United States Department of Agriculture | **Forest Service** | Northern California Shared Service Area | **2400 Washington Ave. Redding, CA 96001 530-242-2335**

File Code: 3420 **Date:** October 25, 1999
Route To:
Subject: Evaluation of Insect and Disease Conditions at the Divide-Auger Timber Sale Area (FPM Rept. N00-1)
To: Forest Supervisor, Mendocino NF

On October 4, 1999, Dave Schultz (Entomologist) and I accompanied Jesse Rosenquist and Jim Harvey to the Divide-Auger Timber Sale Area of the Grindstone Ranger District. The purpose of the visit was to evaluate the potential impacts of insects and diseases on various units of the proposed Divide-Auger Timber Sale, and to provide suggestions for management strategies that may be used to improve the health of the stands. Three units were visited- Units 21, 17 and 22. All units have a management emphasis for timber production, but are subject to wildlife, watershed and other considerations.

Unit 21

Unit 21 contains an overstory and understory mix of conifers, including white fir, red fir, sugar pine, and lesser amounts of Douglas-fir and ponderosa pine. Regeneration is generally plentiful. In the past, this stand probably had more pine and Douglas-fir, but over the years, fire suppression has resulted in an increase in the true firs. Many of the overstory trees are declining, showing flat tops and thinning crowns. Many diseases were noted in the stand. Annosus root disease, caused by *Heterobasidion annosum*, is scattered in pockets in the true firs throughout the stand. Density of the stand is relatively high, with at least 300 BA outside of the infection centers, and about 200 BA within the centers. Low-to-moderate levels of red fir dwarf mistletoe *(Arceuthobium abietinum,* f.sp. *magnificae*), white fir dwarf mistletoe (Arceuthobium abietinum, *f.sp. concoloris),* and sugar pine dwarf mistletoe *(Arceuthobium californicum)* were noted as well. Cytospora cankers, caused by *Cytospora abietis,* were likewise present, associated with dwarf mistletoe infections in the red and white firs. The canker fungus caused branch mortality on its hosts. White pine blister rust *(Cronartium ribicola)* was also present in some sugar pines. Because of the combined effects of disease, this stand is stagnating, and without treatment, will continue to unravel.

Recommendations:

Impacts due to disease are high in this stand, but because of the current high stocking levels, treatment during the upcoming harvest is feasible. A combination of overstory removal and understory sanitation thinning is recommended. Removal of most of the overstory (up to 85%) will help the understory trees to release, while leaving enough trees for wildlife and snag recruitment. While overstory tree selection should favor the pines and Douglas-fir as leave trees, some of the best looking red and white firs may also be retained. Dwarf mistletoe-infected sugar pines, red fir and white fir should likewise be removed. Sugar pines with multiple bole cankers from white pine blister rust may also be removed. Sanitation thinning in the understory should focus on the removal of diseased and poor-form trees, leaving the best pines and Douglas-fir, along with some red and white fir. Where stocking is a concern, some lightly-infected (DMR<2)

sugar pines, red fir and white fir may also be retained. Because annosus root disease is scattered throughout the stand, it is not feasible to perform removals of individual infection centers. However, since vigorous true firs can usually regenerate root tissues faster than they are lost to the root disease, red and white firs with good form may also be chosen for retention. In addition, because annosus root disease can spread aerially by spores, great care will need to be taken to avoid the wounding of residual leave trees. Freshly created stumps are also very susceptible to infection. Application of a borate fungicide to stumps larger than 12 inches in diameter is recommended to reduce the aerial spread of the fungus. Sporax is the material currently registered for this use. Because of the overall good regeneration in the area, seedlings will probably not need to be planted. However, any areas that are understocked after treatment should be planted with ponderosa pine, Douglas-fir or rust resistant sugar pine.

Unit 17

Unit 17 contains a multi-layered canopy of Douglas-fir, ponderosa pine, sugar pine and white fir. As at Unit 21, the overstory is stagnating. Disease problems are minimal at present, though minor amounts of flatheaded wood borer *(Melanophila drummondi)* were noted in the some of the Douglas-fir.

Recommendations:

As at Unit 21, this unit would benefit from overstory removal and thinning in the understory. Again, at least 15% of the overstory will need to be left to address wildlife concerns. Thinning in the understory should again concentrate on retaining the most vigorous trees, while favoring Douglas-fir, ponderosa pine and sugar pine over white fir. Again, since annosus root disease is present in the area, application of Sporax to all stumps over 12 inches in diameter is recommended. Any planting that is done should also be of ponderosa pine, Douglas-fir or rust resistant sugar pine.

