gardening centres). WNV fact sheets were also distributed to the general public. The fact sheets contained information on personal protection measures and source reduction. The Health Unit also used the radio to make people aware of the bird surveillance program.

The public was encouraged to phone the Health Unit and report any dead bird sightings. Media releases and newspaper ads were also used to keep the public informed of WNV activities in the community throughout the summer and fall.

2002 Public Education and Community Outreach

Human surveillance information packages were sent to physicians and emergency rooms. Public education was developed around two messages – source reduction and personal protective measures. The Health Unit distributed WNV prevention pamphlets and posters developed by the MOHLTC to schools, households, camping areas and garden centres. Prevention information was also included in the community activity guides of both Haldimand and Norfolk Counties. Finally, press releases, newspaper ads, and radio were used to keep the public informed of WNV activities in Haldimand and Norfolk. For example, newspapers were used to keep the public informed about dead bird surveillance activities from early spring to fall.

2003 Public Education and Community Outreach

Public education and community outreach was a key component of the WNV program in 2003 in Haldimand, Norfolk and Ontario. All news media outlets were used by both the Provincial and the Federal Governments. A WNV "Fight the Bite" booklet was mailed out to every household in Ontario. This booklet contained detailed information about WNV including the use of repellents containing DEET for personal protection. It was the responsibility of each Health Unit to develop their education strategy.

The Health Unit hired two WNV students to develop the education program. The WNV students developed education materials/packages used during information sessions at schools, day cares, households, garden centres, camping areas, and worksites. The key messages in this package included: the origin of WNV, methods of transmission, human risks, source reduction strategies (eliminating standing water areas), personal protective measures (long sleeve clothing, mosquito repellents and nets), public awareness (sign/symptoms of WNV) and the importance of mosquito and dead bird surveillance.

The Health Unit also sent out printed information to local health care providers to keep them up to date and to encourage their cooperation. For example, the Health Unit sent out human surveillance information and guidelines to our local physicians and infection control practitioners in local hospitals and long term care facilities. These information packages included the symptoms of infection, case definitions, laboratory tests required to confirm positive status, reporting requirements and prevention measures. A section dedicated to WNV was developed on the Health Unit website to help answer any questions and to provide updates (www.haldimand-norfolk.org/health/cd/WNV/WNV_main.htm). Finally, the Health Unit established a WNV hotline to address community questions or concerns relating to WNV.

2004 Public Education and Community Outreach

In 2004, one WNV student was hired to continue the WNV public education activities for both counties. Two additional WNV students were hired in 2004 to implement other components of the WNV program in Haldimand and Norfolk. The content of educational materials in 2004 was similar to the materials used in 2003. The student responsible for the WNV public education activities continued with the development and distribution of WNV educational packages and kept the Haldimand-Norfolk Health Unit's website updated with current WNV information. Other responsibilities included providing educational sessions as required by the public. A bi-weekly WNV update was created which outlined the surveillance activities (human, dead bird, and mosquito). This update was posted on the website, sent to all local politicians (Haldimand and Norfolk) and our local news media to keep everyone up to date on WNV activities in the community. Media releases were used to advise the public when a positive bird, mosquito pool or human case was confirmed, as well as, to advise the public of the larviciding of catch basins in the community. WNV information was updated and maintained on the Health Unit's website to help answer any questions (www.haldimand-orfolk.org/health/cd/WNV/WNV_main.htm). Finally, the Health Unit continued to offer the WNV hotline to address community concerns and questions relating to WNV activity.

CONCLUSION

Over the last five years there have been considerable changes in the WNV public education efforts in Haldimand and Norfolk. Source reduction and personal protective measures were the key messages of the public education campaign.

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"Human surveillance provides us with risk factor information that is invaluable in preventing further cases of the disease."

Linda Vrbova, M.Sc.,
Epidemiologist
Ontario Ministry of Health and Long-Term Care

Human Case Surveillance

The goal of WNV human surveillance is to monitor the occurrence of human cases of WNV in the community. There are a number of benefits to collecting human surveillance information. First, the location of human cases is a source of early detection of WNV activity for health care professionals and the public.[30] Second, "human surveillance can also help us understand the risk factors associated with contracting the disease, and factors influencing the outcome of the disease".[28] Third, human surveillance is an important component of conducting a risk assessment, to assess the relative risk of human infection.[29] Finally, human surveillance helps protect the blood supply in Canada by obtaining important information on blood transfusions and organ transplants.[31] This information is important since WNV can be transmitted via blood transfusions and organ transplants.[31]WNV was added to the list of reportable diseases for Ontario in 2003.[32] This chapter provides a 5 year perspective of human surveillance in Haldimand and Norfolk Counties, the surrounding Health Units, as well as a provincial and national overview. During the WNV surveillance period of 2000-2004, there have only been 3 confirmed human cases of WNV recorded in Haldimand and Norfolk, all of which occurred in 2002.

CASE IDENTIFICATION

The physician's identification of a person with the symptoms of WNV infection is the first step.[20, 30] The next step involves submitting a blood sample to the MOHTLC Central Public Health Laboratory (CPHL) for testing.[28] CPHL performs the Igm ELISA (Enzyme-Linked Immunosorbent Assay) test with lab results available in 24 hours.[28] If positive, the test is repeated to eliminate false positive results.[28] If there is a true positive result the patient is considered a 'probable' WNV case and advised of the positive test results.[28] The PRNT (Plague Reduction Neutralization Test) is needed to confirm the diagnosis.[28] This test result takes 7 days.[28] Health Units are notified of positive WNV results and Health Unit staff conduct a comprehensive interview of the positive case. [28] The interview gathers information on blood transfusions and organ transplants.

CASE DEFINITIONS

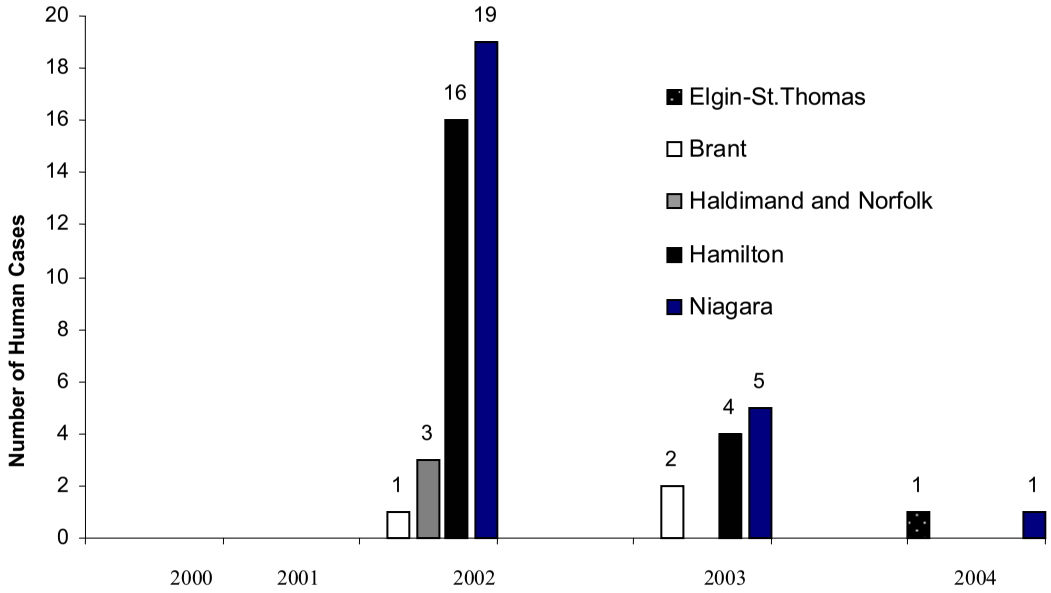
A number of changes have been made in the case definitions of WNV illness between 2002 and 2003. In 2003, the MOHLTC divided WNV into 3 types of illness. First, 'WNV Asymptomatic Infection' referred to those people who had no clinical symptoms but had positive laboratory tests for WNV.[26] Second, 'West Nile virus Fever' referred to a mild form of the illness.[26, 27] The main defining symptom was the sudden onset of fever, as well as one or more of the following symptoms; myalgia, arthalgia, headache, fatigue, photophobia, lymphadenopathy and/or maculopapular rash. [26, 27] Third, 'West Nile Neurological Syndrome', which is the most severe type of illness, could result in encephalitis (inflammation of the brain), meningitis (inflammation of the membrane surrounding the brain and spinal cord) or meningoencephalitis (inflammation of the brain and the surrounding membrane).[26, 27] WNV Asymptomatic Infection was further classified as either 'probable' or 'confirmed'. [26, 32] The other two types of WNV illnesses (West Nile virus Fever and West Nile virus Neurological Syndrome) were classified into 1 of 4 levels of categories - 'suspect', 'possible', 'probable' or 'confirmed'.[26,32] WNV has an incubation period ranging from 3 to 14 days.[27]

HUMAN SURVEILLANCE

Human Surveillance – Haldimand and Norfolk (2000-2004)

To date there have been 3 confirmed cases of WNV in Haldimand and Norfolk.[33] These are the only human cases of WNV that have been recorded in Haldimand and Norfolk since the start of human surveillance in 2000 (See Figure 3). The Counties of Haldimand and Norfolk are surrounded by five other Health Units; Oxford, Elgin-St-Thomas, Hamilton, Brant and Niagara. There were no WNV cases in Haldimand or Norfolk or the surrounding Health Units in 2000 or 2001.[34] There were a total of 36 (confirmed/probable) cases of WNV in the surrounding Health Units in 2002, 11 in 2003 and 2 in 2004 (See Figure 3). [33,35,36] In total, there have been 49 human cases recorded in the surrounding Health Units over the last 5 years, with 2002 having the highest number recorded (36 cases).[24] Since 2002 the number of cases in the surrounding Health Units have shown a considerable decline. Although there were no WNV human cases in Haldimand and Norfolk over the last couple of years, there were numerous cases in the areas surrounding Haldimand and Norfolk during this same period. There were no human cases in Oxford during the period 2000-2004, and therefore no data is represented in Figure 3.

Figure 3 - Number of Human Cases (Confirmed/Probable) of West Nile virus in Surrounding Health Units (Oxford, Elgin-St. Thomas, Hamilton, Brant and Niagara) & Haldimand-Norfolk (2000-2004)



Data Source: Public Health Agency of Canada
http://www.phac-aspc.gc.ca/wnv-vwn/index.html

Table 2 provides a summary of symptoms for the 3 confirmed human cases of WNV in Haldimand and Norfolk in 2002. All 3 cases reported fever, fatigue and rash. Two cases reported additional common symptoms, stiff neck and headache. The onset of symptoms for the 3 cases was about one month apart and occurred late summer and early fall. None of the 3 cases were WNV travel related or had received a blood transfusion.

Table 2 - Haldimand and Norfolk West Nile virus Human Cases in 2002 - Summary of Symptoms

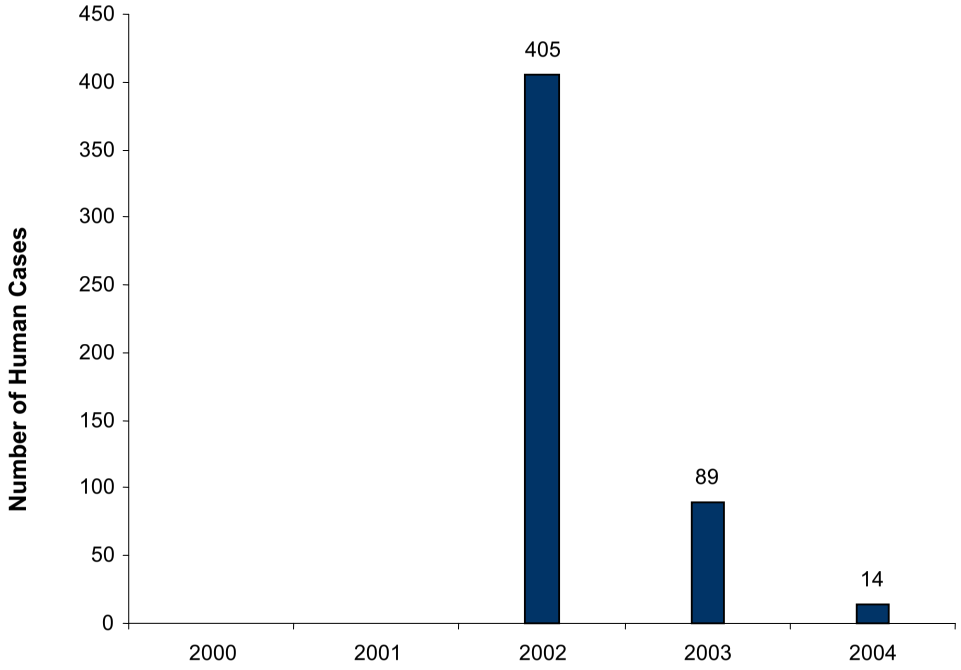
2004
Fever (≥ 38º C)
Muscle Weakness
Stiff Neck
Fatigue
Rash
Headache
Chills
Altered Mental Status
Visual Distortion
Swollen Glands
Tremors

Data Source: Haldimand-Norfolk Health Unit

Human Surveillance – Ontario (2000-2004)

No human cases of WNV were recorded in Ontario in 2000 or 2001[34] (See Figure 4). In 2002, there were 405 human cases of WNV in Ontario (Confirmed and Probable).[33] Between 2002 and 2004, we have seen a dramatic decline in the number of human cases in Ontario with 405 in 2002, 89 in 2003 and 14 in 2004.[35, 36] See Table 3 for a detailed summary of the 14 human cases in Ontario in 2004.

