Don't Color Us In (Yet): Will Regulations and Research Keep Vermont Adelgid-Free?

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ABSTRACT

Vermont is currently free of hemlock woolly adelgid, although natural spread into the state is expected. Recent introductions on nursery stock have demonstrated that inspections in the state of origin cannot reliably exclude the insect and have highlighted the danger of propagating trees outside of the region where they are to be planted. When hemlock woolly adelgid becomes established in Vermont, cold is expected to reduce its impact. Because we do not anticipate "the next chestnut blight," research promises to help us maintain hemlock as a viable species. Recommended actions are to 1) develop reliable survey protocols to delineate infested counties in affected states, including standards for quality assurance, 2) identify strategies to promote local propagation of nursery trees, 3) continue to emphasize biocontrol efforts, focusing on a broad spectrum of agents, and ensuring that safeguards are followed and made widely known, 4) use new technology to produce forest type maps so hemlock stands can be located, and 5) continue research on factors associated with susceptibility and vulnerability and develop management strategies to maintain the values hemlock provides.

DODGING THE BULLET: THE HISTORY OF HEMLOCK WOOLLY ADELGID IN VERMONT

Hemlock woolly adelgid, *Adelges tsugae* (Homoptera: Adelgidae), is not known to occur in Vermont, although it has spread naturally within ten miles of the state line in Massachusetts. Cold temperatures may have held the insect back, but spread into the state is expected given a period of mild winters. Hemlock occurs statewide and accounts for over 5% of Vermont's trees (USDA Forest Service 2005).

Hemlock woolly adelgid has been introduced via hemlock nursery stock as Vermont is a net importer of hemlock transplants (USDA 1998). The risk of introduction via this pathway was recognized in 1988, when a state quarantine was enacted. Hemlock nursery stock from infested states was admissible only with a declaration that the trees were free from hemlock woolly adelgid (State of Vermont 1988).

In July 1990, hemlock woolly adelgid was detected on tublings that had been planted in a high elevation clearing in the town of Stockbridge. Prior to planting, they had been held in New Jersey near infested trees. Eradication surveys were done twice a year for six years, and all hemlocks located on the site were burned. Live adelgids were found on tublings in 1991, but none were found in subsequent years. This eradication is considered a success, in part because the site is at 2,500 feet elevation, in cold hardiness zone 4, and no native hemlocks occur nearby.

No other introductions are known until May 2004, when infested trees were reported to have come into the state through a wholesale nursery in Hartford, New Hampshire. This nursery had received five hemlock shipments from North Carolina and one from Pennsylvania. All had been certified by state inspectors to be free of hemlock woolly adelgid and were therefore legally imported to Vermont. As a first step in eradicating this introduction, all 413 trees remaining at the wholesale nursery were cut and burned on site.

In subsequent tracing, it was found that 100 trees from the same wholesale nursery were still at retail nurseries, and 160 had been planted in the landscape. An emergency order, issued by the state, required that all of these trees be removed and destroyed by June 25. The chance of a successful statewide eradication was good, since trees had been on-site for only a few weeks. The impact of alternatives, such as no action or a more limited action, could be great, since potentially infested trees had been planted statewide. The state provided no compensation for the trees removed, but landscapers were compensated for their labor if they chose to remove trees for their clients.

Fourteen hemlocks from the wholesale nursery had been sold cash-and-carry from retail nurseries. An attempt was made to find these trees through mass media. Although none of the fourteen were located, many requests were received for tree inspections. These included one for a recent planting of hemlocks from a New Hampshire nursery that proved infested. These trees, and another planting from the same nursery were destroyed.

In all, hemlocks potentially infested with hemlock woolly adelgid had been shipped to or planted in 33 towns (Figure 1). These sites will be monitored to ensure that no adelgids had moved to existing trees. Two-thirds of the planting sites had native hemlocks within 100 feet. The presence of nearby hemlock, plant hardiness zones, and additional information from the GIS-based pest risk assessment project will be used to prioritize monitoring efforts.

