Larval Mosquito Surveillance

Introduction

Mosquitoes go through complete metamorphosis. The lifecycle of the mosquito has four distinct developmental stages: egg, larva, pupa and adult (Figure 13). Mosquitoes lay their eggs on top of stagnant water or damp soil that will be flooded with rain or melting snow. The first three stages of development occur in an aquatic environment. The adults emerge from the pupae and take flight shortly after emergence.

Only the female mosquito requires a blood meal and bites animals - warm or cold blooded - and birds. Stimuli that influence biting (blood feeding) include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Male mosquitoes do not bite, but feed on the nectar of flowers or other sources of sugar. The acquisition of a blood meal (protein) is essential for egg production, but generally both male and female mosquitoes are nectar feeders. The females will seek blood meals from mammal, avian or amphibian sources, depending on the feeding preferences of that mosquito species.

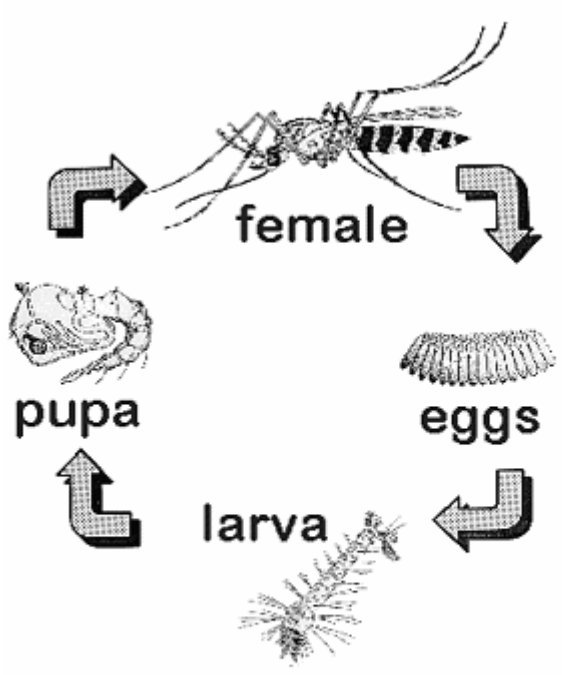


Figure 13: Mosquito Life Cycle

Source: Courtesy of Rutgers State University Web page
http://www.rci.rutgers.edu/~insects/lcycle.htm

Larval surveillance results are important in guiding and implementing appropriate prevention and reduction activities. They are used to determine the location, species and population densities of vector mosquitoes. Larval surveillance activities are vital for predicting adult emergence and establishing optimal times for application of larval reduction measures.

Larval surveillance was undertaken at approximately 2,300 potential mosquito breeding sites on publicly owned lands in Peel in 2004.

Methods

Stagnant Water Surveillance

Seasonal staff surveyed a variety of aquatic habitats for the presence of mosquito larvae from early May to late October. Staff identified mosquito breeding sites by referencing historical breeding site information collected in 2002 and 2003. In addition, stagnant water complaints received from the public assisted in identifying additional sites. In 2004, the public were able to report stagnant water sites using an on-line reporting form. This was recommended in the WNV evaluation report.[6] The larval sampling procedure involved collection of larvae in a standard aquatic dipper (Figure 14). A standardized larval sampling method was used to quantify larvae density and the breeding sites were ranked as nil, low, medium or high density. This information was entered into a handheld computer in the field. Other data captured were the type and dimensions of the breeding site and the date of the inspection. The exact latitude and longitude of the potential breeding site was recorded using a Global Positioning System (GPS) unit and entered into the breeding site data base.

Figure 14: Standard Mosquito Dipper

Source: Photo taken by Peel Public Health WNV Team

Larval Mosquito Identification

Breeding sites were continually surveyed and sampled for mosquito larvae. Field samples were sent to one of our in-house mosquito laboratories for species identification by trained Peel Public Health staff. In order to expedite mosquito larvae identification, laboratories were set up in our offices in Mississauga and Brampton in 2004. The number of larvae that were collected was dependent on the number and frequency of the dips taken and the larval activity at the time of the breeding site survey. The number of specimens collected was completely random but likely provided a good indication of larval activity throughout the Region. Laboratory identification results were used to determine species

distribution, habitat preferences, abundance and seasonal occurrence and were a valuable tool in guiding larval reduction measures.

