SILVICULTURAL OPTIONS FOR MANAGING HEMLOCK FORESTS THREATENED BY HEMLOCK WOOLLY ADELGID

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ABSTRACT

The introduced hemlock woolly adelgid (HWA), *Adelges tsugae*, continues to migrate north into New England, causing widespread hemlock decline and mortality, and an increase in hemlock removal. This outbreak has led to management dilemmas about pre-salvage and salvage logging in hemlock stands: should they be cut down or not? Regardless of the decision made, there is a critical need to review the available options and clearly determine the appropriate goals first, especially if HWA has not reached your forest yet. Although there are various chemical and biological control options for HWA that are effective in ornamental situations, they are not practical or effective at larger scales of stands to landscapes. This paper describes silvicultural options available to help landowners manage their hemlock forests infested with or threatened by HWA.

KEYWORDS

Silviculture, salvage logging, forest management, hemlock forests.

HWA INFORMATION

HWA is widely distributed throughout the eastern United States and moves from 10 to 20 miles per year, transported primarily by wind, birds, and humans. In New England, adelgid movement has been primarily in a northeasterly direction. Tree health and the timing and severity of HWA impacts are influenced by several site and forest factors, including elevation, latitude, topographic position (ridgetop, side slope, hollow, wetland, riparian area etc.), and structure. For example, research has shown that hemlock trees are just as likely to be infested with HWA whether they occur in a hemlock-dominated system or in mixtures with hardwoods or other conifer species (Orwig et al. 2002). It appears that no sites are immune from HWA damage once the insects are firmly established, although hemlock trees growing on ridgetops, on exposed drier sites, or infested with any other secondary pests like scale insects often succumb more quickly to HWA infestation (Bonneau et al. 1999, McClure et al. 2000, Orwig et al. 2002). In addition, extreme cold winter temperatures (below -5^{o}F or -20^{o}C) can cause severe HWA population reductions that may temporarily slow the spread and impact of HWA across the landscape (Parker et al. 1998, 1999, Skinner et al. 2003).

SILVICULTURAL OPTIONS

We often desire to manage forests in a way that is most "natural"; however, the current HWA outbreak is novel and many would argue not natural. Harvesting options and related costs differ depending on the unique structure of hemlock in a particular forest and whether the management goal is aesthetics, wildlife habitat, water quality protection, public safety, future successional dynamics, timber revenue, or a combination of these goals. Pre-emptive cutting of uninfested forests is not recommended unless maximizing timber revenue is the main objective, because many questions exist regarding the future dynamics of hemlock and HWA, and cutting could remove potentially resistant hemlock genes. Once a decision has been made to cut hemlock, Best Management Practices (BMPs) should be used to protect forest soils and water quality (Kittredge and Parker 1989, Ward et al. 2004; see also below) during harvesting operations.

For infested hemlock-dominated forests, silvicultural options include:

Do nothing: Infested hemlock trees will die gradually over 4- 12 years depending on site characteristics, and the amount of light reaching the ground will gradually increase. Hemlock mortality will typically result in hardwood establishment, primarily black birch (*Betula lenta*) (Orwig and Foster 1998, Orwig et al. 2002). In Massachusetts and northern New England, white pine (*Pinus strobus*), yellow birch (*Betula alleghaniensis*), oak (*Quercus*), and maple (*Acer*) species may also replace hemlock. In addition, herbaceous plants like ferns and sedges (*Carex* spp.) may establish with the death of hemlock (Orwig 2002). Branches, treetops, and boles will fall over a period of 8 to 15+ years, with little or no scarification (soil disturbance). The dead standing and downed wood will provide valuable wildlife habitat for a variety of bird, mammal, and invertebrate species (Brooks 2001, Tingley et al. 2002). In public areas, doing nothing may require fencing to limit access to hazard trees along trails, roads, and vistas.

Light selection cut/shelterwood cut: This option removes 20 to 50% of the tree basal area, including the dying and heavily damaged hemlock trees throughout the stand or in 0.5- to 1-acre openings. Since more light enters the stand through this treatment than the *Do nothing* option, raspberry (*Rubus* spp.), black birch, and white pine will be stimulated (Kizlinksi et al. 2002), and they can be enriched with plantings (see below). Skid roads and landings used in this treatment can be used for subsequent cuts and/or salvage.

High intensity cutting: This option involves removing more than 50% of the tree basal area and is used if the stand is heavily damaged and/or recovering timber value is the main goal. High light reaches the forest floor, often leading to regeneration of black birch and several weedy species, including raspberry, pokeweed (*Phytolacca Americana*), hay-scented fern (*Dennstaedtia punctilobula*), and—sometimes—invasive species (Kizlinksi et al. 2002, Orwig and Kizlinski 2002). Heavy cutting may also lead to more abundant slash and damage or mortality of residual trees. In many cases, more valuable hardwood species are also removed to increase the value of the timber sale (Brooks 2004), leading to hardwood sprouts from the stumps. The decision to remove species other than hemlock needs to be carefully considered prior to cutting activity. If cutting is done without any regeneration present on steep slopes or near streams, it may pose risks of erosion and nutrient export to streams until newly established vegetation takes up nutrients and impedes overland flows.

