LARVAL MOSQUITO SURVEILLANCE

Introduction

A mosquito's life cycle includes four stages, three of which often take place in water.[6] Many mosquito species lay their eggs in or near water, where the eggs hatch into larvae and grow into pupae. The pupae become adults, which are able to take flight. In preparation for breeding, females then seek a blood meal from mammal, avian or amphibian sources, depending on their feeding preferences.

Larval surveillance data are integral in planning and implementing an effective mosquito reduction program. Measures can be directed at those habitats likely to support the breeding of mosquito larvae important to WNV transmission within areas populated by humans, including standing water sources, whether natural or man-made.

Surveys of road-side catch basins, ditches, culverts, field pools and other potential mosquito breeding sites conducted in 2001 and 2002 confirmed the presence of mosquito larvae in Peel. In 2001, 77% (20 of 26) of catch basins examined were found to contain mosquito larvae, while in 2002, the presence of mosquito larvae was identified in 42% (118 of 278) of the potential mosquito breeding sites from which samples were taken.

Surveillance of potential breeding sites on publicly-owned lands was enhanced in 2003 in order to determine the presence, volume and type of larvae in surface water at over 2100 sites across the Region of Peel.

Methods

Standing Water Surveillance

Peel Health seasonal field staff surveyed a wide range of aquatic habitats for the presence of mosquitoes in the larval stage from mid-May to late October. Staff identified breeding sites by referencing historical breeding site data collected from 2002, conducting field surveys and by investigating standing water complaints received from Peel residents. In areas where positive dead crows, positive adult mosquito batches or human cases were identified, concentrated breeding site field surveys were conducted.

The larval sampling procedure involved collection of larvae in a standard aquatic dipper. 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.

Catch Basin Study

A study was conducted in late August, 2003 by Peel Health to explore the presence and density of larvae in catch basins in industrial areas and along main roads. This would assist with determining the extent to which larvae were present in these types of catch basins, and the need for future larval control measures. Catch basins situated in residential areas have abundant vegetation and are therefore likely to contain mosquito larvae. This was confirmed by studies conducted in previous years.

A convenience sample of catch basins in industrial areas and on main streets was identified, with 20 catch basins randomly selected from each group for inclusion in the study. Samples were collected from catch basins on selected main streets between August 22 and August 25th, 2003 and in industrial areas on August 27th, 2003.

Larval Mosquito Identification

Larval surveillance also involved the identification of larvae found at the breeding sites. Larvae were collected and sent to an in–house mosquito laboratory for species identification by Peel Health staff. When species could not be distinguished, they were classified as a group (e.g. *Aedes/Ochlerotatus spp*.). These data were used to determine mosquito species distribution, abundance and seasonal occurrence and assisted in guiding larval control measures.