Unit 22

Unit 22 cantains a multi-layered canopy of Sugar pine, ponderosa pine, Douglas-fir and white fir, with lesser amounts of incense-cedar. As in Unit 21, stocking levels are high. While minor white pine blister rust cankers were noted in some of the sugar pines, moderate-to-high amounts of Douglas-fir dwarf mistletoe *(Arceuthobium douglasii)* were noted in the unit below the road, and lesser amounts were found above the road. Low amounts of white fir dwarf mistletoe and cytospora canker were also noted in the white fir. While there were not many stumps in the stand, minor amounts of annosus root disease were also found.

Recommendations:

Overstory removal (leaving a least 15%) and thinning in the understory is recommended for most of the unit. Again, removals in the overstory and understory should concentrate on retaining the

most healthy, vigorous trees, favoring the pines, Douglas-fir and incense-cedar. Trees with poor form and disease should be removed. However, because of the dwarf mistletoe in the Douglas-fir, more white fir (without dwarf mistletoe and cytospora cankers) may need to be retained than at the other units. While sanitation thinning should be sufficient to address the white fir dwarf mistletoe and cytospora canker situation throughout the unit, it is only sufficient enough to address the Douglas-fir dwarf mistletoe situation above the road. Below the road, the infestation level of dwarf mistletoe in the Douglas fir is high enough (DMR > 2 in parts of the stand) that sanitation thinning will probably not be effective. Small patch cuts, removing all infected Douglas-firs and all Douglas-firs one tree length from infected trees will be needed. Again, all new stumps over 12 inches in diameter should be treated with Sporax to address future annosus root disease concerns. Again, any planting that is done should be of ponderosa pine, Douglas-fir or rust resistant sugar pine.

To assist with the development of prescriptions for the Divide-Auger Timber Sale Area, I've included information on the biology of the pest organisms discussed above. If you have any questions or comments regarding the observations or recommendations in this report, feel free to contact me here in Redding. As always, I am available to assist with this project in any possible.

/s/ Pete Angwin
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BIOLOGY OF FOREST DISEASE ORGANISMS AT THE

DIVIDE/AUGER TIMBER SALE AREA

Dwarf Mistletoes

Dwarf mistletoes are parasitic seed plants which are generally host specific. Red fir dwarf mistletoe *(Arceuthobium abietinum* f.sp. *magnificae)* infects red and noble fir. White fir dwarf mistletoe *(A. abietinum* f.sp. *concoloris)* infects white and grand fir. Douglas-fir dwarf mistletoe *(A. douglasii)* infects Douglas-fir. Sugar pine dwarf mistletoe *(A. californicum)* infects sugar pine and western white pine. The dwarf mistletoes are obligate parisites which are completely dependent on their host for support, for water, and for most of their mineral and organic nutrients. Infection of trees by dwarf mistletoe results in reduction of growth, growth abnormalities, mortality, and predisposition to other pests. Dwarf mistletoe swellings on true fir provide openings in the host bark for invasion by the canker-causing fungus *Cytospora abietis*, and a favorable environment for growth and development of the fungus. Open bole swellings resulting from dwarf mistleote infections provide entrance courts for insects and decay fungi and weaken the tree at that point, making them prone to wind breakage.

Dwarf mistletoes spread between trees and within crowns by means of small seeds that are forcibly ejected into the air. A period of 4 to 6 years elapses between initial infection and shoot production. Spread from overstory to understory trees is limited to the distance traveled by the seeds. The lateral distance that seeds are dispersed is given by the rule of thumb: maximum distance potential is equal to the height of the dwarf mistletoe plant above the ground. Lateral spread of the parasite in an even-aged stand is probably somewhat less than 1 to 2 feet per year while the vertical spread within the crown averages 3 inches per year. In practical terms, the long life cycle and slow rate of spread means that the buildup of dwarf mistletoe in a stand is relatively slow. Saplings and poles growing more than a foot or more in height per year, and free from a source of overstory infection, will outgrow the effects of any dwarf mistletoe.

