gdg Canada

Driving Ecological Solutions
for a Better Living

FINAL REPORT - 2019

Biological control of biting insects

PRESENTED TO:

GEORGINA

STATEMENT OF CONFIDENTIALITY

Our final report includes information that shall not be disclosed, duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate this final report. The Town of Georgina shall have the right to duplicate, use, or disclose the data to the extent required for inclusion in the resultant contract, (upon consultation with G.D.G. Environment) and in accordance with the Freedom of Information Act.

Insofar as certain information must be made public as an attachment to a contract, a supplement will be prepared, identifying the main key elements of goods and any related products used and/or services executed in accordance with our contract with the Town of Georgina.

In accordance with this legislation, we are requesting the identification of all such parties requesting such information in advance of any disclosure.

Benjamin Russell.
Operation Director
Date: August, 2019

Mark Ardis B.Sc. H. Wildlife Bio - Geo
Scientific Advisor
Date: August, 2019

Table of Contents

List of Tables

List of Figures

Abbreviations

Bsph	Bacillus sphaericus
Bti	Bacillus thuringiensis israelensis
EEE	Eastern Equine Encephalitis
ESA	Environmentally Sensitive Area
GDG	G.D.G. Environnement
GDGC	G.D.G. Canada
GIS	Geographic Information Systems
GPS	Global Positioning System
IPM	Integrated Pest Management
IT	Information Technology
MOECC	Ministry of Environment and Climate Change
NMCP	Nuisance Mosquito Control Program

RT-PCR ..... Reverse Transcriptase-Polymerase Chain Reaction

WNV ..... West Nile virus

1. INTRODUCTION

The quality of life for residents of Pefferlaw has been impacted by significant populations of “nuisance” mosquitoes. The catchment basin of the Pefferlaw area is part of the Lake Simcoe watershed system, and is drained by the Pefferlaw River which runs from south to north. Important mosquito development sites are situated within the Pefferlaw River flood plain. The high water table and the flat topography creates a haven for mosquito reproduction and favour the creation of large mosquito development sites, many of which remain flooded throughout the season. For this reason, GDG Environment was contracted by the Town of Georgina to control spring mosquito larvae through the application of a biological larvicide in the communities of Pefferlaw, Port Bolster and Udora since 2016. The surface area of the treatment zone is approximately 3908 hectares. The work and treatment was executed by GDG Canada which is a full subsidiary of GDG Environment.

The biological larvicide (*Bacillus thuringiensis israelensis* - Bti.*)* application was intended to control the spring mosquito larvae identified following snow melt. The applications of Bti were carried out by helicopter and by ground equipment.

Mosquitoes establish their larval development sites in environments containing stagnant waters, such as wetlands, marshes, bogs, flood plains, poorly drained forests, ditches, etc. Certain species prefer temporary environments (rainfall dependent) while others prefer permanent sites (remaining throughout the seasons). Some species have many generations per season (multivoltine) while others have only one generation (univoltine). In addition, of the approximately 30 species found in the area, some are a nuisance to the residents, some are only targeting specific animal species (amphibian, birds, etc). Because of these factors it is essential to analyze the mosquito species composition of the area as well as categorize the different habitat types to aim the right species that cause nuisance for humans.

This report will outline the operational activities and analysis of mosquito surveillance during the 2019 spring program.

1.1 GEORGINA PROJECT HISTORY

In 2006 and 2007, a two-year study was led by GDG for mosquito population and species identification including larval and adult mosquito surveillance and breeding site mapping in and around the Pefferlaw community of Georgina. The objective of this study was to identify the realistic requirements of a program which will have a real and noticeable impact on the quality of life for the residents and visitors while maintaining the ecological integrity of the area. Larval sampling has provided insight into the spatial and temporal distribution of nuisance mosquito breeding sites.

The entomology study conducted by GDG Environment in Pefferlaw determined that the major cause of nuisance stemmed from the species *Ochlerotatus (Oc.) stimulans, Oc. canadensis, Oc. abseratus-punctipenis*, and *Oc. provocans*. These species are part of the spring *Ochlerotatus* group. They have one generation per season, their eggs will hatch in temporary standing water caused by spring snow melt or where the Pefferlaw River overflows its banks. The eggs will only hatch in the spring as they must go through a dry period followed by a freezing period before hatching. Hatching is triggered by immersion in water followed by a drop in dissolved oxygen levels. Once eggs have hatched, larvae will emerge. Other species harmful to humans hatch later from the end of May (summer species) such as *Aedes vexans* and *Coquillettidia perturbans. Aedes vexans* will have many generations during summer directly dependent on rain accumulation.

In 2008, the Town of Georgina put into place a biological mosquito control program using the larvicide *Bacillus thuringiensis israelensis* (Bti*)*. In 2008, 2016, 2017, 2018 and 2019 GDG has led the program. The goal of a biological control program is to dramatically reduce the numbers of spring mosquito species emerging from development sites without otherwise impacting the surrounding flora or fauna, through a onetime spring treatment application.

The key to a successful program is monitoring larvae breading sites, monitoring larval development stages and sequencing the treatments based on the larval surveillance data results. The biological larvicide (Bti) application is carried out by helicopter and by ground teams.

2. THE BTI PRODUCTS USED AND PERMITS

2.1 BTI QUALITIES

To control mosquitoes, GDG uses a biological insecticide called *Bacillus thuringiensis israelensis* (Bti). This bacteria is unique in that it is toxic only to the larval stages of dipteran insects such as mosquitoes and black flies. It has no impact on other types of insects, amphibians, fish or wildlife. The active ingredient in Bti is a small diamond shaped protein crystal that is produced by the fermentation of the bacterium. This bacterium occurs naturally in the soil and is not the result of genetic manipulation.

Mosquito larvae are known as filter feeders, and when the larvae filter water to find food, the Bti is ingested. These crystal shaped proteins become toxic only when the Bti enters the insect's gut. At this point, the Bti crystals react in the high pH level of the gut and the gut wall is perforated. The contents of the gut spills into the body cavity and death occurs rapidly, usually within a few hours.

The Bti formulations used in our biological control programs are manufactured by Valent BioSciences. It comes in two forms; a water based liquid and a granular product that uses corn cob granules as a carrier. The liquid VectoBac® formulation is used to control mosquito larvae in many circumstances and it can also be used to control black flies when it is applied in running water where the larvae develop. The granular formulation of VectoBac® is applied to standing water; it floats for a short while, releasing the Bti product dose to the mosquito larvae which feed near the surface.

Part of the applications are made from the ground with trained and licensed field technicians equipped with backpack sprayers. Larger areas or harder to reach sites are more efficiently treated by our aerial support team. VectoBac® formulations may be applied several times during the spring and summer to

control successive generations and species of mosquitoes as they emerge at various periods throughout the year, from early spring until first frost.

Over the years VectoBac® has proven to be a quality product that provides consistent cost-effective results; it is the biological insecticide now used throughout the world to control the mosquito species that can carry harmful and debilitating diseases such as West Nile Virus, Encephalitis, Chikungunya, Dengue Fever and more recently Zika virus. In fact, VectoBac® formulation was the first microbial larvicide to be recognized and approved by the World Health Organization and throughout North America, many public health agencies rely upon VectoBac® Bti to control mosquitoes that can transmit the West Nile Virus.

Here in Canada, residents of the many communities that conduct mosquito control programs can now fully enjoy the outdoors and experience a better quality of life.

2.2 PERMITS

Permits and land authorizations to treat are required before any larvicide applications are conducted. GDG must request permits from the Ministry of the Environment and Climate Change (MOECC) for ground/aerial application and authorization from Transport Canada to fly over the treatment area.

Table 2.1 MOECC Permit conditions for ground application.

