



LARVAL MOSQUITO CONTROL AND ENVIRONMENTAL MONITORING

Introduction

Larval surveillance programs are intended to identify the presence, type and abundance of vector larvae in a defined geographic area. Information obtained from such programs aids in making decisions as to whether or not WNV control measures are necessary. In 2002, data collected in the Region of Peel verified the presence of vector larvae in standing surface water found in catch basins and other man-made structures, as well as in natural habitats.

Using larval surveillance data from 2002, a larval mosquito reduction program involving the inspection and larviciding of over 75,000 roadside catch basins across Peel Region was undertaken in 2003. Catch basins are designed to collect rain and storm water from city streets, diverting it into receiving bodies such as streams, creeks, rivers and lakes. One method of controlling mosquito breeding in these catch basins is by the application of the larvicide Methoprene.

Methoprene is a chemical substance that mimics the mosquito's juvenile growth hormone²³ and prevents the emergence of adult mosquitoes from the pupal stage.²⁴ Standing water in the breeding site is treated with Methoprene pellets that dissolve in the water and allow the larvae to develop into pupae; however, the artificially higher hormonal level in the water causes the mosquitoes to stay as pupae and eventually die or to develop into adult mosquitoes which are unable to reproduce.²³

In addition to roadside catch basins, plans were also made to larvicide other mosquito breeding sites located on federal, provincial, municipal and private lands. Decisions to larvicide these other sites were based on the results of larval surveillance activities and in response to standing water complaints. If these sites were considered to be in sensitive areas or significant wetlands, the larvicide Bti (*Bacillus thuringiensis* variation *israelensis*) was to be used. The use of this larvicide may be ordered by the local Medical Officer of Health if risk assessments identify an abundance of WNV-vector mosquito larvae in standing water which is in close proximity to inhabited areas.²⁵

Bti is a bacterium found to naturally occur in soils. It targets only mosquito and blackfly larvae.²⁶ Bti works by producing a microscopic protein crystal that, when ingested by feeding larvae, gets converted to a toxin. The toxin destroys the walls of the insect's stomach and within hours, the insect stops feeding, dying within days.²⁶

Measures of the effectiveness of Methoprene, including the lack of adult mosquito emergence and amounts of residual Methoprene, were obtained from samples of standing water taken from 33 catch basins in Peel. In addition, monitoring of the storm water outflow downstream from a sample of four catch basins was undertaken to



measure any impacts on the environment and its aquatic life from the use of Methoprene.

Methods

Larval Mosquito Control

The 2003 larval mosquito reduction program involved obtaining the correct permits from the Ministry of the Environment for the purchase of pesticides to perform water exterminations in either municipal roadside catch basins or standing surface water found in ditches, storm water retention ponds, lakes and woodland or field pools.

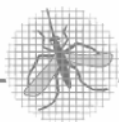
Pestalto Environmental Products Inc. was contracted by the Region of Peel to provide these larval mosquito control services. The contract involved locating catch basins and standing water sites, measuring mosquito larval populations prior to the application of larvicide, larviciding the site, collecting samples post-treatment and determining larvicide efficacy.

Locations of catch basins and standing surface water sites were either provided to Pestalto by Peel Health staff from historical breeding site data, through field surveys, by investigating standing water complaints received from Peel residents, or they were found in the course of conducting the treatment program.

The condition of each catch basin was assessed to determine if it was environmentally sensitive, dry, had flowing water, or was a likely mosquito breeding site. Treatments of catch basins located within 30 metres of environmentally sensitive areas (e.g. bodies of water including creeks, rivers, marshes or ponds) were conducted using a special ultrasound-emitting device called a Larvasonic[®]. If the catch basin was not near an environmentally sensitive area and its condition suitable for treatment, Methoprene in the form of Altosid[®] pellets was deposited into the standing water in the catch basin at a rate of approximately 0.7 grams per application. Catch basins were generally treated three times over the course of the mosquito season.²⁷

Environmental Monitoring

Environmental monitoring of a sample of roadside catch basins was conducted by Peel Health in conjunction with staff from Pestalto Environmental Products Inc. and Peel Public Works.²³ Thirty-three catch basins (20 in Mississauga, 10 in Brampton and 3 in Caledon) were randomly selected to test for the presence and effectiveness of Methoprene, with the interval between larvicide application and sample collection varying between two and 44 days. The sampling and testing was done by Region of Peel staff. Samples were taken a minimum of three times each following the application. Selected catch basins in Mississauga were sampled a total of five times.