A geographic information system (GIS) was used to maintain all larval surveillance data. Maps identifying the location of all the potential breeding sites were generated using a mapping software program. These maps were also used to identify the sites that contained larvae and more importantly the sites that supported WNV vector larvae. This information was used to determine the types of habitats where larvae were found as well as the distribution of the different mosquito species in Peel.

Results

In 2004, a total of 2,296 potential breeding sites were surveyed for the presence of larvae (Figure 15). Mississauga had 75% (1,726) of the total sites, 17% (383) were found in Brampton and 8 % (187) in Caledon. The proportion of breeding sites surveyed by municipality is consistent with the 2003 figures. The distribution of these sites is influenced in part by stagnant water complaints received from Peel residents and by historical information of the types of habitat that support larvae.

Mosquito larvae were found in 32% (728 of 2,296) of the breeding sites that were monitored in Peel. Vector larvae (larvae of a species found to have tested positive for WNV in Canada) were identified in 27% (627 of 2,296) of these locations.

Larval surveillance results by municipality and habitat type are shown in Figures 16 to 18. As in 2003, man-made structures, such as ditches and culverts were the most frequent types of sites in which larvae were found in Peel (Figure 19). Mosquito larvae were also frequently found in the naturally-occurring woodland pools and field pools. These naturally occurring sites are generally not a concern by mid-summer as they tended to dry up. The storm water management (dry and wet) ponds which are highly visible due to their size and location generally did not support significant numbers of mosquito larvae.

In 2004, three storm water management (SWM) ponds required treatment: two in Caledon and one in Brampton. These sites were treated as a result of moderate to high counts of vector larvae being found in these locations. Although a number of natural ponds or marshes were found to have larvae present, none required treatment as the larvae found at these sites were generally not WNV vectors.

Figure 15: Surveyed Locations of Mosquito Breeding Sites, Sites with Larvae and Vector Larvae*, Region of Peel, 2004