Permit number	Pesticide Product Name	PCP No.	Amount and rate allowed under permit	Total area allowed under permit (ha)
544-BBAFCT	Vectobac 1200L	21062	1,200 L at maximum 1 L/ha	672

Table 2.2 MOECC Permit conditions for aerial application.

Permit number	Pesticide Product Name	PCP No.	Amount and rate allowed under permit
8642-BBAF93	Vectobac 200G	18158	8300 kg at maximum 6 kg/ha

As requested by the MOECC, all residents of the treatment area were notified at least a month in advance (December 2018) by the Town of Georgina through an information/objection letter. Public notifications were also published in the local newspaper, the *Georgina Advocate* (see Appendix 1).

3. MOSQUITO CONTROL PROGRAM 2019

3.1 WEATHER

GDG compiled weather data to better track mosquito development trends in Georgina. Mosquito population size and species composition has been shown to be influenced by weather conditions such as rainfall and temperature. Based on our analysis of the weather data from the weather station, the 2019 season (April to May) can be summarized in the Tables 3.1; 3.2; 3.3, 3.4 and 3.5:

Table 3.1 Daily total precipitation in Georgina for April 2019.

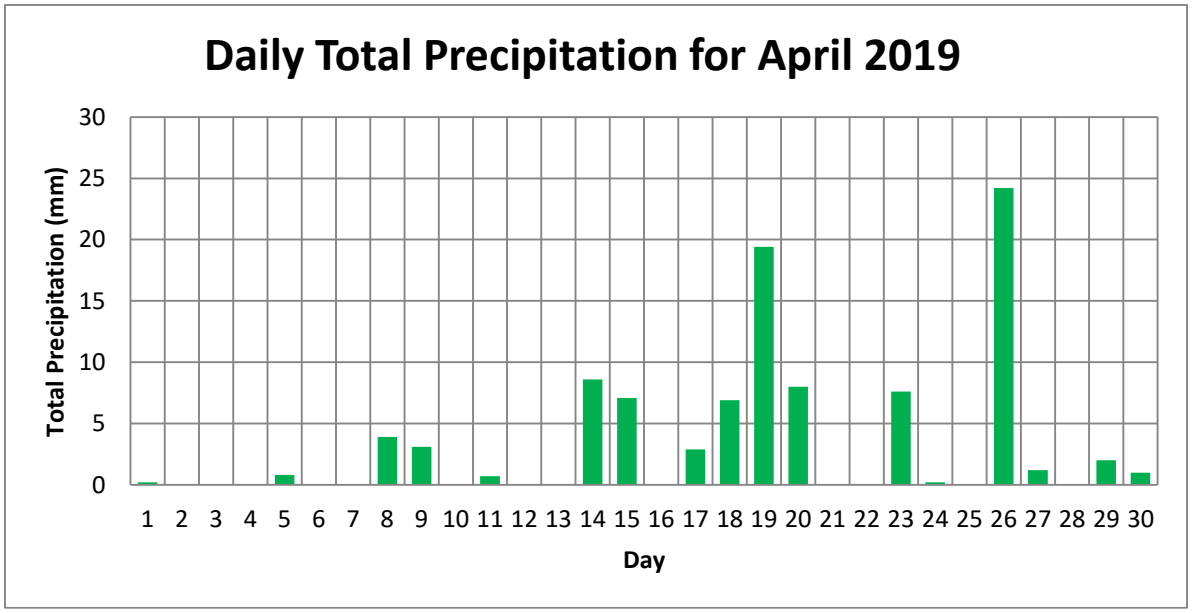


Table 3.2 Daily mean temperature in Georgina for April 2019.

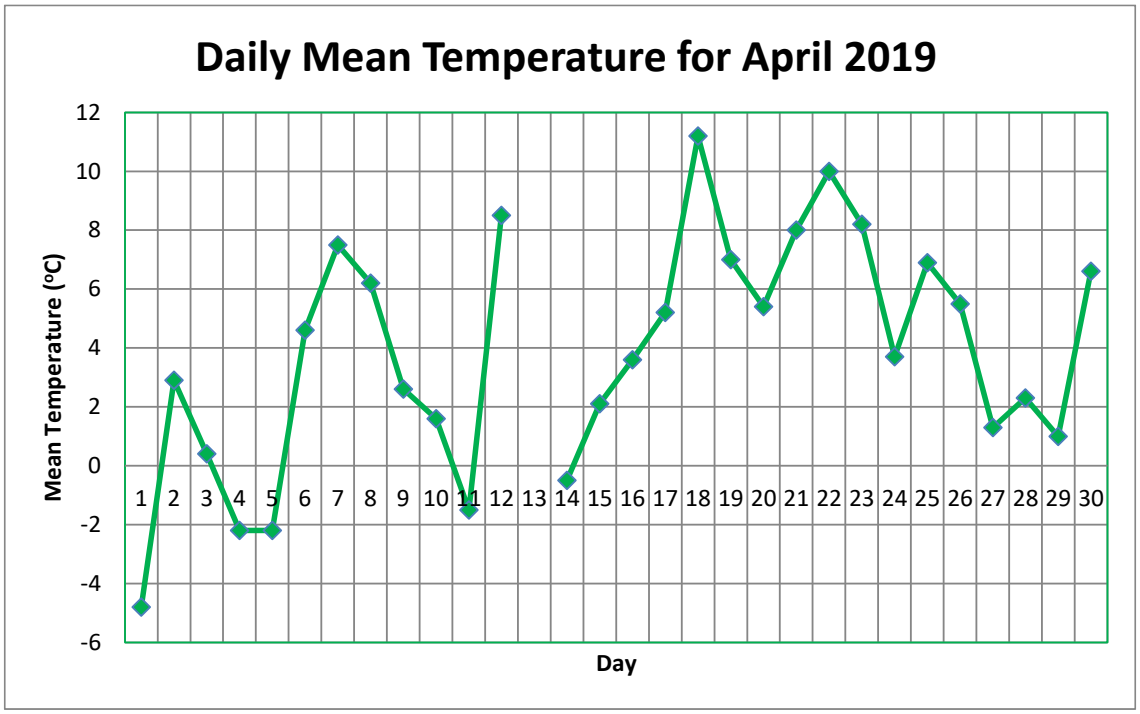


Table 3.3 Daily Snow accumulation in Georgina for April 2019.

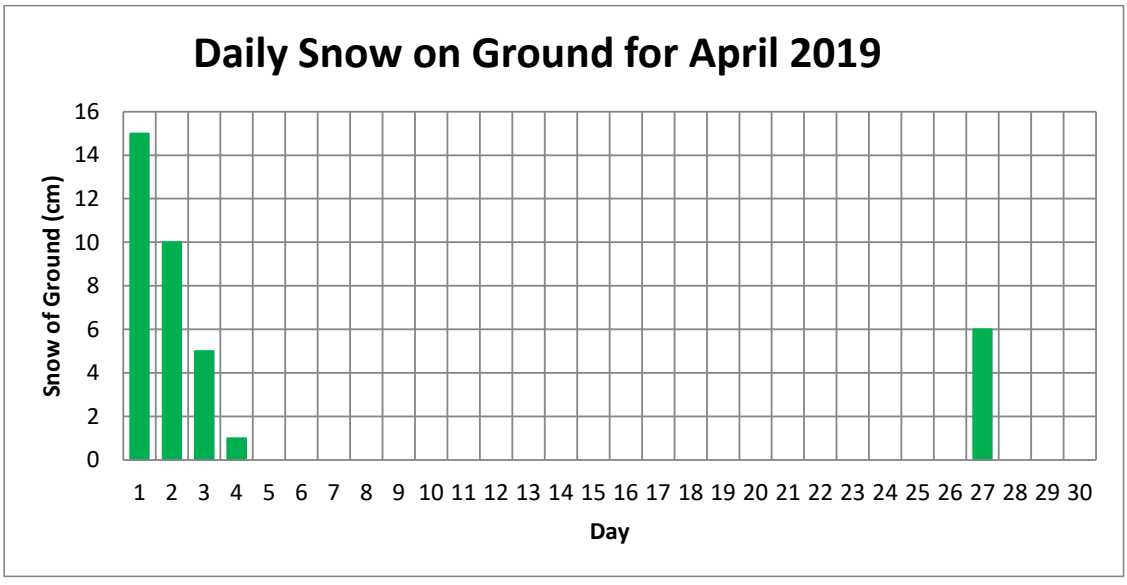


Table 3.2 shows that the month of April was pretty typical for larvae development with temperatures above zero for the majority of the month. We had some snowfall events at the start of April, but nothing out of the ordinary. Precipitations amounts were fairly normal for the month of April.

