FOREST HEALTH AND TIMBER HARVEST ON NATIONAL FORESTS IN THE BLUE MOUNTAINS OF OREGON

A REPORT TO GOVERNOR KITZHABER

by

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June 15, 1995

For John Lowe

John 5/16/95

Your people did you proud. Our entire Team was impressed with the dedication and professionalism of the Forest Service in the Blue Mountains. Your District people are working diligently to improve forest health under a very challenging set of rules and procedures. I hope that this report gives them encouragement. Thank you for all your help.

Norm Johnson

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Major Points

1. The east-side "forest health problem" should be defined broadly to consider forests, streams, and watersheds.

2. Most of the forest in the National Forests of the Blue Mountains is alive, but much of it has recently experienced severe problems:

a) Sizable amounts of certain species, such as Douglas-fir and true firs, have died as a result of overcrowding on drier sites, drought, and insects. Historical forest management practices (fire exclusion, harvest practices) have contributed to the problems.

b) Large stand-replacing (crown) wildfires have recently occurred, due to a build-up in fuels, in forests where that type of fire behavior was historically infrequent.

c) A major portion of the live forest is under stress because stands are too dense, especially the true fir/Douglas-fir understories beneath pines and larch, which increases the likelihood of future mortality in both the understory and overstory.

3. Restoration treatments, including thinning and fuel reduction, could reduce the risk of loss from insects and fire on large areas of these forests.

a) Forests at highest risk are primarily in the low and moderate severity natural fire regimes (ponderosa pine, Douglas-fir, and dry grand fir types). Forest restoration should start here, with reduction in live tree density and fuel loadings, concentrating on the smaller live tree component (eg., thinning from below).

b) The more "boom and bust" types of fire disturbance regimes were naturally a part of the cooler, higher elevation ecosystems, with stand-replacing fires approximately every 100-300 years. Intensive treatment there may actually move the ecosystems away from natural (historical) conditions.

c) In general, treatment should begin in upland zones and work down to lower- priority riparian zones.

d) Active management of forest stands can help recreate the historical mosaic of stands in different conditions that offers natural firebreaks and less concentrated food sources for insects.

c) Cumbersome, overlapping processes to implement the laws that guide National Forest management. The major environmental laws have helped bring about a more ecologically-sound approach to National Forest management. The current complexity in their implementation, though, could unnecessarily slow salvage and restoration work.

11. With the environmental controls on timber harvest now in place, the major risks to aquatic systems come from other sources (such as sedimentation from existing roads and grazing in riparian areas).

12. Monitoring and internal and external review will be important to ensure that management works toward desired goals.

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Acknowledgements

A large number of people contributed to this project. Dean George Brown of the College of Forestry provided financial support and encouragement. Regional Forester John Lowe said that we would have the complete cooperation of the Forest Service and he made good on this commitment in every way. Charles Philpot, Director of the PNW Station, provided his support and encouragement.

Forest Service employees from the Long Creek and Bear Valley Districts of the Malheur National Forest, Ukiah District of the Umatilla National Forests, and La Grande District of the Wallowa-Whitman National Forest guided us though their respective Districts and patiently answered our questions. We were uniformly impressed with the dedication of these fine people.

The Natural Resource Branch of Region 6 made the information on the Blue Mountain National Forests available to us as we needed it. Sarah Crim, John Nunan, Julie Johnson, and John Teply were all very helpful.

Kashare Eagle, a June graduate in Forest Management in the College of Forestry, coordinated our field trip. Debbie Johnson helped prepare the report.

We, of course, are solely responsible for the analysis and conclusions reported here.

Introduction

Objectives

In March, 1995, Governor Kitzhaber asked a group of forest, watershed, and fishery scientists to meet with him to help him understand forest health and salvage issues in the management of the National Forests of eastern Oregon. After that meeting, the Governor sent a letter to the scientists asking for an analysis of these issues.

In that letter (Appendix A), the Governor said "I want to thank each of you for your participation in the forest health meeting on Feb. 21, 1995. The discussion provided me with a better understanding of the environmental and economic sideboards for federal timber harvest."

"Based on the momentum of that meeting, I am asking you to take an additional step in charting a course for this administration. I would like you to participate in a work group over the next five weeks to further define environmentally sound timber harvest. The challenge to the group would be to establish principles for environmentally sound timber harvest, and to propose examples for implementation in the short term. Our goal is to identify specific harvest opportunities under current law that would promote (or at least not substantially degrade) forest health, and provide short-term volume."