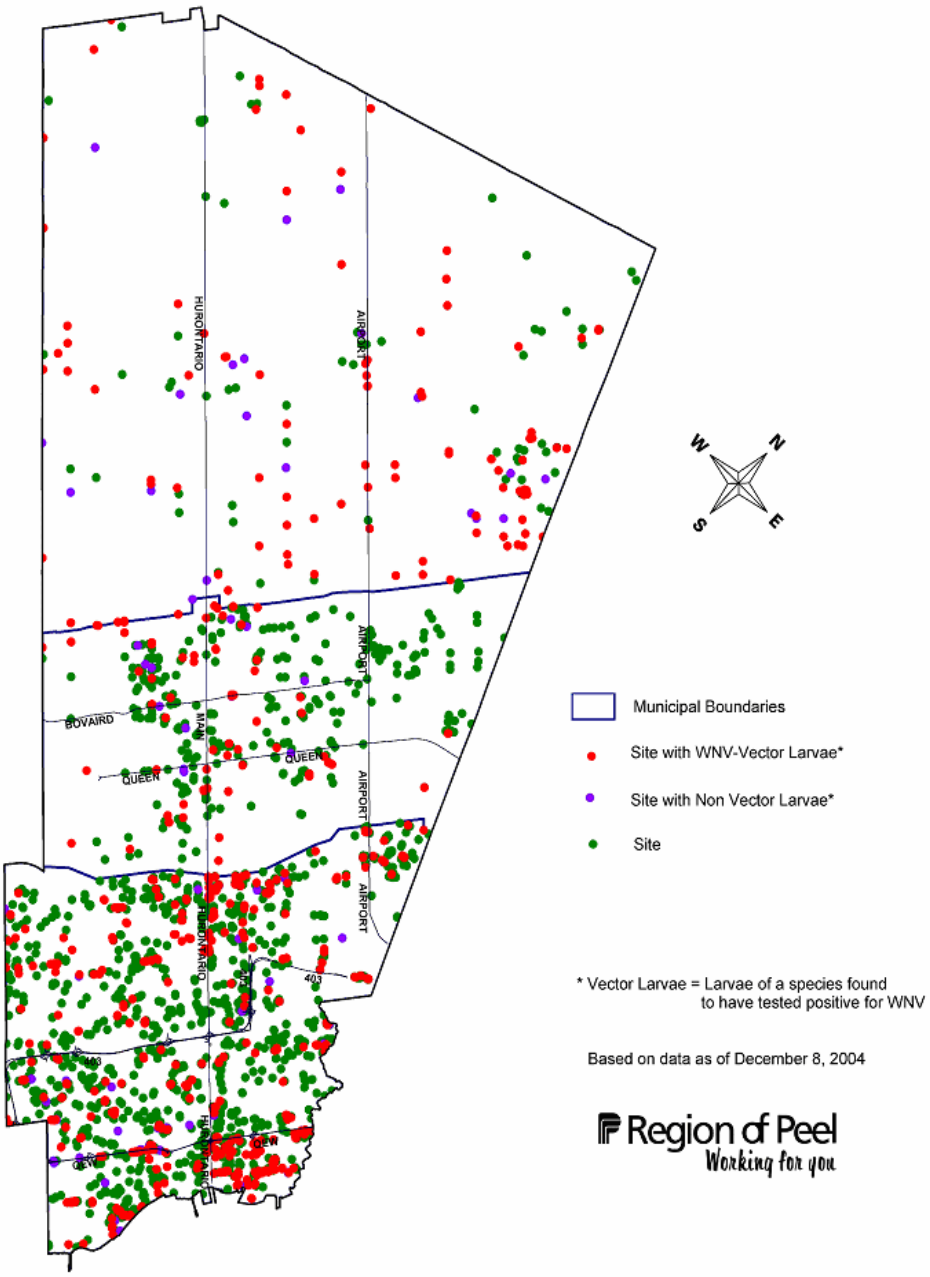
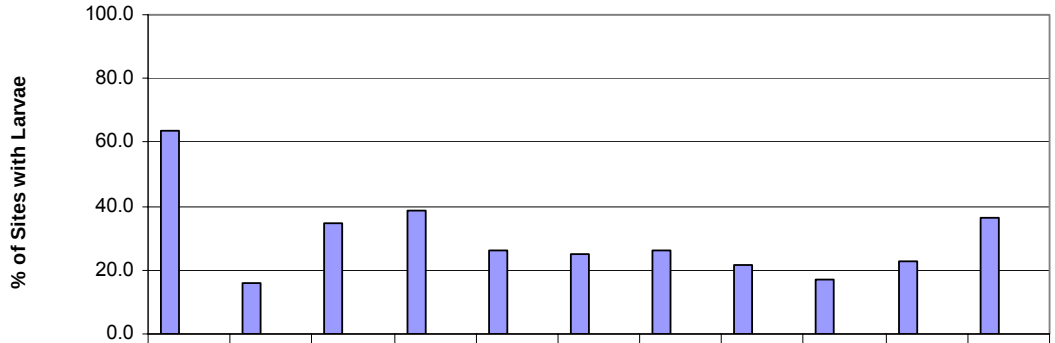


Figure 16 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Mississauga, 2004

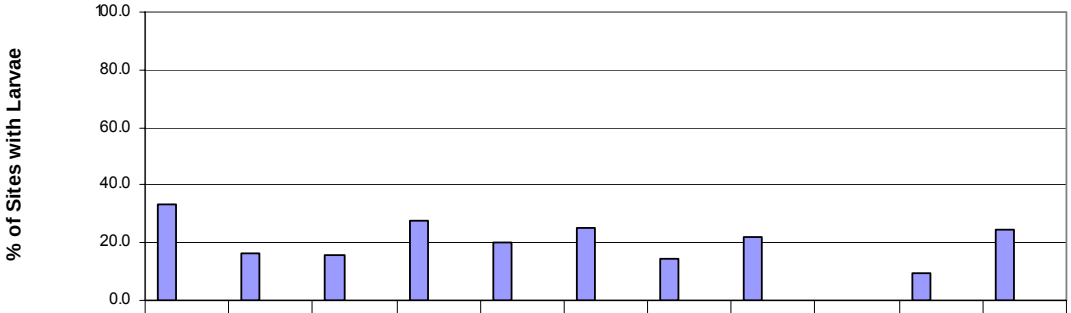


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	63.6	16.0	34.5	38.8	26.3	25.0	26.3	21.6	17.2	22.9	36.3
# Sites With Larvae	14	25	110	173	94	19	5	38	5	8	33
Total Sites	22	156	319	446	357	76	19	176	29	35	91

Site Description

Note: Catch Basins (n=158) are excluded from this chart as they were primarily checked for the presence of standing water and not for the presence of larvae. 'Other' – tree holes, plants, plant leaves and other natural container microhabitats.

