TORONTO STAFF REPORT

June 1, 2004

To: Board of Health

From: Dr. Barbara Yaffe, Acting Medical Officer of Health

Subject: Program Update for the West Nile Virus (WNV) Prevention and Control Program 2004 and Review and Evaluation of the 2003 WNV Program

Purpose:

This report provides an update on the activities already underway for the control of West Nile Virus (WNV) in Toronto for 2004. It also responds to a motion from the Board of Health requesting the Medical Officer of Health to report to the Board on a program to monitor the effectiveness of public education and outreach activities in 2003.

The report contains a description of the major findings of the evaluation of the Toronto Public Health 2003 WNV program, and a full description of the 2003 WNV Program is attached to this transmittal report.

Financial Implications and Impact Statement:

City Council approved base funding for the 2004 West Nile Virus Program of $3,502,646.00 (gross) / $1,751,323.00 (net) and 35.39 FTE's within the Toronto Public Health (TPH) Operating Budget. This funding is to cover all Toronto Public Health (TPH) WNV Program activities, including surveillance, public education, and mosquito control.

No funding is available for a requested budget enhancement for additional WNV program activities in Public Health ($526,786 gross, $263,393 net), Parks & Recreation ($398,739 gross, $199,370 net) and Urban Development Services ($270,000 gross, $135,000 net), as City Council approved these requests subject to 100% funding from the Province. The Ministry of Health and Long-Term Care (MOHLTC) has confirmed that it will only provide 50:50 cost sharing for local WNV program needs for 2004.

The enhanced budget would have provided for expanded WNV activities as well as a contingency for emergency intervention in the event of a serious WNV outbreak in 2004. Should this situation arise, Toronto Public Health will report any financial implications to the Board of Health and City Council.

The Chief Financial Officer and Treasurer has reviewed this report and concurs with the financial impact statement.

Recommendation:

It is recommended that the Board of Health receive this report for information.

Background:

The first human cases of West Nile virus (WNV) in Toronto were reported in 2002. There were 130 confirmed and 33 probable cases comprising the 163 WNV infections reported to Toronto Public Health. Among these cases, 11 deaths occurred. In 2003, there were 44 human cases of WNV, with no deaths.

The goal of the WNV prevention and control program is to minimize the risk of West Nile virus, through a graded response based on assessment of specific risks with response strategies designed for minimal environmental impact. The summary report of the 2003 WNV program activities is attached in Appendix 1.

Comments:

The Evaluation of the 2003 WNV Program:

Toronto Public Health staff continuously evaluate the WNV Program and conducted a full evaluation of the 2003 WNV program. The evaluation identified the following four areas that could be strengthened:

(a) earlier start in planning for the WNV program;
(b) more extensive larval surveillance in catch basins and surface waters;
(c) greater emphasis on controlling *Culex* larvae in surface waters early in the season; and
(d) improvements in surveillance data collection, management, and analysis.

The full technical report on the 2003 evaluation is currently being finalized and will be shared with key stakeholders when available. With respect to the effectiveness of public education and outreach activities in 2003, surveys from a number of jurisdictions indicate that people were generally more aware of WNV than three years ago but there were still low levels of behaviour change. Additional research specific to Toronto is necessary to determine which messages influenced Toronto residents and who they relied on for information.

To address the public education issues that arose in 2003, TPH has been meeting regularly with the province and other GTA municipalities to ensure messaging is consistent and clear. Influencing behaviour change through public education occurs over time and TPH, in consultation with local partners, has developed a public education strategy to assist in promoting behaviour change. Focus groups are planned for the fall to ensure messaging is effective. The

Rapid Risk Factor Surveillance System (RRFSS) has also been increased during the summer months to help guide TPH's response to WNV.

The WNV Prevention and Control Program for 2004:

The 2004 program incorporates the findings of the evaluation and builds on the activities carried out in 2003.

The planning process for the 2004 program began in November 2003 to allow enough lead time to set up our computer database, hire and train staff, obtain the necessary equipment and supplies, develop a communication strategy, and coordinate with our many City and external partners. However, the timing of the budget approval process continues to pose an obstacle to the timely mobilization of the program's resources.

To address the need for increased larval surveillance in 2004, more field operators have been hired to carry out this surveillance. To enable better control of *Culex* larvae in surface waters, there will be increased surface water inspection and larviciding. In addition, to improve the quality of surveillance data, an epidemiologist and a data analyst will be responsible for managing and providing quality assurance for surveillance data.

The 2004 WNV prevention and control program includes a public education campaign, bird, mosquito and human surveillance, and mosquito control.

(1) Public Education and Community Outreach:

The City of Toronto has a public education campaign to reach residents through a variety of communication vehicles including: community information sessions; existing City publications and on-line information; paid advertising and circulation of materials to libraries and civic and recreation centres. This information will describe both what the City is doing and what residents, businesses and institutions can do. Strategies to reduce mosquito breeding sites will also be promoted to the private sector, City staff and institutional partners such as school boards, hospitals, TTC, Toronto Community Housing Corporation, Toronto Hydro, etc.

The WNV information line (416-338-7600) is available from 8:30 AM to 4:30 PM on weekdays to receive and respond to reports of dead birds, potential health hazard complaints related to standing water and general WNV enquiries. After hours and on weekends, the information line will be set up to forward calls regarding bird pick-up to Toronto Animal Services until 7:00 PM, and to advise callers, through a recorded message, to call back on the next business day. There will also be recorded information available to callers after hours with basic information about WNV.

The City of Toronto is asking residents to help prevent WNV in the following ways:

(a) Eliminate breeding sites

TPH is encouraging Toronto residents to address mosquito-breeding sites on their properties, which may include catch basins. Elimination of mosquito breeding sites is the most effective way to prevent the spread of WNV. The mosquitoes that transmit the virus breed in small pools of stagnant water and in places with decaying organic matter (e.g., leaves, grass clippings, animal waste). Mosquitoes need only a very small amount of water to breed. To eliminate breeding sites in and around the home and/or business, people are asked to clean out roof gutters, flowerpots, etc. and any other place that can collect water. TPH recommends that residents change birdbath and untreated recreational and decorative pool water twice a week. Owners of private properties with catch basins are advised to cover them with a secured screen, or to hire a licensed pesticide applicator to treat the catch basins. Unlicensed individuals should not apply anything in catch basins.

(b) Protect yourself from bites

TPH is asking residents to take personal protection measures by limiting their exposure to mosquitoes. Education materials recommend residents wear clothing that minimizes the amount of exposed skin and to apply insect repellent when outside, especially during dusk and dawn when mosquitoes are most active.

(2) WNV Surveillance

Toronto Public Health will monitor WNV activity in the City through the following activities:

(a) Bird surveillance and pick-up

Residents are requested to report all dead bird sightings. Toronto Animal Services staff will pick up all crows and blue jays reported. Crows and blue jays will be sent to the Canadian Co-operative Wildlife Health Centre in Guelph for WNV testing. The results of these tests help to determine the presence of the virus in the City. The Toronto Animal Services Call Centre is operational from 8:30 AM to 7:00 PM, seven days a week.

(b) Mosquito surveillance – adult

Toronto Public Health will monitor mosquito populations twice a week using traps set up throughout the city and will test mosquitoes for WNV. Beginning the first week of June, Toronto Public Health will monitor the 40 permanent trap locations in the city, plus a number of ad hoc locations and traps in the vicinity of positive findings.

