Generally, the final cut should be made before the seedlings are taller than the average snow depth or about 10 years of age. Prior to this the seedlings provide only a small target and most seeds landing on seedlings will be removed by snow before they have germinated.

Stand conversion to nonsusceptible species is effective but generally more radical than is required for dwarf mistletoe control.

Reduction: Infested overstory removal and thinning of heaviest infected understory trees will reduce dwarf mistletoe losses to acceptable levels in many stands.

WHITE PINE BLISTER RUST

Seventy percent of the commercial forest land on the Clearwater National Forest is composed of vegetative habitat types that are desirable for growing western white pine 5/. Western white pine is among the most valuable and fast-growing tree species in the Northwest. Yet in 1968 its management on National Forest lands was suspended (Ketcham et al. 1968). White pine blister rust, caused by *Cronartium ribicola* Fisch., had made white pine management uneconomical because of high mortality rates. More than 30 years ago efforts to breed blister rust resistant western white pine began. The fruits of this labor, "resistant stock," have been tested and are available to the Clearwater Forest through the Inland Empire Tree Improvement Cooperative. Resistant stock matched to site blister rust hazard combined with other silvicultural control procedures may yield highly productive white pine stands (Hoff et al. 1976, Steinhoff 1971, McDonald 1979).

Sources of Loss

Losses to blister rust are mortality, tree value degrade, and discrimination against white pine as a timber species. Mortality is greatest in seedlings and saplings. Larger poles and mature trees are more tolerant because they are less readily girdled. Value degrade is less important than mortality. Poles and mature trees may be deformed by top-killing cankers; resinous wood surrounding cankers is less millable.

Discrimination against western white pine in managed stands results in a less tangible loss. Differences in wood value between white pine and other tree species accounts for most of this loss. However, white pine has additional merit in its resistance to some important root disease pathogens. It can replace Douglas-fir and grand fir where these species are severely affected by root disease.

Present and Potential Losses

Losses or potential losses must be measured on a stand-by-stand basis. Blister rust damage is influenced by zoological, climatic, and genetic characteristics of each site and stand.

5/ Gene Norby; Minutes of Clearwater Western White Pine Management Committee meeting November 1981 in Moscow, Idaho.

Ribes viscosissimum and R. sanguineus are "upland" species, they tend to be scattered over disturbed sites. Other ribes species are largely restricted to streamsides. Because blister rust spores travel short distances from ribes bushes (only about 50 feet, functionally) to infect pines, the distribution of ribes bushes greatly influences the amount of damage in a stand (McDonald 1979).

Several types of blister rust resistance in white pine also are known, so ribes ecology and white pine genetics are usable for blister rust control.

Losses are also influenced by the prevalence and ages of white pine in a stand. Other tree species in a stand will intercept a proportion of the spores reducing the likelihood of white pine becoming infected.

These principles can be used to develop western white pine management systems for stands on the Clearwater National Forest. Such a system is being developed by Gene Norby (silviculturalist, Clearwater National Forest) and the Clearwater Western White Pine Management Committee. Survey information including stand composition, rust incidence (status) and ribes species and distribution should be used to develop stand management plans.

Management

Control procedures should be integrated and practiced throughout rotations for most effective blister rust control.

Following are four phases in stand management which may include recommended blister rust control measures.

1. Thinning phase.

a. Poor trees, with obvious stem infections, should be removed (Hoff and McDonald 1977) and species mixture maintained. White pines should be thinned to maximize growth between 10 and 25 years of age. They are most likely to contract lethal infections while in this age group, so bringing them through this stage as quickly as possible will minimize infection rates (McDonald 1979). If ribes hazard is high because of upland ribes species present or seed sources nearby, steps to reduce ribes populations following thinning may be appropriate (McDonald 1979).

2. Intermediate cutting phase.

a. Trees with healthy full crowns and good form should be selected for crop trees (Hoff and McDonald 1977).

b. Dead and dying trees may be salvaged where economical.

3. Harvest phase.

(a) Shelterwood silvicultural systems can be used to suppress ribes in stands in which ribes hazard may be high. White pines which are disease free, fast growing and best formed should be left (Hoff and McDonald

1977). A species mixture should be maintained.

