5.1 INSECTS AND DISEASES

BACKGROUND

Endemic populations of native insects and pathogens are important in healthy forest ecosystems. However, introduced non-native exotics can cause excessive damage.

Insects are prey items at the very bottom of the food chain. Along with other decay organisms, some insects transform dead and dying plant material (including trees) into nutrients that feed new plants. Insects and diseases become problems when populations reach out-of-balance, epidemic levels. Tree-growth loss and mortality can occur and the economic impact can be severe. The most devastating insect and disease outbreaks often occur when non-native pests are introduced into locations where they have no natural enemies. Throughout North America, exotic insects such as balsam woolly adelgid, gypsy moth, pear thrips, Asian longhorned beetle, and emerald ash borer have all caused growth loss and mortality. Exotic diseases such as Dutch elm disease, chestnut blight, and butternut canker have virtually eliminated their host species.

OBJECTIVE

Reduce undesired mortality and growth loss from native pests, limit introductions of exotic pests, and eradicate new introductions as they are detected.

CONSIDERATIONS

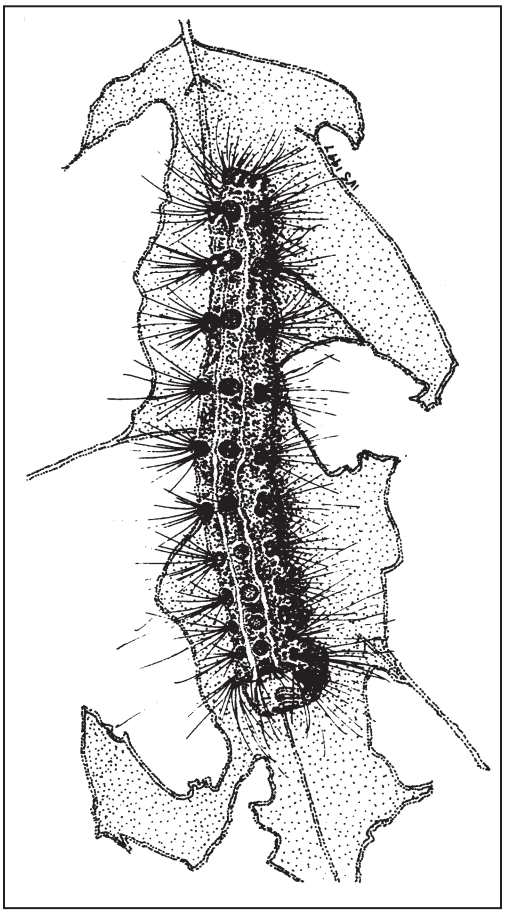
- Well-recognized benefits from natural-disturbance factors include the provision of dead and down woody material, snags and cavity trees for wildlife, and openings for regeneration. While native pests are part of naturally functioning ecosystems, many of the most destructive insect and disease problems are the result of exotic pests introduced into the state.
- While predators such as birds can't control outbreaks, they provide important constraints on insects at endemic population levels and can extend the period between outbreaks.
- Recommended pest control can conflict with other recommended practices. For example, removing trees with beech bark disease may conflict with recommendations to protect mast-producing beech showing evidence of bear use.
- Many regional and national activities have been implemented to limit damage by forest pests. Examples include introduction of biological controls, imposition of federal quarantines, and pheromone trapping.
- Exotic invasive pests found in neighboring states threaten New Hampshire's forests. Early detection will make the difference between success and failure with regard to their eradication. Knowing their signs and symptoms, their locations, and how they spread improves chances of detection and eradication. Internet searches and direct contact with state and federal forest health specialists can provide the latest information.
- State law (RSA 227-K:3) allows the director of the Division of Forests and Lands to designate control areas when localized infestations of exotic, non-native insects or diseases threaten to spread to adjacent lands. The law also requires landowners to take actions to control the infestation; if the landowner is unwilling, the State may take such actions.

- Forest-pest quarantines fall under the authority of the N.H. Dept. of Agriculture, Markets and Food and the N.H. Division of Forests and Lands (NHDFL).
- Pesticide applications in any form, from aerial applications to systemic applications, can have secondary consequences. Pesticide applications are strictly regulated by federal and state laws and may require several permits and licenses.
- The emphasis in this section is on silvicultural methods that may limit undue losses on individual ownerships. Where severe infestations from insects are already underway, regional biological or chemical control programs may be necessary. Maintaining populations of native predators such as birds and small mammals will help reduce the intensity of infestations.

RECOMMENDED PRACTICES

Defoliators

Defoliators feed on leaves or needles during the growing season. Common examples include spruce budworm and large aspen tortrix in the north, saddled prominent and forest tent caterpillar in central New Hampshire, and gypsy moth and hemlock looper in the southern part of the state. A forest diversified in both age structure and species composition limits susceptibility to defoliators. Most insects are host-specific and prefer one or two species of a particular age group (e.g., a large, uniform area of sugar maple is highly susceptible to forest tent caterpillars and a large area of mature fir to spruce budworm).