(c) Mosquito surveillance – larvae

Toronto Public Health staff, with the assistance of Works and Emergency Services, will monitor 90 catch basins city-wide for mosquito larvae throughout the summer. Staff will also conduct larval surveillance in surface waters city-wide, based on evaluation of sites, complaints from the

public, or proximity to identified areas of viral activity. Surveillance will identify breeding sites for *Culex pipiens and Culex restuans,* the primary carriers of the virus and the target of larviciding measures, and the findings will determine any potential health risks.

(d) Human surveillance

West Nile virus is a reportable disease and must be reported to Toronto Public Health by physicians, laboratories, hospitals and others. Public Health will track the number of human cases of West Nile virus and will provide relevant information to physicians and hospitals on a regular basis.

(3) Mosquito Control

The City of Toronto will utilize both non-chemical and chemical strategies as required to reduce mosquito breeding in the City through the following activities:

(a) Standing water investigations

Toronto Public Health, Municipal Licensing and Standards, Parks and Recreation and Works and Emergency Services (WES) are co-operating on responses to complaints regarding standing water. Toronto Public Health and Municipal Licensing and Standards (MLS) developed a joint West Nile Virus response protocol to respond to complaints of standing water on private property. Authority to issue orders and take appropriate action is under the Building Code Act, the Municipal Act and the Health Protection and Promotion Act. A flow chart has been developed to assist in the re-direction of complaints to the appropriate departments.

Toronto Public Health will take care of seasonal collections of stagnant water, such as rain water in containers and unused pools. MLS will be responsible for maintenance and building deficiencies, such as obstructed drainage, ground depressions, debris and building materials resulting in collections of stagnant water. WES will take care of infrastructure issues such as blocked catch basins and depressions in roadways. Parks and Recreation will attend to standing water concerns on City park property.

(b) Mosquito control – larviciding

The larvicide component of the WNV program is designed to reduce the mosquito population at the larval stage and therefore reduce the health risks from WNV. TPH will focus on the control of larvae within storm water catch basins in residential areas and parks and laneways that are owned and maintained by the city. Methoprene will be applied to catch basins by TPH staff. All larvicide applicators are provincially licensed and trained technicians.

Bti (*Bacillus thuringiensis israelensis*) will be applied by a private company to selected stagnant surface water where larvae have been found.

Conclusions:

In 2004, TPH will be conducting a WNV Program that includes the same major components as the programs in 2002 and 2003. These include surveillance, public education and mosquito control. Using the experience and surveillance data obtained from two previous years of addressing WNV in Toronto, TPH has made adjustments to a number of program components to maximize their effectiveness. The most notable of these adjustments for 2004 are an increased emphasis on mosquito control through the application of the larvicide Bti to surface waters in the City, enhancing larval surveillance City-wide and improving the management of the surveillance data collected.

Contact:

Danny Kartzalis
Acting Manager, West Nile Virus
Toronto Public Health
Tel: 416-338-3673
E-mail: dkartzal@toronto.ca

Dr. Karl Kabasele
Associate Medical Officer of Health, Healthy Environments
Toronto Public Health
Tel: 416-338-8041
E-mail: kkabase@toronto.ca

Ron de Burger
Director, Healthy Environments
Toronto Public Health
Tel: 416-338-7953
E-mail: rdeburg@toronto.ca

Dr. Barbara Yaffe
Acting Medical Officer of Health

List of Attachments:

Appendix 1: West Nile Virus in the City of Toronto 2003

Appendix 1

West Nile Virus in the City of Toronto 2003

A Summary of the Toronto Public Health West Nile Virus Program for 2003

June 1, 2004

Table of Contents

Title **Page Number**

EXECUTIVE SUMMARY

INTRODUCTION

West Nile Virus (WNV) is a mosquito-borne virus that first appeared in North America in 1999, in New York City. Since then it has spread across the Americas. In Canada, WNV has been detected in wildlife as far west as the province of Alberta. WNV can cause neurologic disease in humans and animals.

In humans, there is a broad spectrum of severity of illness from WNV. Most people infected with WNV show no symptoms or have mild flu-like illness. However, some people may become very sick and experience serious illness (such as encephalitis and meningitis) that can have lasting effects. Rarely, infection may lead to death.

The first human cases of WNV in Toronto occurred in 2002. There were 130 confirmed and 33 probable cases reported to Toronto Public Health (TPH). Eleven Toronto residents with evidence of WNV infection died that year. In three of these individuals encephalitis brought on by the virus was the cause of death.

In 2002, TPH established a WNV program that included surveillance activities and public education. The program was based on a contingency WNV plan created in 2001 and incorporated an integrated pest management (IPM) approach to mosquito control as a method of minimizing human health risk. In keeping with the IPM framework, and in light of the significant burden of illness caused by WNV in 2002, TPH added a chemical mosquito control component to the 2003 program and enhanced surveillance and public education activities from the 2002 program.

The TPH WNV program in 2003 included the following key elements:

1. Public Education and Community Outreach

(a) Communications, Public Education and Community Outreach

TPH developed a campaign to reach residents through a variety of communication vehicles, including: community information sessions; existing City publications and on-line information; paid advertising; and circulation of materials to libraries and civic and recreation centres. This information emphasized both what the City was doing and what residents, businesses and institutions could do. Strategies to reduce mosquito breeding sites were promoted to the private sector, to City staff and to institutional partners such as school boards, hospitals, TTC, Toronto Community Housing Corporation, and Toronto Hydro.

(b) Information Line and Reporting Call Centre

An information line (416-338-7600) was available seven days a week for general information and to report stagnant water and dead birds or to request dead bird pick-up. Staff answered questions during regular business hours, and an automated information and reporting service was available 24 hours a day.

2. WNV Surveillance

(a) Surveillance and Pick-Up of Dead Birds

Up to six crows per week were sent to the Canadian Co-operative Wildlife Health Centre (CCWHC) in Guelph for testing to determine the presence of WNV in the city. (Six was the maximum number of birds allowed for submission by the CCWHC).

(b) Surveillance of Adult Mosquitoes

TPH monitored 40 portable mosquito traps set up throughout the city to track the numbers, species and prevalence of WNV among adult mosquito populations.

(c) Surveillance of Larval Mosquitoes

TPH surveyed catch basins and surface waters (e.g. ponds, streams, ditches) for the presence of mosquito larvae. In addition, TPH assessed the efficacy of larviciding in catch basins through larval surveillance.

(d) Surveillance of Human Cases

WNV is a reportable disease and must be reported to TPH by physicians, laboratories, hospitals and others. TPH tracked the number of human cases of WNV and provided relevant information to physicians and hospitals on a regular basis.

3. Mosquito Control

(a) Source Reduction

TPH staff worked with other City of Toronto departments, the public and a variety of external partners to identify areas of standing water and eliminate them in order to reduce mosquito breeding. Stagnant water on public lands was also surveyed in 2003 to determine the presence of larvae and assess the need for control measures.

(b) Larviciding

Storm water catch basins are concentrated breeding grounds of the mosquito species (culex pipiens) most likely to carry WNV. These mosquitoes breed in small, stagnant pools of water such as those found in catch basins. A 2002 study confirmed the presence of these mosquito larvae in virtually all Toronto catch basins sampled. TPH staff applied a larvicide in about 123,000 storm water catch basins in the city, in order to prevent the development of immature mosquito larvae into biting adults. Catchbasins were treated on a priority basis, up to two times over the course of the season, using surveillance data to assess risk.