Figure 4 - Number of Human Cases (Confirmed & Probable) of West Nile virus in Ontario (2000-2004)



Data Source: Public Health Agency of Canada
http://www.phac-aspc.gc.ca/wnv-vwn/index.html

Table 3 - Ontario WNV Human Case Summary – 2004

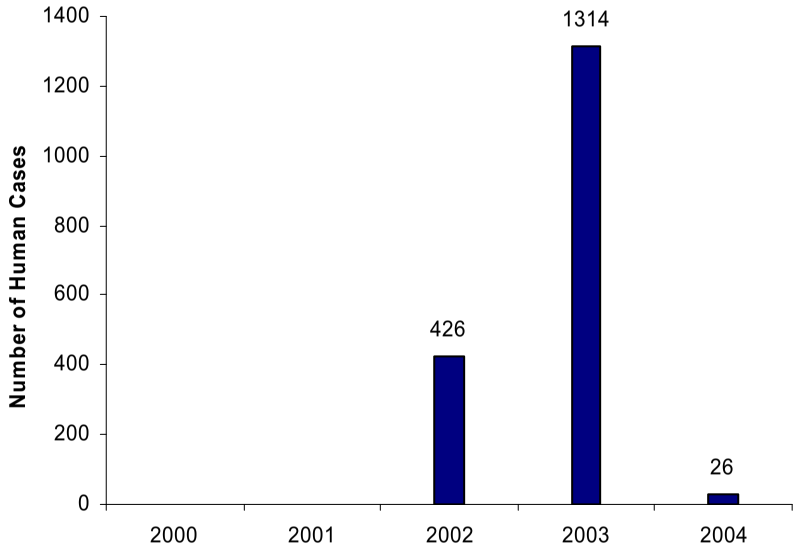
Demographics	Number
Age (N=14)	
20-29	2
30-49	1
50-59	7
60-79	3
80+	1
Gender (N=14)	
Male	7
Female	7
Case Definition (N=14)	
Confirmed	11
Probable	3
Hospitalizations (N=14)	
Yes	9
No	5
Diagnosis (N=14)	
West Nile Fever	3
West Nile Neurological Syndrome	10
West Nile Asymptomatic Infection	1

Data Source: Linda Vrbova, Ontario Ministry of Health and Long-Term Care, 2004 WNV Wrap-up Meeting

Human Surveillance – Canada (2000-2004)

No human cases of WNV were recorded in Canada in 2000 or 2001 (Figure 5). In 2002, there were 426 human cases (Confirmed and Probable) of WNV in Canada (Quebec, Ontario and Alberta).[33] In 2003, there were 1314 cases of WNV in 7 provinces (Ontario, Quebec, Nova Scotia, New Brunswick, Manitoba, Saskatchewan and Alberta).[35] In 2004, there were 26 WNV cases in Canada (Quebec, Ontario, Manitoba, Saskatchewan and Alberta).[36] In 2004, 45% of the cases occurred in Ontario and 35% in Saskatchewan (a combined total of 80% of the cases).[36] See Table 4 for a summary of the WNV cases in 2003 and 2004 by type of diagnosis. Over the last two years (2003 and 2004) we have seen a dramatic decline in the number of human cases in Canada with 1314 cases in 2003 and 26 cases in 2004.[35, 36] See Figure 5 for a summary of the number of human cases in Canada over the last five years.

Figure 5 - Number of Human Cases (Confirmed & Probable) of West Nile virus in Canada (2000-2004)



Data Source: Public Health Agency of Canada
http://www.phac-aspc.gc.ca/wnv-vwn/index.html

Table 4 - 2003 & 2004 WNV Human Cases by Type of Diagnosis in Canada

Diagnosis (Confirmed and Probable)	2003 Cases	2004 Cases
WNV Neurological Syndrome	168	13
WNV Fever	1130	12
WNV Asymptomatic Infection	16	1
Total	**1314**	**26**

Source: Public Health Agency of Canada
http://www.phac-aspc.gc.ca/wnv-vwn/index.html

CONCLUSION

In conclusion, although there were only 3 WNV cases in Haldimand and Norfolk over the last 5 years, ongoing WNV human surveillance is still important in determining the nature of WNV illness. Although there were no human cases in 2003 or 2004 in Haldimand and Norfolk Counties, there were numerous cases in the surrounding areas (2003 - 11 cases and 2004 - 2 cases).[35, 36] Human cases in Haldimand and Norfolk Counties and surrounding areas were important factors in the decision of both counties to initiate a larviciding program in 2003. The highest number of human cases in Ontario occurred during the 2002 WNV season. Since 2002 the number of cases has been declining in Ontario (405 - 2002, 89 – 2003, 14 - 2004). In Canada the highest number of cases was reported in 2003 (1314 cases). The number of WNV human cases in Canada declined significantly in 2004 (26 cases).[35, 36]

"Dead bird surveillance provides the earliest indication of when WNV activity begins each year and the geographic location of the activity."

Ian Barker, DVM, M.Sc. PhD
Ontario/Nunavut Coordinator of the Canadian Cooperative Wildlife Health Centre

Dead Bird Surveillance

Dead bird surveillance is an important tool to identify WNV in a community. To date, dead bird surveillance continues to be the best early warning measure to communities.[37] The WNV has been found in more than 150 bird species in North America.[37] While some of these bird species infected with WNV are asymptomatic, other bird species such as crows, blue jays, magpies, and ravens get sick more often and are more likely to die from the virus.[38] After being infected with the virus most crows die from inflammation of the brain (encephalitis) and other organs.[38] Dead bird surveillance programs involve several sequential steps that include: dead bird sightings, collecting or retrieving dead bird carcasses, dead bird testing, and collecting and reporting data. A 5 year overview of the various components of dead bird surveillance is explored in the proceeding sections to capture dead bird surveillance in Haldimand and Norfolk from 2000 to 2004. Specifically, the following chapter provides an overview of the dead bird surveillance program, dead bird sightings, and dead bird surveillance data.

The Canadian Cooperative Wildlife Health Centre (CCWHC) WNV surveillance program supported by Health Canada, implements Ontario's testing on birds. The program mainly tests corvid species, to include crows, blue jays, and ravens, except for 2002 and 2003 when no blue jays were tested.[37] This is key information that assists each Health Unit in decision making for the purpose of WNV prevention and control.[37] It is not intended to provide ongoing monitoring of WNV with respect to bird health.[37] Health Units submit birds to CCWHC from spring to fall. Each Health Unit is allotted a fixed number of birds for testing.[37] Once it is determined that WNV is prevalent in the community, bird testing is no longer deemed necessary.[37] The CCWHC reserves the rights to cease testing for that community and re-allot testing submissions to other areas that are not deemed WNV positive in their bird population.[37]

2000 - WNV Dead Bird Surveillance Program in Haldimand and Norfolk

In 2000, the WNV dead bird surveillance program in Haldimand and Norfolk was introduced. In 2000, species of particular concern, Corvidae (American crows, ravens, blue jays and magpies), Accipitridae and Falconidae (eagles, hawks) were collected. The Health Unit encouraged the public not to handle any dead birds, but rather phone the Health Unit and report any dead bird sightings. A member from the Communicable Disease Team would then go to the site and collect the dead bird carcass. All the dead

birds collected were submitted to CCWHC for testing. The CCWHC clearly defined what they expected from each Health Unit in regards to the specimen, submission process, packaging and shipping of the dead birds in order to maintain a good specimen. All bird carcasses which exhibited signs of trauma, injury, emaciation or predation (injury from a cat) were not submitted for testing to the CCWHC. Only dead birds listed under the 'Species of Particular Concern' were collected. In 2000, WNV bird surveillance public education was limited to newspapers.

2000 – Dead Bird Surveillance Data

In 2000, there were a total of 34 dead birds submitted/tested from Haldimand and Norfolk. The dead birds included (4 crows, 8 blue jays and 22 other birds). In 2000, there were no WNV positive dead birds.

2001 - WNV Dead Bird Surveillance Program in Haldimand and Norfolk

In 2001, only American crows, blue jays, ravens and other birds that died in large numbers were collected. The Health Unit continued to encourage the public not to handle any dead birds, but rather phone the Health Unit to report any dead bird sightings. A member of the Communicable Disease Team would go to the site and collect the dead bird carcass. All dead birds, in accordance to CCWHC standards, were submitted to CCWHC for testing. The WNV Bird surveillance education program expanded to include newspaper advertisements, radio ads and the provision of information to camping grounds.

2001 - Dead Bird Sightings/Surveillance Data

In 2001, 57 dead bird sightings (crows, blue jays, and other birds) were reported in Haldimand-Norfolk of which 25 (44%) were from Norfolk and 32 (56%) were from Haldimand. For both counties, a higher number of crows were reported. Thirty-three birds were tested from Haldimand and Norfolk County and none were found to be WNV positive.

2002 - WNV Dead Bird Surveillance Program in Haldimand and Norfolk

In 2002, only American crows were tested (no blue jays) in Haldimand and Norfolk Counties and across Central and Western Ontario. Blue jays were not tested because crows were abundant across Central and Western Ontario. In accordance to the CCWHC dead bird standards, the public was asked to report any dead bird sightings to the Health Unit. A member from the Communicable Disease Team would then go to the site and collect the dead bird carcass. All the dead birds collected were submitted to CCWHC for testing.

2002 - Dead Bird Sightings/Surveillance Data

In total 143 dead crow sightings were reported in Haldimand and Norfolk. A higher number of dead crows were reported in Haldimand (88 crows or 62%), compared with Norfolk County (55 crows or 38%). In total, 23 dead crows were submitted for testing of which 6 were tested for WNV. Of the 6 birds tested for WNV, all were found to be WNV positive (Norfolk-4 and Haldimand-2).

2003 - WNV Dead Bird Surveillance Program in Haldimand and Norfolk

In 2003, the WNV bird surveillance public education program expanded and included more communication channels. Members of the public were asked again to contact the Haldimand-Norfolk Health Unit, and report on the location and condition of the bird. Once a member of the Communicable Disease Team received this information, and confirmed the species of the bird, an appointed member would go out to the field and collect the dead bird.

2003 - Dead Bird Sightings/Surveillance Data

In 2003, there were a total of 67 dead crow sightings reported in Haldimand and Norfolk, of which 47 (70%) were from Norfolk and 20 (30%) were from Haldimand. In 2003, 19 crows and other dead birds (not blue jays) were submitted for testing for WNV and of that 16 were tested for WNV. Nine dead crows were confirmed WNV positive (Haldimand - 6 and Norfolk - 3) in 2003.

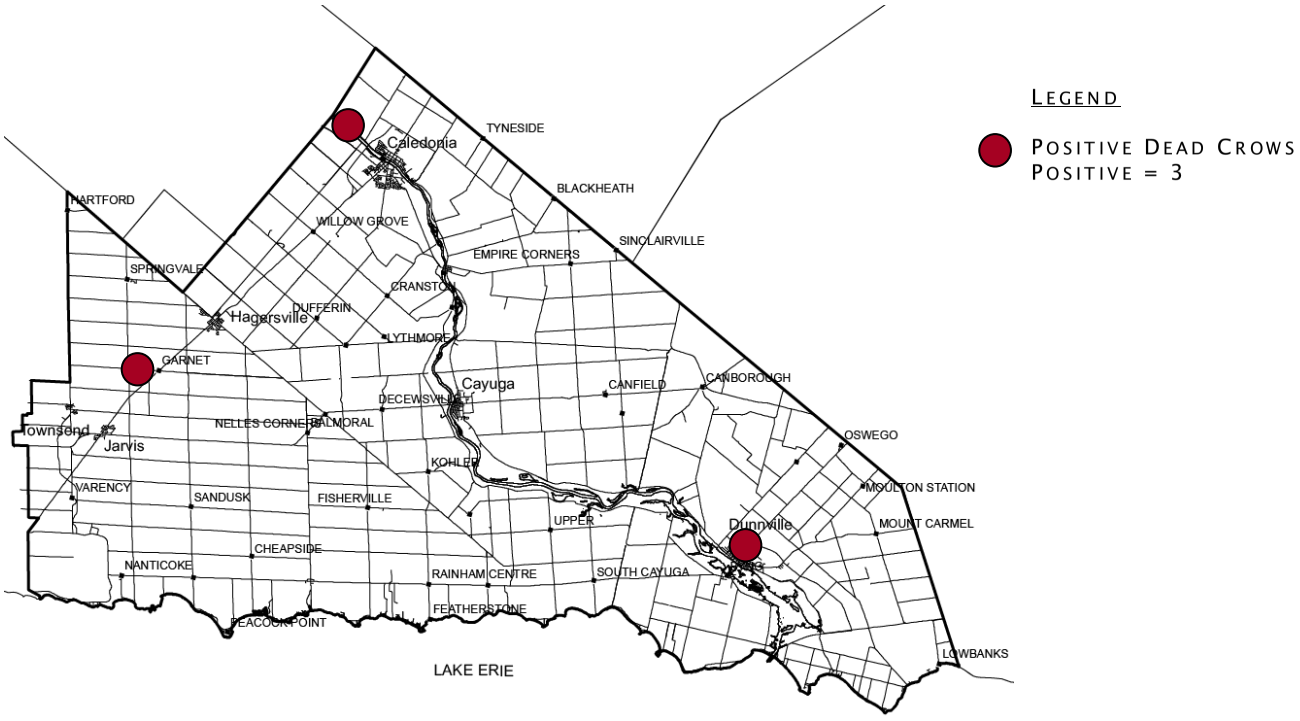
2004 - WNV Dead Bird Surveillance Program in Haldimand and Norfolk

In 2004, the public continued to contact the Health Unit to report any dead bird sightings from spring to fall. The location of the dead crows was collected by obtaining the actual longitude and latitude measurements using a Global Positioning System (GPS), which were accurate to within plus or minus three to five meters. Once the dead crows were collected they were sent to the CCWHC for testing. Each week, the number of dead birds that were submitted was recorded and analyzed. Although the CCWHC was accepting both crows and blue jays, only crows from Haldimand and Norfolk were submitted. Bird surveillance began on May 5 and continued until October 29, 2004.[46] Once the CCWHC confirmed 6 positive cases for WNV (Haldimand - 3 and Norfolk - 3), it was confirmed that WNV was present in the community.