Table 3.4 Daily total precipitation in Georgina for May 2019.

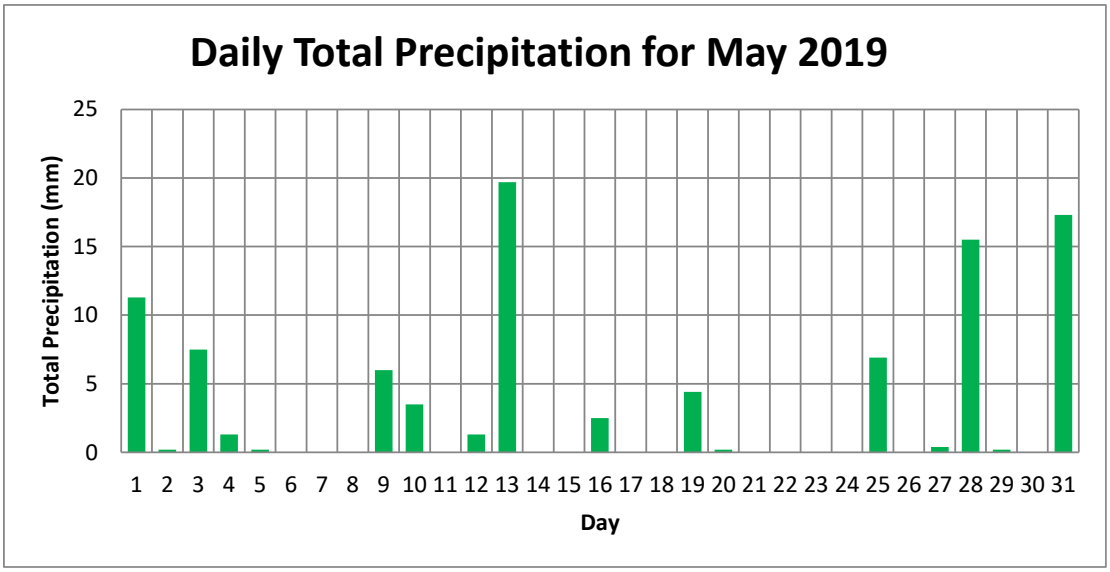
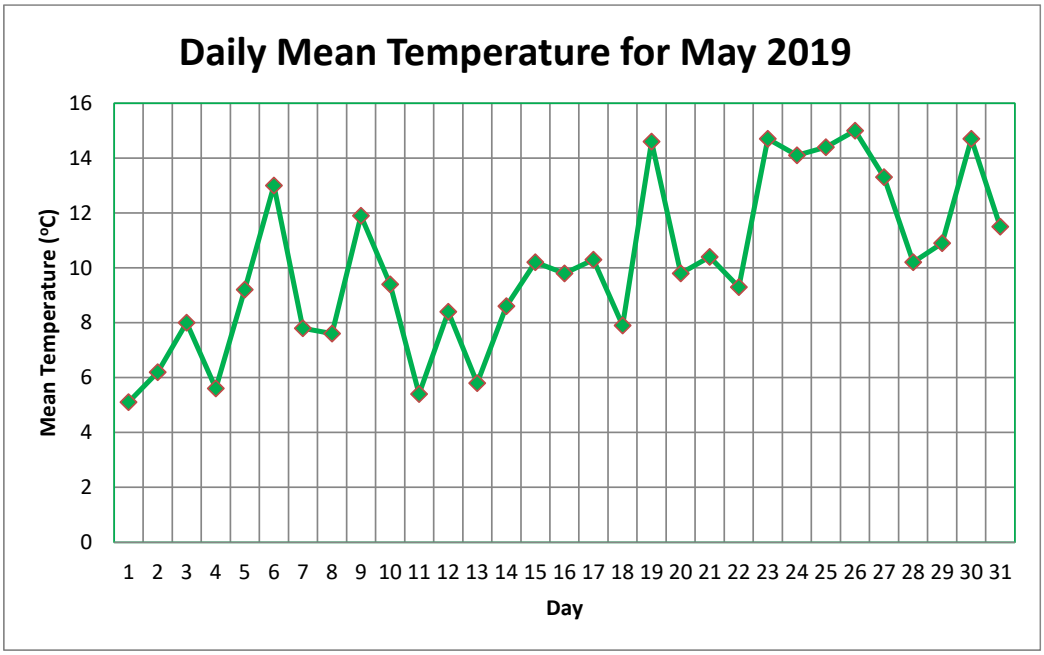


Table 3.5 Daily mean temperature in Georgina for May 2019.



As shown in table 3.4, very little precipitation was received in the month of May. Precipitation received early in the season do not affect our treatment as the sites under treatment are already wet. Warmer temperatures in early May contributed to egg hatching in colder, more shaded areas (Table 3.5).

3.2 SURVEILLANCE, MONITORING AND TREATMENT TIMELINE

The first pre-treatment monitoring was completed on April 10th. The pre-orientation meeting was held on the same day. During the first monitoring, there was still a bit of snow in the woods and the temperatures were still quite cool. Even with the cooler temperatures, at this moment hatching had already started, larvae were found in low densities, all were in 1st instar stages, indicating the start of egg hatch. Water temperatures ranged from 0 to 8°C.

The project coordinator arrived in Pefferlaw on April 17th. At this time, none of the breeding sites were ready for treatment.

Figure 3.1 Pefferlaw power line on April 3rd

The complete team arrived on April 22nd. There were seven (7) GDG staff on site for most of the mandate, including one (1) director, one (1) coordinator and five (5) ground technicians. The team stayed in Pefferlaw and was available at all times.

On April 18th, the treatment area was monitored. At this time, hot spots were found in open areas where we found a majority of 2nd instar and few 3rd instar larvae. The first small sites were treated by the coordinator on April 20th. The general treatment started on April 24th. In the colder areas, 1st instar larvae were still found indicating hatching was still ongoing. Monitoring, treatment and post-monitoring continued until every sites in the protection zone were treated and verified.

3.3 TREATMENT

Treatments took place when the majority of larvae were in their 3rd instar. Our technicians also ensured that the spring larval egg hatch was complete before starting the treatment. The larvicide application is intended to improve the quality of life for local residents by reducing the number of mosquitoes in the treatment area, by controlling the spring mosquito larvae identified following snow melt. This is accomplished through a well-timed application of VectoBac Bti by air, using helicopters and by ground, using backpack style sprayers. A single application is usually sufficient to achieve 100% mortality of the spring mosquito larvae in most of the treatment areas, with some small areas requiring a follow up treatment to achieve 100% larval mortality. Mosquito breeding sites were treated on public lands and, as needed, on private properties participating in the program.

3.3.1 Ground and aerial treatment

Two formulations (liquid and granular) of the biological larvicide *Bacillus thuringiensis var. israelensis* (Bti) were used: VectoBac 1200L and VectoBac 200G from Valent BioSciences Corporation. The liquid formulation was used exclusively by the ground team while the helicopter applied the granular formulation of Bti. The areas that have been treated by air and ground are differentiated in Figure 3.3.

