Using Diverse Plant Species to Maintain Forest Health[1]

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Planting of disease resistant species is advocated for the management of forest diseases and insect pests. Laminated root rot in the Pacific Northwest and pests of Eastside Oregon and Washington and the California mixed conifer type are used as examples to demonstrate how planting diverse plant species combined with stocking control, limits pest problems on forest lands and recreation sites.

INTRODUCTION

Forest disease management has always been dependant upon the use of silvicultural methods. Manipulation of tree, shrub, and herb species on diseased sites has been and continues to be our main tool. We don't have much choice: there are no silver bullets. We don't have safe, cost effective chemical or direct control methods.

Most disease management involves vegetation management through altering species composition. Choice of species to plant or favor depends on three factors:

1. What plant species will not be unacceptably damaged by the particular disease or complex of diseases present on the site? What is the relative degree of tolerance or resistance exhibited by various candidate species?

2. What are the ecological amplitudes of candidate plant species? Which plants are really adapted to the particular sites?

3. What is the management objective? Which plants are best suited to attaining desired objectives in both the short and long term. What are the time constraints, social and political pressures that need to be considered?

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MANAGEMENT OF LAMINATED ROOT ROT IN THE PACIFIC NORTHWEST

Diverse plant species can be used to suppress, prevent or manage many different forest pests. One successful example is management of laminated root rot on the westside of the Cascades and Coast Range of Washington and Oregon. Laminated root rot, caused by the fungus Phellinus weirii, is a disease of the site. The causal fungus survives for up to 50 years in old infected stumps or snags. New regeneration of susceptible species becomes infected when its roots contact the roots of the old stumps and snags and the fungus grows across onto the new hosts. Subsequent spread occurs from tree to tree via root contacts forming radially expanding infection centers (Hadfield et. al, 1985).

Different native forest tree species vary in their susceptibility to Phellinus weirii. Douglas-fir, grand fir, and mountain hemlock are very susceptible; they are readily infected and usually killed by the pathogen. Death may result from windthrow or the tree's roots may be rotted away sufficiently to make it impossible for the tree to obtain sufficient water and nutrients.

Western hemlock, spruces, and noble fir are considered to be intermediately susceptible; they are often infected but rarely killed by P. weirii. These species may develop a butt rot. The cedars and pines are tolerant or resistant to P. weirii. They are rarely infected and almost never killed. All hardwoods are immune to P. weirii (Sinclair et. al, 1987).

In natural ecosystems P. weirii is an agent for diversity. The fungus selectively kills highly susceptible tree species which often occur in relatively pure, heavily stocked stands. It creates openings of various sizes, usually from .1 to 10 acres in size.

These openings fill in with less susceptible plant species. Depending on the location of seed sources, less susceptible conifers or immune hardwoods, especially shrub species, may dominate. In these centers, species richness is often greatly increased. Habitat for deer is also increased by the juxtaposition of cover in the surrounding forested areas and browse contained in the regenerating openings. Habitat for cavity nesting birds and mammals is also enhanced by the creation of a continuous supply of snags in many stages of deterioration (van der Kamp, 1991).

The recommended management regime takes advantage of the difference in susceptibility of various species to P. weirii. It mimics nature, but gives the land manager control of species composition in infection centers. To reduce or eliminate laminated root rot we recommend removing all susceptible hosts from disease centers and 50 foot buffer zones and regenerating openings with intermediately susceptible, tolerant, resistant or immune species that are adapted to the site (Hadfield, 1985).

Currently in areas where timber production is the management objective, our preferred species for use in disease pockets on the west side of Oregon and Washington are blister rust-resistant western white pine or sugar pine, western red cedar, and red alder. Western hemlock is also frequently used.

In Pacific Northwest recreation areas the occurrence of laminated root rot is of increasing concern. The amount of disease in developed sites, especially in old-growth Douglas-fir stands, is sobering and is a major safety concern because of the likelihood of windthrow. Where laminated root rot centers are being treated in recreation sites, long term needs are very different from those in timber production areas. Desired attributes of vegetation include fast growth, shade tolerance, resistance to trampling, screening capability, and aesthetic appearance as well as disease resistance.

The following species have been planted into diseased portions of recreation areas: Pacific yew, western red cedar, incense cedar, blister rust-resistant western white or sugar pine, shore pine, western hemlock, red alder, black cottonwood, big leaf maple, vine maple, dogwood species, Pacific madrone, tanoak, Oregon hazel, ocean spray, cascara, choke cherry, huckleberry species, blood current, willow species, and osoberry. This list is not exhaustive; other species might also be useable but as yet have not been considered.