For hemlock-hardwood or hemlock-conifer mixes (with or without planting) silvicultural options include:

Do nothing: As with hemlock dominated forests, infested hemlock trees will gradually die over 4 to 12 years, and the stand will convert to a hardwood dominated stand or a mix of hardwoods and white pine. The dead standing and downed wood will provide valuable wildlife habitat for a variety of bird, mammal, and invertebrate species. Often no understory changes will occur if hemlock is a minor component of stand.

Cut hemlock in groups or throughout stand: This option will speed up the conversion to hardwood stands or will facilitate white pine and hemlock regeneration, especially if the stand is not infested or only lightly infested.

If cutting infested hemlock for timber revenue or removing hazard trees is the objective, cutting should begin by the time hemlocks have lost 50 to 75% of foliage, since it is unlikely that they will recover with continued HWA infestation, and they become more hazardous to cut if severely damaged or dead.

PLANTING OPTIONS

Tree planting is not necessary, since trees and other vegetation will reproduce abundantly on their own in the brighter environment caused by hemlock mortality. There are no species that can adequately replace hemlock. However, many species have been planted on sites that have lost or will lose their hemlocks due to HWA or logging (Ward et al. 2004). If conifer trees are desirable, consider planting native species like white pine, red pine (*Pinus resinosa*), or white or red spruce (*Picea glauca* and *Picea rubens*). The exotic Norway spruce (*Picea abies*) has been planted because of its full crown of dark green foliage. If promoting desirable hardwoods is the goal, then various oak species could be planted. If planting in areas of high deer densities (i.e., greater than 20-25/mile^2), seedling shelters and/or fencing may be required to allow the young trees to become established. When planting in logged areas, be aware that black birch and raspberry species will directly compete with any species planted, so planting should immediately follow logging.

HWA/HEMLOCK BEST MANAGEMENT PRACTICES (BMPS)

To reduce the chance that logging activities will spread HWA, consider:

Time of year — HWA has two generations per year and has mobile crawler stages in both late spring and early summer from March through June (McClure 1989). Examine the foliage and logs for the presence of HWA during this time as the pest may be transported on machinery that is moved from site to site, including personal vehicles. If possible, harvest in fall and winter to reduce the risk of transporting the pest and minimize soil disturbance.

Machinery — If harvesting during the months of March through June, power wash logging equipment to remove HWA.

State Quarantines — Vermont, New Hampshire, and Maine currently have quarantines that prevent transportation of hemlock seedlings, nursery stock, logs, lumber, bark, and chips into their

states except to pre-approved locations or under specific conditions. Contact individual State Forest Health specialists listed below for details.

Location — Know where your logging is with respect to HWA. Has HWA been identified in the town where logging is taking place? Is it nearby? To find out the current distribution of HWA in your state contact the forest health specialists listed at the end of this paper.

SUMMARY

In conclusion, a variety of silvicultural alternatives are available for forest landowners with hemlock threatened by HWA. The options range from doing nothing to directly influencing vegetation succession with a variety of cutting methods and supplemental plantings, depending on landowner objectives, overall hemlock health, and stand conditions. All options and associated costs should be considered carefully when planning the appropriate management strategies to effectively meet the desired goals.

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STATE FOREST HEALTH COOPERATORS

CONNECTICUT : Connecticut Agricultural Experiment Station, P.O. Box 1106, 123 Huntington Street, New Haven, CT 06504-1106

MAINE: Maine Department of Conservation, Maine Forest Service, 22 State House Station, Augusta, ME 04333-0022

MASSACHUSETTS: Massachusetts Department of Conservation and Recreation, Division of Forests and Parks, Region 4 Headquarters, P.O. Box 484, Amherst, Massachusetts 01004-0484

NEW HAMPSHIRE: NH Dept. of Resources and Economic Development, Division of Forests and Lands, P.O. Box 1856, 172 Pembroke Rd., Concord, NH 03302-1856

NEW YORK: New York Dept. of Environmental Conservation, Division of Lands and Forests, 625 Broadway, Albany, NY 12233-4253

RHODE ISLAND: Rhode Island Dept. of Environmental Management, Division of Forest Environment, 1037 Hartford Pike, North Scituate, RI 02857-1030

VERMONT: Forest Resource Protection, VT Dept. of Forests, Parks and Recreation, 103 S. Main Street, 10 South, Waterbury, VT 05671-0602

For more information on HWA and various control methods, see: *http://www.fs.fed.us/na/morgantown/fhp/hwa/hwasite.html.*

For information about hemlock timber value, see: *http://forest.fnr.umass.edu/stumpage.html.*