Peel Health also worked with staff from the Credit Valley Conservation Authority and the Ontario Ministry of the Environment (MOE) on a study to determine the environmental impact of Methoprene in receiving waters and the impact the larvicide might have on aquatic species. Four sites were selected in Peel: three in Mississauga (Credit River, Mullet Creek and Sheridan Creek) and one in Brampton (Etobicoke Creek). Each site was visited one day before the application of Methoprene, then on day plus three, plus seven, plus 14, plus 28, plus 56, and plus 112. Water and invertebrate samples were taken immediately upstream of a catch basin, at the outflow, immediately downstream of the outflow and well downstream of the outflow. The samples were taken to the MOE laboratory for analysis.

The MOE also tested drinking water from 29 water treatment plants across the province, including the Lakeview and Lorne Park plants in Peel Region.

Results

Larval Mosquito Control

Four permits to purchase pesticide for the purpose of water extermination of mosquito larvae were obtained for use in the Region of Peel and received by Pestalto. Peel Health notified the public about the application of larvicide treatments as per MOE requirements.

In 2003, there were a total of 75,516 roadside municipal catch basins in Brampton, Mississauga and Caledon (Table 7). Methoprene, in the form of Altosid[®] pellets, was applied to 71,664 catch basins (95%) in the first round of applications conducted between May 26 and June 11, 2003. The second application took place from June 23 to July 16, and included 73,556 catch basins (97%). The third treatment was applied to all 75,516 catch basins from July 21 to August 14. Larvicide applications were not made to catch basins which were deemed to be environmentally sensitive, found to be dry or had flowing water.

In addition, 372 catch basins not located on municipal streets were identified as needing to be treated. A total of 327 catch basins in residential backyards received 522 treatments with Altosid[®] pellets from June 10 to August 14, 2003. Thirty treatments were applied at 15 catch basins located at the three Regional Long-Term Care facilities and 54 treatments were made in 30 catch basins located in 10 parks during July and up to August 14 (Table 7). Over the course of the 2003 mosquito season, a total of 221,342 larvicide treatments were made in roadside, backyard or other types of catch basins using a quantity of 155 kilograms of pesticide.



Table 7: Number of Catch Basin Treatments Using Altosid® Pellets, Region of Peel, 2003

Type of Catch Basin (number)	Number of Catch Basin Treatments	Quantity Used (grams)
Municipal Roadside (n=75,516)		
1st Treatment	71,664	50,165
2nd Treatment	73,556	51,489
3rd Treatment	75,516	52,861
Backyard (n=327)		
1st + 2nd Treatments	522	365
Long Term Care Facilities (n=15)		
1st + 2nd Treatments	30	21
Parks (n=30)	54	38
Total	221,342	154.94 Kg

Source: Pestalto Environmental Products Inc., February 2004

Site surveys of standing surface water by Peel Health staff resulted in the identification of 128 open surface water sites for monitoring and treatment. Those with moderate to high larval densities as per MOE guidelines were treated with Bti in the form of Aquabac 200G. Mississauga had 57 sites of which 23 were treated one or more times; Brampton had 30 sites of which 23 received applications one or more times; and Caledon had 41 sites of which 22 received treatments. Pestalto administered a total of 131 Bti treatments at these 68 sites using approximately 18 kilograms of larvicide, with a resulting efficacy of 100% based on samples taken 48 to 72 hours after the treatment was applied.²⁷

Considering that 362 surface water sites were identified as having vector larvae only 19% (68/362) of sites that required treatment received it. This was due in part to a lengthy process which involved larval identification, then assessment for remediation and then treatment referral. As well, a proportion of these sites were found to contain amounts of larvae too low to be considered for treatment.

Treatments of catch basins located within 30 metres of environmentally sensitive areas (e.g. bodies of water including creeks, rivers, marshes or ponds) were conducted using a special ultrasound-emitting device called a Larvasonic®, rather than using pesticides. A total of 162 sensitive catch basins were treated in this way.