Paula Burgess, the Governor's Advisor for Natural Resources, wrote a letter further describing our assignment (Appendix A). In that letter, she ask that we describe principles for environmentally sound timber harvest with examples for different ecological conditions, make estimates of the number of acres and volume potentially available for harvest in different ecological categories, do an economic analysis of the harvest opportunities, and describe obstacles and impediments to harvest.

Procedure

We decided to focus on the Malheur, Umatilla, and Wallowa-Whitman National Forests--the National Forests of the Blue Mountains--in our analysis. We made this decision for two major reasons: 1) much of the forest health discussion has centered on the Blue Mountains, 2) the National Forests of the Blue Mountains lie in close proximity to each other to ease our field tour of the issues.

Following several organizational meetings and discussions by participating scientists, a field trip to the Blue Mountains in late March initiated our evaluation. Norm Johnson spent the week before the field trip in the Blue Mountains touring the area and designing the three day tour. With the help of the Forest Service and others, we attempted to design a tour that would expose us to the major forest, watershed, and stream conditions in the Blue Mountains. Our schedule on that field trip was as follows:

Event	Time
Arrive in John Day	Friday night
Meet with members of the Long Creek and Prairie City Districts of the Malheur NF.	Saturday morning
Tour the Vinegar Hill area of the Middle Fork, John Day, with employees of the Long Creek District, Malheur NF.	Saturday afternoon
Tour the Cave Creek watershed with employees of the Ukiah District, Umatilla NF.	Sunday morning
Meet with a Louisiana-Pacific forester to discuss wood utilization	Sunday afternoon
Meet with employees of La Grande District, Wallowa-Whitman NF on the upper Grande Ronde River	Sunday afternoon
Hold group meeting to discuss issues, Starkey Experimental Forest.	Sunday afternoon
Tour Grande Ronde River watershed with employees of the La Grande District, Wallowa Whitman, NF.	Monday morning
Return to Corvallis	Monday evening

Five members went on the complete tour. Others attended portions of it, but all were there for the Sunday sessions. Paula Burgess joined us for the Saturday tour.

During our field tour, we spent many hours at different sites and conditions in the Blue Mountains discussing and debating the current conditions of these forests, watersheds, and streams, the causes for their condition, and how they might be improved. The color photos in the next section and the text that follows documents some of what we saw and some of our ideas about conditions, causes, and remedies. All scientists agree that a field tour was an extraordinarily useful way to both become more familiar with the resource issues in a short time and provide a backdrop to discuss and debate forest health issues.

After that trip, we had numerous group meetings to organize and synthesize our findings, knowledge, and understanding into a draft report. It might not be surprising that we had a healthy debate about a number of issues as we hammered out our conclusions.

Presentation to Governor Kitzhaber

We presented the draft report to Governor Kitzhaber on April 7, 1993. In that presentation, we relied heavily on a set of slides, mostly taken on the trip, to illustrate major issues and conclusions. Many of those photos are included in the picture section here.

Governor Kitzhaber's office then made a limited distribution of our draft report.

Preparation of the Final Report

Since April 7, we have been documenting our findings and writing the final report as best we can among our other responsibilities. In this process, the scientific team met a number of times.

In addition to this introductory section, we have added a number of other sections to the final report as compared to the draft report : 1) a set of pictures documenting our trip and our findings,2) maps showing the progress of insect infestations in the Blue Mountains, 3) a revised, documented, and slightly expanded set of major points in the body of the text, and 4) an appendix on logging system alternatives and their economic implications.

The National Forests of the Blue Mountains and the Pattern of Recent Insect Outbreaks

Figure 1. The national forests of the Blue Mountains. Cross-hatch indicates management allocations in the Forest Plans which contain lands suited for timber production. (Note: some of the land within these allocations is not suited for timber production for a variety of reasons including lands that are unstable and within riparian buffers.)