Ground applications were performed in sites smaller than 5 ha, and sites close to environmentally protected areas. A total of seven (7) ground technicians treated all around Pefferlaw, Port Bolster and Udora. The ground treatment started on April 20th and ended on May 3rd. The technicians treated 135.7 hectares of surface water at an average rate of 0.75 liters of VectoBac 1200L per hectare for a total of 101.8 liters (table 3.6).

Figure 3.2 Ground technician treating in cedar forest in Pefferlaw.

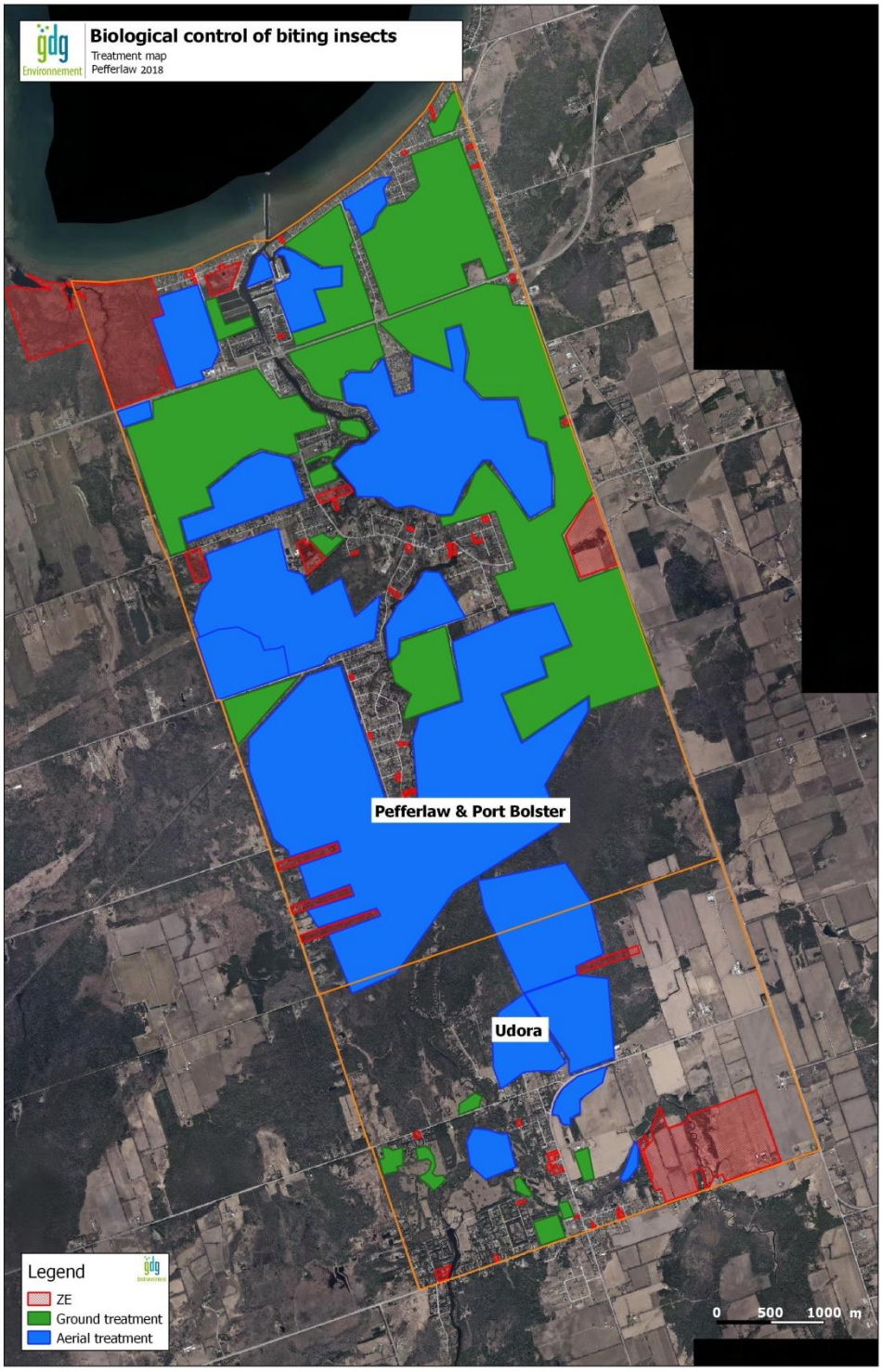


Figure 3.3 Map of areas treated with Bti for the control of nuisance mosquitoes.

Table 3.6 Quantity of Bti used and surface covers by aerial and ground treatments

Mosquito treatment	Date	VectoBac 1200L (l)	VectoBac 200G (kg)	Surface (ha)
Ground	April 18th to May 3rd	101.8	-	135.7
Aerial	May 2nd to May 3rd	-	5,212.8	941.14

Aerial applications were performed in mosquito breeding sites greater than 5 ha or in areas with limited ground access. The granular form of Bti (Vectobac 200G) is used in densely vegetated areas where the granules will penetrate vegetation and land in the water. The application rate is between 5 to 6 kg/ha. The helicopter (Table 4.2) flew from May 2nd to May 3rd. The aircraft treated 941.14 hectares at an average rate of 5.5 kilograms (kg) of VectoBac 200G per hectare for a total of 5,212.8 kg (table 3.6).

Figure 3.4 GDG Aviation – Bell helicopter equipped with Simplex spreading system used in Georgina

4. RESULTS

Surveillance was conducted by monitoring both larval and adult mosquito stages. Post-treatment larval surveillance provided information on the efficacy of the larvicides whereas adult mosquito surveillance provides information on the location of development sites to always better target the treatments and to improve the program over the following years. Nuisance sweep net tests were performed and adult mosquito light traps were installed to monitor the geographic and temporal distribution of adult mosquitoes as well as their species composition.

4.1 POST-TREATMENT LARVAL SURVEILLANCE

A post-treatment monitoring was completed in every treated site 24 hours after the treatments. Results of the monitoring showed 100% efficacy of larval mortality after 24 hours. However, in a few places touch-up treatments were completed, if needed.

Table 4.1 illustrates the ground application larval monitoring results and Table 4.2 illustrates the aerial application larval monitoring results. Both tables illustrate the post-treatment monitoring as well.

The data is presented by Center for Disease Control (CDC) week. This is a standard used in mosquito control programs. CDC week 16 is April 14th to April 20th.

The monitoring results are displayed as Site Rate. A Site Rate is determined by number of larvae collected in 10 dips. The rate is assigned as follows:

- Nil, 0 mosquito larva
- Low, 1 to 6 mosquito larvae
- Moderate, 7 to 30 mosquito larvae
- High, greater than 30 mosquito larvae

Table 4.1 Ground application - Pre and Post-treatment monitoring results for sites treated.