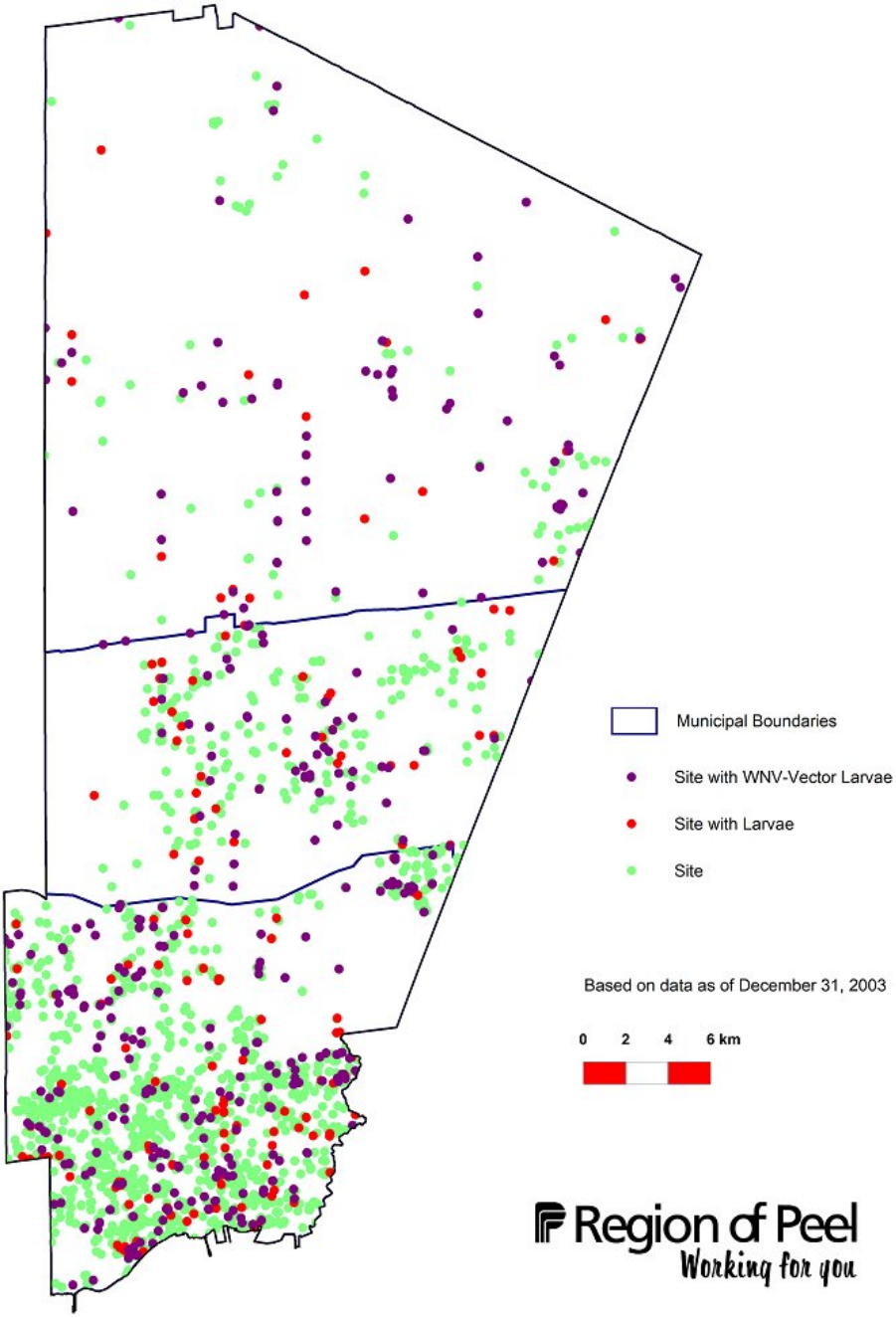
A computer-based geographic information system (GIS) was used to maintain all the larval surveillance information. Maps identified the location of all potential breeding sites in the Region of Peel. The breeding site software program was used to compile and extract the laboratory and field surveillance data. This information was used to determine the type of habitats that supported mosquito populations and the abundance of vector species present in an area.

Results

Standing Water Surveillance

In 2003, over 2,100 potential mosquito breeding sites were surveyed for standing water (Figure 9). Of these, 77% (1,627) were in Mississauga, 15% (304) were in Brampton and 8% (172) were in Caledon. The distribution of these sites was highly influenced by standing water complaints from Peel residents.

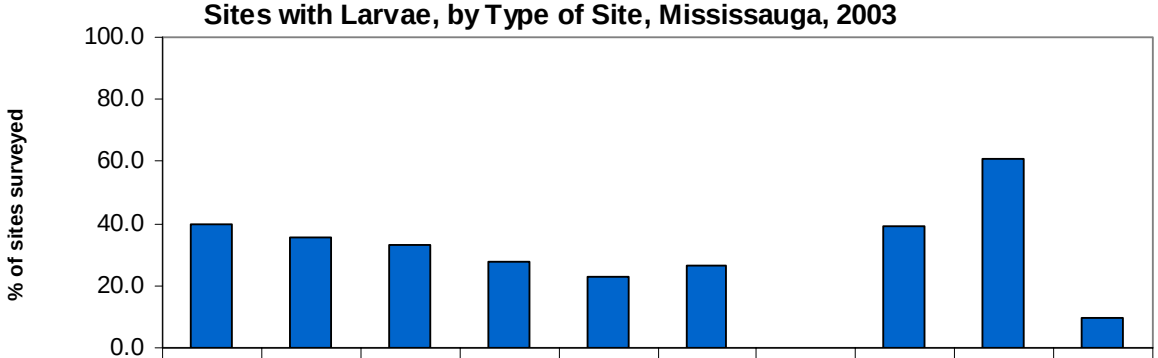
Figure 9: Locations of Mosquito Breeding Sites, Sites with Larvae and Vector Larvae, Region of Peel, 2003