Gypsy Moth caterpillar

- ✓ Avoid partial harvests during an outbreak, as this will divert the epidemic insect population to fewer and more-exposed trees, and likely exacerbate defoliation and subsequent stress and tree decline.
- ✓ Don't partially harvest a stand until at least three years after the last major year of defoliation. After three years the weakest trees will be evident or dead. Until three years have passed, the defoliated stand is highly susceptible to residual logging damage. Defoliators reduce the amount of carbohydrates stored in the root system during the dormant season. Root damage and basal wounding from logging equipment compound the stress to residual trees and may cause growth reductions and branch dieback.
- ✓ Aerial pesticide applications are rare. When an outbreak is severe and the forest value exceptional, it may be appropriate but will require a special pesticide application through the N.H. Division of Pesticide Control. Contact the NHDFL forest health office for guidance.

Spruce Budworm: Increasing the proportion of spruce to fir and developing a mix of forest types and ages over several thousand acres will minimize spruce budworm. Consider the forest structure within a broader landscape rather than focusing on a single, small property.

- ✓ Spruce budworm prefers balsam fir and white spruce. Spruce budworm is most destructive and epidemic in 60-to-80-year-old stands with a high proportion of balsam fir. Approaches for

avoiding serious damage include (1) harvesting fir stands before they become overmature, (2) encouraging higher spruce-to-fir ratios through regeneration practices and early cultural work, (3) breaking up extensive stands of fir and spruce-fir with intervening hardwood or mixed-wood stands, provided that management objectives and site conditions permit, and (4) encouraging budworm predators.

- ✓ At least 49 bird species prey on budworm pupae, and 11 species are considered important predators at low to moderate levels. The most effective predators include: (1) in mature conifer mixtures—blackburnian warbler, golden-crowned kinglet, yellow-rumped warbler, and red-breasted nuthatch; (2) in brushy openings and edges—Nashville warbler, white-throated sparrow, and black-capped chickadee; and (3) in somewhat open, immature conifer stands and hardwood regeneration—magnolia warbler and solitary vireo.

Piercing-Sucking Insects

These insects are more chronic than the defoliators. Once infested, a stand remains infested for a long time. Hemlock woolly adelgid, balsam woolly adelgid, and elongate hemlock scale are non-native, exotic piercing-sucking insects.

- ✓ Though silvicultural practices don't result in true control, they can help reduce stand susceptibility to attack and vulnerability to damage.
- ✓ Proper stocking improves tree and stand vigor. Trees competing for growing space and nutrients are far more likely to succumb to chronic infestations.
- ✓ Harvest stands infested with balsam woolly adelgid in the winter because nymphs attached to tree tops can't survive. If the trees are cut in the summer, the insects are mobile enough to spread to uncut trees.
- ✓ Consult the quarantine map for hemlock woolly adelgid before harvesting hemlock. Any hemlock material from within the quarantine area needs to be certified clean of adelgid before shipment out of the zone (RSA 227-K). Hemlock stands can be certified clean of adelgid prior to harvesting by licensed foresters, UNH Cooperative Extension county foresters, NHDFL personnel, or other professionals specifically trained by the NHDFL.
- ✓ If a hemlock woolly adelgid infestation covers less than one-quarter acre, cut and burn the hemlock foliage before harvesting. If the infestation is larger than one-quarter acre, it's likely the infestation can't be eradicated before harvesting. The infested products must remain inside the quarantine area. Contact the NHDFL for further information and for mills and burn facilities inside the regulated area.
- ✓ Insecticides work well for these insects, however access and tree size may limit their use. Adelgid populations are most successfully treated with soil injections, soil drenches or basal bark treatments to limit exposure to nontarget insects. Contact the NHDFL forest health office for specific information on products, dosages and application methods.

Beech Bark Disease: Managing to reduce or eliminate beech bark disease will take several generations of silviculture. Some beech trees, recognized by their clean, smooth boles with a minimal presence of the white woolly scale, are resistant to the beech scale insect that precedes infection by the *Nectria* fungus.

- ✓ In thinnings, selection cuts, and other partial harvests, remove trees heavily infested with the white, woolly scale or red, small fruiting-bodies of the *Nectria* fungus, including those rough-barked trees that show evidence of previous beech bark damage. To minimize regeneration by root suckers from these nonresistant trees, avoid damage to beech roots by logging on snow and keep skidding activity away from the cut beech trees to the extent possible. Alternatively, when the clean-barked, resistant trees are removed, encourage root-suckering by logging during snow-

free season and allowing moderate skidding activity near these resistant trees or groups of trees. Summer-cut sprouts of diseased beech have low vigor and don't persist well as compared to regeneration of healthy northern hardwoods on the same site.

- ✓ To reduce the percentage of beech, use larger openings to regenerate less shade-tolerant species that will out-compete the beech sprouts. Winter harvesting also will reduce sprouting due to reduced root damage.
- ✓ Leave trees with evidence of bear-claw marks.