Treatment CDC Week	Habitat	Site ID	Pre monitoring date	Site rate	Site rate	Product	Treatment date	Qty Product	Surface (ha)	Rate (ml/ha)	Post monitoring date	Site rate
16	Natural Site	SU08A	2019-04-18			Vectobac 1200L	2019-04-20	1.5	2	.75	2019-04-22	NIL
17	Natural Site	RV10A	2019-04-21			Vectobac 1200L	2019-04-24	6.84	9.12	.75	2019-04-28	NIL
17	Natural Site	RV16A	2019-04-22			Vectobac 1200L	2019-04-24	0.62	0.83	.75	2019-05-04	NIL
17	Natural Site	RW02A	2019-04-23			Vectobac 1200L	2019-04-24	0.06	0.08	.75	2019-05-04	NIL
17	Natural Site	SV13A	2019-04-20			Vectobac 1200L	2019-04-24	1.64	2.19	.75	2019-04-29	NIL
17	Natural Site	TV23A	2019-04-21			Vectobac 1200L	2019-04-24	0.86	1.15	.75	2019-05-01	NIL
17	Natural Site	SV17A	2019-04-18			Vectobac 1200L	2019-04-24	0.81	1.08	.75	2019-04-28	NIL
17	Natural Site	RW10A	2019-04-23			Vectobac 1200L	2019-04-24	2.96	3.95	.75	2019-04-26	NIL
17	Natural Site	RU02A	2019-04-21			Vectobac 1200L	2019-04-25	0.47	0.63	.75	2019-04-28	NIL
17	Natural Site	RU02A	2019-04-21			Vectobac 1200L	2019-04-25	2.98	3.97	.75	2019-04-28	NIL
17	Natural Site	SW04A	2019-04-23			Vectobac 1200L	2019-04-25	2.73	3.64	.75	2019-05-01	NIL
17	Natural Site	SW04A	2019-04-23			Vectobac 1200L	2019-04-25	5.02	6.69	.75	2019-05-01	NIL
17	Natural Site	TV24b	2019-04-24			Vectobac 1200L	2019-04-25	0.1	0.13	.75	2019-05-04	NIL
17	Natural Site	TV01A	2019-04-18			Vectobac 1200L	2019-04-26	0.53	0.71	.75	2019-04-29	NIL
17	Natural Site	UV01	2019-04-25			Vectobac 1200L	2019-04-26	0.57	0.76	.75	2019-04-29	NIL
17	Natural Site	TV01A	2019-04-18			Vectobac 1200L	2019-04-26	0.5	0.67	.75	2019-04-29	NIL
17	Natural Site	UV01	2019-04-25			Vectobac 1200L	2019-04-26	0.6	0.8	.75	2019-04-29	NIL
17	Natural Site	TV25b	2019-04-18			Vectobac 1200L	2019-04-26	0.06	0.08	.75	2019-04-29	NIL
17	Natural Site	PW01A	2019-04-25			Vectobac 1200L	2019-04-26	1.32	1.76	.75	2019-04-30	NIL
17	Natural Site	TV01b	2019-04-18			Vectobac 1200L	2019-04-26	0.08	0.11	.75	2019-04-29	NIL
17	Natural Site	PW05A	2019-04-24			Vectobac 1200L	2019-04-26	1.08	1.44	.75	2019-04-30	NIL
17	Natural Site	UV02A	2019-04-24			Vectobac 1200L	2019-04-26	1.2	1.6	.75	2019-04-29	NIL
17	Natural Site	UV02A	2019-04-24			Vectobac 1200L	2019-04-26	1.27	1.69	.75	2019-04-29	NIL
17	Natural Site	RW05A	2019-04-23			Vectobac 1200L	2019-04-27	0.28	0.37	.75	2019-05-05	NIL
17	Natural Site	SU04A	2019-04-25			Vectobac 1200L	2019-04-27	4.4	5.87	.75	2019-05-04	NIL
17	Natural Site	TV21A	2019-04-20			Vectobac 1200L	2019-04-27	1.62	2.16	.75	2019-05-01	NIL
17	Natural Site	RW03A	2019-04-23			Vectobac 1200L	2019-04-27	1.6	2.13	.75	2019-05-05	NIL
18	Natural Site	SV04	2019-04-20			Vectobac 1200L	2019-04-28	0.02	0.03	.75	2019-04-30	NIL
18	Natural Site	TV12A	2019-04-27			Vectobac 1200L	2019-04-28	7.2	9.6	.75	2019-05-04	NIL
18	Natural Site	TV21A	2019-04-20			Vectobac 1200L	2019-04-28	0.76	1.01	.75	2019-05-01	NIL
18	Natural Site	TV28	2019-04-20			Vectobac 1200L	2019-04-28	0.58	0.77	.75	2019-04-30	NIL
18	Natural Site	SW03A	2019-04-23			Vectobac 1200L	2019-04-28	0.61	0.81	.75	2019-05-01	NIL
18	Natural Site	UV02A	2019-04-24			Vectobac 1200L	2019-04-29	0.1	0.13	.75	2019-04-29	NIL
18	Natural Site	SV19b	2019-04-24			Vectobac 1200L	2019-04-29	0.03	0.04	.75	2019-05-01	NIL
18	Natural Site	TV06A	2019-04-27			Vectobac 1200L	2019-04-29	0.44	0.59	.75	2019-05-01	NIL
18	Natural Site	TV05A	2019-04-28			Vectobac 1200L	2019-04-29	0.1	0.13	.75	2019-05-01	NIL
18	Natural Site	TV08A	2019-04-27			Vectobac 1200L	2019-04-29	0.03	0.04	.75	2019-05-01	NIL
18	Natural Site	SV09A	2019-04-20			Vectobac 1200L	2019-04-29	2.67	3.56	.75	2019-05-01	NIL
18	Natural Site	SV05A	2019-04-24			Vectobac 1200L	2019-04-29	2.89	3.85	.75	2019-05-01	NIL
18	Natural Site	TV06A	2019-04-27			Vectobac 1200L	2019-04-29	0.16	0.21	.75	2019-05-01	NIL
18	Natural Site	SV08A	2019-04-28			Vectobac 1200L	2019-04-29	3.04	4.05	.75	2019-05-01	NIL
18	Natural Site	TV25A	2019-04-27			Vectobac 1200L	2019-04-29	0.44	0.59	.75	2019-05-04	NIL
18	Natural Site	TV03A	2019-04-27			Vectobac 1200L	2019-04-29	0.1	0.13	.75	2019-05-04	NIL
18	Natural Site	TV05A	2019-04-28			Vectobac 1200L	2019-04-29	0.05	0.07	.75	2019-05-01	NIL
18	Natural Site	SV01	2019-04-24			Vectobac 1200L	2019-04-29	0.08	0.11	.75	2019-05-04	NIL
18	Natural Site	SV09A	2019-04-20			Vectobac 1200L	2019-04-29	1.06	1.41	.75	2019-05-01	NIL
18	Natural Site	TV08A	2019-04-27			Vectobac 1200L	2019-04-29	0.09	0.12	.75	2019-05-01	NIL
18	Natural Site	SU03A	2019-04-28			Vectobac 1200L	2019-04-29	0.9	1.2	.75	2019-05-04	NIL
18	Natural Site	RV18A	2019-04-22			Vectobac 1200L	2019-04-29	0.13	0.17	.75	2019-05-04	NIL
18	Natural Site	SV13A	2019-04-20			Vectobac 1200L	2019-04-30	0.42	0.56	.75	2019-05-02	NIL
18	Natural Site	SV11A	2019-04-29			Vectobac 1200L	2019-04-30	1.54	2.05	.75	2019-05-04	NIL
18	Natural Site	SU30A	2019-04-29			Vectobac 1200L	2019-04-30	0.78	1.04	.75	2019-05-02	NIL
18	Natural Site	SU02A	2019-04-29			Vectobac 1200L	2019-04-30	4.04	5.39	.75	2019-05-02	NIL
18	Natural Site	SV11A	2019-04-29			Vectobac 1200L	2019-04-30	0.36	0.48	.75	2019-05-04	NIL

Table 4.2 Ground application - Pre and Post-treatment monitoring results for sites treated (cont'd).

