

Managing Hemlock Woolly Adelgid in Pennsylvania

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ABSTRACT

Forty-two of Pennsylvania's 67 counties are infested with the introduced hemlock woolly adelgid. PA DCNR has been using a variety of integrated pest management techniques to manage this destructive insect. We implemented a monitoring program in 2004 that provides township level, georeferenced data on hemlock condition in Pennsylvania. We have had an active biocontrol program for hemlock woolly adelgid since 1999. To date we have released over 186,985 predatory *S. tsugae* beetles and 600 *L. nigrinus* beetles for use against hemlock woolly adelgid. We have confirmed overwintering and reproduction success of *S. tsugae* in the field. Unfortunately, no *L. nigrinus* have been recovered at the experimental release site in central Pennsylvania, but efforts will continue in the future. We have identified 103 high value hemlock blocks on state forest and state park land that will be chemically treated with imidacloprid in spring 2005. Pre-treatment data was collected on treatment and control trees at eight of the sites in fall 2004. These sites will be used to evaluate the efficacy of chemical treatments in 2005 and 2006. Our future plans include expanding biocontrol efforts, using remote sensing in uninfested areas, and collaborating with others on hemlock resistance.

OBJECTIVES

- Identify eastern hemlock sites in Pennsylvania impacted by hemlock woolly adelgid, elongate hemlock scale, *Fabrella tsugae* needle blight, and other stressors
- Provide a general overview of hemlock condition in Pennsylvania
- Release predatory Coleopteran biocontrol agents, *Sasajiscymnus tsugae* and *Laricobius nigrinus*, in forests infested with hemlock woolly adelgid
- Assess establishment (overwintering and reproduction) of biocontrol agents at previous release sites
- Chemically treat hemlock woolly adelgid on selected high-value hemlocks on state forest and state park sites
- Evaluate chemical efficacy a subset of treatment sites

RESULTS

General Hemlock Survey: The DCNR surveyed 1,988 sites in 2004. Abundant new growth was observed on 80% of hemlocks surveyed, probably due to ample rainfall received during the past two years. Most, or 54% of hemlocks surveyed were in light decline, 33% were healthy, 10% were in moderate decline and 3% were in severe decline. HWA was found at 721 sites, while 258 contained elongate hemlock scale, 501 contained spider mites, and 78 contained spittlebugs. Townships with the highest populations of HWA were located in central and eastern PA (Fig. 1).

The DCNR released 43,890 *S. tsugae* (Coleoptera: Coccinellidae) on infested, vigorous hemlocks in central and southern areas of Pennsylvania between March - July 2004 (Fig 2). 186,985 *S. tsugae* have been released since 1999. To date 254 adults and 54 larvae have been recovered at 11 of the release sites using beating sheets in the year following release, including 11 adults recovered in 2004 (Fig. 3).

The DCNR released 600 *L. nigrinus* in Huntingdon County, PA, in fall 2003 and spring 2004. Evaluations of prior releases of *L. nigrinus* were conducted bimonthly from September - November 2004. No *L. nigrinus* were recovered.

Chemical Suppression: Eight sites were established and pre-treatment data were taken in fall 2004. Chemical treatments will be conducted in spring 2005 on all evaluation and regular suppression sites.

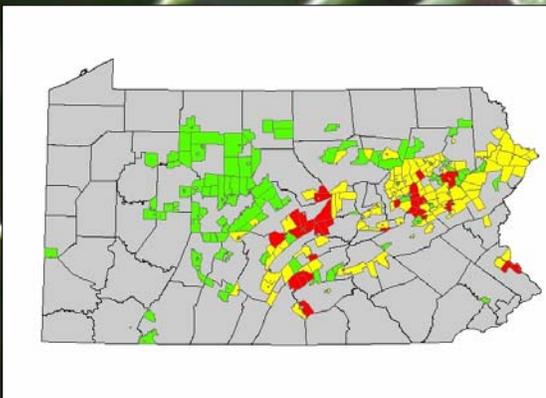


Fig. 1: PA General Hemlock Survey: Townships uninfested with Hemlock Woolly Adelgid are shown in green, lightly infested in yellow, and heavily infested in red.

