CMMCP AERIAL MOSQUITO LARVAL CONTROL PROGRAM

SPRING 2014

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ABSTRACT

The Central Mass. Mosquito Control Project has the capacity to utilize aerial applications of mosquito larvicide to reduce the number of early summer pestiferous adult mosquitoes. This program is a supplement to the ground-based larvicide program, and targets larger, inaccessible wetland bodies with *Bacillus thuringiensis israelensis* granules. Participating towns in the 2014 spring aerial larvicide application included Billerica, Boxborough, and Chelmsford. The application for all three towns took place over two days, April 22nd and 23rd. Pre- and post application larval surveillance showed an 85.93% overall reduction in the emergence of spring mosquito species at treated monitoring sites, while untreated areas displayed a population decline of 20.18%.

OBJECTIVE

Following a winter that left sufficient snow pack on the region, the temporary woodland pools of the Central Mass. Mosquito Control Project (CMMCP) service area were suitable for mosquito development. *Ochlerotatus abserratus* and *Ochlerotatus excrucians* are two mosquito species in particular that this type of habitat fosters each spring. Both of these species are quite pestiferous, but fortunately are univoltine, having only one generation per year. Any eggs laid by the adults of this species will not hatch until the following spring. In addition to *Oc. abserratus* and *Oc. excrucians*, the species Ochlerotatus canadensis may develop in these temporary pools, but unlike the other two species, *Oc. canadensis* can be multivoltine. This species may therefore have multiple generations, and more troublesome, can harbor West Nile virus and Eastern Equine Encephalitis among others (Andreadis 2005). Due to their early season emergence, these species tend to account for most of the mosquito related issues in the beginning portion of the summer months. A greater level of control can be achieved by addressing these mosquitoes when they are still in the larval stage, as opposed to the adult stage. Once on the wing, these adult mosquitoes can disperse making it more difficult to reach the same degree of control as found in the aerial larvicide application. By targeting *Oc*. *abserratus*, *Oc*. *excrucians*, and *Oc*. *canadensis*, a significant number of pestiferous mosquitoes can be reduced, and in the case of *Oc*. *canadensis*, a potential vector of mosquito-borne disease.

METHODS AND MATERIALS

As with previous aerial larvicide applications by CMMCP, *Bacillus thuringiensis israelensis* (Bti), under the product name of VectoBac G® (EPA Reg. No. 73049-10), was used to reduce the number of mosquito larvae in target areas. Bti is a bacterium that naturally occurs in certain soils, and when applied to an application medium can be utilized as a larvicide. The “biopesticide” product used in this aerial application is the same one that is used

in the ground larvicide program of CMMCP (CMMCP 2014). Control is achieved through this bacterium strain when a target specific toxin is created and ingested by the mosquito larvae. Normal digestion is disrupted within the larvae, and typically results in control within a 48 hour window (Extension Toxicology Network 1996). With the approach of pupation, feeding begins to slow for mosquito larvae in the 4th instar stage and is nonexistent once pupation occurs. Because of this factor the Bti product is most effective in the early to mid larval development. The application rate of VectoBac G® used for this aerial application was 5lbs/acre (2.5-10lbs/acre label range) (low rate; VectoBac G® label).

North Fork Helicopters (Cutchogue, New York) was chosen to perform the aerial application with CMMCP assisting at the staging areas. Several factors were involved in the selection of aerial targets. These included historical mosquito activity, proximity to human activity, pre-application surveillance, and size. Targeted wetlands tend to be at least 5 acres and difficult to treat by field technicians on the ground. These wetland bodies are categorized through DEP as wooded swamp, deciduous, conifer, mixed, shallow marsh, or shrub swamp (MassGIS 2013). Other wetlands in the area not meeting these classifications are investigated and treated by CMMCP field technicians if warranted through ground larviciding. The Billerica and Chelmsford portion of the application took place on April 22nd, using Warren Farm in Chelmsford as a staging area for the helicopter. The Boxborough portion of the aerial larvicide program was conducted the following day, April 23rd. Minute Man Airfield (Stow, MA) was used as a staging area for the Boxborough application. In 2014 approximately 600, 880, and 540 acres were designated for treatment in Billerica, Boxborough, and Chelmsford respectively. As per 333CMR 13.04 (7) a legal notification of the aerial larvicide was placed in The Boston Globe on February 5th, 2014, and also posted on the CMMCP website (http://www.cmmcp.org/) (Appendix A).