2004 - Dead Bird Sightings/Surveillance Data

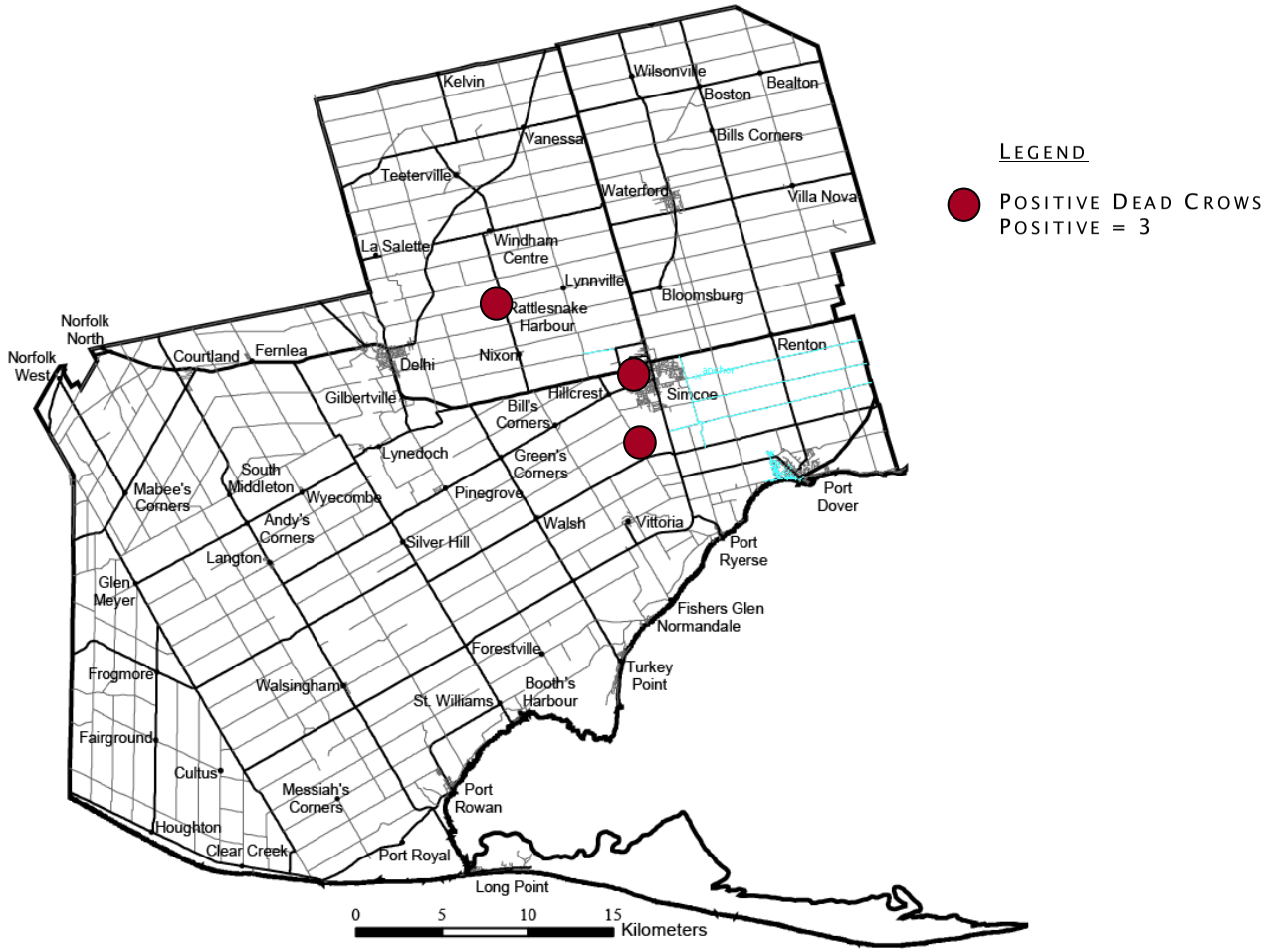
In total, 48 dead bird sightings including crows and blue jays were reported in Haldimand and Norfolk from May 16, 2004 to October 2, 2004 (weeks 20-39). Of the 48 birds reported, a higher percentage were from Norfolk (26 birds or 54%) than Haldimand (22 birds or 46%). For both Haldimand and Norfolk a higher proportion of crows were reported. In Norfolk, the highest number of bird sightings occurred at the end of the season in week 34 (August 22, 2004 - August 28, 2004). In Haldimand, the highest number of bird sightings occurred in week 22 (May 30, 20904 - June 5, 2004). In total 9 dead crows were submitted for testing. All 9 birds were tested, of which 6 birds were found to be WNV positive (Haldimand-3 and Norfolk-3). See Map 1 and Map 2 for the location of WNV positive dead birds in Haldimand and Norfolk Counties in 2004.

Map 1 - Location of WNV Positive Dead Crows, Haldimand County, 2004



Source: Planning Department, Haldimand County

Map 2 - Location of WNV Positive Dead Crows, Norfolk County, 2004



Source: Planning Department, Norfolk County

Dead Bird Surveillance Data – Canada and Ontario (2000-2004)

From a national and provincial perspective in 2000, 2,288 birds were submitted for testing in Canada and none were found to have WNV present.[38] In 2001, 2,804 birds were tested in Canada and 5% (128) were found to have the virus, of which all confirmed positive cases were from Ontario (128).[41] In 2002, 3218 birds were tested in Canada and 17% (555) were WNV positive.[42] Of the birds that were WNV positive, 51% (281) were from Ontario.[42] In 2003, 11,332 birds were tested in Canada and 14% (1633) were found to be positive with WNV.[43] Of the 14% (1633) birds that were WNV positive in Canada, 15% (242) were from Ontario.[42] During this year (2003), a significantly higher number of dead birds were submitted for testing. In 2004, 6236 birds were tested in Canada and 7% (416) were found to be positive with WNV.[43] Of the 416 confirmed cases of WNV positive dead birds in Canada (2004), Ontario has the highest confirmed cases of WNV accounting for 60% (250) of the specimens.[44]

Clearly over the past 5 years there have been significant changes in the total number of birds tested and the number confirmed positive for WNV in Canada and Ontario. See Table 5 for a summary of the total number of birds tested and confirmed positive in Ontario and Canada over a 5 year period. The amount of birds confirmed WNV positive in Canada reached a plateau in 2003 (1633), and then substantially decreased in 2004 (416). This may be a result of the substantially higher number of birds tested for the year 2003.

Table 5 - Number of Birds Tested and Confirmed WNV positive in Ontario and Canada 2000-2004

Year	Number Tested		Number Confirmed	
	Canada	Ontario	Canada	Ontario
2000	2288	172	0	0
2001	2804	1725	128	128
2002	3218	972	555	281
2003	11332	1484	1633	242
2004	6236	1403	416	250

Data Source: Ontario Ministry of Health and Long-Term Care
http://www.phac-aspc.gc.ca/wnv-vwn/mon_e.html

CONCLUSION

Within the last 5 years, with the exception of 2000 and 2001, WNV has been present within Haldimand and Norfolk Counties. To date there have been 315 dead bird sightings in both Haldimand and Norfolk County of which 64 were confirmed tested (2001-2004) and 21 found to be positive with WNV. See Table 6 for a summary of dead bird sightings and Table 7 for a summary of dead bird surveillance data.

Table 6- Summary of Dead Bird Sightings in Haldimand and Norfolk 2001-2004

Bird Type	2001		2002		2003		2004	
	H	N	H	N	H	N	H	N
Crow	15	12	88	55	20	47	12	18
Blue Jay	7	8	N/A	N/A	N/A	N/A	10	8
Other	10	5	N/A	N/A	N/A	N/A	N/A	N/A
Total	**32**	**25**	**88**	**55**	**20**	**47**	**22**	**26**

H- Haldimand N-Norfolk N/A Not Applicable

Data Source: Haldimand-Norfolk Health Unit

Table 7- Summary of WNV Bird Surveillance Data in Haldimand and Norfolk 2001-2004

Year	Dead Crows Submitted		Dead Blue Jays Submitted		Other Dead Birds Submitted		Dead Birds Tested	WNV Positive Crows		WNV Positive Blue Jays	
	H	N	H	N	H	N	H	H	N	H	N
2001	12	9	11	9	4	0	33	0	0	0	0
2002	15	8	N/A	N/A	N/A	N/A	6	2	4	N/A	N/A
2003	7	8	N/A	N/A	3	1	16	6	3	N/A	N/A
2004	6	3	0	0	0	0	9	3	3	N/A	N/A
Total	**40**	**28**	**11**	**9**	**7**	**1**	**64**	**11**	**10**	**0**	**0**

H- Haldimand N-Norfolk N/A- Not Applicable

Data Source: Haldimand-Norfolk Health Unit

The number of dead bird sightings slightly decreased over the last 2 years. The decrease in sightings was not likely due to an underreporting of calls, but rather an increase of awareness of the type and condition of the birds wanted for collection. In 2004 the number of dead bird sightings was the lowest during the 5 year surveillance period. The dead bird public education program expanded and used a variety of communication channels to inform the general public of dead bird surveillance in Haldimand and Norfolk Counties. In 2004, GPS was used to provide an accurate location of dead crows in Haldimand and Norfolk.

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"Surveillance is the key to success in managing a mosquito borne disease like West Nile virus."

Syed Jawid, M.Sc.– Medical Entomologist
Ministry of Health and Long-Term Care

Adult Mosquito Surveillance

The purpose of mosquito surveillance is to help determine the risk of contracting WNV in a particular area.[48] This is achieved through monitoring the type of mosquito species, abundance, location of mosquitoes and infection rate.[47] This information assists each Health Unit in decision making for the purpose of WNV prevention and control.[47]

There are 74 species of mosquitoes in Canada, of which approximately 10 species have been found to be WNV positive.[48] The mosquito population can be affected by the time of year, rainfall, and temperature.[48] Mosquitoes can be categorized into 2 types of vectors, "bridge" and "enzootic".[49] Bridge vectors and sometimes Enzootic vectors are mosquito species that pose a risk to humans.[49] Enzootic vectors primarily feed on birds, although they may occasionally feed on humans.[49] *Culex pipiens* and *Culex restuans* are Enzootic vectors that commonly transmit the virus.[48] WNV positive mosquito pools are an important indicator of the threat from WNV in a specific area.[47]

Mosquito surveillance programs involve several sequential steps that include: mosquito trapping, collecting mosquito traps, mosquito testing, and collecting and reporting data. A 5 year overview of the various components of mosquito surveillance is explored in the proceeding sections to outline mosquito surveillance in Haldimand and Norfolk from 2000 to 2004.

2000- 2001 WNV Mosquito Surveillance Program in Haldimand and Norfolk

In 2000 and 2001, there was no mosquito surveillance program in Haldimand and Norfolk.

2002- WNV Mosquito Surveillance Program in Haldimand and Norfolk

In 2002, adult mosquitoes were trapped from spring to fall. Centres for Disease Control and Prevention's (CDC) miniature 'light' traps were used to attract exclusively mosquitoes. These light traps use carbon dioxide (CO_2) and either a black light that emits ultra-violet light or white light.[50] The Health Unit used white light to attract female mosquitoes. In 2002, adult mosquito surveillance consisted of 5 fixed trap locations. The traps

within Simcoe were located in 'secure' areas on private property and were monitored on a regular basis. Each trap was coded based on a numbering and set letter system created by Brock University (A-1, B-1, C-1, D-1, G-1, etc.). The mosquitoes from the traps were collected, refrigerated, and transported live to Brock University for WNV identification and testing. Brock University identified a proportion of female mosquitoes by species.[52] Some of the testing was done at Health Canada's National Microbiology Laboratory in Winnipeg.