Treatment CDC Week	Habitat	Site ID	Pre monitoring date	Site rate	Site rate	Product	Treatment date	Qty Product	Surface (ha)	Rate (ml/ha)	Post monitoring date	Site rate
18	Natural Site	RW02A	2019-04-24			Vectobac 1200L	2019-05-01	0.26	0.35	.75	2019-05-04	NIL
18	Natural Site	RV06A	2019-04-30			Vectobac 1200L	2019-05-01	0.46	0.61	.75	2019-05-03	NIL
18	Natural Site	TV18A	2019-04-20			Vectobac 1200L	2019-05-01	0.16	0.21	.75	2019-05-04	NIL
18	Natural Site	RU01A	2019-04-30			Vectobac 1200L	2019-05-01	4	5.33	.75	2019-05-03	NIL
18	Natural Site	RV06A	2019-04-30			Vectobac 1200L	2019-05-01	0.58	0.77	.75	2019-05-03	NIL
18	Natural Site	RV15A	2019-04-30			Vectobac 1200L	2019-05-01	1.2	1.6	.75	2019-05-03	NIL
18	Natural Site	TV17A	2019-04-20			Vectobac 1200L	2019-05-01	0.57	0.76	.75	2019-05-04	NIL
18	Natural Site	RW01A	2019-04-30			Vectobac 1200L	2019-05-01	0.03	0.04	.75	2019-05-03	NIL
18	Natural Site	RV15A	2019-04-30			Vectobac 1200L	2019-05-01	0.94	1.25	.75	2019-05-03	NIL
18	Natural Site	PV04A	2019-05-01			Vectobac 1200L	2019-05-02	0.35	0.47	.75	2019-05-04	NIL
18	Natural Site	PV10A	2019-04-24			Vectobac 1200L	2019-05-02	0.8	1.07	.75	2019-05-04	NIL
18	Natural Site	TV31A	2019-04-21			Vectobac 1200L	2019-05-02	3.43	4.57	.75	2019-05-04	NIL
18	Natural Site	SU02A	2019-04-29			Vectobac 1200L	2019-05-02	4.88	6.51	.75	2019-05-04	NIL
18	Natural Site	SV20A	2019-04-29			Vectobac 1200L	2019-05-03	1.26	1.68	.75	2019-05-05	NIL
18	Natural Site	SV20A	2019-04-29			Vectobac 1200L	2019-05-03	1.68	2.24	.75	2019-05-05	NIL
18	Natural Site	SW01A	2019-05-02			Vectobac 1200L	2019-05-03	0.3	0.4	.75	2019-05-05	NIL
18	Natural Site	QV01A	2019-04-21			Vectobac 1200L	2019-05-03	0.51	0.68	.75	2019-05-05	NIL
18	Natural Site	SW01A	2019-05-02			Vectobac 1200L	2019-05-03	0.46	0.61	.75	2019-05-05	NIL
18	Natural Site	QV01A	2019-04-21			Vectobac 1200L	2019-05-03	0.78	1.04	.75	2019-05-05	NIL
18	Natural Site	RV01A	2019-05-03			Vectobac 1200L	2019-05-04	1.68	2.24	.75	2019-05-06	NIL
18	Natural Site	SV12A	2019-05-03			Vectobac 1200L	2019-05-04	0.25	0.33	.75	2019-05-06	NIL
18	Natural Site	RV09A	2019-05-03			Vectobac 1200L	2019-05-04	0.4	0.53	.75	2019-05-06	NIL
18	Natural Site	SV12A	2019-05-03			Vectobac 1200L	2019-05-04	0.46	0.61	.75	2019-05-06	NIL
18	Natural Site	RV09A	2019-05-03			Vectobac 1200L	2019-05-04	0.36	0.48	.75	2019-05-06	NIL
18	Natural Site	RV01A	2019-05-03			Vectobac 1200L	2019-05-04	5.68	7.57	.75	2019-05-06	NIL
								101.8	135.7			

Table 4.2 Aerial application - Pre and Post-treatment monitoring results for sites treated.

Treatment CDC Week	Habitat	Site ID	Pre monitoring date	Site rate	Site rate	Product	Treatment date	Qty Product	Surface (ha)	Rate (ml/ha)	Post monitoring date	Site rate
18	Natural Site	QW20	2019-05-01			Vectobac 200G	2019-05-02	141.41	24.99	5.66	2019-05-04	NIL
18	Natural Site	TV30	2019-05-01			Vectobac 200G	2019-05-02	49.38	8.96	5.51	2019-05-04	NIL
18	Natural Site	RV10	2019-05-01			Vectobac 200G	2019-05-02	491.86	83.15	5.92	2019-05-04	NIL
18	Natural Site	SV20	2019-05-01			Vectobac 200G	2019-05-02	556.52	105.8	5.26	2019-05-04	NIL
18	Natural Site	RU10	2019-05-01			Vectobac 200G	2019-05-02	85.78	15.54	5.52	2019-05-04	NIL
18	Natural Site	TV20	2019-05-01			Vectobac 200G	2019-05-02	53.89	9.52	5.66	2019-05-04	NIL
18	Natural Site	RW20	2019-05-01			Vectobac 200G	2019-05-02	600.35	113.4	5.29	2019-05-04	NIL
18	Natural Site	QW10	2019-05-01			Vectobac 200G	2019-05-02	80.44	15.7	5.12	2019-05-04	NIL
18	Natural Site	TU40	2019-05-01			Vectobac 200G	2019-05-02	227.87	39.96	5.70	2019-05-04	NIL
18	Natural Site	QW30	2019-05-01			Vectobac 200G	2019-05-02	359.71	63.5	5.66	2019-05-04	NIL
18	Natural Site	RW10	2019-05-01			Vectobac 200G	2019-05-02	337.3	59.49	5.67	2019-05-04	NIL
18	Natural Site	RV40	2019-05-01			Vectobac 200G	2019-05-02	1568.75	281.9	5.56	2019-05-04	NIL
18	Natural Site	TU20	2019-05-01			Vectobac 200G	2019-05-02	8.95	1.57	5.70	2019-05-04	NIL
18	Natural Site	TV10	2019-05-02			Vectobac 200G	2019-05-03	24.68	4.49	5.50	2019-05-05	NIL
18	Natural Site	RV20	2019-05-02			Vectobac 200G	2019-05-03	32.92	5.99	5.50	2019-05-05	NIL
18	Natural Site	RW04	2019-05-02			Vectobac 200G	2019-05-03	68.32	12.43	5.50	2019-05-05	NIL
18	Natural Site	TU30	2019-05-02			Vectobac 200G	2019-05-03	17.75	3.23	5.50	2019-05-05	NIL
18	Natural Site	SU30	2019-05-02			Vectobac 200G	2019-05-03	245.56	44.33	5.54	2019-05-05	NIL
18	Natural Site	RV06	2019-05-02			Vectobac 200G	2019-05-03	58.15	10.58	5.50	2019-05-05	NIL
18	Natural Site	SV10	2019-05-02			Vectobac 200G	2019-05-03	203.21	36.61	5.55	2019-05-05	NIL
								5212.8	941.14			

4.2 SWEEP NET TESTS

Eight (8) nuisance sweep tests were conducted in the protected area and 2 outside the treated area, once weekly for a four (4) week period following successful completion of the larvicide application (from May 15th to June 5th. See the map on Figure 4.1 nuisance sweep net test location.

The results of the sweep net tests show a great control with an average of 6 mosquitos per test inside the control area. Results are shown in Table 4.2. An average of 11 mosquitoes were caught outside the control area.

Figure 4.1 Nuisance sweep net test locations.

Table 4.3 Sweep net test results.

