Silvicultural Options for **Managing Hemlock Forests**

Threatened by Hemlock Woolly Adelgid

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Fig. 1 **TYPICAL HEMLOCK STAND** with some hardwood and pine. Note very few seedlings/saplings.

The introduced HEMLOCK WOOLLY ADELGID (HWA; *Adelges tsugae* Annand) continues to migrate north into New England, causing widespread hemlock decline and mortality, leading to associated salvage and pre-salvage cutting across the region. Continuing HWA outbreaks lead to management dilemmas about pre-salvage and salvage logging in hemlock stands: should they be cut or not? Regardless of which approach is selected, advance planning that includes reviewing options and articulating goals will be highly beneficial, 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 in forest stands and landscapes. This pamphlet describes several silvicultural options available to aid landowners in managing their hemlock forests infested with or threatened by HWA and provides information to assist in making an informed decision.

HWA Information

As of 2004, HWA is found in 16 eastern states, including New York and all New England states except Vermont. (See map on the back). It is estimated that HWA migrates 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.

It appears that no sites are immune from HWA damage once the insects are firmly established, although the timing and severity of HWA-induced mortality is influenced by several site and forest factors including elevation, latitude, topographic position (ridgetop, side slope, hollow, wetland, riparian area etc.) and structure.

Fig. 2 **UNCUT YEAR 5**–Hemlock woolly adelgid results in standing dead trees and thinning crowns; some modest increased light results in more hardwood undergrowth.

Fig. 3 **UNCUT YEAR 15**–There has been additional hemlock mortality, standing dead wood, accumulation of woody debris, and slight development of hardwood undergrowth.

Fig. 4 **LIGHT CUT YEAR 5**–If harvested lightly in the first year, greater light reaches the forest floor by year 5, resulting in more hardwood undergrowth development.

Fig. 5 **LIGHT CUT YEAR 15**–By year 15, hardwood undergrowth has developed more, and some crown thinning has occurred in hemlock that remained.

For example - 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. In addition, extreme cold winter temperatures (below – 5°F or – 20°C) for even a few hours can cause severe HWA population reductions, which may temporarily slow the spread and impact of HWA across the landscape. Research has also 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.

Silvicultural Options

There is often a desire to manage a forest in a way that is most "natural." However, the current widespread outbreak of the invasive HWA is novel and not like any other form of natural disturbance known to affect hemlock trees or forests. Therefore harvesting options and related costs will differ depending on the size 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. Unless timber revenue is the main objective, **pre-emptive cutting or pre-salvage of uninfested forests is *not recommended***, as the future interactions between hemlock and HWA are uncertain and cutting could remove potentially resistant hemlock.

Line drawings above: Nancy Haver, Cover and background photos: Don Niebyl and David Orwig

Fig. 6 **HEAVY CUT YEAR 5**–If the stand is heavily cut in the first year, high light levels result in aggressive new hardwood vegetation by year 5. There is little dead or dying woody material.

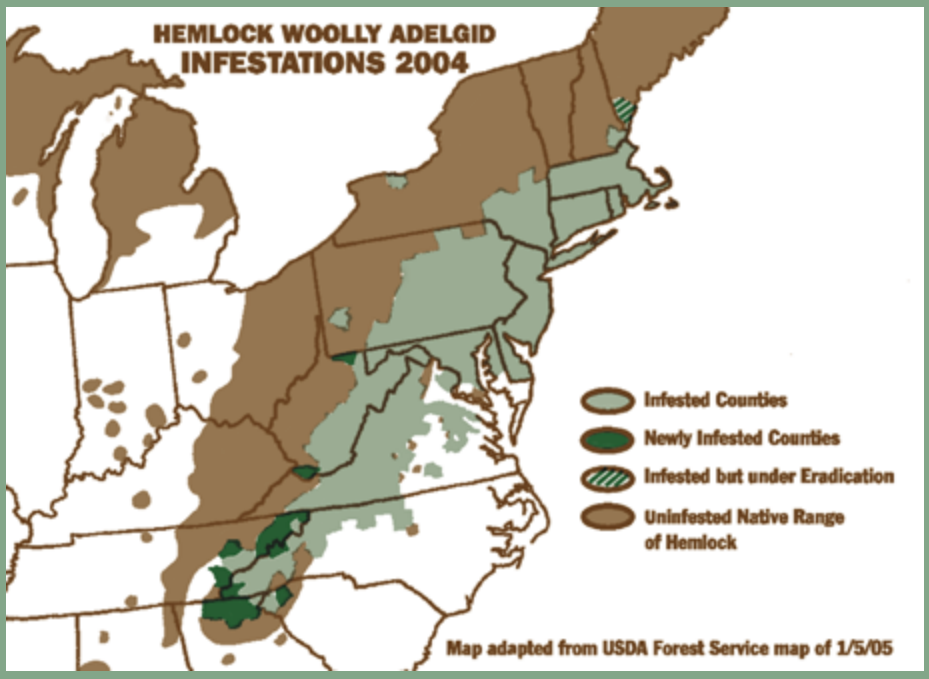
Fig. 7 **HEAVY CUT YEAR 15**–By year 15 new hardwood forest is strongly developed.