2002- Mosquito Surveillance Data

In 2002, mosquito traps were only set up in Norfolk County (Simcoe); therefore there is no mosquito identification data for Haldimand County. There were 6 positive mosquito pools confirmed in Norfolk. In 2002, *Ae vexans vexans* (Bridge vectors) was the species of mosquito found most often in Norfolk (See Table 8). See Appendix I for the estimated number of female mosquitoes identified by species.

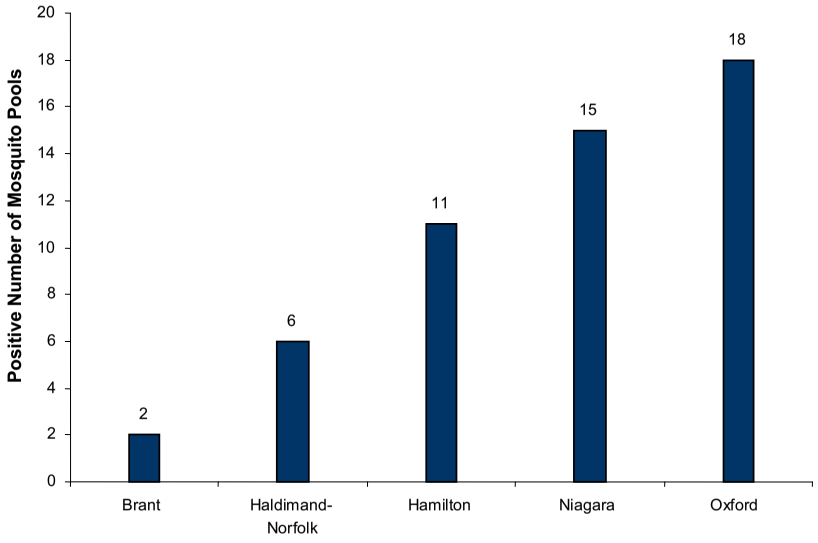
Table 8 – Estimated Number of Female Adult Mosquitoes Identified by Species, Norfolk, 2002

Norfolk	Number
Ae.vexans vexans	*531*[1]
Cx.pipiens/restuans	*127*[2]
An.punctipennis	*57*[1]
Culex spp.	*57*
Ae.vexans/canator	*53*[1]

1 – Bridge vector 2 – Enzootic vector
Data Source: Ministry of Health and Long-Term Care

In Canada there were 663 confirmed positive mosquito pools in 2002.[53] There were 598 positive pools in 21 Health Units, with Toronto having the highest number of positive mosquito pools (175).[54] Overall, there were 46 positive mosquito pools found in the surrounding Health Units in 2002 (Oxford-18, Hamilton-11, Brant-2, and Niagara-15)[54] (See Figure 6). No positive mosquito pools were found in Elgin-St.Thomas in 2002. That Health Unit is therefore not represented in Figure 6.[54]

Figure 6 - Number of Positive Mosquito Pools of West Nile virus in Surrounding Health Units (Oxford, Elgin-St.Thomas, Hamilton, Brant and Niagara) & Haldimand-Norfolk (2002)



Data Source: Ministry of Health and Long-Term Care
http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_03/wnv_surveillance.html

2003- WNV Mosquito Surveillance Program in Haldimand and Norfolk

In 2003, mosquito surveillance involved using miniature CDC light traps every other week. In total 5 traps were put out every other week at seven different sites within Haldimand and Norfolk Counties. Five sites were regular sites and 2 traps were used to coincide with hot spots. Hot spots were areas that have been found to have WNV activity (bird, mosquito pool, or a human case). The purpose of 'hot spot' trapping is to determine the intensity of WNV activity.[50] The traps were located in 'secure' areas on private property, and were monitored on a regular basis. Each trap was coded based on a numbering and set letter system created by Brock University (A-1, B-1, C-1, D-1, G-1, etc.). All trapped mosquitoes were sent to Brock University for testing. There, the contents were spread out on a dry ice platform and other insects were removed from the sample.[52] One-hundred female mosquitoes were randomly selected by a sorter. [52] The 100 females were separated into species, recounted and then pooled by location. [52] Counts of sampled female mosquitoes by species, unidentifiable females, males, extras and total mosquitoes were entered into a Microsoft ® Excel spreadsheet at Brock University and disseminated to the Health Units. The date of collection and site identification number were also identified.

In 2003, the WNV mosquito public education program expanded and included more communication channels (radio, schools, work places, households, camping grounds and garden centres). Two WNV students were hired to carry out these activities. The primary focus of the Health Unit was to promote source reduction and personal protective measures, in accordance to the MOHLTC, "Fight the Bite" campaign (i.e. wearing protective clothing).[55]

2003 - Mosquito Surveillance Data

In 2003, there was 1 positive mosquito pool confirmed in Haldimand and Norfolk. The positive pool was found in Port Dover on Aug 7, 2003. The species of mosquitoes that were found to be WNV positive was Cx.*pipiens/restuans*.

In 2003, *Ae vexans vexans* (Bridge vectors) was the species of mosquito found most often in both Haldimand and Norfolk (See Table 9). There were some clear differences in the top 5 species between Haldimand and Norfolk in 2003. A higher number of Bridge species were identified in Haldimand and Norfolk compared to Enzootic species. *Culex pipien/restuans* (mosquito species that commonly transmit the virus) were among the top 5 mosquito species found in both Haldimand and Norfolk. See Appendix II for an estimated number of female adult mosquitoes identified by species and county.

Table 9 – Estimated Number of Female Adult Mosquitoes Identified by Species, Haldimand and Norfolk, 2003

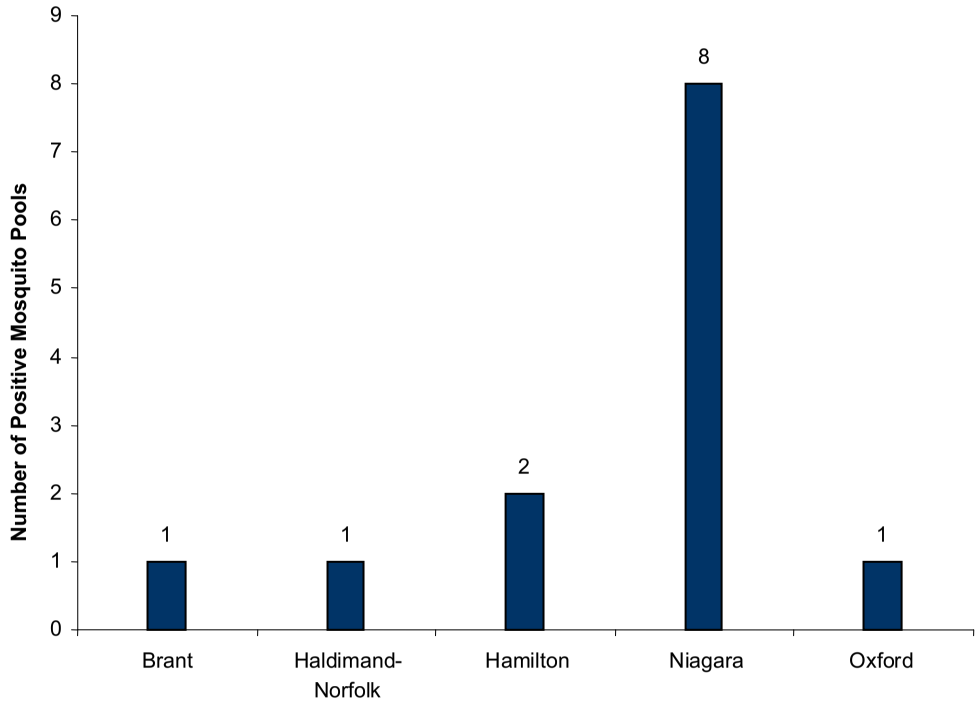
Norfolk	Number	Haldimand	Number
Ae.vexans vexans	*439*[1]	*Ae.vexans vexans*	*565*[1]
An.punctipennis	*86*[1]	*Ae.vexans/cantator*	*103*[1]
Cx.pipiens/restuans	*73*[2]	*Ae./Oclerotatus spp.*	*84*
Oc.trivittatus	*49*[1]	*Oc.trivittatus*	*82*[1]
Ae.Oclerotatus spp.	*38*	*Cx.pipiens/restuans*	*42*[2]

1 – Bridge Vector 2 – Enzootic Vector

Data Source: Brock University

In Canada there were 579 confirmed positive mosquito pools.[56] During the 2003 WNV season in Ontario, there were 137 positive pools in 17 Health Units.[57] Toronto had the highest number of positive mosquito pools in 2003 – 56. [57] There were 12 positive mosquito pools found in surrounding Health Units (1-Oxford, 1-Brant, 2-Hamilton, and 8-Niagara) [57] (See Figure 7). No positive mosquito pools were found in Elgin-St. Thomas; therefore Elgin-St.Thomas was not represented in Figure 7. [57]

Figure 7 - Number of Positive Mosquito Pools of West Nile virus in Surrounding Health Units (Oxford, Elgin-St. Thomas, Hamilton, Brant and Niagara) and Haldimand-Norfolk (2003)

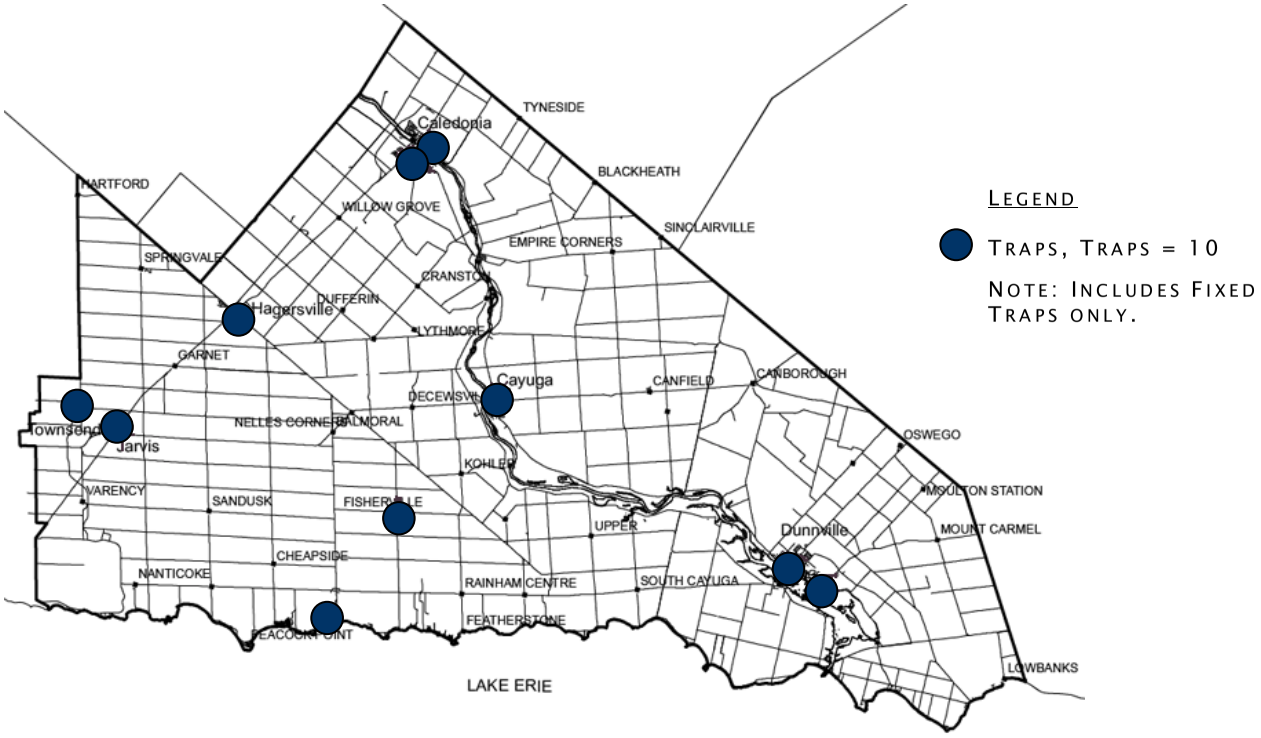


Data Source: Ministry of Health and Long-Term Care
http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_03/wnv_surveillance.html