Date	Hour	Protected area	Qty Mosquitoes*	Hour	Unprotected area	Qty Mosquitoes*	Efficacy
May 14, 2019	18:11	Clovelly Cove and 7 Street	0	18:43	Concession Rd 14 and Side road 17 (Coyd's side road)	0	
	18:57	546, Pefferlaw Road	0	20:59	Smith Blvd	0	
	19:15	Hastings Road and Pefferlaw Road	0	20:03	Duclos Point Park		
	19:28	Petes Library	0				
	19:48	17, Otter Cove	0				
	20:29	Paatie Road and Takatie Road	0				
	20:47	Estonian children's camp	0				
May 21, 2019	18:08	Clovelly Cove and 7 Street	0	18:27	Concession Rd 14 and Side road 17 (Coyd's side road)	1	
	18:58	Hastings Road and Pefferlaw Road	0	18:44	Duclos Point Park	0	
	19:12	Petes Library	1	19:30	Duclos Point Park	0	
	20:03	Paatie Road and Takatie Road	5	19:44	Duclos Point Park	1	
	20:20	Estonian children's camp	2	20:39	Duclos Point Park	23	
May 28, 2019	18:48	546, Pefferlaw Road	1	18:21	Concession Rd 14 and Side road 17 (Coyd's side road)	0	
	19:00	17, Otter Cove	1	20:14	Smith Blvd	3	
	18:07	4, Pinecrest Road	0				
	18:37	Estonian children's camp	0				
	19:17	Petes Library	0				
	19:27	Paatie Road and Takatie Road	7				
	19:47	Hastings Road and Pefferlaw Road	1				
	20:00	Clovelly Cove and 7 Street	1				
June 07, 2019	18:09	Clovelly Cove and 7 Street	0	18:25	Concession Rd 14 and Side road 17 (Coyd's side road)	2	
	18:39	546, Pefferlaw Road	3	20:20	Smith Blvd	93	
	18:49	Hastings Road and Pefferlaw Road	44				
	19:01	Petes Library	2				
	19:15	17, Otter Cove	21				
	19:29	4, Pinecrest Road	41				
	19:49	Paatie Road and Takatie Road	33				
	20:05	Estonian children's camp	10				
		Average	6		**Average**	11	

* Quantity of mosquitoes captured in 5 minutes

4.3 CDC LIGHT TRAPS

Following the successful completion of the larvicide application, five (5) CDC light traps were installed in the treatment area weekly, for a four (4) week period starting on May 5th and ending on June 1st. Traps were installed in the afternoon and collected the following morning, location of sites are shown in tables 4.2 to 4.7. An additional trap, Site GEO006, was installed in 2019 just outside the treatment area. The exact location is shown at the Appendix 2.

Once mosquitoes were collected, they were placed on dry ice and shipped to our laboratory for identification to species level. This allowed GDG to document the mosquito species present in the treated area after the last larvicide applications.

Tables 4.5 to 4.7 show the total of mosquitoes captured per site, per week for a four-week period following treatments. The numbers shown in the table represent the average number of mosquitoes captured per trap night.

The most abundant species captured were *Oc. provocans*, *Oc. abserattus.*

Table 4.5 Number of mosquitoes captured per site, at week 19.

Locality	Site	Longdec	Latdec	Cx pip-res	Aedes vexans	Anophele	Coq perturbans	Culiseta	Oc japonicus	Oc tris-hen	Oc abs-punct	Oc banded legs	Oc black legs	Oc dect-dian-aur	Oc prov-implic	Oc stim-excruc	Other	Number of sample	Total of captured mosquitoes
Georgina	GEO001	-79.20722	44.34411	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
	GEO002	-79.20525	44.29209	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
	GEO003	-79.18230	44.27071	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
	GEO004	-79.23027	44.32844	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
	GEO006	-79.22141	44.27453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
			Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0

Table 4.6 Number of mosquitoes captured per site, at week 20.

Locality	Site	Longdec	Latdec	Cx pip-res	Aedes vexans	Anophele	Coq perturbans	Culiseta	Oc japonicus	Oc tris-hen	Oc abs-punct	Oc banded legs	Oc black legs	Oc dect-dian-aur	Oc prov-implic	Oc stim-excruc	Other	Number of sample	Total of captured mosquitoes
Georgina	GEO001	-79.20722	44.34411	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
	GEO002	-79.20525	44.29209	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	4
	GEO003	-79.18230	44.27071	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
	GEO004	-79.23027	44.32844	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
	GEO006	-79.22141	44.27453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1	1
			Total	0.0	0.0	5.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0	7.0

Table 4.7 Number of mosquitoes captured per site, at week 21.

Locality	Site	Longdec	Latdec	Cx pip-res	Aedes vexans	Anophele	Coq perturbans	Culiseta	Oc japonicus	Oc tris-hen	Oc abs-punct	Oc banded legs	Oc black legs	Oc dect-dian-aur	Oc prov-implic	Oc stim-excruc	Other	Number of sample	Total of captured mosquitoes
Georgina	GEO001	-79.20722	44.34411	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1	1
	GEO002	-79.20525	44.29209	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
	GEO003	-79.18230	44.27071	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	1	2
	GEO004	-79.23027	44.32844	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	14.0	0.0	0.0	0.0	1	15
	GEO006	-79.22141	44.27453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	1	5
			Total	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	21.0	0.0	0.0	0.0	5.0	24.0

Table 4.8 Number of mosquitoes captured per site, at week 22.

Locality	Site	Longdec	Latdec	Cx pip-res	Aedes vexans	Anophele	Coq perturbans	Culiseta	Oc japonicus	Oc tris-hen	Oc abs-punct	Oc banded legs	Oc black legs	Oc dect-dian-aur	Oc prov-implic	Oc stim-excruc	Other	Number of sample	Total of captured mosquitoes
Georgina	GEO001	-79.20722	44.34411	0.0	0.0	1.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	3.0	0.0	0.0	1	24
	GEO002	-79.20525	44.29209	1.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0	22.0	0.0	0.0	1	42
	GEO003	-79.18230	44.27071	2.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	10.0	0.0	0.0	1	18
	GEO004	-79.23027	44.32844	1.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0	4.0	2.0	0.0	1	37
	GEO006	-79.22141	44.27453	2.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	16.0	0.0	0.0	1	43
			Total	6.0	0.0	1.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	55.0	2.0	0.0	5.0	164.0

4.4 DISCUSSION

The post-monitoring of mosquito larvae demonstrates 100% larval mortality, showing the efficacy of the treatments.

The adult surveillance data, collected both by trap and sweep net test, indicates that nuisance mosquitoes are occurring later in the season after the completion of the initial treatment. Adult mosquito populations start to appear late in the month of May, 3-4 weeks after the last application. Some spring mosquito species take longer to hatch given that their development sites take longer to thaw.

Trapping results indicate that the most abundant species captured were *Oc. provocans* with 88 specimens captured over the 4 weeks and *Oc. abserattus* with 100 specimens captured over the 4 weeks. *Ochlerotatus provocans* is a spring time mosquito species that typically develop in transient snow melt pools with a lack of vegetation and a thick layer of leaf litter. They only have one generation per season and overwinter as eggs.

Oc. provocans shares the same habitats with *Oc. stimulans* mosquito, however they can travel further distances than *Oc. stimulans.*

Ochlerotatus abserratus are univoltine spring mosquitoes that prefer to develop in permanent wetlands and marshes.

5. RESIDENT LOG AND OBJECTORS

A total of three (3) residents reached out to GDG for information regarding the mosquito control program. Of the 3 residents, only one has been logged inside the treatment area. A resident near Udora requested that we knock and inform him before treating around his property. The two other residents, located outside the treatment area, wanted to be included in the program.

For the 2019 program, a total of 49 property owners in Pefferlaw, Udora and Port Bolster registered their properties as exclusion zones, this prevented us from accessing surface waters located on their lands for monitoring and treatment purposes.