(b) Seedtree silvicultural systems utilize natural resistance in regenerating sites. Leave trees selected are disease free, fast growing, and best formed (Hoff and McDonald 1977). If ribes hazard is high, control measures may be taken. A species mixture should be maintained.

(c) Clearcut silvicultural systems provide greater opportunity for utilizing tested resistant stock, but can also result in higher levels of ribes populations and proportionally increased hazards. Some ribes control as a part of brush control operations may be advantageous within a few years of harvest, especially if broadcast burning is prescribed.

(d) White pine planting stock should have resistance matched to rust hazard index of the site. If hazard is low the stock may be derived from local disease-free trees. A species mixture should be maintained.

4. Stand replacement may be judged necessary in severely affected stands coming under management. In these cases consideration should be given to the possibility that hazard is too high to raise white pine.

STEM DECAYS

Echinodontium tinctorium (E. & E) E. & E. (Indian paint fungus) in true firs and western hemlock and Phellinus pini (Thore ex Fr.) Pil. in the pines, western larch, western hemlock, Douglas-fir and, to a lesser extent, grand fir are the most damaging stem decay agents on the Clearwater National Forest. Phaeolus schweinitzii (velvet top fungus), causing brown cubical root and butt rot, is also prevalent. This pathogen has been discussed under "Root Diseases" and should be managed as a root disease.

E. tinctorium and P. pini

Damage is greatest on wet sites at lower elevations in slow growing, dense stands. Infection takes place through stubs of dead branchlets. Most infection occurs after trees are about 40 years old (Maloy and Gross 1963) because this is the age where most stands have closed sufficiently for shade-killing of lower branchlets (Ethridge and Craig 1976).

Cool, moist air conditions favor sporophore production, and subfreezing temperatures stimulate spore germination. E. tinctorium may remain inactive for 40 years or more after invading branchlet stubs (quiescent infection). Wounding may be among the factors stimulating development of decay from previously quiescent infections. This is likely the case for P pini infections as well.

Management

Stagnated stands with symptoms of infection may not be cost-effective to thin; stimulation of quiescent infections in such stands results in low-value crops (Ethridge and Craig 1976).

Young stands on hazardous sites should be thinned to increase vigor and air flow preventing infection (Ethridge and Craig 1976), (Maloy 1967). Trees without signs of infection and nonsusceptible or less susceptible species may be favored in thinning.

Avoid wounding to prevent infection or activation of quiescent infections during thinning and partial cutting.

Defective trees should be removed to salvage the remaining volume. Cull factors are listed in the Forest Pest Management Training Manual 6/ and should be used in estimating merchantable volume. Severely affected stands should be scheduled for early harvest.

Nonsusceptible species can be managed on high E. tinctorium hazard sites, i.e., in wet bottoms where the pathogen is abundant.

6/ Available from Forest Pest Management, Regional Office in Missoula.

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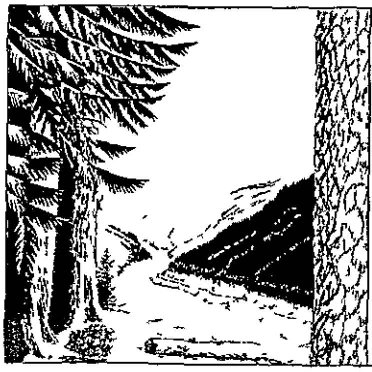

Appendix P
Documents Available on Request

APPENDIX P

DOCUMENTS AVAILABLE UPON REQUEST

The following documents provide more detailed information for specific areas of the Clearwater National Forest, and Regionwide direction. Except where noted otherwise, each document is available from:

Forest Supervisor
Clearwater National Forest
12730 Highway 12
Orofino, Idaho 83544

1. Selway-Bitterroot Wilderness Management Guide.
2. River Guide - Middle Fork of the Clearwater including the Lochsa and Selway.
3. Management Guides - Middle Fork of the Clearwater including the Lochsa and Selway - 1973.
4. Lochsa River Whitewater Floating Management Guides, June 29, 1984.
5. Clearwater Forest Visitors and Travel Plan Map, (1986).
6. Lolo Trail System Implementation Guidelines, (Draft July 1985).
7. Northern Regional Guide, June 10, 1983, (available from Regional Forester, Missoula, Montana).
8. Clearwater National Forest Best Management Practices, 1985.
9. Establishment Report - Lochsa Research Natural Area.