2004- WNV Mosquito Surveillance Program in Haldimand and Norfolk

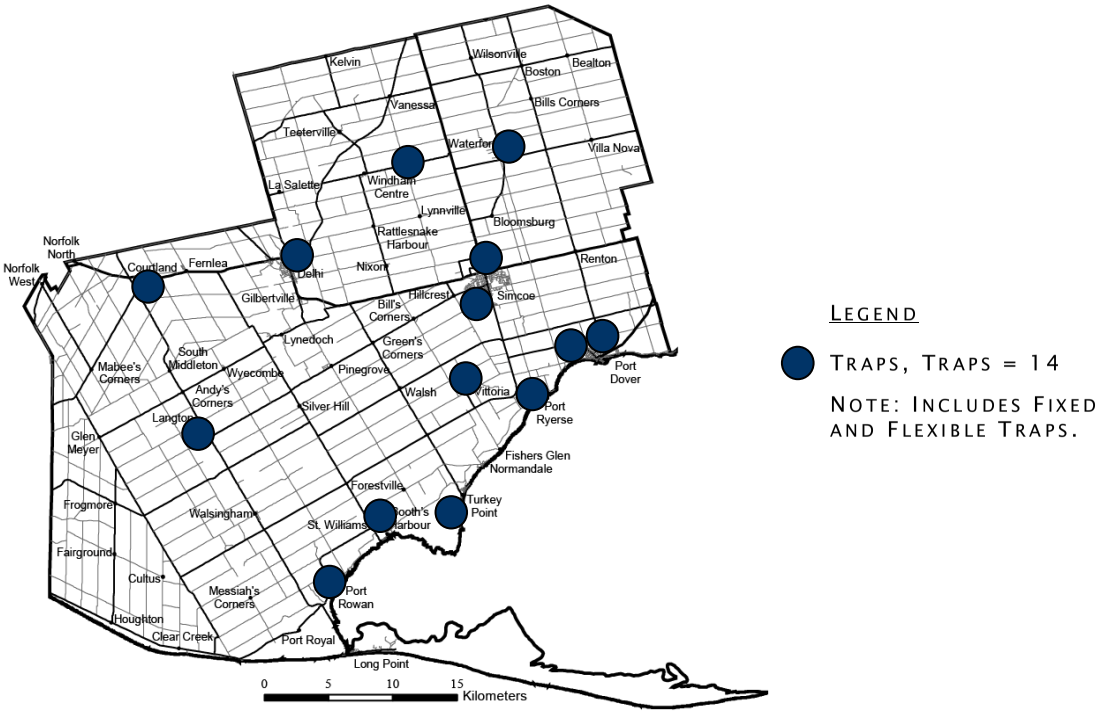
The mosquito WNV surveillance program in 2004 was very similar to 2003. Mosquito surveillance in 2004 was expanded to set up CDC light traps at designated sites every week and to have some mobile traps for identified 'hot spots'. In 2004, 20 traps were set up every week. See Maps 3 and 4 for the location of mosquito traps in Haldimand and Norfolk Counties. Of these 20 traps, there were 10 fixed traps in Haldimand and 8 fixed traps in Norfolk. Norfolk had 2 traps that were rotated among 7 different flexible sites on a weekly basis. The traps were located in 'secure' areas on private property, and were monitored weekly. Each trap was coded based on a numbering and set letter system created by Brock University (A-1, B-1, C-1, D-1, G-1, etc.). Similar to 2003, mosquitoes were collected and sent to Brock University for testing. Testing procedures mirrored that of 2003. In 2004, the WNV mosquito public education program expanded its communication channels and answered any public calls regarding WNV mosquito surveillance and other WNV inquires. The Health Unit continued to promote source reduction and personal protective measures.

Map 3 - Location of Mosquito Traps, Haldimand County 2004



Data Source: Planning Department, Haldimand County

Map 4 - Location of Mosquito Traps, Norfolk County 2004



Data Source: Planning Department, Norfolk County

2004 - Mosquito Surveillance Data

In 2004, there were no positive mosquito pools confirmed in Haldimand and Norfolk. In 2004, *Ae. vexans vexans* (Bridge vectors) was the species of mosquito found most often in both Haldimand and Norfolk. There were some clear differences in the top 5 species identified in Haldimand and Norfolk in 2004. (See Table 10) In 2004, significantly higher numbers of Bridge vectors were identified in Haldimand and Norfolk compared to Enzootic vectors. *Culex pipien/restuans* were among the top 5 mosquito species found in both Haldimand and Norfolk. See Appendix III for an estimated number of female adult mosquitoes identified by species and county.

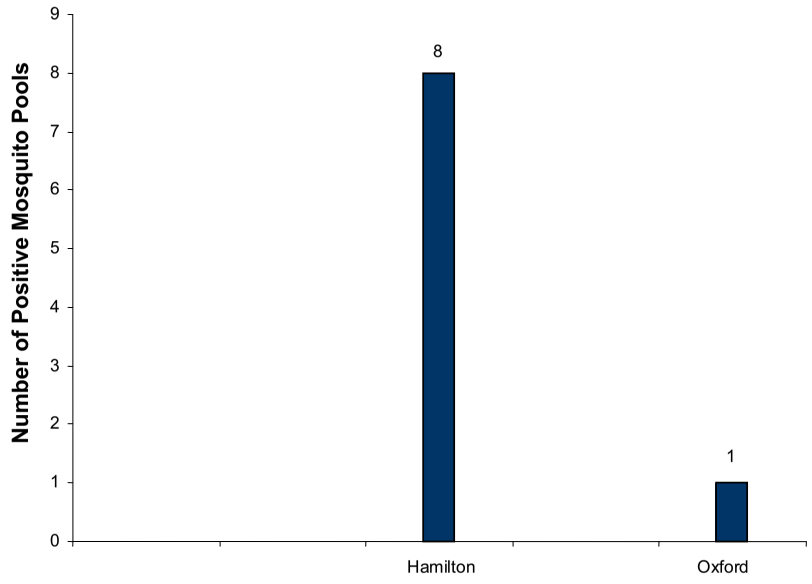
Table 10 - Estimated Number of Female Adult Mosquitoes Identified by Species, Haldimand and Norfolk, 2004

Norfolk	Number	Haldimand	Number
Ae.vexans vexans	*999*[1]	*Ae.vexans vexans*	*1958*[1]
An.walkeri	*379*[1]	*Oc trivittatus*	*204*[1]
Cx.pipiens/restuans	*320*[2]	*Ae./Oc. Spp.*	*162*
An.quadrimaculatus	*249*[1]	*Cx pipiens/restuans*	*120*[2]
Cq.perturbans	*233*[1]	*Ae vexans/cantator*	*111*[1]

1 – Bridge vector 2 – Enzootic vector
Data Source: Brock University

In Canada there were 176 confirmed positive mosquito pools. In Ontario there were 69 positive pools in 14 Health Units.[59] Toronto had the highest number of positive mosquito pools in 2004, with 31 positive mosquito pools.[59] There were 9 positive mosquito pools found in surrounding Health Units (1-Oxford, 8-Hamilton)[59] (See Figure 8). No positive mosquito pools were found in Elgin-St.Thomas, Niagara, and Brant, therefore they are not represented in Figure 8.[59]

Figure 8 - Number of Positive Mosquito Pools of West Nile virus in Surrounding Health Units (Oxford, Elgin-St.Thomas, Hamilton, Brant and Niagara) & Haldimand-Norfolk (2004)



Data Source: Ministry of Health and Long-Term Care
http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_03/wnv_surveillance.html

CONCLUSION

Over the last 3 years there have been a number of changes in the WNV adult mosquito surveillance program: an increase of mosquito traps, the use of 'hot spots' versus "mobile trapping" and a modification of the mosquito testing procedures. There was no WNV adult mosquito surveillance program in 2000 or 2001 in Haldimand and Norfolk. There were 6 positive mosquito pools in Haldimand and Norfolk in 2002, 1 in 2003, and none in 2004. The decline in the number of positive mosquito pools was also reflected in the number of positive mosquito pools reported in the surrounding Health Units (46 positive pools in 2002, 12 positive pools in 2003 and 9 positive pools in 2004). *Ae vexans vexans* was clearly the most predominant type of mosquito found in Haldimand and Norfolk Counties in 2002, 2003 and 2004. *Culex pipiens/restuans* were among the top 5 mosquito species found in both Haldimand and Norfolk in 2002, 2003 and 2004.

"Larviciding is an effective means of source control for West Nile virus."

Jerry Khumalo, Dip. P.H.I., B.A.Sc., C.P.H.I. (C)
Public Health Inspector
Haldimand-Norfolk Health Unit

Larval Mosquito Surveillance and Control

Preventing the spread of WNV begins with control of the mosquito population before it reaches maturity and begins searching for a blood meal.[69] A mosquito life cycle has 4 stages, 3 of which take place in water. Most mosquitoes lay their egg (stage 1) in or near water. These eggs hatch into larvae (stage 2) and grow into pupae (stage 3) and then into adult mosquitoes (stage 4). In stage 2, the larva (wiggler) has four developmental periods or instars called 1st, 2nd, 3rd, and 4th instars.[68] During each developmental period or instar, the larvae increase in size. At the end of each instar, the larvae shed their skin by a process called molting.[67]

The most environmentally sound and effective method of mosquito control is the integrated pest management program. This program helps to reduce the risk of WNV positive mosquitoes by eliminating or controlling potential breeding sites. This program encompasses the following components, the detection of potential breeding sites, source reduction (elimination) and source control by larviciding potential breeding sites of mosquitoes.[64] Although source reduction is the preferred method, if source reduction fails or could not be implemented, source control or larviciding becomes an alternative. The Health Unit larviciding program targeted areas (within and around populated areas) which were likely to support the breeding of mosquitoes. These areas included man-made and natural sites such as catch basins, ditches, culverts, field pools and other potential breeding sites. [64]

The proceeding sections capture the larviciding program in Haldimand and Norfolk from 2000 to 2004. Specifically, this chapter provides an overview of the larviciding program, larval mosquito control, catch basin and standing water surveillance results, and public education.

2000-2002- Haldimand & Norfolk Larval Mosquito Surveillance Program

Larviciding Program

There was no larviciding program in Haldimand and Norfolk from 2000-2002 however, the public identified breeding sites on private property and requested that they be larvicided. The public also

reported several standing water complaints, and voiced several environmental concerns associated with larviciding. In 2002, there were 84 standing water complaints, 24 requests for larvicide on private property and 33 environmental concerns associated with larviciding (See Table 12).

2003-Haldimand & Norfolk Larval Mosquito Surveillance Program

Larviciding Program

The larviciding program decision was made in 2003 after the occurrence of human cases in Haldimand, Norfolk and surrounding Health Units in 2002. In 2003, larval mosquito surveillance was implemented to assess mosquito composition and distribution. This larviciding surveillance program involved collecting data (larval dipping) from potential breeding sites of mosquitoes. At frequent intervals, three to four weeks apart, these potential breeding sites were dipped to determine the presence of larvae, stage of development, and the type of species. Dipping involved immersing a standard aquatic dipper to scoop water from the suspected site. The data collected was used to determine the density, composition and the developmental stage of mosquito populations in order to increase and measure the effectiveness of any larval control activity.[63] Surveillance of all potential breeding sites from catch basins and standing water were monitored.

Catch Basins

Catch basins were sampled (dipped) to determine the presence and species of the mosquitoes. The catch basins were evaluated based on their design (did they hold water), their location (proximity to populated areas), and the potential for breeding mosquitoes. When a catch basin was found to contain mosquito larvae, that catch basin was larvicided immediately. All catch basins were treated with Methoprene or Altosid.[63] Methoprene arrests the development of larvae so that adults do not emerge to carry WNV. It is administered when the larvae are mainly in the 4th instar. The main ingredient is released slowly for a period of about 21 days. This targets the specific larvae meanwhile not harming other insects or the surrounding aquatic environment.[70]

Standing Water

Standing water also serves as a breeding ground for mosquitoes. Potential permanent breeding sites were identified by Public Works staff within public property. These breeding sites mainly included road side ditches, waste water treatment ponds and golf course standing water. All these sites were regularly dipped (3 to 4 week intervals) for the presence of mosquito larvae and treated if necessary. From the time the site was determined to be a potential breeding site, Pestalto Environmental Products Inc. (Pestalto) monitored that site and treated it if necessary. This activity was carried throughout the WNV season (June to September). All standing water sites within public property were treated using Bacillus thuringiensis israelensis (Bti). The Health Unit has no available data on the number of property owners who larvicided. A domestic-quantity formulation of Bti (Aquabac) became available to homeowners through licensed retail outlets for application on private property. In 2003, most private property breeding sites were unmanned swimming pools, small ponds and other standing water areas like birdbaths. Pestalto dealt only with sites on public property. It is quite difficult to estimate the amount of larvicide used within private property. Property owners do not necessarily require a permit to larvicide within their individual properties if larviciding activities were contained within private property boundaries.

Catch Basin and Standing Water Surveillance Results

Pestalto was hired to perform larvae surveillance for both counties. Pestalto monitored 768 sites of which 126 sites had larvae (102 catch basins, 20 roadside ditches, 2 ponds and 2 woodland pools). The 126 catch basins had predominately *Culex* species. A total of 3835 grams of Altosid (Methoprene) were applied to catch basins in Haldimand and Norfolk in 2003 (Application 1 - 1906 grams and Application 2 - 1929 grams), in both large and small communities.[64] All catch basins located closer to environmentally sensitive areas were not treated to avoid chemicals being discharged directly to wetlands or rivers. Larval

dipping data collected during 2003 clearly demonstrated that many mosquito vectors were found in both counties. It was found that standing water sites had more diverse range of species. Monitoring of catch basins indicated that *Culex pipiens* and *Culex restuans* were more abundant.[63] A total of 7025 catch basins were larvicided (Haldimand - 2756 and Norfolk - 4269) with each catch basin being larvicided twice (See Table 11).