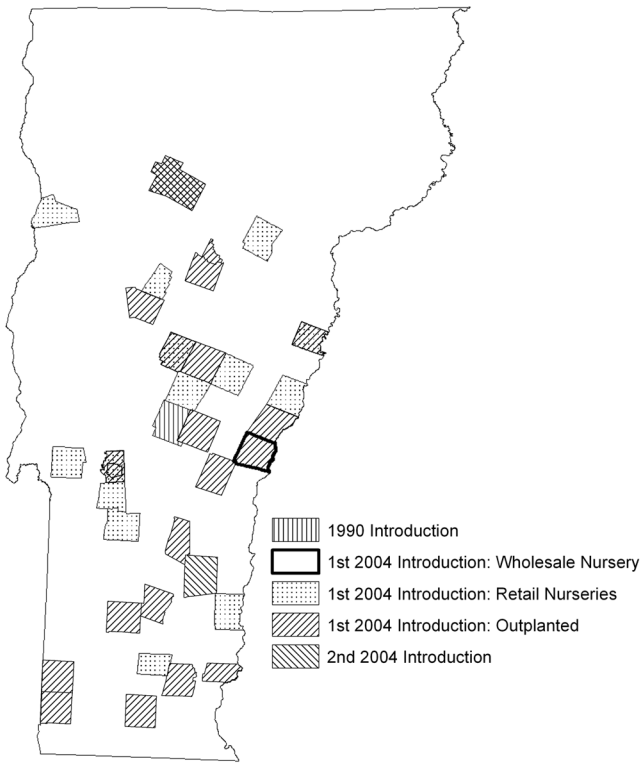

Figure 1. Vermont towns where hemlocks potentially infested with hemlock woolly adelgid were held or shipped, 1990-2004.

WILL REGULATIONS KEEP VERMONT ADELGID-FREE?

Vermont is now the only eastern state in the range of hemlock without an established population of hemlock woolly adelgid. While it is not realistic to count on excluding it forever, delaying its introduction will increase the lead time for research to develop pest management strategies.

The 2004 introduction demonstrated that inspection in the state of origin does not ensure that nursery stock will be free of hemlock woolly adelgid. With its tiny life stages, the insect is difficult to detect at trace levels on densely sheared trees. Vermont is amending its regulations to prohibit all hemlock nursery stock from the area under quarantine, defined as the counties listed in the U.S. Forest Service "List of Counties and States with Known Hemlock Woolly Adelgid Infestations" (USDA Forest Service 2003).

The regulations on hemlock logs, lumber with bark and chips will remain essentially unchanged. These are admissible from areas under quarantine, to sites with a compliance

agreement. In fact, there has been little demand for hemlock logs from other states, and no mills have requested compliance agreements.

By contrast, there is a large volume of logs from infested areas being transported through Vermont, mostly to mills in Canada. It is plausible that hemlock woolly adelgid could be introduced on these logs. However, no infestations elsewhere are known to have developed via this pathway, and trucking through the state is not regulated.

The proposed quarantine changes will require that non-quarantined areas adjacent to quarantined counties be surveyed annually and found negative for hemlock woolly adelgid. It is not specified how this is to be done. Quarantine regulations will only work if good protocols with adequate quality assurance are established for delineating the extent of hemlock woolly adelgid on this continent. Developing protocols will be a challenge, since most new infestations are, in fact, located by reports from the public and incidental sightings.

Transport of forest pests on nursery stock is nothing new: that's how white pine blister rust arrived in North America. Although we now appreciate the risk of importing live trees from other countries, restrictions on the state-to-state movement of trees focus on a few pests. Hemlock woolly adelgid, emerald ash borer, and the sudden oak death pathogen have all proved their ability to hitch a ride to new states on nursery trees. To prevent these pests, and species we have yet to recognize from using this pathway, efforts should be made to promote local propagation of nursery trees. Possible strategies might include extension efforts to teach propagation methods, a "locally grown" green certification, and incentives through local economic development groups.

WILL RESEARCH KEEP US ADELGID-FREE?

While research will not keep us adelgid-free, research results may prevent it from eliminating hemlock in Vermont. Once hemlock woolly adelgid has become established in the state, the impact of cold temperatures should slow the rate of hemlock decline. This should provide opportunities to maintain hemlock as a viable species if efforts are guided by research results.