(c) Mosquito Control Pilot Project

The City conducted a pilot project to test experimental, non-chemical methods to control mosquito populations in the City's catch basins. These included steam, ultrasonic equipment,

vacuum, drainage holes, and filter cloth. The results of the pilot showed that none of the methods tested would be effective or practical for use in the City's catch basins. However, the filter cloth was found to be effective if intensive maintenance was performed, and therefore this option could be suitable for use by owners of private property.

(1) PUBLIC EDUCATION AND COMMUNITY OUTREACH ACTIVITIES

The City's West Nile virus (WNV) communications plan included a wide range of activities: educating the public on personal protection measures; informing the public of control measures being taken by the City (e.g. larviciding of catch basins); informing the public of appropriate measures to reduce mosquito breeding grounds; and keeping the risk of WNV in the proper perspective.

Communication Activities

A print advertising campaign ran in major dailies and ethnic papers during June and July with two themes: reducing the risk of human illness and eliminating fear by encouraging the public to stay informed; and highlighting what the City was doing and what residents could do to reduce the risk. The campaign also included advertising on 125 transit shelters and 250 OMG bins in August and September. As per Ministry of the Environment regulations, TPH placed ads in the Toronto Sun, the Toronto Star, and the Metro newspapers, notifying residents of larviciding activities.

In addition to the advertising campaign, a number of other communication strategies were employed. TPH held press conferences in May, June and August to inform the public of personal protection measures, to announce the first larvicide application, and to report on the first positive mosquito results. Starting in May 2003, TPH put eight media releases on the news wire. These press releases covered a number of topics, including: encouraging the adoption of personal protective measures against mosquito bites; publicly reporting WNV-positive bird and mosquito findings in Toronto; reporting on probable and confirmed human cases; and informing residents that mosquitoes are still active during cooler weather in the fall. As well, Toronto Public Health WNV staff participated on a number of TV and radio call-in shows.

Information on WNV was available to the public on the TPH web site at http://www.toronto.ca/health. The site was updated weekly from May 1st to October 31st with information on the status of WNV in Toronto, and a list of current larviciding locations. All media releases were posted on the site. Fact sheets on WNV could also be downloaded. People who did not have access to the internet could also call the WNV information line (416-338-7600) which was listed on all of TPH's WNV literature. The information line received 8,153 calls from April 1st to October 31st, 2003. A total of 2,629 calls were regarding complaints of standing water. The District offices received 467 of these calls and 2,132 were received through the WNV information line. The information line also received 355 requests for information.

A number of additional communication activities included:

- WNV fact sheet distribution to schools, day care centres, and long-term health care facilities.
- Distribution of information on WNV to all Toronto households via "Water Watch", the Works and Emergency Services Newsletter.

- Production of an eleven-page Q&A document on WNV by the interdepartmental communications group. This document provided answers to questions City service providers may encounter in speaking with the public as well as questions staff may have. The Q&A was made available on the City's Intranet and an email was sent to all City staff advising them of the posting.
- Updating Public Health managers regularly by email on the status of WNV.
- Working closely with public health staff and interdepartmental colleagues in neighbouring municipalities in applying provincial guidelines and directives on communications.
- Meetings of the WNV Advisory Committee.

Education and Outreach

The West Nile virus program included a comprehensive community outreach and education component aimed at keeping the public informed and to provide information regarding personal protective measures that individuals could take to minimize risk of infection.

The education and outreach component was multifaceted. TPH provided information via a telephone line, a website, weekly updates for city councillors, and direct outreach to the community. To support the direct outreach component, a colourful and eye-catching display and pamphlet were developed using the theme of 'Healthy Summer Living'. With support from the "Toronto - You Belong Here" campaign, six summer students promoted the Healthy Summer Living message. The Healthy Summer Living resources were produced mainly in English but were also available in eight other languages.

The direct outreach activities consisted of presentations to community groups, displays in malls and community centres, and promotion at 22 community events including the CNE. TPH held information and training sessions for community leaders who work with the public in community health centres, parks and recreation facilities as well as public housing and shelters. TPH sent information packages to libraries and community centres. In early September, to raise awareness of the increased risk at that time of year, TPH sent a notice through Community Information Toronto to over 1,200 agencies for posting, as well as a door-to-door mail drop to all residents in the City of Toronto.

Summary

The direct outreach strategy consisted of the following:

West Nile virus

16 Presentations: 382 total attendees
48 Displays: 35,867 people reached
4 community information sessions

Healthy Summer Living:

Promotion at 22 Community events
Information Packages for Healthy Summer Living (consisting of Healthy Summer Living Pamphlets and Posters) Distributed to:

12 Community Centres: 2300 resources
200 Community Agencies: 1000 resources
96 Libraries: 8280 resources
100 pamphlets to all Councillors
School Fact sheet provided to the Toronto Catholic District School Board, Toronto District School Board, and 185 private schools

(2) SURVEILLANCE

(a) Dead Bird Surveillance

The West Nile virus bird surveillance program ran from April 14th to October 31st 2003. To estimate the intensity of West Nile virus activity, Toronto Animal Services (TAS) recorded data on telephone reports of dead birds and other WNV-related inquiries. In addition, the number of field responses for dead bird pickup and responses to sick/injured birds were collected on a daily basis and classified by species. Any required responses related to the corvid species (the family of birds that include crows, blue jays and ravens) were given priority because these birds are known to be carriers of WNV. In particular, dead crows were picked up on a priority basis for potential testing, as they are most likely to be indicators of WNV activity in an area.

From April to October 2003, TAS staff responded to 5,396 WNV-related calls. The breakdown by month is as follows:

Month	Dead Birds	Sick & Injured Birds	Education on Bird Disposal	Other	Total Calls
April	178	33	13	61	285
May	526	79	431	160	1196
June	407	130	773	209	1519
July	321	117	607	145	1190
August	240	49	277	51	617
September	124	49	189	46	408
October	39	52	55	35	181
	1835	**509**	**2345**	**707**	**5396**

Of the 5,396 West Nile virus related calls, 1,835 calls were for dead bird pick-ups (134 of these were dead crows), 509 were in response to a sick/injured bird and 2,345 were reported dead bird sightings in which the caller was informed about proper disposal of the cadaver as per Canadian Cooperative Wildlife Health Centre (CCWHC) guidelines. A total of 38 birds (37 crows & one blue jay) were sent to CCWHC for testing. Of these, 16 crows and the one blue jay tested positive for WNV.

(b) Adult Mosquito Surveillance

Introduction

West Nile virus (WNV) survives by cycling between the bird and mosquito populations. A mosquito obtaining blood from an infected bird can become infected and pass on the virus to another host animal during the mosquito's next feeding. Once in a new host, the virus multiplies. The fate of the host depends on its ability to cope with the infection. In infected humans, the majority of young and healthy individuals remain asymptomatic. However, WNV can cause illness and rarely death in some persons.

WNV appears to be firmly established in Ontario, and researchers expect its continued spread and entrenchment in wildlife populations. Enhanced surveillance is a high priority for those regions that are affected or at higher risk for being affected by West Nile virus. Mosquito surveillance, along with bird-based surveillance, is the mainstay of the City of Toronto's surveillance program. The surveillance component of TPH's 2002 and 2003 WNV programs has provided early evidence of viral activity in specific areas of the City, plus information on potential mosquito vector species, indication of potential risk to humans and animals and an estimate of vector species abundance. Mosquito surveillance activity establishes baseline data to guide WNV control measures.