Public Education

Residents of Haldimand and Norfolk were encouraged to reduce mosquito breeding grounds by reducing standing water areas. The Health Unit did investigate standing water complaints and larviciding location requests. In addition, the Health Unit addressed any environmental concerns associated with larviciding. In 2003, there were a total 234 standing water complaints, 187 larviciding requests (54 general larviciding location requests and 133 requests for larviciding on public property) and 69 environmental concerns associated with larviciding (See Table 12). Before each application, larviciding notifications were printed in the local papers in Haldimand and Norfolk Counties advising the residents why and when this activity would take place as per legislative requirements.

2004 Haldimand & Norfolk Larval Mosquito Surveillance Program

Larviciding Program/Larval Mosquito Control

In 2004, the larviciding surveillance program was similar to 2003, with the exception of catch basin larviciding. Not all catch basins were monitored. Only catch basins that were located in the large communities like Port Dover, Simcoe, Hagersville, Dunnville, and Caledonia were monitored and larvicided. A Global Positioning System (GPS) device was used to obtain larval surveillance information for mapping purposes.

Catch Basin and Standing Water Surveillance Results

In 2004, the same methods of data collection were employed compared with 2003. Orkin (PCO) Service was hired to perform larval surveillance for both counties. PCO dipped individual catch basins and monitored 345 sites of which 220 sites had larvae (88 drainage ditches, 84 roadside ditches, 30 catch basins, 7 ponds, 7 streams, 3 woodland ponds and 1 swamp). Those that contained mosquito larvae or mosquitoes in any stage of development were treated with Altosid pellets (Methoprene). A total of 7114 catch basins were larvicided (Haldimand – 2807 and Norfolk – 4307), with each catch basin being larvicided four times (See Table 11). See Maps 5 and 6 for a general overview of the areas in Haldimand and Norfolk with larvae or vector larvae and Maps 7 and 8 for the general location of catch basins that were larvicided in both counties.

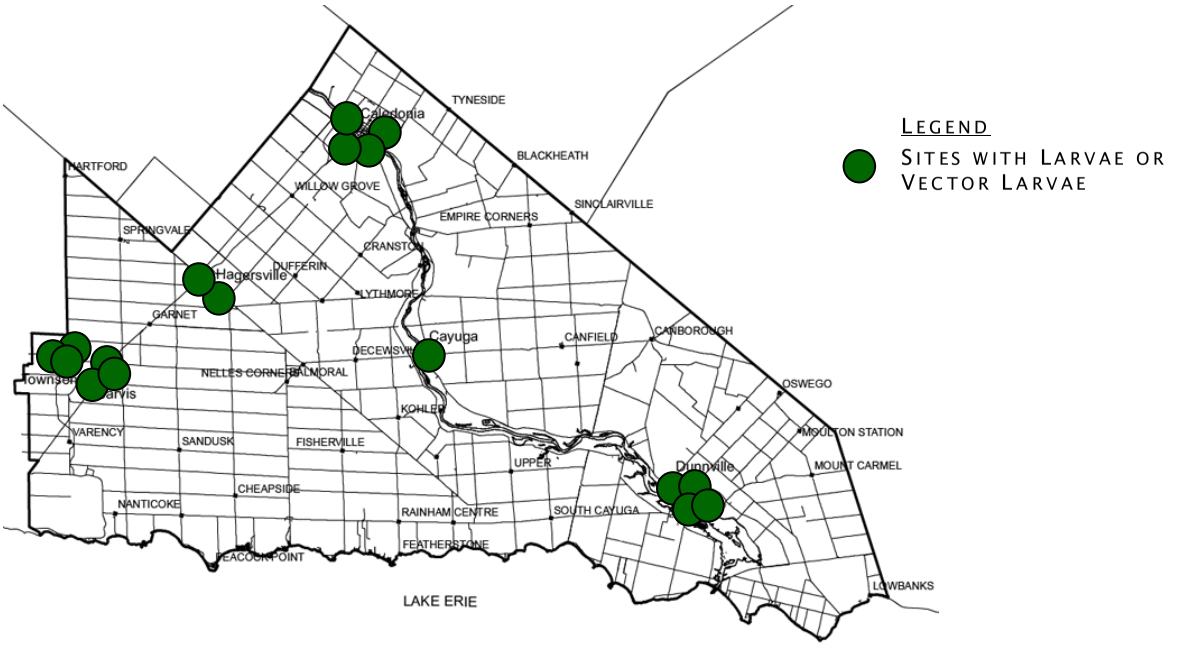
Table 11 - Number of Catch Basins Larvicided in Haldimand & Norfolk (2000 – 2004)

County	2000	2001	2002	2003	2004
Haldimand	N/A	N/A	N/A	2756 (2 applications)	2807 (4 applications)
Norfolk	N/A	N/A	N/A	4269 (2 applications)	4307(4 applications)
Total	N/A	N/A	N/A	7025	7114

N/A Not Applicable

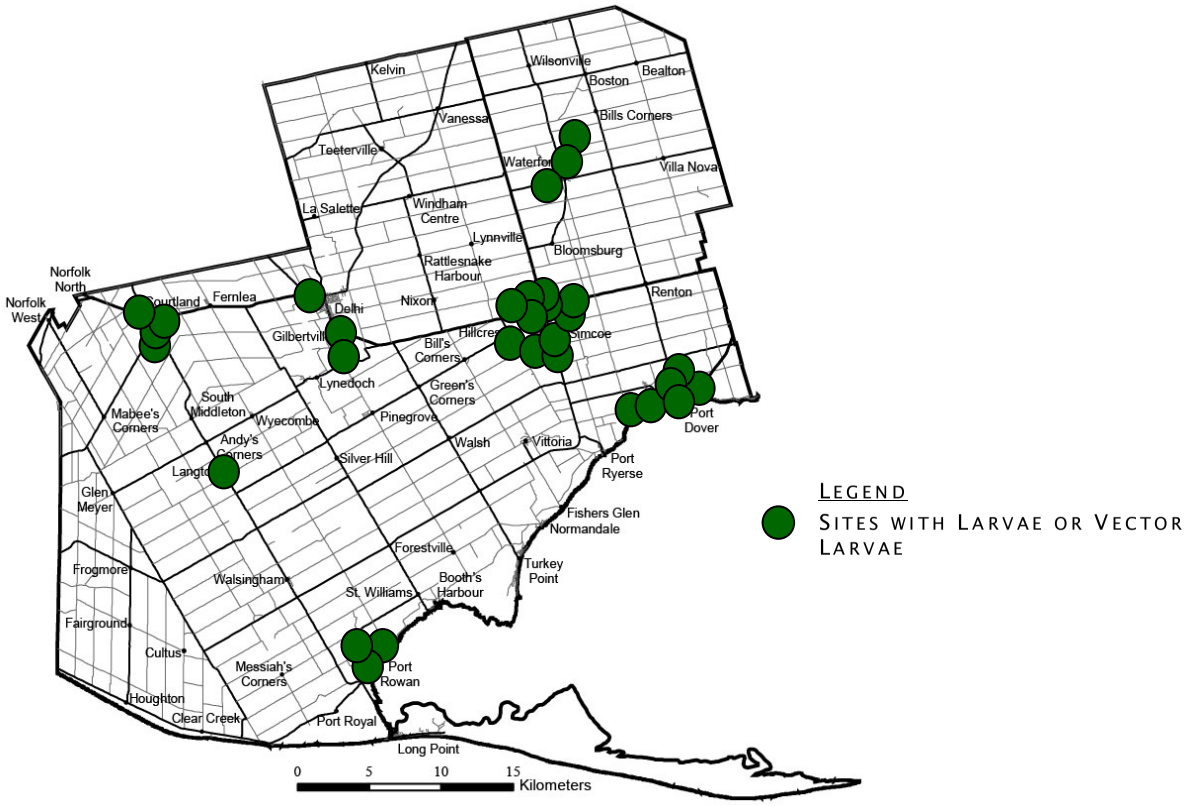
Data Source: Orkin PCO Service and Pestalto Environmental Products Inc.

Map 5 - Locations of Mosquito Breeding Sites (Standing Water), Sites with Larvae and Vector Larvae, Haldimand County, 2004



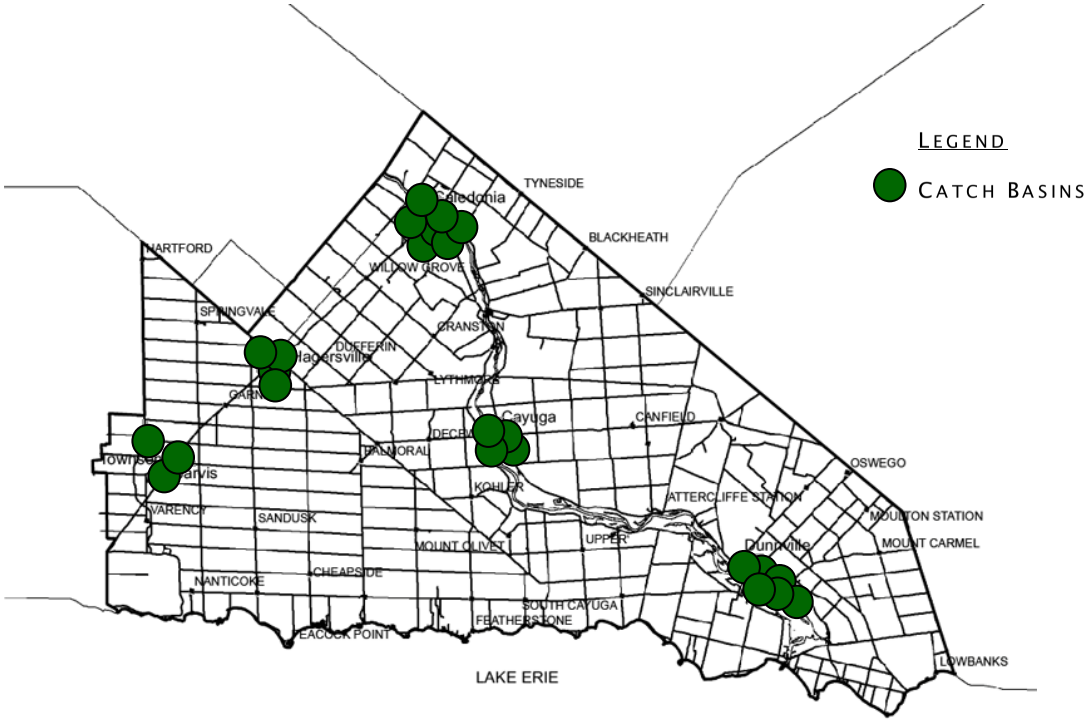
Data Source: Planning Department, Haldimand County

Map 6 - Locations of Mosquito Breeding Sites (Standing Water), Sites with Larvae and Vector Larvae, Norfolk County, 2004



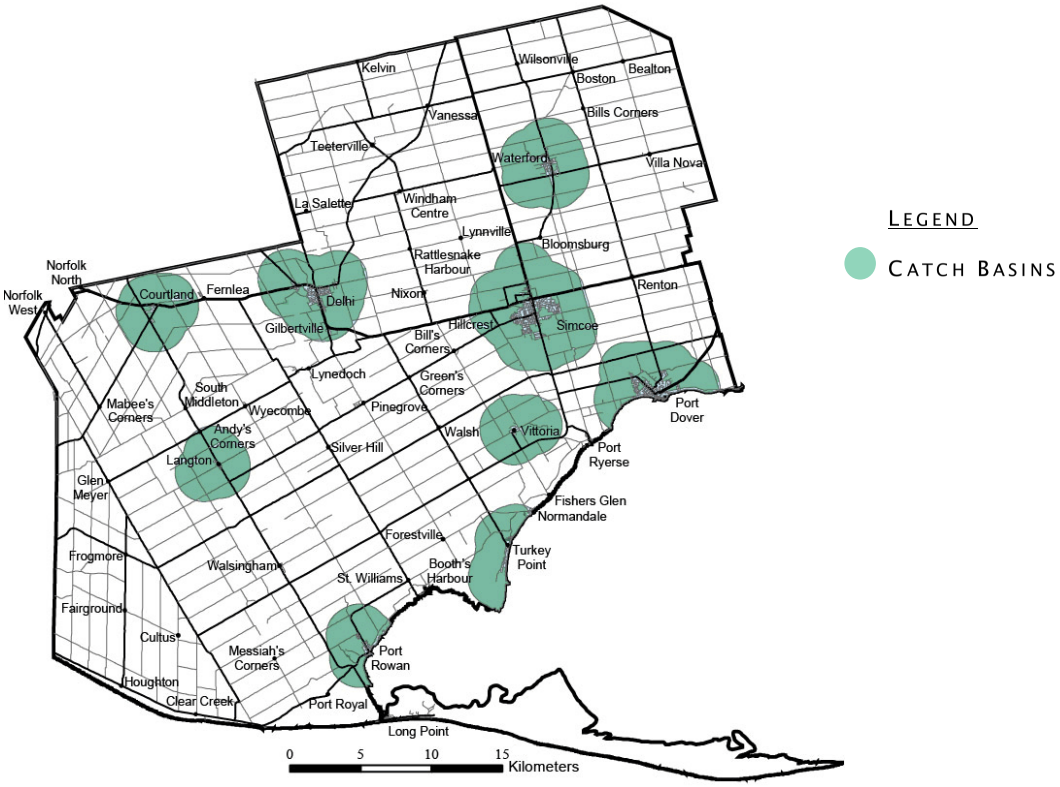
Data Source: Planning Department, Norfolk County

Map 7 – General Location of Catch Basins in Haldimand County



Data Source: Planning Department, Haldimand County

Map 8 – General Location of Catch Basins in Norfolk County



Data Source: Planning Department, Norfolk County

Public Education

In 2004, there was no standing water by-law in effect for either Haldimand or Norfolk. Residents of Haldimand and Norfolk were encouraged to reduce mosquito breeding grounds by reducing standing water areas. The Health Unit continued to investigate standing water complaints and larviciding requests. In addition the Health Unit continued to address any environmental concerns associated with larviciding. In 2004, there were a total of 181 standing water complaints, 198 larviciding requests (77 general larviciding location requests and 121 requests for larvicide on private property) and 10 environmental concerns associated with larviciding (See Table 12). At the beginning of the WNV season, larviciding notifications were printed in the local papers in Haldimand and Norfolk Counties advising the residents that the Health Unit would larvicide standing water on public property under the direction of the Acting Medical Officer of Health (AMOH). A registration number and sign were posted at each location indicating when the larvicide would be applied.