Cytospora Canker

The fungus *Cytospora abietis* causes a canker and dieback disease of true firs throughout their range. In California, dwarf mistletoe predisposes branches to attack by the fungus by providing openings in the host bark through which the fungus can infect. Together with the dwarf mistletoe, *Cytospora* is responsible for frequent and often severe branch flagging. *Cytospora* is generally a weak parasite, requiring a stressed or predisposed tree before it can attack. Other stressing factors that can predispose true firs to *Cytospora* infections are moisture stress and drought, wounds form fire or logging, weakening of trees from sudden exposure, and patch killing of the cambium by twig or bark beetles. Avoiding situations which create these stress factors, and removal of dwarf mistletoe-infected trees, will reduce damage from this disease.

Annosus Root Disease

Heterobasidion annosum (Fomes annosus) is a fungus that attacks a wide variety of woody plants. In western North America, *H. annosum* consists of two intersterility groups, or biological

species, the 'S' group and the 'P' group. These two biological species have distinct differences in host specificity. To date, all isolates of *H. annosum* from naturally infected ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense-cedar, western juniper, pinon pine and manzanita are of the 'P' group. Isolates from true fir and giant sequoia are of the 'S' group. This host specificity is not apparant in isolates occupying stumps, with both the 'S' and 'P' groups recovered from pine stumps, and the and the 'S' group and occasionally the 'P' group from true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for many years. Young conifers of a species that is susceptible to the particular intersterility group established near these stumps often die shortly after their roots contact infected roots in the soil.

New annosus root disease infection centers begin by aerial spread of spores and subsequent colonization of freshly cut stump surfaces and/or basal wounds. The fungus then spreads via root contacts into the root system of adjacent live trees. In pines, it grows through root cambial tissue to the root crown where it girdles and kills the trees. In less resinous species, such as true firs, the fungus sometimes kills trees, but more frequently it is confined to the heartwood and sapwood of the larger roots where it causes a butt rot and reduced tree growth. Thus, while infection in true fir usually does not kill the host, it does affect its growth and thriftiness. Losses in true fir from *H. annosum* are mainly the result of butt rot, windthrow resulting from root decay, and predisposition of trees to attack and eventual death by bark and flatheaded and roundheaded borers.

Vigorous young firs are usually able to regenerate root tissues faster than they are lost to the root disease. But when true firs slow in growth because of stand or site conditions, root development decreases to where there is a net loss in roots and the trees slowly decline due to the gradual loss of their root systems.

Stumps are susceptible to infection immediately after cutting. Ponderosa pine, Douglas-fir, and coast redwood stumps remain susceptible to infection for 2 to 4 weeks. The decrease in susceptibility with time is probably a result of colonization of the stumps by microorganisms that compete with and replace *H. annosum*. Prevention of annosus root disease includes treatment of freshly cut conifers with registered products. Sporax is the borate fungicide currently registered for this use. Borate is toxic to the spores of the fungus and prevents germination; it does not have an effect on existing infections. Other preventative treatments include carrying out silvicultural activities to lessen stand susceptibility to the disease and minimizing logging damage and mechanical injuries.

White Pine Blister Rust

White pine blister rust is caused by the fungus *Cronartium ribicola*, an obligate parasite that attacks sugar and western white pines and several species of *Ribes*. The fungus needs the two alternate hosts to survive, spending part of its life on the 5-needled pines and the other of *Ribes.* Infection of pines results in branch mortality, top kill, and tree mortality.

Spores are produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to *Ribes* where they infect the leaves. Spores produced in orange pustules on the underside of the leaves reinfect *Ribes* throughout the summer, resulting in an intensification of

the rust. Another spore stage forms on *Ribes* leaves in the fall. These spores are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After 2 to 3 years, spores are produced on the cankers and spread to *Ribes* to continue the cycle. Although blister rust may spread hundreds of miles from pine to *Ribes,* its spread from *Ribes* back to pine is usually limited to a few hundred feet.

Branch cankers continue to enlarge as the fungus invades additional tissues and moves toward the bole. Branch cankers within 24 inches of the bole will eventually form bole cankers. Bole cankers result in girdling and death of the tree above the canker. Cankers whose closest margins are more than 24 inches from the main bole are unlikely to reach the bole and only branch flagging will occur.

Environmental conditions are critical during the infection processes and limit the disease in most years. Moisture and low temperatures favor infection of both hosts, and must coincide with spore dispersal for infection to occur. In California, these conditions occur only infrequently, usually in cool moist sites such as stream bottoms or around meadows. When these favorabble years (wave years) occur, high levels of infection can result. Wave years have occurred at approximately ten year intervals in the past. As one moves from sites most favorable for rust to less favorable sites, the frequency of wave years decreases.