There are several options for **hemlock-dominated forests**

1 Do nothing: (see Figures 1, 2 & 3) Most infested hemlock trees will die gradually over 4–15 years, depending on site characteristics, and weather. The amount of light reaching the ground will gradually increase. Hemlock mortality typically results in patchy hardwood establishment, primarily black birch (*Betula lenta*), which increases over time. In Massachusetts and northern New England, white pine, yellow birch, and oak and maple species may also replace hemlock. In addition, herbaceous plants like ferns and sedges may establish with the death of hemlock. Branches, tree tops, 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 provides valuable wildlife habitat for a variety of bird, mammal, and invertebrate species. In public areas, doing nothing may require removing particularly hazardous trees or fencing off access to hazard trees along trails, roads, and vistas.

2 Light selection cut/shelterwood cut: (see Figures 1, 4 & 5) 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 species, black birch, and white pine regeneration will be stimulated and they can be enriched with plantings (see Planting Options Section on next page). Skid roads and landings used in this treatment can be used for subsequent cuts and/or salvage.

3 High intensity cutting: (see Figures 1, 6 & 7) 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 extremely dense regeneration of black birch and several weedy species including raspberry, pokeweed, hay-scented fern and sometimes, invasive species. Heavy cutting may also lead to more abundant slash, damage or mortality of residual trees, and removal of hardwood species, leading to hardwood sprouts from the cut stumps. Carefully consider the decision to remove species other than hemlock prior to cutting. 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.



Options for hemlock-hardwood or hemlock-conifer mixes:

1 Do nothing: As with hemlock dominated forests, infested hemlock trees will gradually die over 4–15 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 provides 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.

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

> **Note:** *These patterns and processes of increased light, hemlock crown thinning leading to mortality, responding understory vegetation, and the accumulation of dead wood will occur in either pure hemlock stands or mixed stands with other species. They will be less pronounced in mixed stands.*

Planting Options

Tree planting is not necessary, since trees and other vegetation will reproduce abundantly in the brighter environment caused by hemlock mortality. In the first 1–3 years following logging or mortality, there will be a natural pulse of herbaceous vegetation that may complicate planting.

There are no species that adequately replace hemlock, but many species have been planted on sites that have lost or will lose their hemlocks due to HWA or logging.

FOREST HEALTH COOPERATORS

CONNECTICUT: CT Agricultural Experiment Station, P.O. Box 1106, 123 Huntington Street, New Haven, CT 06504-1106 Phone: (203) 974-8474

MAINE: ME Department of Conservation, Maine Forest Service, 22 State House Station, Augusta, ME 04333-0022 Phone: (207) 287-4981

MASSACHUSETTS: MA Department of Conservation & Recreation, Division of Forests & Parks, Region 4 Headquarters, P.O. Box 484, Amherst, MA 01004-0484 Phone: (413) 256-1601

NEW HAMPSHIRE: NH Dept. of Resources & Economic Development, Division of Forests & Lands, P.O. Box 1856, 172 Pembroke Rd., Concord, NH 03302-1856 Phone: (603) 271-7858

NEW YORK: NY Dept. of Environmental Conservation, Division of Lands & Forests, 625 Broadway, Albany, NY 12233-4253 Phone: (518) 402-9419

RHODE ISLAND: RI Dept. of Environmental Management, Division of Forest Environment, 1037 Hartford Pike, North Scituate, RI 02857-1030 Phone: (401) 647-3367

VERMONT: Forest Resource Protection, VT Dept. of Forests, Parks & Recreation, 103 S. Main Street, 10 South, Waterbury, VT 05671-0602 Phone: (802) 241-3676

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UMASS EXTENSION

If conifer trees are desirable, consider planting native species like white pine, red pine, or white or red spruce. The exotic Norway spruce has been planted because of its full crown of dark green foliage. If desirable hardwoods are 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.