During the 2003 WNV season, over 28,000 mosquitoes were collected from traps across the City of Toronto. The number of mosquitoes found in a trap is influenced by a variety of factors. These include weather (rainfall increases the number trapped in some species, and decreases it in others; wind tends to decrease numbers of mosquitoes collected in a trap; and warmer temperatures tend to decrease the length of the reproductive cycle and therefore increase the number of mosquitoes trapped) and mosquito life cycle (certain species only have one generation per year, whereas others have multiple generations).

Methods

Adult mosquito surveillance was conducted by trapping mosquitoes, and speciating and testing a proportion of them. All trapping was performed using CDC miniature light traps, which use carbon dioxide and black or white light to attract host-seeking adult female mosquitoes from up to 2 km away. TPH began trapping on May 14, 2003, using 15 traps at fixed locations until the mosquito season ended on October 21, 2003. From August 11 to the end of the season, TPH increased the number of fixed locations to 40 in order to get a better sense of the viral activity City-wide.

In order to manage the WNV program more effectively, TPH subdivided the city into four regions. The regions include West Region (the former cities of York and Etobicoke), North Region (the former city of North York), South Region (the former city of Toronto), and East Region (the former cities of Scarborough and East York). Using this framework, there were 14 fixed sites in West Region, 11 in North Region, five in South Region, and 10 in East Region, for a total of 40 fixed sites. Due to vandalism, one trap was relocated.

In addition to the 40 fixed mosquito-trapping sites, "hot spot" trapping sites were set up around positive indicators (WNV-positive dead birds or human cases). For each positive indicator, up to five traps were set up around either the location where the dead bird was found, or the residence of the human case. This extra trapping was performed for two to three consecutive weeks for each trap site in the hot spot area. Over the course of the summer, 132 hot spot trapping locations were used for two- to three-week periods.

Adult mosquito traps were placed as shown in Figure 1. There were 50 sites in West Region, 32 in North Region, 69 in South Region, and 21 in East Region over the course of the season, for a total of 172 locations (40 routine locations and 132 hotspot locations). Adult mosquitoes were collected once a week at fixed locations and on a different day at "hot spot" locations. Trapped mosquitoes were placed on ice, and transported to the Department of Biological Sciences at Brock University, in St. Catharines, Ontario. Once at the lab, non-mosquito insects were removed and mosquitoes were counted and separated into male and female groupings. The females were separated into species, re-counted, and then "pooled" by species, date and location of collection and tested. In the event that there were more than 50 mosquitoes in one grouping, these would be separated into separate pools (samples), with a maximum of 50 mosquitoes per pool.

When the species of a mosquito could not be distinguished during the identification process, it was either identified as part of a group (e.g. *Culex pipiens/restuans*) or to the level of genus (e.g. *Culex spp.*). Some mosquitoes ended up being identified as unknown, likely because it was not possible to properly identify the specimens due to normal degradation over time or they were damaged during collection, shipping, or storage.

Counts of mosquitoes by species, date collected, trap type and site were entered into an Excel spreadsheet by staff at Brock University. This file was then distributed to the public health units that had submitted specimens.

Figure 1: Locations of Mosquito Traps and Traps with WNV-Positive Results, Toronto 2003
Cumulative October 31, 2003

Produced by Toronto Public Health

TORONTO
Public Health

Results

In the City of Toronto, approximately 28,000 male and female mosquitoes were trapped over the course of the 2003 season. Of these, 18,877 adult female mosquitoes of 44 different speciation categories were tested (Table 1). A speciation category was either a single species of mosquito or a grouping of species where the insect could not be identified down to the level of individual species. Adult female mosquitoes are the focus of study because they bite whereas males do not.

Table 1: Number of Adult Female Mosquitoes Collected by Species and Region, City of Toronto, 2003

Species Name	North	South	East	West	Unspecified	Toronto
Cx. pipiens/restuans	1360	764	1196	2172	299	**5791**
Ae. vexans	1475	470	889	1619	161	**4614**
Oc. stimulans	917	11	72	302	10	**1312**
unidentifiable females	357	149	164	349	12	**1031**
Cq. Perturbans	27	162	116	545	96	**946**
Cx. restuans	163	142	280	194	65	**844**
Ae./Ochlerotatus spp.	352	55	175	235	13	**830**
Oc. canadensis	5	1	263	344	-	**613**
An. punctipennis	107	49	146	189	37	**528**
Cx. pipiens	77	110	63	250	1	**501**
Oc. trivittatus	249	10	60	63	3	**385**
Oc. broad-banded	223	3	24	98	1	**349**
Culex spp.	41	73	128	34	23	**299**
Oc. triseriatus	90	31	76	59	30	**286**
Ae. vexans/cantator	51	27	61	76	-	**215**
Ae. cinereus	10	1	11	68	-	**90**
Oc. excrucians	22	3	18	1	-	**44**
An. quadrimaculatus	4	2	11	23	-	**40**
Oc. triseriatus/hendersoni	8	7	14	3	1	**33**
Oc. provocans	1	0	23	1	-	**25**
Oc. black-legged	2	2	6	2	1	**13**
Anopheles spp.	6	0	3	3	-	**12**
Cx. salinarius	3	1	1	7	-	**12**
An. perplexans	3	0	5	2	-	**10**
Ae. vexans nipponi	0	2	2	3	-	**7**
Ur. sapphirina	2	4	1	0	-	**7**
Oc. cantator	0	0	5	1	-	**6**
Oc. Euedes	0	0	0	5	-	**5**
Cs. morsitans	0	0	2	2	-	**4**
Cx. territans	0	2	2	0	-	**4**
Oc. Communis	0	0	0	4	-	**4**
An. earlei	0	0	3	0	-	**3**
Cs. inornata	0	1	1	1	-	**3**
Oc. fitchii	0	0	1	2	-	**3**
An. crucians	0	0	1	0	-	**1**
Cs. minnesotae	0	1	0	0	-	**1**
Culiseta spp.	0	1	0	0	-	**1**
Oc. aurifer	0	0	0	1	-	**1**
Oc. hendersoni	0	0	1	0	-	**1**
Oc. japonicus	0	1	0	0	-	**1**
Oc. punctor	0	0	0	1	-	**1**
Oc. riparius	0	0	0	1	-	**1**
Total	**5555**	**2085**	**3824**	**6660**	**753**	**18,877**

Source: WNV Investigation Unit, Brock University

The shaded species on Table 1 are the ones that were found to be positive in 2003.

There was wide variation in the mean number of mosquitoes caught in traps city-wide over the course of the 2003 season. There was also variability in the number of mosquitoes trapped across the city on different nights. Although the pattern is variable, there were generally more mosquitoes trapped in June and early July than later in the season.

The first four mosquito pools testing positive for WNV in Toronto in 2003 were collected on August 12, 2003. There were two in North Region, one in South Region and one in West Region. As of December 31, 2003, a total of 56 positive mosquito pools had been documented, with the following regional breakdown: 23 (41%) of the positive pools were in North Region, 20 (36%) in West Region, eight (14%) in South Region, four (7%) in East Region and one unspecified (2%) (see Table 2). Locations of WNV-positive mosquitoes found in Toronto are identified by triangular symbols in Figure 1.