DISEASE AND INSECT COMPLEXES IN EASTSIDE OREGON, WASHINGTON, AND CALIFORNIA MIXED CONIFER TYPES.

Disease and insect complexes in Eastside Oregon, Washington and in the California Mixed conifer type may also be managed by planting a diverse mix of tree species. Stands in these areas once were open and park-like, composed largely of seral species, and maintained by frequent, low-intensity fires. Due to fire exclusion and high-grade logging, these stands have changed dramatically in the last 70-80 years and are now rather uniformly dominated by shade-tolerant tree species, especially white and grand fir and, in some cases, Douglas-fir.

Diseases and insects have major affects on these very damage-prone species. Damage has attained the proportions of a "Forest Health Crisis" in some areas. Major influencing agents include the following pests:

a. Armillaria root disease on true firs and Douglas-fir
b. Annosus root disease on true firs. C.
Dwarf mistletoes on true firs and Douglas-fir (and other species as well)
d. Indian paint fungus on true firs
e. Western spruce budworm and Douglas-fir tussock moth on true firs and Douglas-fir
f. Bark beetles on true firs, Douglas-fir, and pine species

Pests develop in stands with particular species compositions, stand structures, and stocking levels. Infected stands tend to be composed of high proportions of true firs that seed back readily. There often is a continuous progression of regeneration, reinfection by root diseases, damage by other insects and diseases, and mortality. Many areas, though stocked with firs at any given moment are in a chronic state of decline and trees never reach maturity.

These pest-riddled stands are multi-storied, which greatly favors spread and intensification of dwarf mistletoes and defoliating insects. The stands tend to be very heavily stocked, promoting bark beetle activity and facilitating root to root spread of root disease organisms.

Conditions favoring insects and diseases that affect true fir components are likely to intensify, especially if single tree selection, uneven age management systems are used in these types. Also, if such management schemes are employed and fire is successfully excluded, natural establishment of tree species other than true firs and Douglas-fir will become less and less common (Schowalter, 1991).

To promote healthier conditions in Eastside mixed conifer stands, we advocate actively establishing a greater mix of species including seral species and hardwoods at every opportunity, especially in areas where existing true fir-dominated stands are experiencing noticeable impacts due to defoliating insects and root diseases. We also recommend careful attention to stocking control. We view insecticide spraying as only a band-aid measure that may buy a little time but only affects some of the important pest populations and has no long term effect on stand conditions.

We recommend the following:

a. Create openings, prepare sites, and, in the absence of opportunities for natural seeding, plant western larch, ponderosa pine, lodgepole pine, blister rust-resistant white pine, sugar pine, and/or incense cedar. Seed supply problems need to be overcome for some species, especially larch. Whenever possible center openings on root diseased areas.

b. Do not attempt to eliminate true firs and Douglas-fir from sites, but try to keep the proportion of total stocking that they represent under 30%. Discourage these species in root-diseased areas.

c. Encourage or actively establish groupings of hardwood trees and shrubs, especially in areas where wildlife management is a concern. Feature quaking aspen, serviceberry, willow species, ceanothus, ninebark, and huckleberries.

d. Practice stocking control to keep basal areas below 120 square feet per acre.

CONCLUSION

Planting diverse tree species into diseased areas can limit the spread and development of many forest pests. Increasing species diversity, combined with stocking control provides increased wildlife habitat and a more scenic forest. Managing species composition in diseased areas is critical to counteract the dominance by shade tolerant, disease prone species in forests where fire is excluded.

LITERATURE CITED

Hadfield, J.S. 1985. Laminated root rot - a guide for reducing losses on Oregon and Washington forests. USDA Forest Service. Pacific Northwest Region. Portland, OR. 16 p.

Hadfield, J.S., D.J. Goheen, G.M. Filip, C.L. Schmidt, and R.D. Harvey. 1986. Root diseases in Oregon and Washington forests. USDA Forest Service. Pacific Northwest Region. Portland, OR. R6-FPM-250-86. 27 p.

Schowalter, T.D. 1991. Roles of Insects and Diseases in Sustaining Forests. Paper presented at the Silviculture, Forest Genetics and Tree Improvement, Forest Pest Management, and Soils session at the SAF National Convention, held at San Francisco, CA on August 4-7, 1991.

Sinclair, W.A., H.H. Lyon and W.T. Johnson. 1987. Diseases of trees and shrubs. Comstock Publishing/Cornell University Press. Ithaca, N.Y. 575 p.

van der Kamp, B. 1991. Pathogens as agents of diversity in forested landscapes. The Forestry Chronicle. 67:4(353-354).