Summary of WNV Telephone Calls Received by the Health Unit

General inquiries about WNV increased each year from 2001-2004 with 45 calls in 2001 and 188 calls in 2004. Mosquito testing calls doubled between 2003 (54 calls) and 2004 (113 calls). There were 84 standing water complaints received by the Health Unit in 2002, 234 calls in 2003 and 181 calls in 2004. There was almost a three fold increase in standing water calls between 2002 and 2003, with a reduction in calls between 2003 and 2004. Finally, the Health Unit received 33 environmental concern calls in 2002, 69 calls in 2003 and 10 calls in 2004. Based on telephone calls received by the Haldimand-Norfolk Health Unit, residents of Haldimand and Norfolk have fewer environmental concerns associated with larviciding (See Table 12).

Table 12 - Summary of WNV Telephone Calls Received by the Health Unit for the Years 2001-2004

	2000	2001	2002	2003	2004
Standing water	N/A	N/A	84	234	181
Request for larvicide on private property	N/A	N/A	24	133	121
Environmental concerns (larviciding)	N/A	N/A	33	69	10
Illegal dump sites/garbage/tires	N/A	N/A	5	44	23
Chemical sensitivity	N/A	N/A	6	78	22
General larviciding location request	N/A	N/A	N/A	54	77
Mosquito testing	N/A	11	1	54	113
General inquiries about WNV	N/A	45	86	121	188

N/A Not Applicable

Data Source: Haldimand-Norfolk Health Unit

CONCLUSION

Over the last five years, 2003 and 2004 were the only years that Haldimand and Norfolk Counties had a larviciding program. The need for a larviciding program was realized after the emergence of WNV human cases in Haldimand and Norfolk and in surrounding areas in 2002. The main difference in the larviciding program between 2003 and 2004 was that in 2003 the larviciding of catch basins included both large and small communities, whereas in 2004 the focus was large communities. Haldimand and Norfolk Counties larvicided 7,025 catch basins in 2003 and 7114 in 2004 using Altosid (Methoprene). Geographical Information System (GIS) mapping proved to be a useful surveillance tool in outlining the location of major standing water sites and catch basins in both Haldimand and Norfolk Counties.

"Ongoing efforts in WNV surveillance and prevention will help reduce the spread of WNV in Haldimand and Norfolk."

Deanna Tries, Hon. B.A., M.A.
Epidemiologist
Haldimand-Norfolk Health Unit

Conclusion

The goal of this West Nile virus Surveillance Report 2005 is to provide the general public, media, local politicians, physicians and other health care professionals with a 5 year summary of WNV surveillance (human, bird and mosquito) and other program activities (public education and larviciding).

The Introduction chapter provides an overview of WNV which included the history of WNV, symptoms, types of illness, transmission cycle, and mosquito life cycle. Also included was a 5 year summary of the Haldimand and Norfolk West Nile virus surveillance program. It is clear that from 2000-2004 there were some significant developments in the WNV program in Haldimand and Norfolk.

The Public Education and Community Outreach chapter provides a summary of the public education efforts over the last five years. Between 2000 and 2004 the public education campaign evolved. The consistent message during this time was personal protective measures and source reduction. WNV students were an important asset in the development of the public education campaign. The Health Unit has utilized a WNV hotline to address public concerns and questions.

The Human Surveillance chapter provides a summary of human cases of WNV in Haldimand and Norfolk over the last 5 years plus a summary of human cases in the surrounding areas. There have been 3 human cases of WNV in Haldimand and Norfolk, all confirmed in 2002. Although there have not been any human cases in Haldimand or Norfolk over the last 2 years, there have been human cases in the surrounding areas during this time. In Ontario, the number of reported human cases has shown a consistent decline from 405 human cases in 2002, 89 cases in 2003 and 14 cases in 2004.

The Bird Surveillance chapter provides a 5 year overview of the dead bird surveillance activities in Haldimand and Norfolk Counties. The identification of positive WNV dead birds is an important surveillance tool to alert the community of the presence of WNV. Crows have been tested for WNV for the last 5 years. Blue jays were tested in 2000, 2001 and 2004. The Health Unit has received laboratory confirmation of positive WNV crows in Haldimand and Norfolk over the last 3 years.

The Mosquito Surveillance chapter provides a summary of the positive mosquito pools over the last 3 years as well as providing important surveillance information on the species of mosquitoes that have been identified in Haldimand and Norfolk. There was no mosquito surveillance program in Haldimand and Norfolk during 2000 and 2001. In 2002, there were 6 positive mosquito pools in Haldimand and Norfolk Counties, 1 in 2003 and 0 in 2004. It is interesting that 2004 had the highest number of mosquito traps (20 traps), compared to 2003 (7 traps) and 2002 (5 traps), but that 2004 had the lowest number of positive mosquito pools. In terms of the surrounding Health Units, there were 46 positive mosquito pools in 2002, 12 in 2003 and 9 in 2004. In 2002, 2003 and 2004, *Ae vexans vexans* (Bridge vectors) was the species of mosquito found most often in both Haldimand and Norfolk.

The Larval Mosquito Surveillance and Control chapter outlines the specific details of the larviciding program for Haldimand and Norfolk Counties. The presence of positive WNV activity in Haldimand, Norfolk and the surrounding Health Units in 2002, 2003 and 2004 was a key factor for both counties to initiate a larviciding program in 2003. The larviciding program was repeated in 2004 due to the occurrence of human cases in surrounding Health Units. A total of 7025 catch basins were larvicided in 2003 and 7114 catch basins in 2004.

Although WNV is only one of many reportable diseases in Ontario it continues to be a priority for the Haldimand-Norfolk Health Unit. The Haldimand and Norfolk West Nile virus Surveillance Report, 2005 is an important resource document for those interested in better understanding the presence of WNV in Haldimand and Norfolk over the last 5 years (2000-2004). This surveillance report also provides very useful information for understanding the pattern of WNV in the community. The data to date tends to support the notion that WNV is on the decline in Ontario and locally in Haldimand and Norfolk. Despite this possible decline, it is important for residents of Haldimand and Norfolk Counties to continue to protect themselves from WNV. Further surveillance data is needed to confirm or disconfirm this decline.

APPENDIX I

Estimated Number of Female Adult Mosquitoes Identified by Species, Norfolk, 2002

	Norfolk
Ae.vexans vexans	531
Cx.pipiens/restuans	127
An.punctipennis	57
Culex spp	57
Ae.vexans/cantator	53
Cx.pipiens	28
Ae./Oc.spp.	24
An.quadrimaculatus	22
Cx.restuans	19
Oc.trivittatus	13
Oc.triseriatus	6
Cx.salinarius	6
An.spp.	4
An.quadrimaculatus/walkeri	1
Coquillettidia perturbans	1
Culex territans	1
excludes *Oc black-legged* and *Oc broad-banded* (not a species type)	
excludes adult female mosquitoes "Unidentified Females" "Extras" and "Males"	

APPENDIX II

Estimated Number of Female Adult Mosquitoes Identified by Species and County, Haldimand and Norfolk, 2003

	Haldimand	Norfolk	Total
Ae.vexans vexans	565	439	**1004**
Ae.vexans/cantator	103	34	**137**
Oc.trivittatus	82	49	**131**
Ae./Oclerotatus spp.	84	38	**122**
Cx.pipiens/restuans	42	73	**115**
An.punctipennis	20	86	**106**
An.quandrimaculatus	15	34	**49**
Oc.stimulans	23	18	**41**
Cx.restuans	15	20	**35**
Anopheles spp.	7	12	**19**
Ae.cinereus	1	18	**19**
Oc.communis	16	0	**16**
Oc.triseriatus	5	11	**16**
Culex sp.	10	5	**15**
Cq.perturbans	9	2	**11**
Oc.cantator	8	1	**9**
Oc.abserratus	6	0	**6**
Ae.vexans nipponi	5	0	**5**
Oc.sticticus	5	0	**5**
An.perplexans	2	3	**5**
Oc.hexodontus	3	0	**3**
An.earlei	1	2	**3**
Oc.dorsalis	2	0	**2**
Oc.canadensis	1	1	**2**
Cx.pipiens	0	2	**2**
Ur.sapphirina	0	2	**2**
Cx.territans	1	0	**1**
Oc.excrucians	1	0	**1**
Oc.fitchii	1	0	**1**
Cs.inornata	0	1	**1**
Oc.hendersoni	0	1	**1**

excludes *Oc black-legged* and *Oc broad-banded* (not a species type)

excludes adult female mosquitoes "Unidentified Females" "Extras" and "Males"

APPENDIX III

Estimated Number Female Adult Mosquitoes Identified by Species and County, Haldimand and Norfolk, 2004

	Haldimand	Norfolk	Total
Ae.vexans vexans	1958	999	**2957**
Cx.pipiens/restuans	120	320	**440**
An.walkeri	7	379	**386**
An.quadrimaculatus	61	249	**310**
Ae./Oc.spp.	162	124	**286**
Cq.perturbans	49	233	**282**
Oc.trivittatus	204	15	**219**
Ae.vexans/cantator	111	82	**193**
An.punctipennis	26	167	**193**
Oc.stimulans	53	129	**182**
Cx.pipiens	56	112	**168**
Cx.spp.	22	82	**104**
An.spp.	9	58	**67**
Cx.restuans	22	31	**53**
Ae.cinereus	10	42	**52**
Oc.triseriatus	10	41	**51**
Oc. canadensis	10	13	**23**
Ae.vexans nipponi	11	5	**16**
Oc.euedes	0	11	**11**
Oc.cantator	9	1	**10**
Oc.dorsalis	9	0	**9**
Oc.japonicus	3	6	**9**
Ur.sapphirina	0	9	**9**
Cs.morsitans	2	3	**5**
Oc.excrucians	2	3	**5**
Cs.inornata	1	2	**3**
An.perplexans	0	2	**2**
Cs.minnesotae	0	2	**2**
Cx.salinarius	1	0	**1**
Cs.spp.	0	1	**1**
Oc.atopalpus	0	1	**1**
Oc.riparius	0	1	**1**
excludes Oc black-legged and Oc broad-banded (not a species type)			
excludes adult female mosquitoes "Unidentified Females" "Extras" and "Males"			