If 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)

Once a decision has been made to cut hemlock, Best Management Practices (BMPs) should be used to protect forest soils and water quality. In addition, to reduce the chance that logging activities will spread HWA, consider:

Time of year – HWA has 2 generations per year and mobile crawlers exist between April and July. 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 between August and March when HWA is not in its mobile crawler stage, to minimize transport of HWA.

Machinery – If harvesting between April and July, power wash logging equipment to remove HWA.

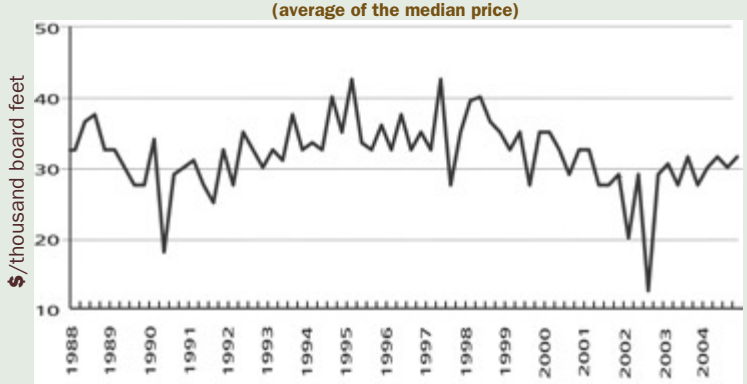
State Quarantines – Vermont, New Hampshire, and Maine currently have quarantines that prevent transportation of hemlock seedlings, nursery stock, logs, lumber, bark, and chips into their states except to pre-approved locations or under specific conditions. Contact individual state forest health offices listed below the map at left 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 offices listed below the map at left.

Financial considerations

Stumpage is the price paid by a logger or sawmill to a landowner for the opportunity to harvest standing timber. Many factors affect stumpage price, including access, terrain, volume, competition, timber quality, and supply-and-demand. It is possible that HWA-induced hemlock mortality will increase the supply of timber on the market, thereby depressing the price.

Hemlock Stumpage Price
Southern New England, 1988 - 2004
(average of the median price)



Since 1988, the stumpage value of hemlock in southern New England has generally fluctuated between $25 and $40/Mbf (thousand board feet). One hemlock tree with a diameter at breast height (dbh) of 18 inches, and three merchantable 16-foot logs has 317 board feet (or 0.317 Mbf). Based on average stumpage prices since 1988 in southern New England, the value of this individual hemlock tree generally tends to be approximately $10.

In general, hemlock can occur in pure stands with volumes ranging from approximately 10 – 30 Mbf/acre. At these densities, and an estimated stumpage price of $35/Mbf, landowners could possibly lose roughly $350 – $1,050 per acre **if** they elect to not pre-salvage or salvage their hemlock **and** it dies. Hemlock can also occur in mixed stands with other species, in volumes ranging from approximately 0.5 – 10 Mbf/acre. If they elect to leave their hemlock and not salvage or pre-salvage it, if it dies they could lose roughly $17 - $350/acre at the general stumpage price of $35/Mbf.

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

Considerations for making an informed decision about hemlock and the threat of HWA

Every woodland owner and manager should consider **these factors to make an *informed decision*** about the future of their hemlock.

- ☑ **Financial:** what value might be lost?
- ☑ **Aesthetics:** what will my forest look like?
- ☑ **Ecological:** what will happen in the forest? Will it be healthy?
- ☑ **Habitat:** what wildlife will occupy the forest?
- ☑ **Liability:** what is the risk of people being injured by falling trees and branches?
- ☑ **Risk or probability of infestation:** how close is HWA to the property? Based on estimates of how it spreads, when might it arrive?
- ☑ **Future:** what are the alternatives?

There is no universally correct decision that can be applied to all situations. Different owners will place greater or lesser importance on the financial implications or ecological consequences. What is important is a thorough consideration of all factors prior to making a decision.

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, 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.

For more information on HWA and various control methods see:
http://na.fs.fed.us/fhp/hwa