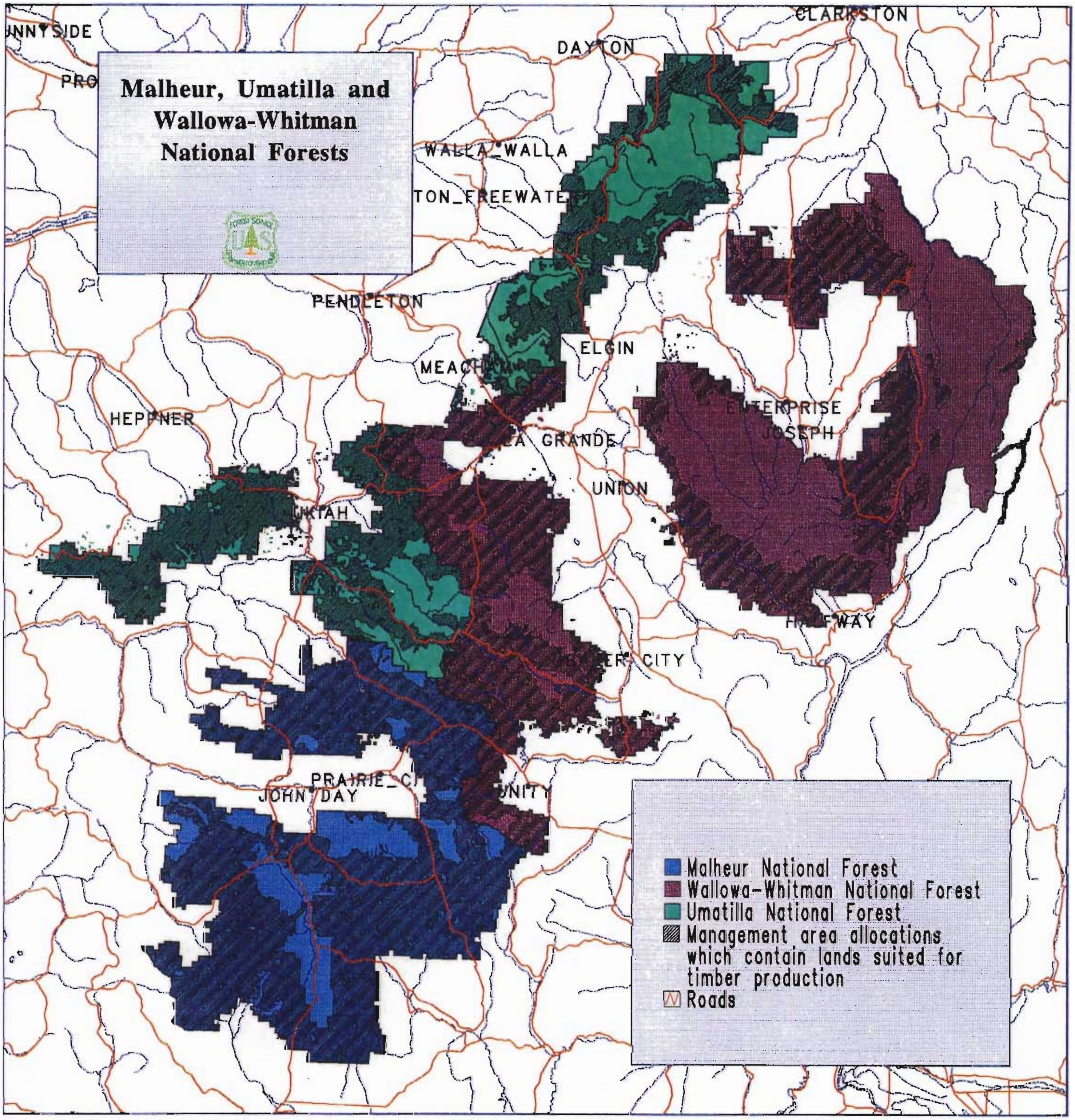
Figures 2-5. Insect and disease activity on the Blue Mountain National Forests from 1991-1994. Note: "budworm" includes the western blackheaded budworm, modoc budworm, and western spruce budworm; "fir beetle" includes Douglas-fir beetle, Douglas-fir engraver, fir engraver, and western balsam bark beetle (sub-alpine fir); "pine beetle" includes mountain pine beetle, ips, western pine beetle.