The Larvasonic® generator provided variable results, with proportions of mosquito larvae being killed ranging from low levels of mortality to 100%. An examination of the effectiveness of the Larvasonic® undertaken at 15 sites in Peel Region resulted in efficacy rates of between 20 and 67%. Pestalto plans to review the performance of this device for use in the 2004 mosquito season to determine reasons for this variability.²⁷



Environmental Monitoring

A random sample of 33 catch basins across Peel was monitored to determine residual levels of Methoprene and its efficacy. The minimum detection limit of Methoprene in water samples analyzed at the Region of Peel Public Works laboratory was 0.47 micrograms per litre ($\mu\text{g/L}$). Sixty-nine per cent of the samples had levels below 0.47 $\mu\text{g/L}$ and 16% of the samples had non-detectable levels of Methoprene.

The overall efficacy rate for 10 samples of pupae and adult mosquitoes collected by Peel Health from 7 catch basins on two different occasions was 74%. This means that Methoprene was generally effective in reducing adult emergence of viable mosquitoes. However, efficacy rates for individual catch basins ranged between 0% and 100% (although the zero per cent was based on a sample of one pupae and one adult that emerged).²³

Caution must be taken when interpreting these results due to small sample sizes and limitations encountered during the course of the study. Some of these limitations included the lack of a recognized protocol, changes in testing methodology over the course of the year, variations in levels of organic matter and water within the catch basins, incomplete recording of treatment dates or conditions of catch basins, and other factors such as human activities or weather conditions that may have affected the efficacy of the larvicide.²³

Three other Ontario studies have found similar results with slightly higher estimates of efficacy. Two were conducted by Pestalto and one by the MOE.

In the first study, Pestalto collected larvae and pupae from catch basins in Peel Region as well as other jurisdictions having contracts with their company. In this study, 68 of 474 pupae emerged into adults, resulting in an efficacy rate of approximately 86%.²⁷

These results are similar to findings of a second Pestalto study of post-treatment Methoprene efficacy, in which 233 samples were drawn from 88 catch basins in southern Ontario.²⁴ The overall efficacy rate was determined to be 81%; however, efficacy rates again ranged from 0% to 100%. The report found that the efficacy of Methoprene is variable and makes numerous recommendations to improve the planning, delivery and monitoring aspects of a larval control program.

The MOE conducted a study of Methoprene efficacy in Halton Region.²⁸ They found that, up to 21 days after application of the larvicide, 96% of pupae failed to emerge from treated catch basins. When corrected for natural factors (e.g. pupae that would not have normally emerged), the efficacy was found to be at least 87%. From 21 to 30 days, the efficacy was found to decline to 43%. As a result, the MOE will be changing



their recommendations for Methoprene pellet use such that applications will be recommended every 21 days, instead of 28 days as was the case in 2003.

Published results from the collaborative study on Methoprene levels in drinking water and downstream from catch basins were not yet available from the MOE at the time of production of this report. However, a presentation made in December 2003 by the MOE reported that among all receiving water samples taken downstream from catch basins, not one contained detectable levels of Methoprene. A single sample taken from Sheridan Creek in Mississauga upstream of a catch basin outfall did contain detectable Methoprene; however, the level of Methoprene found was lower than that of the water quality standard.²⁹ No Methoprene was detected in any of the drinking water samples. Results of studies on the impact of Methoprene on aquatic organisms have yet to be released.

Summary

Based on findings from larval surveillance activities in 2002, a larval mosquito reduction program involving the inspection and larviciding of 75,516 roadside catch basins across Peel Region was undertaken in 2003. An additional 372 catch basins located at Regional Long-Term Care facilities, parks or in private backyards were also treated.

Over the course of the 2003 mosquito season, a total of 221,342 treatments using the larvicide Methoprene were made in roadside, backyard or other types of catch basins. Methoprene was effective in reducing the emergence of viable adult mosquitoes, with an overall efficacy rate of 74% and up to 96% at 21 days post-treatment.

A total of 128 open surface water sites were identified for monitoring and treatment; those with moderate to high larval densities as per MOE guidelines were treated with Bti. A total of 131 Bti treatments were administered at 68 sites, with a resulting efficacy of 100%. This represented only 19% of sites potentially requiring treatment.

Treatments of 162 environmentally sensitive catch basins located within 30 metres of bodies of water, including creeks, rivers, marshes or ponds, were conducted using a device called a Larvasonic[®], producing efficacy rates of between 20% and 67%.

A collaborative study done by the MOE and a number of Ontario health departments showed that Methoprene had no impacts on surface water quality, including drinking water.

Results of studies that examined levels and effects of Methoprene in receiving water collected downstream from catch basins at four sites in Peel Region will be published by the Ministry of the Environment. Preliminary results show that Methoprene was not detectable in drinking water or downstream from catch basin outfalls.