The presence of mosquito larvae was identified in 28% (586 of 2103) of the breeding sites from which samples were taken. However, "vector" larvae (larvae of a species found to have tested positive for WNV) were identified in 17% (362 of 2103) of Peel sites surveyed.

Results by municipality and type of site are shown in Figures 10 through 12. In Mississauga, 25% (402 of 1,627) of sites sampled contained mosquito larvae, but only 14% (234 of 1,627) contained vector larvae. In Brampton, 29% of sites surveyed (89 of 304) were found to have larvae and 17% (53 of 304) contained vector larvae. In Caledon, 55% of sites (95 of 172) contained larvae, while 44% of these (75 of 172) were found to have vector larvae.

Figure 10: Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Mississauga, 2003



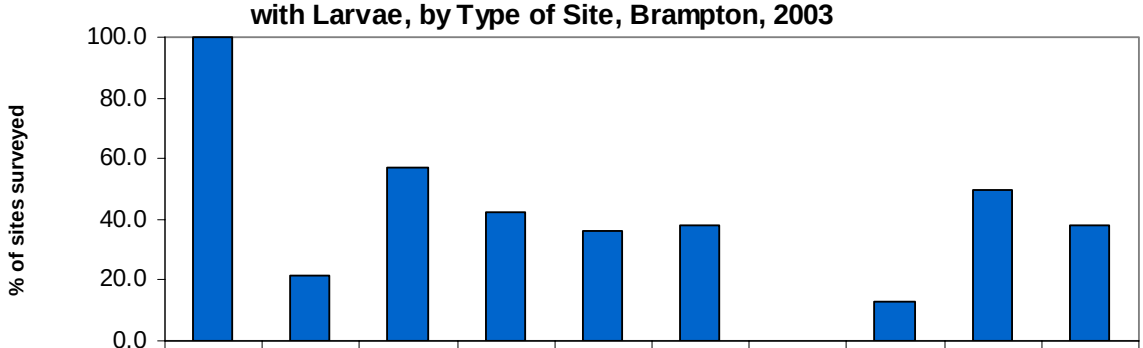
	Artificial Container	Creek/ Floodplain	Culvert	Ditch	Dugout	Field Pool	Marsh	Pond/ Retention	Woodland Pool	Other
%Sites with Larvae	40.0	35.5	33.0	28.0	22.9	26.7	0.0	39.1	60.6	9.4
Sites with Larvae	2	97	34	47	8	48	0	34	60	42
Total Sites	5	273	103	168	35	180	1	87	99	447

site description

Note: Catch basins (n=229) 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.

Among sites that were surveyed in 2003, man-made structures such as ditches and culverts tended to have higher proportions of larvae present than naturally-occurring sites such as lakes, marshes, rivers and woodland pools. In Caledon in 2003, 56% of man-made structures and 52% of natural sites were found to have larvae. In Mississauga, 31% of artificial sites contained larvae, compared to 28% of natural sites. In Brampton, the reverse occurred, with 36% of natural sites having been found to contain larvae, compared to 31% of man-made structures.