6. RECOMMENDATIONS

The following recommendations and considerations are intended to improve the success of the Town of Georgina's biological mosquito control program. The objective is to offer a better quality life to the citizens of the Pefferlaw, Port-Bolster and Udora communities:

- Although the 2019 nuisance observed near the Morning Glory Swamp was not as important as in 2017, to improve the quality of spring mosquito control program, the Town of Georgina officials and GDG should work together in order to obtain all necessary authorizations to be able to treat this area.
- In order to better understand the reasons why a land owner has opted-out of the program, GDG requests a list of objectors so we can communicate directly with them. The goal is to explain the program and answer their questions or concerns.
- The opt-out letter should be sent out by the end of October in order to respond to issues or objectors. The opt-out letter could include information about the program and the product used.
- A four to five question survey (TBD) should also be included when the opt-out letter is sent out to the residents within the treatment area;
- Due to the mandatory 45 day evaluation period by the MOECC, the permit request letter should be sent out to the MOECC by the first week of December in order to be able to respond to issues which could arise;

- For accurate statistical comparison, the nuisance sweep net tests should be done at the same time both in the outside the treatment area and within the treatment area.
- Treatment of *Coquillettidia perturbans* (cattail marsh mosquito) should be considered. *Cq. perturbans* is a species which lives and breeds in large cattail marshes. They attach themselves to the roots of these plants in order to live their larval life underwater. This species needs to be controlled by a different biological larvicide, *Bacillus sphaericus* (Bsph). Our spring monitoring and the entomological study demonstrated that *Coquillettidia perturbans* is well established in Georgina. The treatment, which is normally completed in spring and late summer, would offer a very noticeable difference in mosquito nuisance during the summer months. The emergence of this species usually begins in June and peak at the beginning of July.
- Since we find a variety of mosquito species in the area, we recommend extending the program as to offer a mosquito reduction throughout the summer months. This would allow for a reduction of flood water mosquito species as well as spring species.
- Vegetation control along road ditches should be considered before the winter season, for the following reason:
    a. Allows for better drainage of the water, reducing the amount of mosquito breeding habitats
    b. Increases visibility of wildlife along the roadside reducing the risk of collisions with wildlife such as deer
- Coordinate the press release with a media field interview at the end of the first day of operations.
- Extending the duration of the contract as to make sure all species receive treatment adequately and ensure a longer protection into the summer months.
- Broaden the treatment area towards the west to ensure sites that are productive for *Oc. provocans* are treated.
- Meet with the MNRF to obtain authorization to treat a small portion of adjacent wetland.
- GDG would appreciate the opportunity to present at council the highlights of the program and 2019 recommendations.

7. CONCLUSION

The biological nuisance mosquito control program had the advantage of reducing the intensity and the duration of mosquito nuisance in the protected area while doing no harm to the environment. The mandate of GDG was to control spring mosquito larvae. Our team was proud to deliver the nuisance mosquito control program to the Town of Georgina. We believe that the 2019 biological nuisance mosquito program has improved the quality of life for many residents of Georgina.

APPENDIX 1 – PUBLIC NOTIFICATION

Town Page

GEORGINA

TownofGeorgina · GeorginaTown · @georginatown · TownofGeorgina

Council Meetings

Date	Time	Meeting
Wed., April 11	7 p.m.	Council
Wed., April 18	9 a.m.	Council
Wed., April 25	7 p.m.	Council

Council meetings are open to the public and streamed online. For a full list of upcoming meetings, please visit georgina.ca

Events

Freddy Vette & His Rhinestone Plowboys

Saturday, April 28
Stephen Leacock Theatre, *130 Gwendolyn Blvd.*
8 p.m. | $25 +hst | Licensed Event

Keeping traditional country music alive, one hit at a time! Freddy Vette & His Rhinestone Plowboys bring you crying steel guitars, heartbreak harmonies, and rhinestone suits that Hank Williams, Buck Owens and Johnny Cash would be proud of. Tickets and information at georgina.ca/events.

Need Swag for your G200 Event?

Georgina is marking its 200th anniversary in 2018! To celebrate this important milestone, the G200 Planning Committee is providing local event organizers with G200 branded promotional material to give to members of the community that attend your event.

Available promotional material includes pens, temporary tattoos and stickers. By completing and submitting a form at georginachamber.com, event organizers will receive a quantity of each item, which can be picked up at the Georgina Chamber of Commerce office at The Link, 20849 Dalton Road, Sutton between 9 a.m. to 3 p.m., Monday to Friday.

At the Library

FanFest 3

Saturday, April 7
Keswick Library, *90 Wexford Drive*
10 a.m. to 2 p.m. | Drop-in
Costumes Encouraged

FanFest 3 is going to be even bigger and better than last year. FanFest is dedicated to film, graphic novels, comics, gaming, fan culture, and other related pop art forms. Its goal is to honour and celebrate the historic and ongoing contribution of fandom to literacy, art, and culture. This very family-friendly event is FREE and you do not need to register!

Economic Development

The York Small Business Enterprise Centre (YSBEC) in collaboration with our Economic Development and Tourism Division is hosting two free Social Media Marketing workshops in May. Join us at these evening sessions with Business Growth Guru, Liz Scott owner of Infinity Coach.

Social Media That Sizzles

Wednesday, May 2
Stephen Leacock Theatre, *130 Gwendolyn Blvd.*
6 p.m. to 8 p.m.

Straight to the Top Using Social Media!

Thursday, May 24
Stephen Leacock Theatre, *130 Gwendolyn Blvd.*
6 p.m. to 8 p.m.

Registration is required as space is limited!

To register, and for more information please visit georgina.ca

Waste & Recycling

Yard Waste Collection Begins April 9

Yard Waste will be collected with recycling every second week from April to November. There is no limit on the amount of yard waste that can be placed with collection, providing that acceptable labels/containers are used (yard waste stickers are available at no charge).

Please use environmentally friendly kraft paper bags or regular garbage containers. Tree and shrub clippings should be tied with string and bundled. The maximum diameter of the tree and shrub clippings is 60 cm (24 inches) and 90 cm (36 inches) in length. Tree stumps will not be collected. Bundles or bags shall not exceed 22 kg (50 lbs) in weight.

Please note that we do not accept grass clippings, dirt or sod in our curbside yard waste collection.

For more information, view your Waste & Recycling Calendar, download our free MyWaste App or visit georgina.ca.

For collection inquiries or issues please call GFL at 1-866-421-5625 or e-mail wasteline@gflenv.com

Pitch-in-Week

April 22 to 29

Pitch-In Canada is encouraging residents nationwide to participate in the 49th annual Pitch-In Week April 22 to 29. Pitch-in week is the largest environmental improvement campaign in Canada.

Interested in helping out by organizing a litter pickup team? Call Customer Service at 905-476-4301 and we can register you or your team and provide you with gloves and bags.

For more information about Pitch-In week visit georgina.ca

Put litter in its place

Let's keep Georgina clean.

Public Notices

2018 Mosquito Program Notice Of Ground and Aerial Larvicide Application For The Control of Larval Mosquitoes For Nuisance Control

From April 4 to May 31, GDG Environnement Ltée. will apply a biological larvicide by air and ground to stagnant water to control larval mosquitoes that impact the residents in Georgina, east of Weirs Sideroad. The applications are weather dependent and are likely to occur closer to April 15.

The program will use multiple applications of the biological larvicides VectoBac 200G (PCP #18158, granular) and VectoBac 1200L (PCP #21062, liquid). The granular will be applied by helicopter and the liquid by truck mounted and backpack applicators.

The treatment area map and program details are available from the Town's Operations Division or on our website.

For more information about the larvicide application, please email GDG Environnement Ltée at gdg.environnement@gdg.ca or call 1-877-227-0552 (toll free).

Roads

Adopt-a-Road

The Town of Georgina is proud to offer an Adopt-a-Road Program where volunteer groups can adopt sections of road and assume the tasks of keeping roadsides clear of litter.

If you are interested in adopting a road, please contact Customer Service at 905-476-4301 or see georgina.ca for more information.

Street Sweeping

Spring Street Sweeping Operations take place each spring to remove winter sand from Town roads. Weather permitting, the Town of Georgina will begin its Street Sweeping Operations the week of April 16, and be completed by May 5, 2018.

We ask that all residents sweep any sand from their driveways and sidewalks over the curb and onto the road. A street sweeper will be used to pick up the sand from the roadway.

For more information please call Customer Service at 905-476-4301 or visit georgina.ca

Official source for Town news, events and information
georgina.ca

APPENDIX 2 – EXTRA TRAP LOCATION - 2019