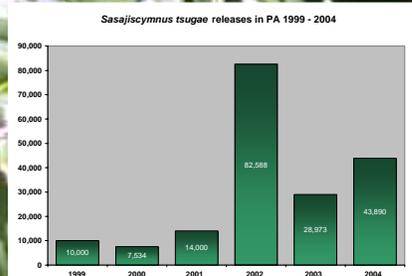


Fig. 2: *Sasajiscymnus tsugae* beetles released in PA since 1999. Philip Alampi Laboratory in NJ, Ecoscientific are provided to PA DCNR from the Solutions of Scranton, and the USFS.

METHODS

General Hemlock Survey: Evaluators select areas that are a minimum of 1 acre and contain a minimum of 25% *Tsuga canadensis*. 10 branches (from between 3 and 10 trees) are randomly selected and inspected for hemlock woolly adelgid, elongate hemlock scale, *Fabrella*, or other stressors, using a hand lens if needed.

***Sasajiscymnus tsugae* biocontrol:** Release sites are relatively healthy stands infested with hemlock woolly adelgid in central, southern, eastern, and northern areas in Pennsylvania especially along the leading edge of HWA infestation. Beating sheet evaluations are used to determine overwintering and reproductive success of these beetles in the field.

***Laricobius nigrinus* biocontrol:** This project is a collaboration with VA Polytechnic Institute. The release site includes 15 release hemlocks located in Huntingdon County, PA at N 40.6548, W 77.7371. There is also a nearby control site containing 10 similar hemlocks at N 40.6707, W 77.7080. The release and control areas have healthy hemlocks with low-density infestations of hemlock woolly adelgid. Beating sheet evaluations and sticky panel traps in hemlock canopies have been used in an attempt to recover previously released beetles.

Chemical Suppression: We have identified 103 high value hemlock treatment blocks on state forest and state park land that will be treated with imidacloprid in 2005. Most sites will be treated using a state-approved contractor, while DCNR personnel will treat a small subset of sites. Trees located on adequate soil that are more than 50' from a stream or lake will be treated using soil injections, while those that are closer to water will be treated using stem injections. We will evaluate hemlock condition before and after chemical treatment at eight of the treatment sites (four soil, four trunk injection sites) between 2004-2006.

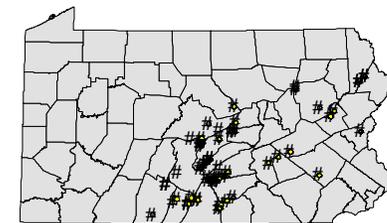


Fig. 3: 2000-2004 *Sasajiscymnus tsugae* release (black triangles) and evaluation (yellow dots) sites. Evaluations are done in the year following release to confirm overwintering and reproduction. Sites with no evaluations indicate new sites where beetles were released in 2004.

INTRODUCTION

Hemlock forest (as classified by FIA) covers approximately 293,000 acres in PA. Hemlock woolly adelgid (HWA) currently occurs in 42 of Pennsylvania's 67 counties, with the current leading edge cutting through the Ridge and Valley Province in the central part of the state. Some of the integrated pest management techniques we use to combat the hemlock woolly adelgid include host monitoring using the General Hemlock Survey, biological control, and chemical control of high value hemlocks on state land using imidacloprid.

We currently use *Sasajiscymnus tsugae* (Coccinellidae) and *Laricobius nigrinus* (Derodontidae) for biocontrol. *S. tsugae* is a tiny black predator native to Japan that consumes the spring and summer generations of HWA. *L. nigrinus* is a tiny black beetle that is native to western North America that feeds on HWA. It has one generation per year. Adult *L. nigrinus* feed on HWA from November - March.

FUTURE PLANS

PA DCNR will continue to explore the use of remote sensing, including hyperspectral imagery, for detecting spot infestations of HWA in NW PA.

PA DCNR plans to continue to release biocontrol agents against HWA in future years. We may add new predators to our current complex, including coccinellids in the genus *Scymnus*, as they become available.

We hope to collaborate or assist researchers who are trying to find potentially resistant hemlocks or who are working to develop hybrid species that are genetically resistant or tolerant to hemlock woolly adelgid.