Figure 11: Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Brampton, 2003

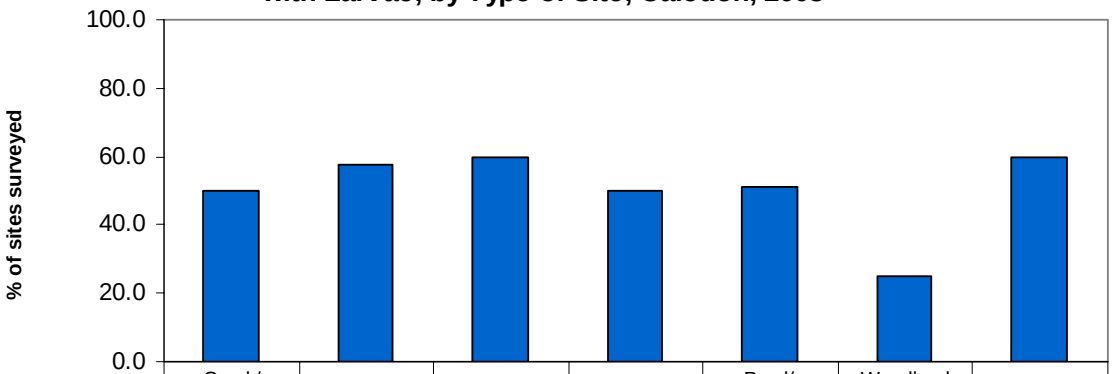


	Artificial Container	Creek/ Floodplain	Culvert	Ditch	Dugout	Field Pool	Marsh	Pond/ Retention	Woodland Pool	Other
%Sites with Larvae	100.0	21.2	57.1	42.6	36.4	37.9	0.0	13.1	50.0	38.1
Sites with Larvae	2	7	4	26	4	11	0	8	17	8
Total Sites	2	33	7	61	11	29	1	61	34	21

site description

Note: Catch basins (n=44) 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 12: Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Caledon, 2003



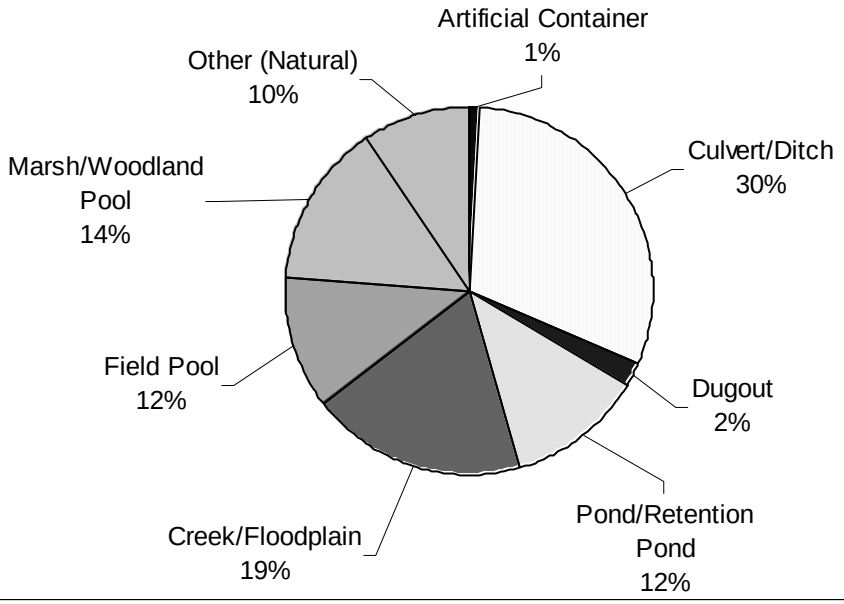
	Creek/ Floodplain	Ditch	Field Pool	Marsh	Pond/ Retention	Woodland Pool	Other
%Sites with Larvae	50.0	57.8	60.0	50.0	51.1	25.0	60.0
Sites with Larvae	1	59	6	2	23	1	3
Total Sites	2	102	10	4	45	4	5

site description

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

Among the sites in Peel containing larvae, ditches and culverts were the most frequent types of sites in which larvae were found (Figure 13).

Figure 13: Types of Sites Found to Contain Mosquito Larvae, Region of Peel, 2003



Note that the larval surveillance data for 2003 are somewhat limited and need to be interpreted with caution. For example, the data do not show relative amounts of larvae or their persistence over time. A site with a few larvae on one occasion cannot be distinguished from a site with many larvae throughout the season.