The lesson from balsam woolly adelgid is encouraging, demonstrating that cold-limited insects cause less damage as they reach the northern edge of their range. This insect has been in Vermont for nearly a century, and yet balsam fir remains the second most common tree species in the state (USDA Forest Service 2005). Although balsam woolly adelgid sometimes builds up to tree-killing levels, cold winters are frequent enough to knock any outbreak back before catastrophic damage occurs (Decker et al. 2005). The contribution of introduced predators is unknown; these include *Laricobius erichsonii*, which was introduced to five Vermont towns in 1961-62.

The lesson from gypsy moth is also encouraging, demonstrating that biological control efforts can pay off. Also introduced nearly a century ago, the first gypsy moth outbreak in Vermont lasted over a decade. More recently, outbreaks have followed a pattern similar to the native forest tent caterpillar (Figure 2), thanks to introduced natural enemies.

Diverse biological control efforts are underway for hemlock woolly adelgid and many show promise. While the research community follows protocols aimed at preventing negative

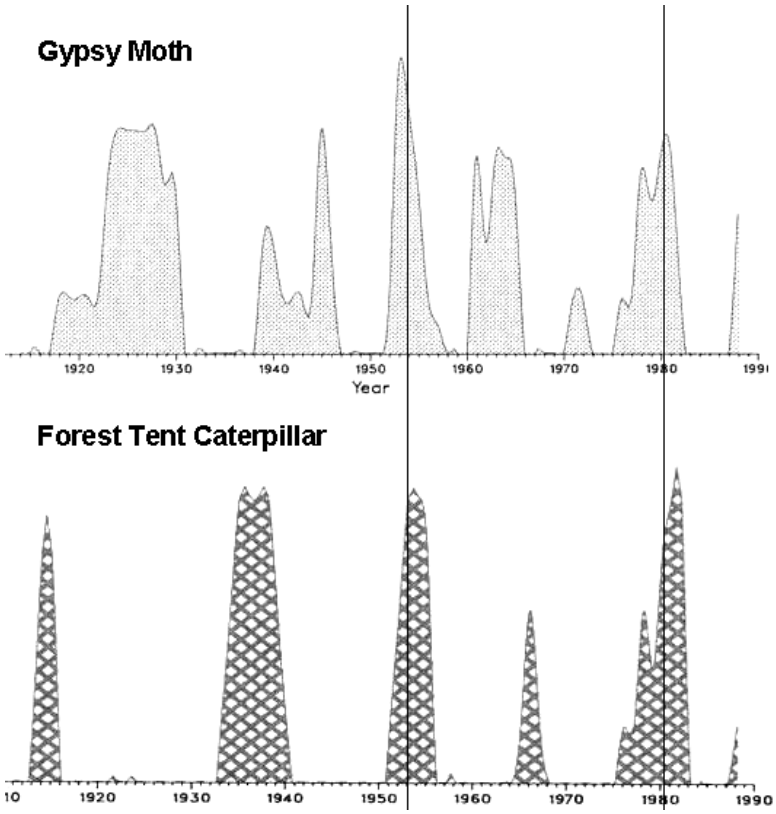

Figure 2. Gypsy moth and forest tent caterpillar population levels in Vermont, 1890-1988. From Parker et al., 1989.

consequences from introduced biocontrol agents, the public remains skeptical. Existing safeguards are not widely known. More transparency in this process would help.

While waiting for hemlock woolly adelgid, existing research results can be used to locate hemlock and prioritize stands for treatment. New technology promises that forest type maps can be produced at a resolution useful on the ground. Like many states, Vermont would need assistance in turning this promise into reality.

Once stands are located, risk assessment maps being developed will allow us to incorporate the expected impact of hemlock woolly adelgid into forest management plans. Continued research into factors associated with susceptibility and vulnerability would help refine these maps. And as hemlock woolly adelgid becomes established, we will benefit from the results of research into strategies which will help us increase stand resistance, maintain crown closure and prevent mortality where possible, and, where necessary, schedule salvage and manage stand conversion.

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