The Generic Environmental Impact Report (GEIR) establishes a standard for monitoring aerial applications in Massachusetts (Massachusetts Department of Agricultural Resources 1998). This protocol involves recoverable dip stations (RDS) where each town involved must contain at least one treatment RDS for every 250 acres treated. For a control comparison, an additional RDS outside the application areas must be established for each town. The relative level of control achieved by the aerial intervention can then be determined by comparing the larval amounts observed prior to the application to afterwards. At target wetlands selected to become RDS, ten positions are marked and larval surveillance occurs at each, prior to and following the aerial application. This also occurs at the untreated site designated to be the control RDS for each town. Documented observations include the number of mosquito larvae and instar stage, as well as presence or absence of Bti granules following the application. When sampling prior to the application, any larvae collected are immediately returned to the RDS as to not skew the post-application results. Larvae may be collected from other areas of the target wetlands to determine what mosquito species are

present at time of application.

RESULTS

The Billerica, Boxborough, and Chelmsford treatment RDS indicate that the 2014 spring aerial larvicide had an overall observed larval reduction of 85.93% from pre-application levels. Individually, the Billerica treatment RDS exhibited a 95.45% decrease, the Boxborough treatment RDS a 49.38% decrease, and the Chelmsford treatment RDS showed an 87.29% decrease. There was an overall decrease of 20.18% from pretreatment levels for the three untreated (control) RDS (Table 1; Figures 1-4).

Table 1: Larval Surveillance of Treatment and Control RDS

Treatment Sites	Pre-application	Post-application	Observed Change
BIL116	111	5	-95.50%
BIL112	73	3	-95.89%
BIL408	146	7	-95.21%
BOX128	11	5	-54.55%
BOX8	18	7	-61.11%
BOX92	31	14	-54.84%
BOX121	32	20	-37.50%
CHM81	21	0	-100.00%
CHM279	35	5	-85.71%
CHM236	62	10	-83.87%
Control Sites	**Pre-application**	**Post-application**	**Observed Change**
BIL227	110	71	-35.45%
ACT37	64	54	-15.63%
CHM146	44	49	11.36%
Overall:	218	174	-20.18%
BIL227	110	71	-35.45%