Overall, six distinct mosquito speciation categories were found to be positive in the City of Toronto in 2003 (Table 2). Of all the mosquitos tested, *Culex* mosquitoes were most often found to be infected with WNV. They accounted for 39% of the mosquitoes that were tested and over 98% of the WNV-positive mosquito samples. However, WNV was not isolated in all species of *Culex*.

Table 2: Number of Mosquitoes in Pools Testing Positive, by Species, Region and Overall, City of Toronto, 2003

Region	Species	Number Tested	Positive Pools
West	*Culex spp.*	279	2
	Cx. pipiens	252	1
	Cx. pipiens/restuans	2187	15
	Cx. restuans	195	2
North	*Cx. pipiens/restuans*	1336	20
	Culex spp.	123	1
	Cx. salinarius	3	1
	Oc. Triseriatus	90	1
East	*Cx. pipiens*	68	1
	Cx. pipiens/restuans	1201	3
South	*Cx. pipiens*	113	1
	Cx. pipiens/restuans	765	6
	Cx. restuans	142	1
Unspecified	*Cx. pipiens/restuans*	283	1
City of Toronto	*Culex spp.*	402	3
	Cx. pipiens	433	3
	Cx. pipiens/restuans	5772	45
	Cx. restuans	337	3
	Cx. salinarius	3	1
	Oc. Triseriatus	90	1
Total		**7037**	**56**

Looking at the *Culex* speciation categories that are important in the bird-mosquito amplification cycle (*Cx. pipiens, Cx. restuans, Cx. pipiens/restuans,* and *Culex spp*), these mosquitoes accounted for 7,435 of the 18,877 mosquitoes tested (39%) and 54 of the 56 WNV-positive pools in Toronto (96%). Meanwhile, the bridge vector species *Coquillettidia perturbans, Aedes vexans, Anopheles punctipennis, Culex salinarius, Ochlerotatus stimulans, Ochlerotatus triseriatus* and *Ochlerotatus trivittatus* accounted for 8,083 of the 18,877 mosquitoes tested (43%) and only two of the 56 positive pools (4%).

Table 3 shows the dates of collection for the first positive mosquitoes of each speciation category.

Table 3: Collection Date of Positive Viral Test Results by Mosquito Species, City of Toronto, 2003

Mosquito Species	Date Collected
Cx. pipiens/restuans	12-Aug-03
Cx. restuans	12-Aug-03
Culex spp.	19-Aug-03
Cx. salinarius	26-Aug-03
Cx. pipiens	29-Aug-03
Oc. Triseriatus	18-Sep-03

Summary

In 2003, TPH's mosquito surveillance program screened for 70 mosquito species, 57 of which were previously known to be present in Ontario. Surveillance activity revealed 44 mosquito species in Toronto, including one never before seen in this region, *Anopheles perplexans*. Of the 44 different species identified, all 10 of the vector and/or bridging species found to be WNV positive in Ontario in 2003 were present within the city boundaries. The most abundant species of mosquitoes in the City of Toronto were *Ochlerotatus stimulans* in the spring, *Culex pipiens/restuans* in the summer and *Aedes vexans* in the fall. The two *Culex* species are likely to play an important role in the amplification of WNV in Toronto, and *Aedes vexans* is likely to play a role in transmission to humans.

Of the adult mosquitoes collected in traps in Toronto, 18,877 females grouped into 44 speciation categories were tested. Culex species accounted for 39% of the mosquitoes tested and 98% of the WNV-positive pools.

These findings are in keeping with the theory that two *Culex* species, *Cx. pipiens* and *Cx. restuans*, are key WNV "amplification" species because they prefer to feed on birds (the reservoir of WNV), and are effective vectors of the virus. They are more common in urban settings and lay eggs in polluted standing water or slow-moving water. They breed relatively quickly compared to other species, and can have up to four generations a season, which is one of the reasons their numbers greatly increase over the course of the season.

(c) Mosquito Larvae Surveillance

Introduction

The mosquito life cycle is comprised of four stages: egg, larva, pupa and adult. A female mosquito can lay up to several hundred eggs. The larval and pupal stages of the life cycle only occur in water. To maximize survival of the eggs, the female mosquito will lay her eggs either

directly on water, or in moist soil, sod or leaf litter that will be subsequently flooded. Standing or very slowly moving water that contains organic matter is usually preferred for egg laying and is best for larval development. Such locations include edges of marshes or swamps, woodland pools, ponds, catch basins, and ditches.

A larva grows through four stages or 'instars' by moulting (or shedding its outer covering) three times as it grows progressively larger. When fully grown, the fourth instar moults and becomes a pupa. When the adult mosquito is finally formed, the pupal skin splits at the back of the thorax and an adult emerges. Before it is capable of flight, the adult mosquito must then undergo a 'tanning' or hardening process, during which the body and wings stiffen.

The various genera of mosquito differ in their breeding habitats and in their ability to carry and spread disease. Mosquito genera also differ in the preferred source of their blood meals, the number of generations in a season, and the developmental stage and physical location of over-wintering. These factors informed the planning of TPH's larval surveillance program. In order to anticipate the population volumes of the various genera of adult mosquitoes and thereby assess the risk of WNV to human populations in a given area, samples of standing water were obtained from different locations around the City of Toronto in 2003 and checked for larvae.

Methods

During the 2003 summer season, three categories of standing water were targeted for larval surveillance: catch basin surveillance; larval dipping triggered by standing water reports; and larval surveillance performed as part of environmental scans.

Catch basins in representative parts of the city were monitored throughout the season to guide catch basin larviciding activities. A total of 90 catch basins were monitored.

Upon receiving notification of positive WNV cases in humans, and positive findings in birds and mosquitoes, environmental scans were conducted within a 1-5km radius of the positive findings. Areas deemed to be at higher risk of WNV (i.e. areas around positive mosquito pools, positive human cases or positive birds) were identified and maps were reviewed to identify possible sites of standing water (i.e. mosquito breeding sites).

These locations were then physically examined for standing or slow moving water. Water samples or 'dips' were taken from bodies of water where mosquitoes could breed. When mosquito larvae were found they were then counted and identified down to the species level when possible.