REFERENCES

1. Health Canada, http://www.hc-sc.gc.ca/english/westnile/general.html#2, Retrieved Jan 16, 2005.
2. Health Canada, http://www.hc-sc.gc.ca/english/westnile/pregnancy.html, Retrieved Jan 16, 2005.
3. Health Canada, http://www.hc-sc.gc.ca/english/westnile/symptoms.html, Retrieved Jan 16, 2005.
4. Health Canada, http://www.hc-sc.gc.ca/english/pdf/westnile/protect.pdf, Retrieved Jan 16, 2005.
5. Health Canada, http://www.hc-sc.gc.ca/english/westnile/transmission.html, Retrieved Jan 16, 2005.
6. MOHLTC, (n.d). *West Nile virus: The facts.* Retrieved Jan 16, 2005 from http://www.healthyontario .com/english/condition_detail.asp?disease_id=288.
7. MOHLTC, (n.d) *West Nile virus*. Retrieved Jan 16, 2005.from http://www.health.gov.on.ca/ english /public/program/pubhealth/westnile/wnv_mn.html.
8. MOHLTC, (n.d) Public Health: *West Nile virus.* Retrieved Jan 16, 2005 from http://www.health .gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7.html.
9. MOHLTC, (n.d) Public Health: *West Nile virus.* Retrieved Jan 16, 2005.from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7b.html.
10. Ministry of Environment (2004) *Mosquito control around the home to prevent the spread of West Nile virus.* Retrieved Jan 16, 2005 from http://www.ene.gov.on.ca/envision/land/westnile/042501fs1.htm.
11. MOHLTC (2004) *Mosquito proof your home*. Retrieved Jan 16, 2005 from http://www.healthyontario.com/english/features_details.asp?channel_id=0&aggregate_id=71&text_id=894.
12. Harding-Cruz, Susan (2004). *West Nile virus – City of Hamilton 2003 Report, Ontario, Canada: City of Hamilton*
13. Huron County Health Unit (n.d). *West Nile virus*. Retrieved Jan 17, 2005 from http://www.huroncounty.ca/healthunit/media/wnv/generalinfo.pdf.
14. University of Waterloo - Health Services (n.d) *West Nile virus & dead crows*. Retrieved Jan 17, 2005. from http://www.healthservices.uwaterloo.ca/menu/occupationalhealth/westnile.htm.
15. Public Health Agency of Canada (2004) *Surveillance, education, prevention, response*. Retrieved Feb 7, 2005 from http://www.phac-aspc.gc.ca/wn-no/surveillance_e.html.
16. MOHLTC (2005). Public Health: West Nile virus (WNV). *Clean up – all around your house and garden.* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7e.html.
17. MOHLTC (2005). Public Health: West Nile virus (WNV). *What you need to know and what you can do about West Nile virus*. Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/ wnv_factsheet_7.html.
18. MOHLTC (2005). Public Health: West Nile virus (WNV). *How to protect yourself and your family.* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7a.html.
19. MOHLTC (2005). Public Health: West Nile virus (WNV). *What are the symptoms of West Nile virus?* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7b.html.
20. MOHLTC (2005). Public Health: West Nile virus (WNV). *How to protect yourself.* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_7c.html.
21. MOHLTC (2005). Public Health: West Nile virus (WNV). *Outdoor tips for avoiding WNV*. Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/west_nile/wnv_factsheet_6.html.
22. MOHLTC (2005). Public Health: West Nile virus (WNV). *Reducing mosquito breeding grounds around your home.* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/ west_nile/wnv_factsheet_5.html.
23. MOHLTC (2005). Public Health: West Nile virus (WNV). *Helpful information on DEET.* Retrieved March 10, 2005 from http://www.health.gov.on.ca/english/public/pub/pubhealth/ west_nile/wnv_factsheet_10.html.
24. Public Health Agency of Canada (n.d). *West Nile Virus surveillance information.* Retrieved February 28, 2005 from http://www.phac-aspc.gc.ca/WNV-vwn/index.html.
25. Vrbova, L. (2004, December). Epidemiology *of West Nile virus Human Cases in North America*. Symposium conducted at the meeting of the WNV Wrap-Up Meeting, Ontario, Canada.

26. Ministry of Health and Long-Term Care (n.d). West Nile Virus-Case Definition. Retrieved February 28, 2005 from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_03/WNV_phy_pack_definition.html

27. Ministry of Health and Long-Term Care (n.d). *West Nile virus Laboratory Diagnostic Guidelines*. Retrieved March 2, 2005 from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_03/WNV_phy_pack_guidelines.html.

28. Ministry of Health and Long-Term Care (2004). *West Nile virus 2004: Human surveillance*. Retrieved March 2, 2005 from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_04/WNV_humans.html.

29. Ministry of Health and Long-Term Care (2004). *West Nile Virus - preparedness and prevention plan Ontario – 2004.* Retrieved March 2, 2005 from http://www.health.gov.on.ca/english/public/pub/ministry_reports/WNV_plan_2004/WNV_plan_2004.html.

30. Public Health Agency of Canada (n.d). *Surveillance, education, prevention and response.* Retrieved March 2, 2005 from http://www.phac-aspc.gc.ca/wn-no/surveillance_e.html#3.

31. Public Health Agency of Canada (n.d). *Transmission through blood – Health Canada's role*. Retrieved March 2, 2005 from http://www.phac-aspc.gc.ca/wn-no/blood-sang_e.html.

32. Ministry of Health and Long-Term Care (2003). *West Nile Virus - preparedness and prevention plan Ontario - 2003*. Retrieved March 11, 2005 from http://www.health.gov.on.ca/english/public/pub/ministry_reports/wnv_plan_2003/wnv_plan_2003.pdf.

33. Public Agency of Canada (2002). *West Nile virus: results of 2002 surveillance program*. Retrieved March 11, 2005 from http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2003/situation_report_111903_hm.pdf.

34. Public Agency of Canada (2001). *West Nile virus: results of 2001 surveillance program*. Retrieved March 11, 2005 from http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2002/situation_report_041802p.pdf.

35. Public Agency of Canada (2003). *West Nile virus:Human Surveillance results of 2003 program.* Retrieved March 11, 2005 from http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs_2004/surveillance_table_051204_hm.pdf.

36. Public Agency of Canada (2004). West *Nile virus:Human Surveillance results of 2004 program.* Retrieved March 11, 2005 from http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs_2004/situation_report_123104_hm.pdf.

37. Ministry of Health and Long-Term Care. (2003). *West Nile Virus: 2003*. Retrieved November 8, 2004 from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_03/WNV.

38. Health Canada (2004). *West Nile Virus general overview.* Retrieved November 8, 2004 from http://www.hc-sc.gc/english/westnile/general.html.

39. Canadian Cooperative Wildlife Health Centre (2004). *What is West Nile Virus?* Retrieved November 8, 2004 from http://wildlife1.usask.ca/ccwhc2003/west_nile_virus/about_WNV.php.

40. Canadian Cooperative Wildlife Health Centre (2004). *West Nile virus surveillance program 2004.* Retrieved November 8, 2004 from http://wildlife1.usask.ca/ccwhc2003/west_nile_virus?WNV_home.php.

41. Health Canada (2002). *Dead bird surveillance: Results of 2001 program*. Retrieved November 8, 2004 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs/2002/situation_report_041802p.pdf.

42. Health Canada (2003). *Dead bird surveillance: Results of 2002 program*. Retrieved November 8, 2004 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs/2003/situation_report_042303_dp.pdf.

43. Health Canada (2004). *Dead bird surveillance: Results of 2003 program*. Retrieved November 8, 2004 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs/2003/surveillance_table_011204_dp.pdf.

44. Health Canada (2004). *Dead bird surveillance: Results of 2004 program*. Retrieved November 8, 2004 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs/2004/situation_report_091104_ab.pdf.

45. Health Canada (2004, October 28). *Dead birds submitted for West Nile Virus diagnosis by health region in Canada as of October 28, 2004*. Retrieved November 8, 2004 from http://wildlife1.usak.ca/ccwhc2003/west_nile_virus/current_maps/canada04eng.jpg.

46. Massey, C., & Barker, I. (2004, November). West Nile Virus dead bird surveillance summary CCWHC Ontario and Nunavut Regions 2001-2004.

47. Ministry of Health and Long Term Care (MOHLTC) (2005). *West Nile virus 2004: Mosquito surveillance.* Retrieved January 31, 2005, from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_04/WNV.

48. Health Canada (2004, April). *West Nile virus: General overview*. Retrieved January 31, 2005 from http://www.phac-aspc.gc.ca/wn-no/pdf/WNV_general_e.pdf.

49. MOHLTC (2003, May). *West Nile Virus: Preparedness and prevention plan for Ontario*. Retrieved March 2, 2004 from http://www.health.gov.on.ca/english/public/pub/ministry_reports/WNV_plan_2003/WNV_plan_2003.pdf.

50. Magenta, A. (2004). *West Nile virus: Evaluation report, 2003*. Retrieved January 31, 2005 from http://www.healthunit.org/reportpub/reports/WNV_2004_Evaluation_Report.pdf.

51. MOHLTC (2001, October 30). *West Nile virus bulletin: 2001* Archive. Retrieved January 31, 2005 from http://www.health.gov.on.ca/english/providers/programs/pubhealth/westnile/WNV_01/WNV.

52. Funnell, K., Shapiro., H., Wong, K., and Smith, A. (2003). West Nile virus in the region of Peel. Region of Peel, Canada.

53. Health Canada. (2003, April). West *Nile virus results of surveillance program: Mosquito pool test.* Retrieved February 21, 2005, from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs/situation_report_042303_mp.pdf.

54. MOHLTC (2002). *West Nile virus 2002 archive: Mosquitoes.* Retrieved January 31, 2005, from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_02?WNV.

55. MOHLTC (2003, May 27). *West Nile virus: Preparedness and prevention plan for Ontario*. Retrieved February 21 from http://www.health.gov.on.ca/english/public/pub/ministry_reports/WNV_plan_2003/WNV_plan_2003.pdf.

56. Health Canada. (2003, January12). *West Nile virus mosquito surveillance: Results of 2003 program*. Retrieved February 21 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr_rs_2004/surveillance_table_011204_mp.pdf.

57. MOHLTC (2003). *West Nile virus: Mosquitoes*. Retrieved February 21 from http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_03/WNV.

58. Health Canada (2004, October 26). *Mosquito surveillance: Results of 2004 program*. Retrieved February 21 from http://www.phac-aspc.gc.ca/WNV-vwn/pdf_sr-rs_2004/situation_report_102604_mp.pdf.

59. MOHLTC (2004). *West Nile virus 2004: Mosquito surveillance*. Retrieved February 21 from http://www.health.gov.ca/english/providers/program/pubhealth/westnile/WNV_04/WNV.

60. Cutten, J. (2004, December). *West Nile Virus (WNV) Ministry of Environment 2004 program summary*. Paper presented at the Ministry of Health and Long Term Care (MOHLTC) West Nile Virus meeting, Ontario, Canada.

61. Cruz, H., MacDonald, R., Matthews, M., Tavares, A., Tsang, L., Lawson, M. et al. (2003). *West Nile Virus: City of Hamilton 2003 report.* Retrieved December 10, 2004 from http://www.city.hamilton.on.ca/phcs/West-Nile-Virus/WNV-ControlLarvae.asp.

62. Burns, D., McLachlin, L., & Dawson, G. (2003, May). *Elgin-St.Thomas Health Unit West Nile Virus response plan 2003.* Retrieved December 9, 2004 from http://www.elginhealth.on.ca/upload/download.asp?FILENAME=CCROQHBA.pdf.

63. Pestalto Environmental Products Inc. (2003, October 30). Mosquito abatement program for vector reduction of 2003 West Nile Virus: Final report for Haldimand and Norfolk Counties.

64. Pest Control Canada (PCO). (2004). West Nile Virus 2004 program for Haldimand and Norfolk Counties, Ontario, Canada

65. Funnell, K., Shapiro, H., Wong, K., & Smith, A. (2003). *West Nile Virus in the region of Peel.* Retrieved December 9, 2004 http://www.region.peel.on.ca/health/westnile/pdfs/WNV-larval-mosq-surv.pdf.

66. Godwin R., Okogun, A (2003). Epidemiological implications of preference of breeding sites of mosquito species in Midwestern Nogeria. *Ann Agric Environ Med (10)*, 217-222.

67. Beebe, P. (n.d). *Orange County mosquito control program*. Retrieve April 2003 from http://www.co.orange.tx.us/OCMosquitoControl.htm.

68. Grantram, R. (n.d.). Mosquitoes: *General mosquito biology*. Retrieved April 2003 from Toronto Department of Entomology and Plant Pathology http://www.ento.okstate.edu/mosquito/biology.html

69. Bay County, Michigan (n.d.). *Mosquito control program*. Retrieved April 2005 from http://www.co.bay.mi.us/bay/home.nsf/0/0E3C75B0171844078525699000 6C2ABD?OpenDocument

70. Potter, D.A., Buxton, M.C., Redmond, C.T., Patterson, C.T., and Powell, A.S. (1990). A.J. toxicity of pesticide to earthworms (Oligochaeta: Lumbricidae) and effects on thatch degradation in Kentucky bluegrass turf. *J. Econ. Entomol, 86(6)*: 2362-2369, 10-11.

Source Reduction bitten Dead Bird Sightings Meningoencephalitis

Bridge Vectors Dead Crows Catch Basins Humans infection

Encephalitis surveillance Mosquito Traps Deet standing Water

Contacts

Wayne Tucker, M.Sc
Program Coordinator - Communicable Diseases/Epidemiologist
Haldimand-Norfolk Health Unit
Phone (519) 426-6170 Ext. 234
Fax (519) 426-4767
Email wayne.tucker@haldimand-norfolk.org

Deanna Tries, M.A.
Epidemiologist
Haldimand-Norfolk Health Unit
Phone: (519) 426-6170 Ext. 215
Fax: (519) 426-9974
Email: deanna.tries@haldimand-norfolk.org

HALDIMAND-NORFOLK HEALTH UNIT