Figure 1: Billerica Treatment RDS Results Pre- and Post Application

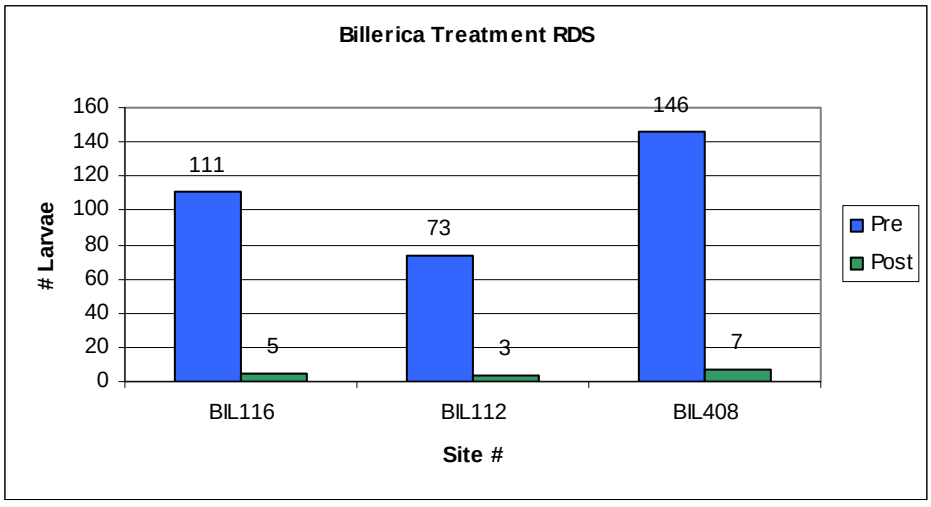


Figure 2: Boxborough Treatment RDS Results Pre- and Post Application

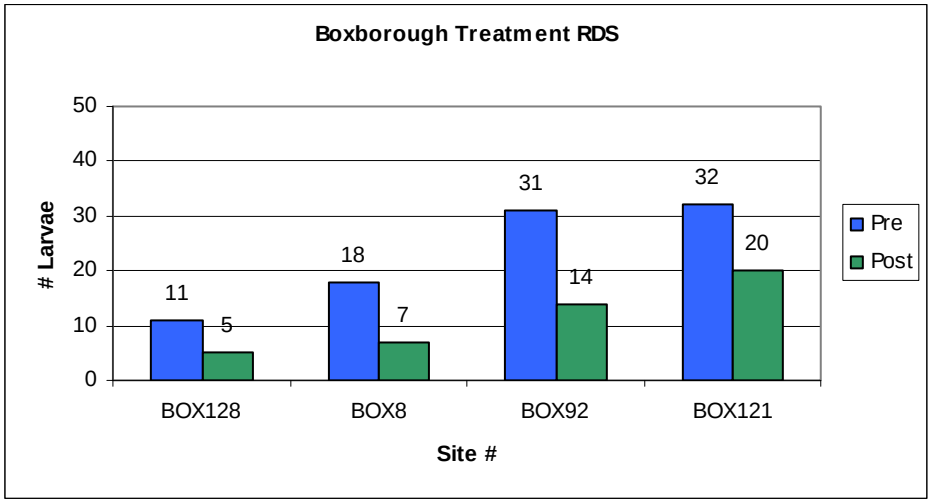


Figure 3: Chelmsford Treatment RDS Results Pre- and Post Application

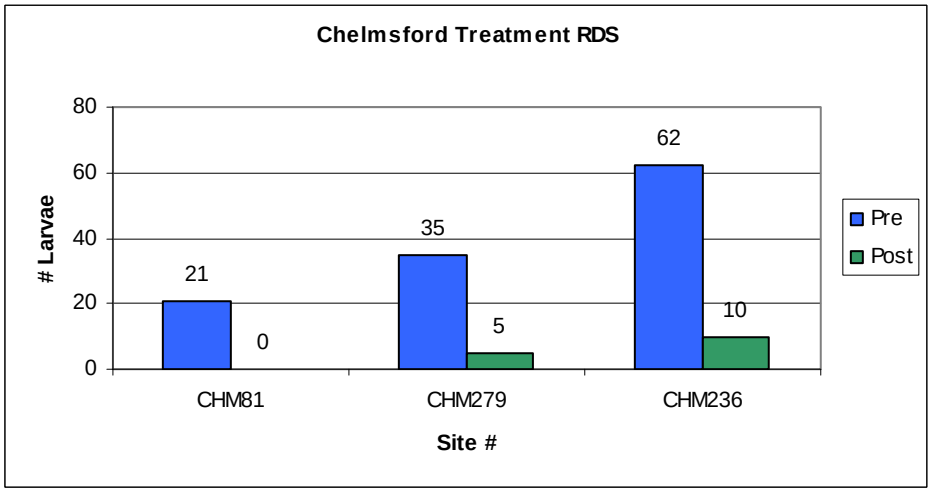
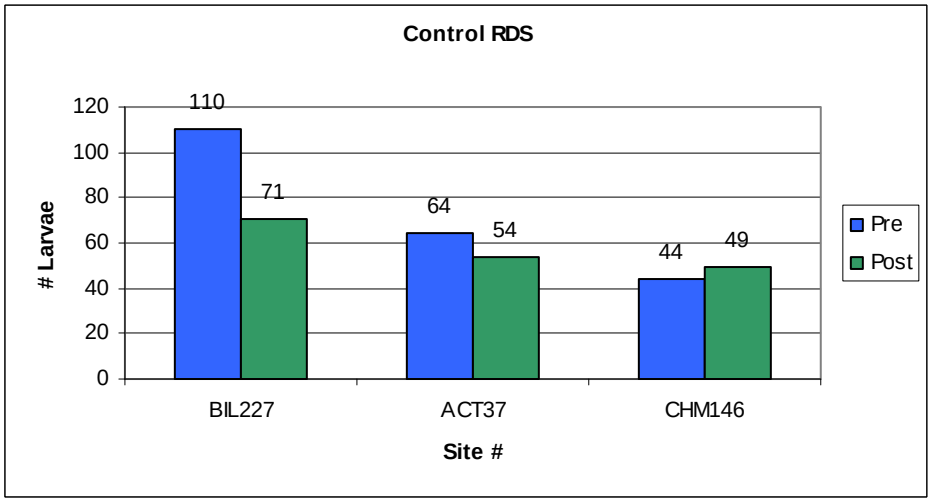