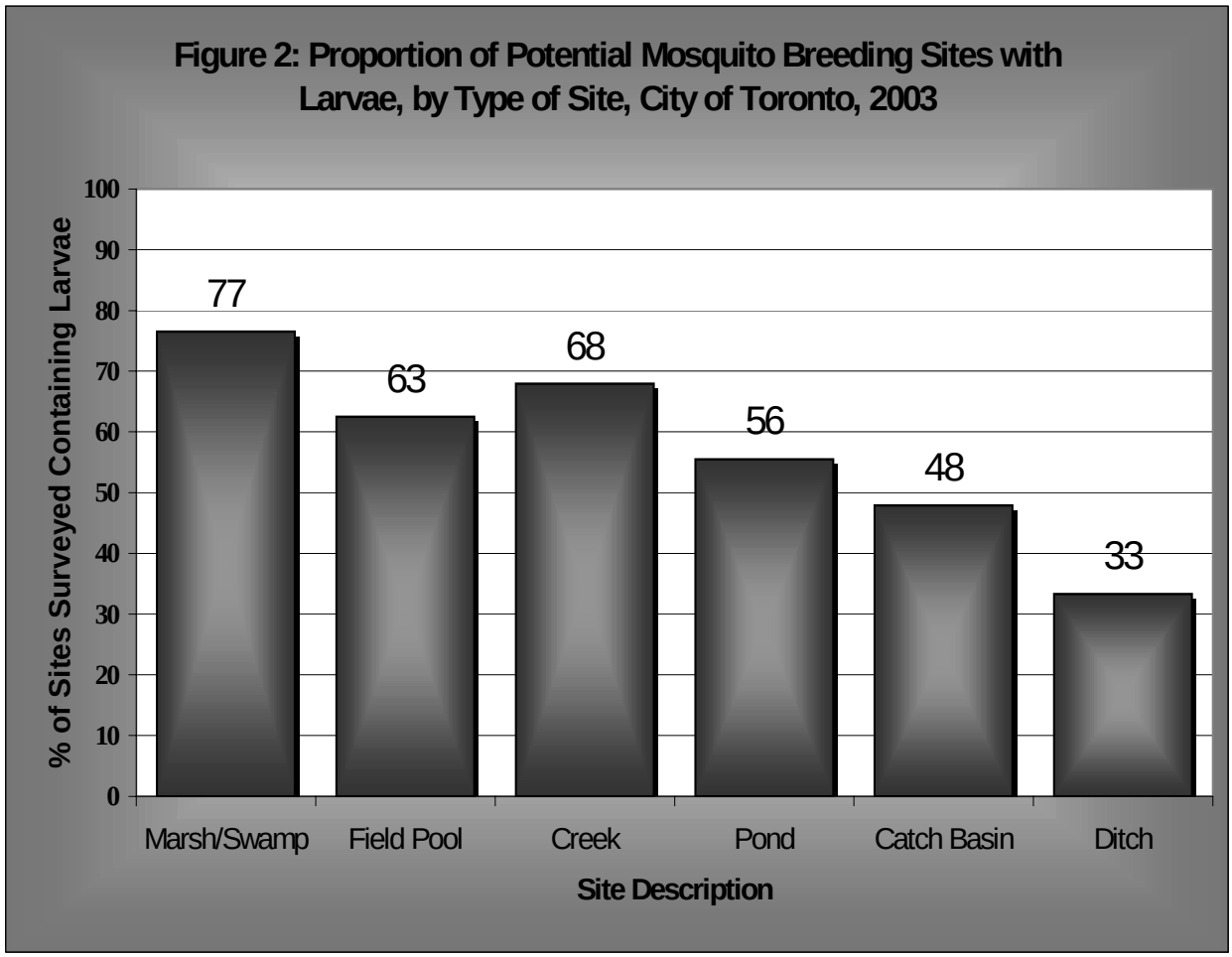
Information recorded for each potential mosquito breeding site included: address (when available), GPS co-ordinates (when available), breeding site description, organic content of water (when available), pool size, presence of emergent vegetation and pool rating (a scale ranging from "nil" to "high" that describes the number of larvae found in a given pool of water). Once results of the site visit were obtained, the information was mapped and compared to the location of sensitive areas, or Areas of Natural and Scientific Interest (ANSI, designated by the Ontario

Ministry of Natural Resources). If the site had no environmental concerns attached to it, it was considered for possible Bti application.

Results

A total of 358 sites were surveyed in the City of Toronto: 80 in North Region, 95 in South Region, 106 in West Region and 77 in East Region. The presence of mosquito larvae was identified in 197 of 358 (55%) of the potential mosquito breeding sites from which samples were taken in 2003. Total results for the City of Toronto by type of site are shown in Figure 2.

In the places where sampling was conducted based on complaints, larvae were found in various amounts. Larvae were found in 77% of the marshes/swamps , 68% of the creeks, 63% of the field pools, 48% of catch basins and 33% of ditches surveyed. Since the surface water larval surveillance was triggered by complaints, this data may not reflect the actual situation across the City. In contrast, all of the catch basins monitored regularly showed evidence of larvae over the course of the summer.



Summary

Larval surveillance provides vital information in the mosquito control effort by determining where and when specific mosquito species are breeding. In 2003, a total of 358 sites were surveyed in the City of Toronto: 80 in North Region, 95 in South Region, 106 in West Region and 77 in East Region. The presence of mosquito larvae was identified in 55% of the potential breeding sites from which samples were taken. Larvae were most often found when surveying marsh and swamp areas. Although there was anecdotal evidence of Culex mosquito larvae in surface waters, more specific speciation data is unavailable. This will likely be available for 2004.

(d) Human Surveillance

Overview

During the 2003 West Nile virus (WNV) season, the Communicable Disease Control (CDC) service of Toronto Public Health (TPH) received 44 reports of Toronto residents who were diagnosed with confirmed WNV. No deaths were reported in Toronto in 2003. This represented a substantial decrease from the 130 confirmed and 33 probable cases reported to TPH during the 2002 season.

In 2003, TPH enhanced the level of follow up of reported WNV cases. In addition to obtaining the required clinical and diagnostic information, the possibility of WNV transmission through receipt or donation of blood/blood products and organs/tissue was thoroughly investigated for each case.

In 2003, each investigation was also expanded to include a detailed interview with each reported case to obtain an activities list and the types of outdoor activities where possible WNV exposure may have occurred. Questions were also asked on personal protective measures taken during the season. Possible environmental exposure locations identified through the interviews were forwarded to TPH Healthy Environments' WNV team for further follow up (i.e. environmental scan to identify and address potential mosquito breeding sites).

In 2003, TPH also continued to provide regular updates and educational materials to physicians, infection control practitioners and hospitals. This was accomplished through regular e-mail updates and through information contained in the physician newsletter, Communique. The goal of this communication was to keep health practitioners in the community apprised of the most recent surveillance data and to ensure that those practitioners were aware that WNV season was in progress.

Summary of cases

In 2003, the Ministry of Health and Long-Term Care (MOHLTC) expanded the number of human WNV case definition categories from 5 to 10, and clarified the wording of each category.

In 2002, the WNV definitions were ambiguous and TPH established the following 5 classifications for WNV:

- Confirmed WNV
- Probable WNV Encephalitis
- Probable WNV Fever
- Suspect WNV Encephalitis
- Suspect WNV Fever.

Appendix A provides a description for each of these categories.

In 2003, the MOHLTC provided the following WNV case categories for use by all Ontario Health Units:

- Confirmed West Nile Neurological Manifestations (WNNM)
- Confirmed West Nile Fever (WNF)
- Confirmed West Nile Asymptomatic Infection (WNAI)
- Probable WNNM
- Probable WNF
- Probable WNAI
- Possible WNNM
- Possible WNF
- Suspect WNNM
- Suspect WNF

The MOHLTC also provided a description of the symptoms that defined each category (neurological manifestations, fever or no symptoms) as well as the method of diagnosis and the type of laboratory tests used to make a diagnosis of WNV.

Appendix B provides an explanation for each of these categories.

As mentioned above, there were 44 confirmed human WNV cases in Toronto in 2003. The number of cases by sex and case type is presented in Table 4:

Table 4: Number of WNV cases by sex and case type, Toronto 2003

Sex	WN Fever	WN Neurological Manifestations	TOTAL
Female	10	14	24
Male	8	12	20
TOTAL	18	26	44

The mean age (in years) by gender and case type is presented in Table 5:

Table 5: Mean age (in years) of WNV cases by sex and case type, Toronto 2003

Sex	WN Fever	WN Neurological Manifestations	Mean age by gender
Female	45.7	54.6	51
Male	43.5	52.8	49
Mean age by case type	44.7	53.8	**50**

Of the 44 confirmed WNV cases reported in 2003, six required hospitalization due to their infection and one required intubation. Hospitalized cases were followed on a daily basis by TPH WNV surveillance staff to obtain an understanding of the severity of illness and to enable daily reporting of hospitalization status in anticipation of media inquiries.