Figure 17 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Brampton, 2004

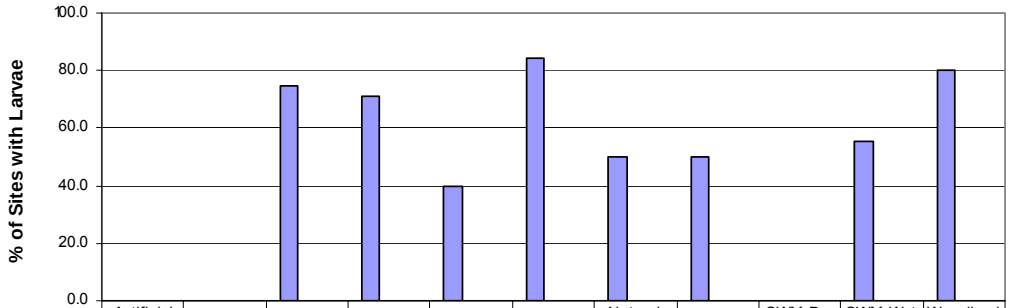


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	33.3	16.7	16.0	27.8	20.0	25.0	14.3	22.2	0.0	9.4	24.4
# Sites With Larvae	1	8	4	35	6	2	3	6	0	5	10
Total Sites	3	48	25	126	30	8	21	27	1	53	41

Site Description

Note: Catch Basins (n=16) are excluded from this chart as they were primarily checked for the presence of standing water and not for the presence of larvae. 'Other' – tree holes, plants, plant leaves and other natural container microhabitats.

Figure 18 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Caledon, 2004

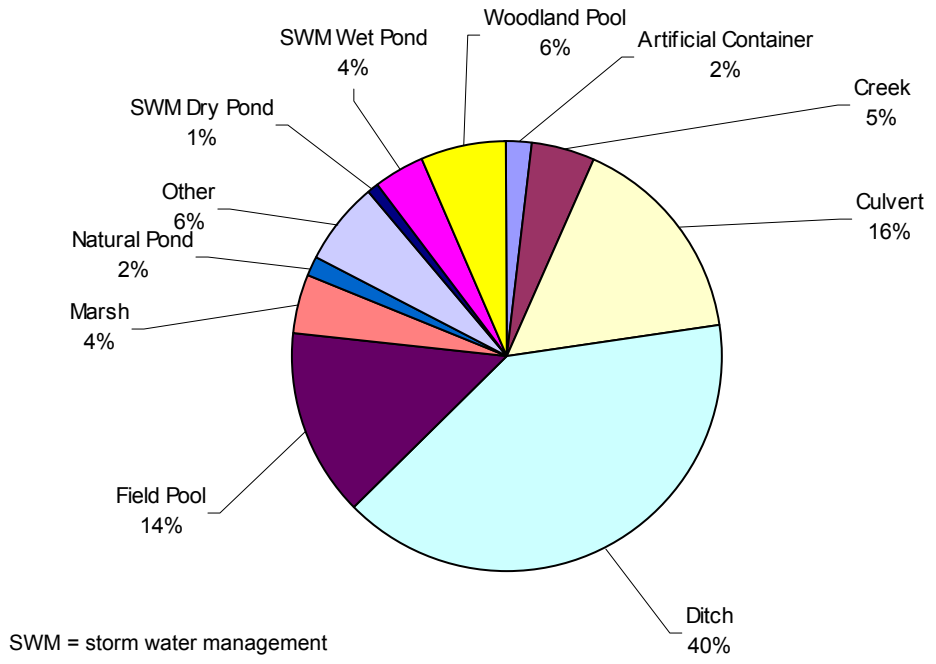


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	0.0	0.0	75.0	70.8	40.0	84.6	50.0	50.0	0.0	55.6	80.0
# Sites With Larvae	0	0	3	80	4	11	3	3	0	15	4
Total Sites	0	2	4	113	10	13	6	6	1	27	5

Site Description

Note: There were no catch basins surveyed in Caledon. 'Other' – tree holes, plants, plant leaves and other natural container microhabitants.