Catch Basin Study

An investigation of catch basins in industrial areas and on main streets was undertaken, where a total of 20 catch basins were randomly selected from each group to explore the presence and density of larvae. Larvae were observed in 50% of the industrial-area catch basins compared to 60% of those on main roads (Figure 14). Higher densities of larvae were observed in catch basins of the industrial areas (30%) than for main roads (10%). Similarly, lower densities of larvae were observed in catch basins around main roads (35%) than in industrial areas (10%).

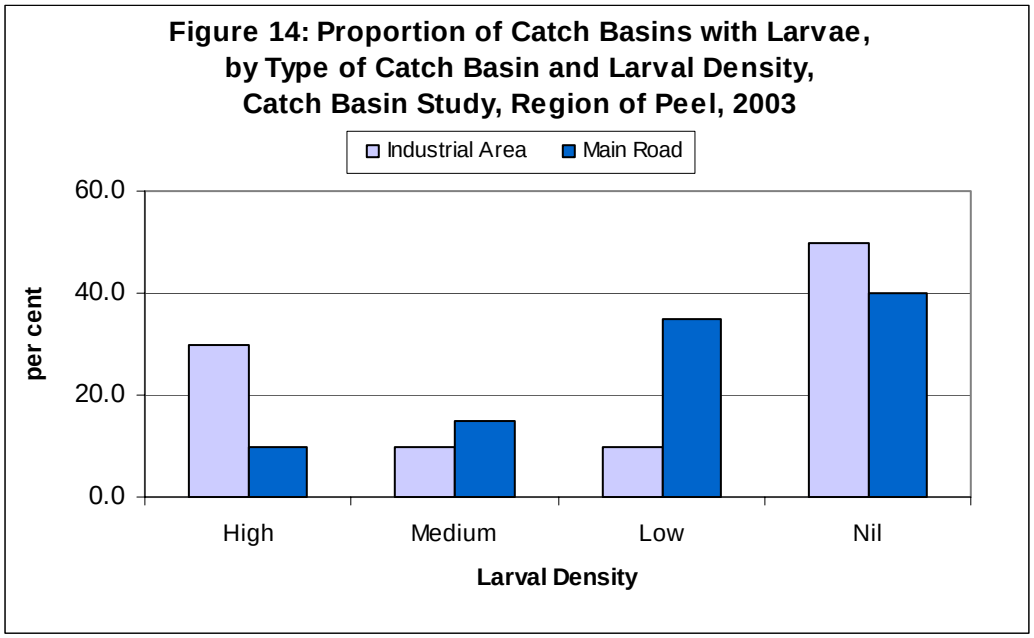


Figure 14: Proportion of Catch Basins with Larvae, by Type of Catch Basin and Larval Density, Catch Basin Study, Region of Peel, 2003

Larval Mosquito Identification

The identification of larval species found at breeding sites took place at an in–house mosquito laboratory. While counts of larvae were dependent on the number and frequency of dips taken, the collected specimens were completely random and would likely be generalizable across the Region.

Table 6 shows the results of the larvae identification process for the period May to October, 2003. Nineteen different species or groups of mosquito larvae were identified from the 3,942 specimens collected. Over 80% of those collected were of two *Culex* species: *Culex restuans* accounted for 42% and *Culex pipiens* accounted for 41% of all larvae collected and able to be identified.

An analysis of these two species by date of collection was conducted to determine when the density of these larvae were at their highest, and whether any differences were seen over the course of the mosquito season (Figure 15). One would expect to find that the abundance of mosquito larvae might increase with increasing generations of adult female mosquitoes.