Appendix C provides the epidemiological curve of the 44 WNV cases reported in 2003 by date of illness onset and reporting date to TPH. The mean length of time from onset of illness to date reported to TPH was 17.6 days (range 0 to 50 days).

(Note: One client presented to hospital on the same day as symptoms first presented and was reported to TPH as a suspect WNV case. This case was later confirmed through laboratory testing.)

Although there were only 44 confirmed cases of WNV in 2003, the WNV human surveillance team investigated a total of 271 clients who were initially reported as suspect WNV. Of these, 113 were found to have a previous infection with either WNV or another flavivirus (WNV is a member of the flavivirus family). The remaining 114 were initially diagnosed with WNV based on their clinical presentation, but WNV was ruled out when the laboratory tests for acute WNV were found to be 'non reactive'.

In comparison, in 2002 there were a total of 326 clients who were initially reported as suspect WNV. Unfortunately, the laboratory testing methodology used in 2002 was unable to discern between current infections and previous infections unless the client submitted two blood samples, the first collected immediately following onset of symptoms and the second collected 10 to 14 days later. Of the more than 325 potential WNV cases reported in 2002, some submitted only one specimen and therefore a diagnosis of WNV could not be confirmed or satisfactorily ruled out. Therefore, only 177 cases met the case definitions for probable or confirmed cases. Note that the immunoglobulin test available in 2003 could discern between recent and old infections, so only one blood sample was required.

Co-ordination between WNV Human Surveillance and Environmental response team

As indicated above, all 2003 probable/confirmed WNV cases were interviewed to obtain a detailed history of outdoor activities for the 21 days prior to symptom onset. The incubation period for WNV is 3 to 15 days. As it is sometimes difficult for clients to clearly identify the date of onset of symptoms, the interview period was extended to 21 days.

Every 21-day history was reviewed in detail by the investigator and program manager and a summary of possible date(s) and locations of exposure to mosquitoes was referred to the Healthy Environments WNV program manager for follow-up. Locations of possible exposures outside Toronto were referred to the appropriate Health Unit.

(3) MOSQUITO CONTROL

The TPH mosquito control program in 2003 aimed to reduce adult populations of mosquitoes in the most effective manner using the principles of integrated pest management (IPM). The IPM framework emphasizes reduction of disease transmission using approaches that have minimal negative impact on human health and the environment. These measures include source reduction of mosquito breeding habitats, public education (e.g., removal of standing water, and personal protection measures) and surveillance activities. All of these strategies were employed in 2003.

Actions taken as a result of investigation of standing water complaints included referrals for follow up, removal of standing water, treating standing water with larvicide, efficacy testing of methoprene in surrounding catch basins, larval dipping of open bodies of water and the placement of additional adult mosquito traps. Referrals were either directed to the District Public Health Inspector or to other City of Toronto Divisions and Departments, including Municipal Licensing and Standards (in Urban Development Services), Works and Emergency Services and Parks and Recreation (in Economic Development, Culture & Tourism).

Toronto Public Health and Municipal Licensing and Standards developed a joint West Nile Virus response protocol to respond to complaints of standing water on private property. Authority to issue orders and take appropriate action was under the Building Code Act, the Municipal Act and the Health Protection and Promotion Act (HPPA). A flow chart was developed to assist in the direction of complaints to the appropriate departments.

Toronto Public Health responded to calls related to seasonal collections of standing water due to the rainfall, whereas Municipal Licensing and Standards focused on maintenance and building deficiencies, such as obstructed drainage and ground depressions. The Building Code Act also provided for emergency powers without having to obtain a warrant. A number of investigation requests resulted in orders and notices directed to private property owners for the removal of standing water on private property by both Urban Development Services (UDS) and Public Health. Seventeen emergency orders were issued by UDS to remove standing water when the property owner ignored these orders. Approximately 12 orders were issued city-wide by TPH under the HPPA. Compliance to these orders was 100%, therefore there were no charges laid by TPH under the HPPA in 2003.

Overall, co-operation across City departments was good. If a potential hazard was on public property (parks, schoolyards, roadways), TPH referred the information about the potential hazard to the relevant department for follow up and corrective action. Highest priority was given to sites where standing water was most likely to occur, such as known wetlands and marshlands, ravines and parks containing streams and creeks.

Specific source reduction activities included the vacuuming of catch basins by Works and Emergency Services (WES), the filling in of depressions, grade corrections, and elimination of standing water through drainage and pumping and the removal of debris in watercourses and ditches to improve flow by both WES and Parks and Recreation.

The 2003 TPH WNV program also included the use of larvicides, i.e. pesticides that prevent the development of larval mosquitoes into biting adults.

Larval dipping of catch basins was undertaken as part of the WNV program in order to inform the timing of larvicide application. Larval dipping was undertaken in 294 catch basins on June 11, 2003. *Culex restuans* (1^{st} and 2^{nd} instar) were found in only three of the 294 catch basins. A second larval dipping event took place on June 24, 2003. Ninety catch basins were sampled for the presence of mosquito larvae and *Culex restuans* were found in 32 of these catch basins. Additional larval dipping was undertaken in 77 catch basins on July 21 and 22, 2003. These results showed catch basins in residential areas had many more larvae than those in either commercial or industrial zones. Based on these data, as of July 30, 2003, larviciding activities were aimed at catch basins found on residential streets. The public was notified of the first and second round of larviciding activities in both the Toronto Star and the Toronto Sun newspapers on June 23, 2003 and August 2, 2003.

The City of Toronto was divided into 18 zones (A to R) for administrative purposes. There were two rounds of methoprene application to City of Toronto catch basins in 2003. The first round of larviciding began on June 25, 2003 and was completed on August 13, 2003. During the first round, a decision was made to concentrate larviciding efforts on residential areas, as larval surveillance data clearly demonstrated more larvae in catch basins in these areas when compared to those in industrial and commercial areas and along major arterial roads. The second round of larviciding, which also concentrated on residential areas, began during the first week of August and ended on September 25, 2003. Methoprene was not applied to all catch basins in round two of the larviciding program because surveillance revealed low mosquito activity in September.

An application of 0.7 g of 4.25% methoprene pellets was applied to each of 123,117 catch basins in the first round of larviciding and to each of 83,794 catch basins during the second round of larviciding. Staff did not apply methoprene to the last two consecutive catch basins before a discharge point that entered a sensitive area identified by the MOE and the Toronto Region Conservation Authority. Although most of the catch basins larvicided were on public road allowances, the Metro Toronto Zoo also requested that larviciding be undertaken in the catch basins on the Zoo property. Two rounds of larviciding were carried out in a total of 254 catch basins on the Zoo property. These numbers are included in the total number of Catch Basins per round. Toronto Public Health completed 206,911 applications of methoprene to catch basins in 2003 and applied a total of 6.2 kg of active ingredient.

Efficacy monitoring was also undertaken to measure the effectiveness of the methoprene application. There was on average 98% emergence in untreated catch basins as opposed to 0% emergence up to 17 days after treatment (emergence is defined as the percentage of larvae that continue to develop and become adult mosquitoes). Emergence increased to about 11% after 20 days, 27.5% after 30 days, and 67.7% after 44 days.