Wood Borers and Bark Beetles

Sugar maple borer, oak borer, *Ips* beetles and *Dendroctonus* beetles are native New Hampshire borers and beetles. They tend not to grow past endemic levels and only attack stressed, dying, and dead trees. White pine weevil is a native borer that does attack healthy trees. The number of non-native, invasive wood boring insects in North America such as Emerald ash borer, Asian longhorned beetle, and sirex woodwasp is growing. Infestations continue to spread closer to New Hampshire each year. Once infested with these exotic pests, trees rarely survive more than a few years.

Asian Longhorned Beetle

- ✓ Keep the forest in diversified species, properly stocked, and minimize logging stress such as soil compaction and mechanical damage to residual trees.
- ✓ The only treatment for heavily infested monocultures (e.g., red pine plantations) may be complete removal.
- ✓ In the event of an infestation by non-native exotics, follow recommendations for control developed for the specific pest.

White Pine Weevil: To avoid excessive white pine weevil injury in the regeneration, maintain partial overstory shade.

- ✓ Grow white pine seedlings and saplings in shade (40 to 80 square feet of basal area or in small openings less than one tree height in diameter) until they have attained at least one unweeviled log height (18 feet). Conifer shade may provide more protection than hardwood shade, since early spring weevil activity (before hardwood leaves are out) is the most damaging to terminals. In addition to the direct effects of shade, overstory trees reduce the size and vigor of the leader, making it less attractive to weevils.
- ✓ In young, even-aged stands experiencing weevil damage, maintain high stand density to minimize the deformations caused by weevil injury. An approximate spacing of less than 6 feet by 6 feet is required for maximum effect.

Root Diseases

Root diseases result from a large group of fungi that cause decay, stress, reduced growth, and death. Common examples are *Armillaria*, and *Heterobasidion annosum* (formerly *Fomes annosus*). Root-attacking fungi such as *Armillaria* are present in almost all forest soils. Damaging root-fungi attacks require favorable moisture and oxygen conditions, a point of entry into the host tree, and low tree vigor, which combine to make it difficult for the tree to defend itself.

- ✓ *Armillaria* travels from cut stumps to stressed trees through the maze of root grafts in the soil. Space harvests more than 10 years apart to minimize root-rot infections from previous timber harvests.
- ✓ Limit damage to the roots and boles of residual trees.

Stem-Canker Diseases

Stem-canker diseases are fungi that attack the stem, shoots and branches and cause lesions or dead areas on the stem. Common examples include *Nectria* canker, *Caliciopsis*, blister rust, chestnut blight, and *Eutypella* cankers.

- ✓ Remove trees with stem cankers. Spores are produced from the margins of infected areas and can infect surrounding trees.
- ✓ For rust diseases that require an alternate host, eliminating the nontimber alternate host is the best control. Gooseberries and currants should be absent within several miles of a young white pine stand.
- ✓ *Caliciopsis* canker on white pine appears like a black mold on the upper stems of the tree. Often lesions weep pitch in streaks. Thinning infected stands to allow more sunlight and warmer air conditions improves the vigor of the residual trees and reduces the moisture conditions needed by the fungi. Remove the trees with heaviest infections.

Foliage Diseases

Foliage diseases result from organisms that attack needles and leaves. Common examples include *Anthracnose*, needlecast fungi, tar spot, and sooty mold.

- ✓ Hardwood foliage diseases are generally less serious than softwood foliage diseases, because hardwoods will drop the infected leaves and refoliate in subsequent years. The specific conditions of moisture, temperature, and host-susceptibility are sporadic and most heavy infections in hardwood forests last just one year. No control is usually needed.
- ✓ Spores overwinter on fallen leaves. In an urban setting, reduce the annual inoculum by raking and removing infected leaves.
- ✓ Softwood foliage diseases most often affect older needles and lower needles on the live crown. Thin stands to reduce the amount of spores and to reduce high-moisture conditions around the base of the trees.
- ✓ Remove the most infected trees in the stand.

Heart Rots

Heart rots are the decay fungi that penetrate to the center of a tree and rot the core from the inside out. There are white rots that feed on lignin and cellulose and red rots that feed just on cellulose. The red rots leave a brown or red brittle material, while the white rots leave a white coloring where lignin was removed. Fruiting structures of these diseases are often shelf-like conks attached to the sides of the tree.

- ✓ Remove trees with conks during harvesting, if leaving them poses a risk to property or personal injury.
- ✓ Avoid logging damage, specifically broken branches in the residual stand, to minimize the entry points for wind-blown spores.

Other Diseases

Other diseases are viruses, mycoplasma-like organism (MLO), and bacteria. Ash yellows is an MLO. The microbe is thought to be carried from tree to tree by leaf hoppers. These insects spend a period of time in

open grassy areas which may explain why ash yellows is more common in urban settings than in the deep forest.

- ✓ There is no control for ash yellows. Cut declining ash with serious signs and symptoms such as witches' brooms and epicormic branching on the bole of the tree.

CROSS REFERENCES

2.1 New Hampshire Forest Types; 2.2 Forest Structure; 2.3 Regeneration Methods; 2.4 Managing for High-Value Trees; 6.2 Cavity Trees, Dens and Snags; 6.3 Dead and Down Woody Material.

ADDITIONAL INFORMATION

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