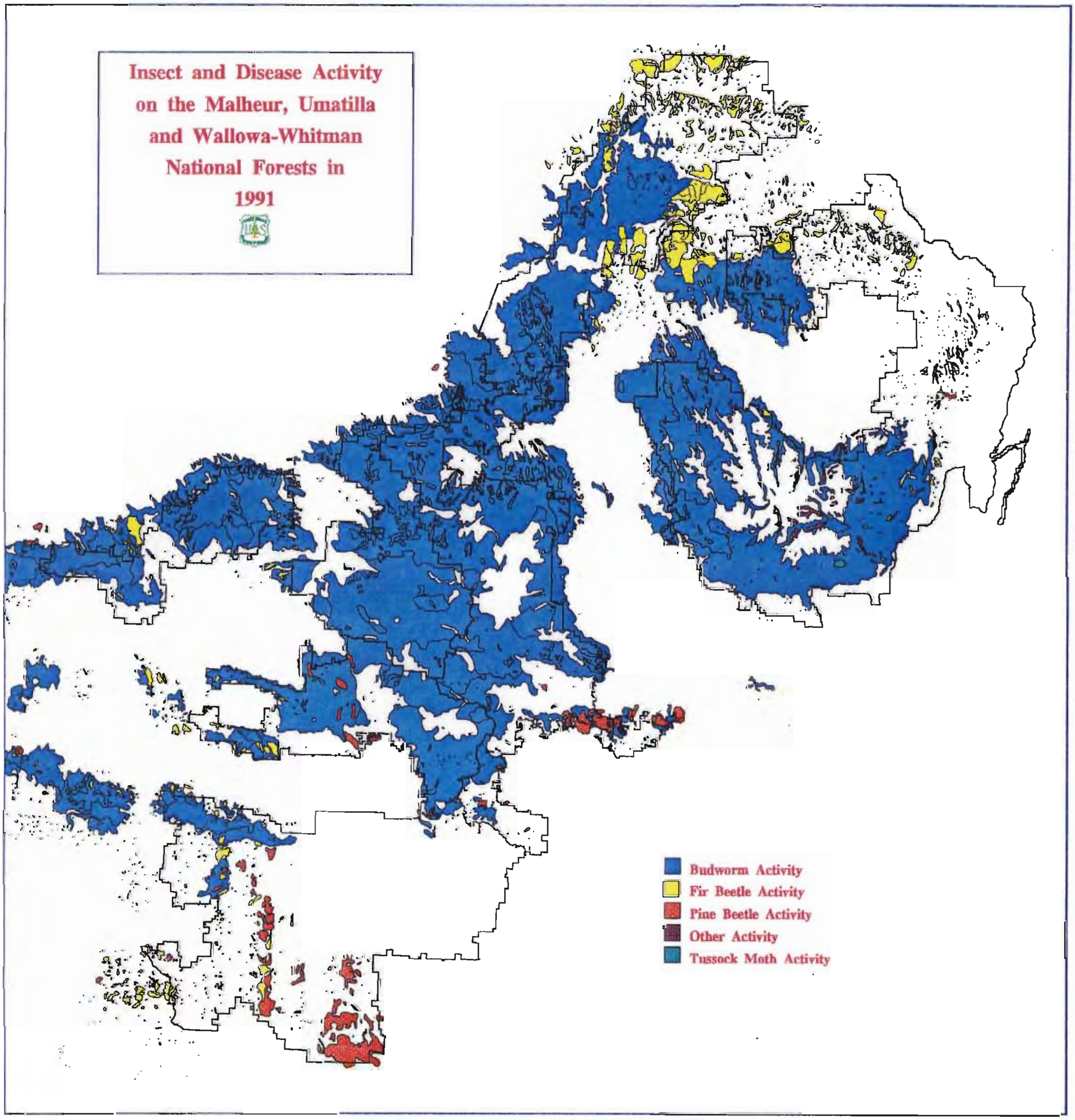
SEE FOLLOWING PAGES FOR FIGURES

Forest Health and Timber Harvest in the Blue Mountains: A Pictorial Summary of Conditions, Causes, and Potential Remedies

Note: all pictures were taken by members of the Study Team on their field trip to eastern Oregon, except for the last three that show low-impact logging which were taken by Loren Kellogg on a separate trip.