Working with PCO Services Toronto, TPH also effected a number of standing water treatments for mosquito larvae in open bodies of water. Treatment was limited to pooling water in creeks, swamps and bogs. A total of 51 different areas were treated with Bacillus thuringiensis

israelensis (Bti), covering an average area of two to 2366 square metres. The total quantity of product used was 26.82 kg. Treatment was performed between August 30th and September 27th and included areas in Centennial Park, Mimico Creek, Smyth Park, Moore Park Ravine, and G. Ross Park.

In addition to areas treated by the City, the following private companies reported mosquito control activities in Toronto:

Pestalto
Abel Pest Control
Leuschner's Lawn and Landscape
Reliable Pest Control

These companies treated more than 9500 catch basins in the City and more than 260 square metres of surface water on private property.

Mosquito Control Pilot Projects

The February 24, 2003, CAO's Report to Toronto City Council "Funding for the West Nile Virus Program" recommended a study to assess the effectiveness of various non-chemical alternatives for the control of mosquito development in catch basins. Water & Wastewater Services (W&WS) of Toronto Works and Emergency Services (WES), in collaboration with TPH, undertook a study of the following control measures as part of a pilot project to test non-chemical alternatives to larviciding:

1. Installation of mesh screens over catch basin openings to prevent mosquitoes from entering;
2. Injection of steam;
3. Ultrasonic device;
4. Vacuuming to remove stagnant water;
5. Drainage holes at the bottom of catch basins.

Results

Of the five methods examined, only the screens installed on the underside of a catch basin grate showed some promise. The screens prevent the entry of female mosquitoes that might lay eggs in the water in the catch basin, and prevent the exit of adult mosquitoes that had been developing in the catch basin before the installation of the screen. The low cost of screen materials and the ease of installation and maintenance make this option possible for homeowners to install on their own back yard basins. It is recommended that screen design guidelines be created for distribution to homeowners with private catch basins. However, homeowners who do install screens should take care not to remove the screen from a catch basin during the season, as this could release mosquitoes, or allow them to enter. Because of this, it is further recommended that regular cleaning of the screen be performed to ensure adequate drainage without the need for removal of the screen. Since the screens require this intensive maintenance, using them on public catch basins would not be feasible.

Steam and the use of ultrasound killed mosquito larvae at the time of application, however these methods do not provide any residual control and mosquitoes soon re-establish themselves in the catch basin. These methods were also time- and resource-consuming, taking up to 15 minutes per catch basin to treat.

Although vacuuming removes water from the sump at the bottom of the catch basin thus eliminating the breeding environment, water soon returns to the sump and re-establishes the mosquito-breeding environment. Vacuuming catch basins is expensive and does not provide long-term control.

Drainage holes did not prove suitable. A number of factors contributed to the limited success of this method, including: the condition of the ambient soil that would receive drained water; the time it took to locate underground utilities prior to drilling; the expertise and equipment required to drill concrete bases; the need to vacuum basins prior to drilling; and the potential for ground settlement.

CONCLUSION

The Toronto Public Health 2003 WNV Program was designed to minimize the risk to human health. The main components of the program included surveillance, public education, and mosquito control. These components were selected based on evidence in the scientific literature, the evidence obtained from ongoing surveillance in the Greater Toronto Area, and a review of the standard of practice in numerous urban centres in North America. TPH worked closely with other City of Toronto departments and divisions, partner health units in the Central East Region of Ontario, the Ontario Ministry of Health and Long Term Care, Health Canada, Brock University, and The Canadian Cooperative Wildlife Health Centre in the development, planning, and execution of the 2003 WNV Program.

The 2003 WNV Program was consistent with the standard of practice of most other major urban areas in North America, including New York City, Chicago, and Winnipeg. Specific activities were modified, based on the best scientific evidence, to accommodate conditions in the City of Toronto. Activities in the TPH program were also modified on an ongoing basis, based on new developments in the scientific literature, new surveillance data in the local area, and lessons learned by frontline staff in terms of improving operational efficiency.

Similarly, what was learned in 2003 will be applied to the 2004 WNV Program in order to continuously improve the ability of TPH and its partners to minimize the human health risk from WNV.

Appendix A

West Nile Virus Case Definitions – 2002

	Level of severity of illness	
Level of Laboratory Certainty	WNv encephalitis	WNv Fever
Confirmed*	Any client who experienced symptoms of Encephalitis and/or of WNv fever such as rash, myalgias and arthralgias and whose specimens (blood, CSF, Tissue) were confirmed as WNV through PRNT.	
Probable*	Have symptoms of Encephalitis with 2 WNV serology titres with a 4 fold or greater increase/decrease between the acute and convalescent specimen.	Have symptoms of WNv fever such as rash, myalgias and arthralgias without encephalitis with 2 WNV serology titres with a 4 fold or greater increase/decrease between the acute and convalescent specimen.
Suspect**	Have symptoms of Encephalitis with one WNV serology titre ≥1:320	Have symptoms of WNv fever such as rash, myalgias and arthralgias without encephalitis with one WNV serology titre ≥1:320.

* Case definition provided by the Ministry of Health and Long Term Care.

** Case definition established by TPH in order to assist in classifying these cases.

Appendix B

West Nile Virus Case Definitions – 2003

	Level of severity of illness		
Level of Laboratory Certainty	Neurological Syndromes	Fever	Asymptomatic Infection (no symptoms)
Confirmed*	Have symptoms of encephalitis with laboratory evidence which first 5 cases is PRNT after initial testing with IgM ELISA and after the first 5 PRNT confirmed cases in a jurisdiction** is WNV IgM reactive.	Have symptoms of WNv fever such as rash, myalgias and arthralgias without encephalitis with laboratory evidence which for the first 5 positive cases are PRNT positive after initial testing with WNV IgM ELISA and after the first 5 confirmed cases in a jurisdiction** is WNV IgM reactive.	No symptoms of WNV but laboratory evidence which for the first 5 positive cases is PRNT after initial testing with IgM ELISA and after the first 5 confirmed cases in a jurisdiction** is WNV IgM reactive.
Probable	Have symptoms of encephalitis, are one of the first 5 cases testing WNV IgM positive (ELISA test), in a jurisdiction** this season and awaiting confirmation by PRNT.	Have symptoms of WNv fever such as rash, myalgias and arthralgias without encephalitis, one of the first 5 cases to test positive using IgM ELISA in a jurisdiction and awaiting confirmation by PRNT.	No symptoms of WNV and one of the first positive cases in a jurisdiction using IgM ELISA, awaiting confirmation with PRNT.
Possible	Have symptoms of encephalitis with laboratory evidence that is equivocal for WNv such as a low HI Titre or intermediate IgM ELISA	Have symptoms of WNv fever such as rash, myalgias and arthralgias without encphalitis with laboratory evidence that is equivocal with WNv such as low HI titre or intermediate IgM ELISA.	Not Applicable
Suspect	Have symptoms of encephalitis with no laboratory evidence of WNv.	Have symptoms of WNv fever such as rash, myalgias and arthralgias without laboratory evidence for WNv.	Not Applicable

Note:

* Once 5 clients who have tested WNV IgM reactive (ELISA) are PRNT confirmed, then all additional clients who test WNV IgM reactive are deemed to be confirmed WNV cases.

** In 2003, jurisdiction was deemed to be the province of Ontario, not each individual Health Unit as was originally planned.

Appendix C

2003 WNV Cases (confirmed)
by Report date and Onset date