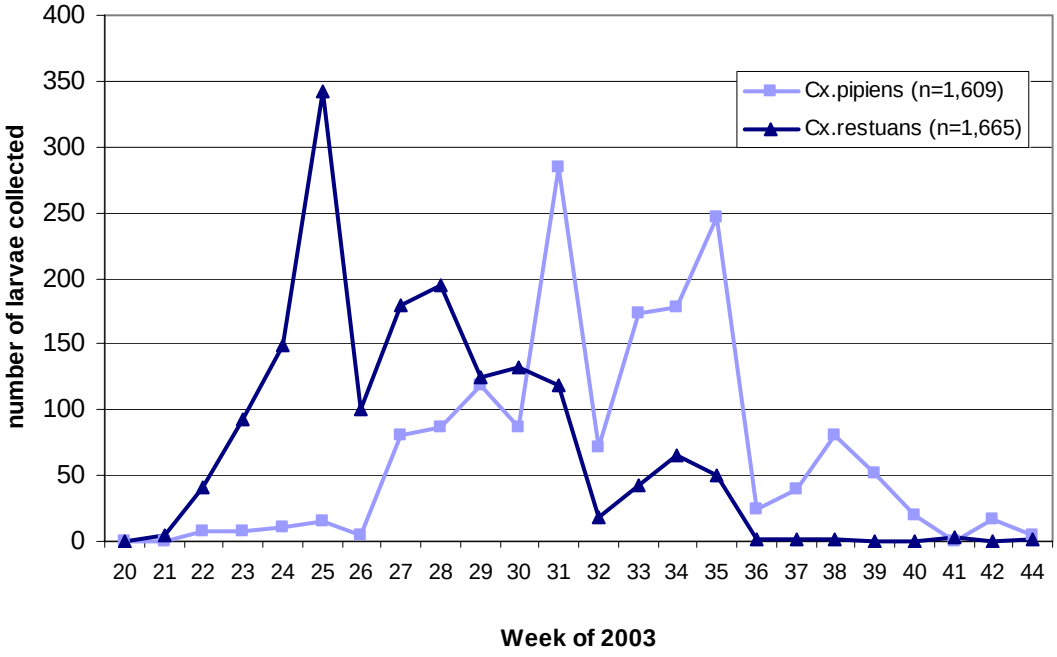
As expected, *Culex restuans* larvae appeared earlier in the mosquito season, and peaked around Week 25 (June 15 to June 21), whereas *Culex pipiens* larvae did not reach their highest numbers until Week 31 (July 27 to August 2). While several peaks can be observed for both species, as the season progressed, there was attenuation in the height of the peaks, possibly meaning that fewer of these species were collected.

After Week 35 (August 24 to 30), the numbers of larvae collected dropped dramatically, likely as a result of the loss of seasonal field staff who had done the majority of sample collections over the summer months.

Table 6: Mosquito Larvae Identification, Region of Peel, 2003

Mosquito Species/Group	Number	Per cent
Culex restuans	1665	42.2
Culex pipiens	1609	40.8
Aedes vexans	198	5.0
Culex territans	185	4.7
Ochlerotatus dorsalis	170	4.3
Anopheles punctipennis	65	1.6
Aedes/Ochlerotatus spp.	12	0.3
Aedes cinereus	9	0.2
Ochlerotatus canadensis	9	0.2
Anopheles quadrimaculatus	4	0.1
Culiseta inornata	3	0.1
Ochlerotatus excrucians	3	0.1
Ochlerotatus triseriatus	3	0.1
Anopheles earlei	2	0.1
Ochlerotatus fitchii	1	0.0
Ochlerotatus hendersoni	1	0.0
Ochlerotatus stimulans	1	0.0
Ochlerotatus trivittatus	1	0.0
Ochlerotatus euedes	1	0.0
Total	3942	100.0

Figure 15: Numbers of *Culex pipiens* and *Culex restuans* Larvae by Week of Collection, Region of Peel, 2003



Summary

Larval surveillance provides crucial information for mosquito reduction interventions. Potential breeding sites were identified on the basis of complaints from Peel residents, by referencing historical breeding site data collected from 2002 and by conducting field surveys for suitable habitats. In 2003, over 2,100 sites were surveyed for standing water in Peel: 77% were in Mississauga, 15% in Brampton and 8% in Caledon. The presence of mosquito larvae was identified in 28% of the potential breeding sites from which samples were taken, while "vector" larvae were identified in 17%. Ditches and culverts were some of the more numerous breeding sites and often contained mosquito larvae.

Between May and October 2003, a total of 19 different species or groups of mosquito larvae were identified from 3,942 specimens collected at breeding sites. Over 80% of those collected belonged to two *Culex* species: *Culex restuans* accounted for 42% and *Culex pipiens* accounted for 41% of all mosquito larvae that were collected and identified.