Figure 4: Control RDS Results Pre- and Post Application



DISCUSSION

Larval inspections prior to the application indicated suitable levels of mosquito development for the intervention. The application for Billerica and Chelmsford was planned for and conducted on April 22nd, with Boxborough anticipated for the following day. Despite challenging weather conditions involving wind and rain, the Boxborough portion of the aerial larvicide was finished on April 23rd. Through post-application surveillance, it was shown that the treatment events resulted in a high level of control with an 85.93% overall reduction in target mosquito species. The 20.18% decrease observed in mosquito larvae at untreated control sites seems to lessen the significance of these findings, but it should also be noted that the rain events did expand the size of control areas following the initial observations. Traditionally there tends to be a slight increase in mosquito larvae abundance at these sites. With significant rains expanding the pools, dilution of larvae concentration was likely.

All of the Billerica and Chelmsford treatment RDS had thorough Bti coverage, but some of the RDS for Boxborough experienced intermittent product around the surveillance flags, as well as low numbers recorded in some dip stations prior to the application. These situations simulated a lower than anticipated rate of control for Boxborough. Although larvicide product may have been irregular at these particular RDS, subsequent investigations by technicians a few days later in several other treated wetland areas showed the majority of targeted wetlands in Boxborough contained sufficient product and low/no larval counts. For future applications, the RDS's in Boxborough will be reviewed to insure that sufficient larval counts are recorded at each RDS to make a proper determination of control/lack of control.

Typically, *Oc*. *abserratus* and *Oc*. *excrucians* are the primary targets of this spring aerial larvicide, with the potential for some *Oc*. *canadensis* control. This was the situation observed for the 2014 aerial application as larval samples pointed toward further developed instars of *Oc*. *abserratus* and *Oc*. *excrucians* with a limited sample of early stage *Oc*. *canadensis* present. This spring aerial larvicide application has demonstrated significant control of mosquito larvae populations for the aforementioned species. As these mosquitoes constitute the majority of late spring/early summer pestiferous mosquitoes, this reduction should create a significant measure of relief for residents in the participating towns, as well as a decrease in the amount of adulticide intervention required. CMMCP will review all aspects of this program to ensure future applications experience continued success.

ACKNOWLEDGEMENTS

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larval monitoring, larval identification, site selection, map development and assisting with the helicopter application.

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APPENDIX A

The Boston Globe

CENTRAL MASS MOSQUITO CONTROL
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Legal Notice-Aerial Application to Control Mosquito Larvae

Per 333CMR 13.04(7), the Central Mass. Mosquito Control and North Fork Helicopters will be conducting helicopter applications of the biological larvicide Bti to control mosquito larvae over selected wetlands in the towns of Boxborough, Billerica and Chelmsford. The applications will be conducted during the daylight hours from March 1 to October 31, 2014 as conditions warrant. The trade name of the product to be used is Vectobac G (EPA Reg. #73049-10). For additional information please contact Tim Deschamps at (508)393-3055.