Figure 19 : Types of Sites Found To Contain Mosquito Larvae, Region of Peel, 2004



SWM = storm water management

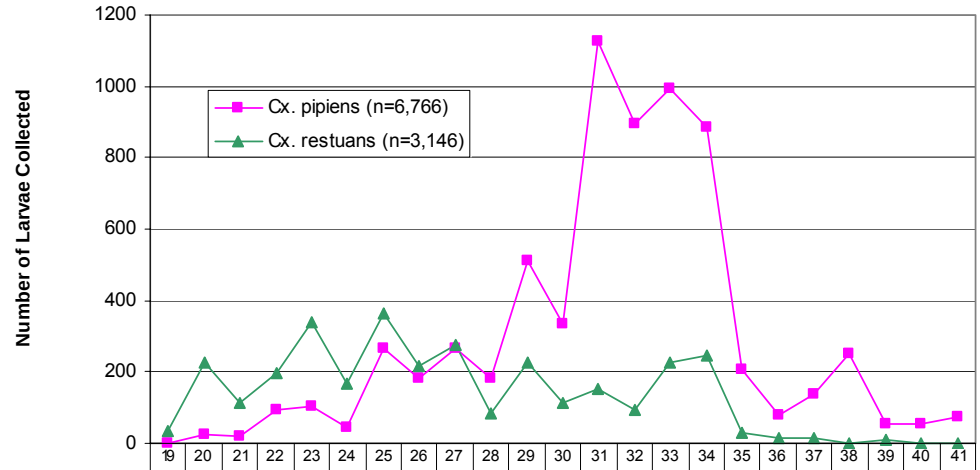
val Mosquito Identification Results

A total of 12,981 mosquito larvae were identified from mid-May to late October. Twenty different species were identified; of those, 76% were of two *Culex* species: *Culex pipiens* accounted for 52% and *Culex restuans* accounted for 24% of the larvae that were identified in 2004.

As in previous years, the *Culex restuans* larvae appeared earlier in the season and was the predominant *Culex* species in May and June (Figure 20). *Culex restuans* larvae numbers peaked in week 25 (June 13 - June 19) the same week as the peak occurred in 2003. However, the peak this year was not as pronounced as in 2003.[2] A crossover occurred in early July when the number of *Culex pipiens* larvae submissions started to exceed the *Culex restuans* submissions. The *Culex pipiens* numbers continued to rise and peaked in week 31 (August 1 - 7), which was one week earlier than the peak noted in 2003. [2] Over the course of the mosquito season, there were about twice as many *Culex pipiens* larvae found as there were *Culex restuans*. In 2003, there were approximately the same numbers of larvae from each of these species identified in Peel. An analysis of more than two years of larval surveillance data will be needed to determine the average ratio of *Culex pipiens* to *Culex restuans* in Peel's surface water sites.

After week 35 (August 29 –September 4), a noticeable decline in the number of larvae that were collected was observed. This can be attributed to the loss of the majority of the seasonal staff who were responsible for larvae collections.

Figure 20: Numbers of *Culex pipiens* and *Culex restuans* Larvae by Week of Collection, Region of Peel, 2004



	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Cx. pipiens (n=6,766)	0	25	21	92	102	42	264	183	267	180	511	334	1124	893	993	884	206	77	136	250	56	52	74
Cx. restuans (n=3,146)	35	228	115	197	338	167	362	216	275	83	228	113	151	92	226	245	30	15	14	2	11	2	1

Includes data from Catch Basins
Cx = Culex

Summary

Larval surveillance has many important functions. It was used to determine the specific aquatic habitats that supported mosquito populations throughout Peel. When specimens were identified and counted, the information was used to determine species composition and vector abundance in an area. The information was also used to project the optimal times to conduct larval reduction measures. In 2004, approximately 2,300 breeding sites were surveyed: 75% in Mississauga, 17% in Brampton and 8% in Caledon. Ditches, culverts, field and woodland pools were the site types where mosquito larvae were most frequently found.

A total of 20 different species were identified from the 12,981 larvae specimens collected. Approximately 76% of those collected were from the *Culex* species: *Culex pipiens* were the most predominant species accounting for 52% and *Culex restuans* accounted for 24% of the mosquito larvae collected and identified.