SEE FOLLOWING PAGES FOR PICTURES


Malheur, Umatilla and Wallowa-Whitman National Forests
CLARKSTON
DAYTON
WALLA_WALLA
TON_FREEWATE
PENDLETON
ELGIN
MEACHAM
HEPPNER
ENTERPRISE
JOSEPH
LA GRANDE
UNION
UKIAH
HALFWAY
CITY
PRAIRIE_CI
JOHN DAY
UNITY
Malheur National Forest
Wallowa-Whitman National Forest
Umatilla National Forest
Management area allocations which contain lands suited for timber production
Roads


Insect and Disease Activity
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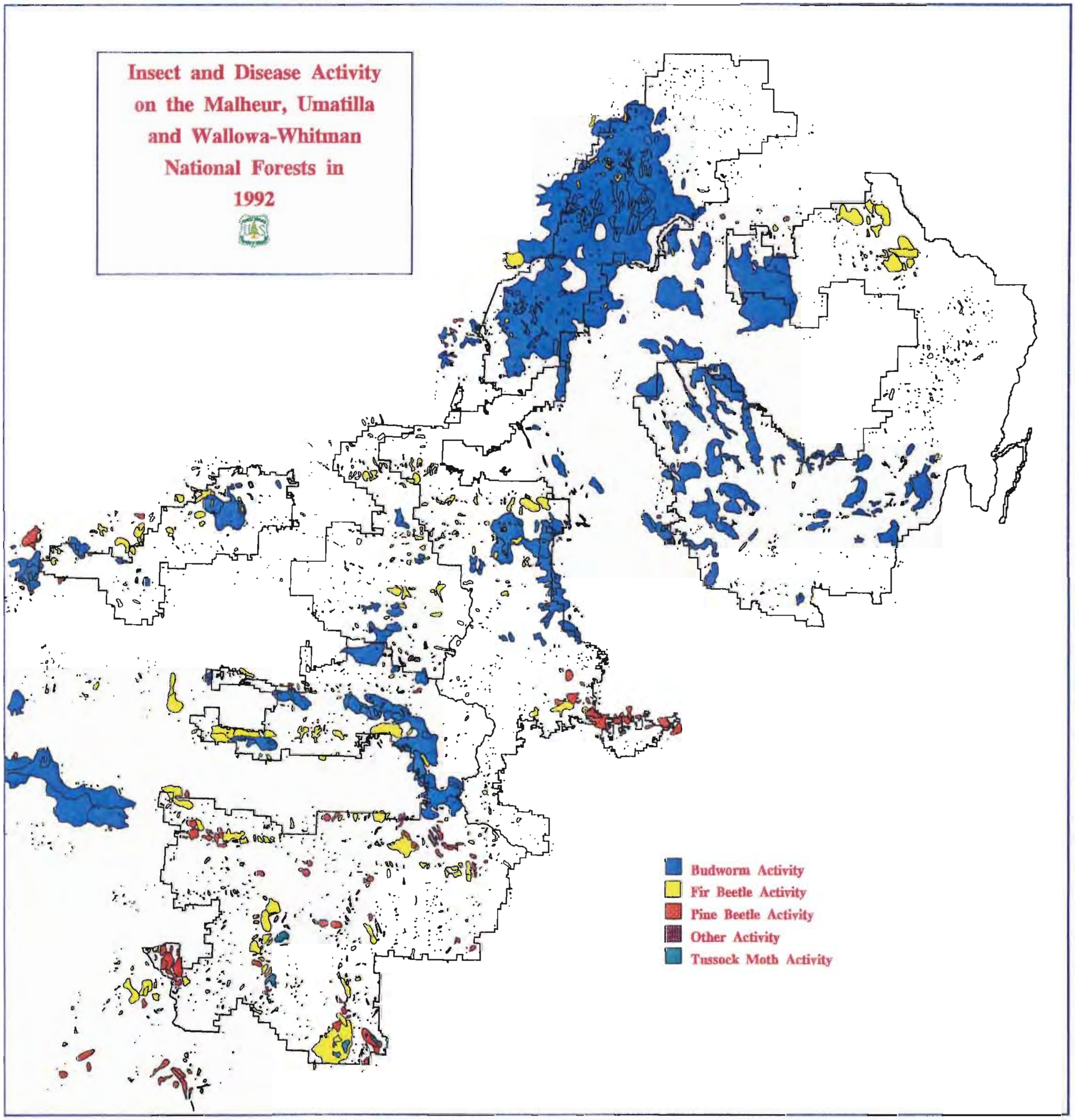
and Wallowa-Whitman
National Forests in
1991
Budworm Activity
Fir Beetle Activity
Pine Beetle Activity
Other Activity
Tussock Moth Activity



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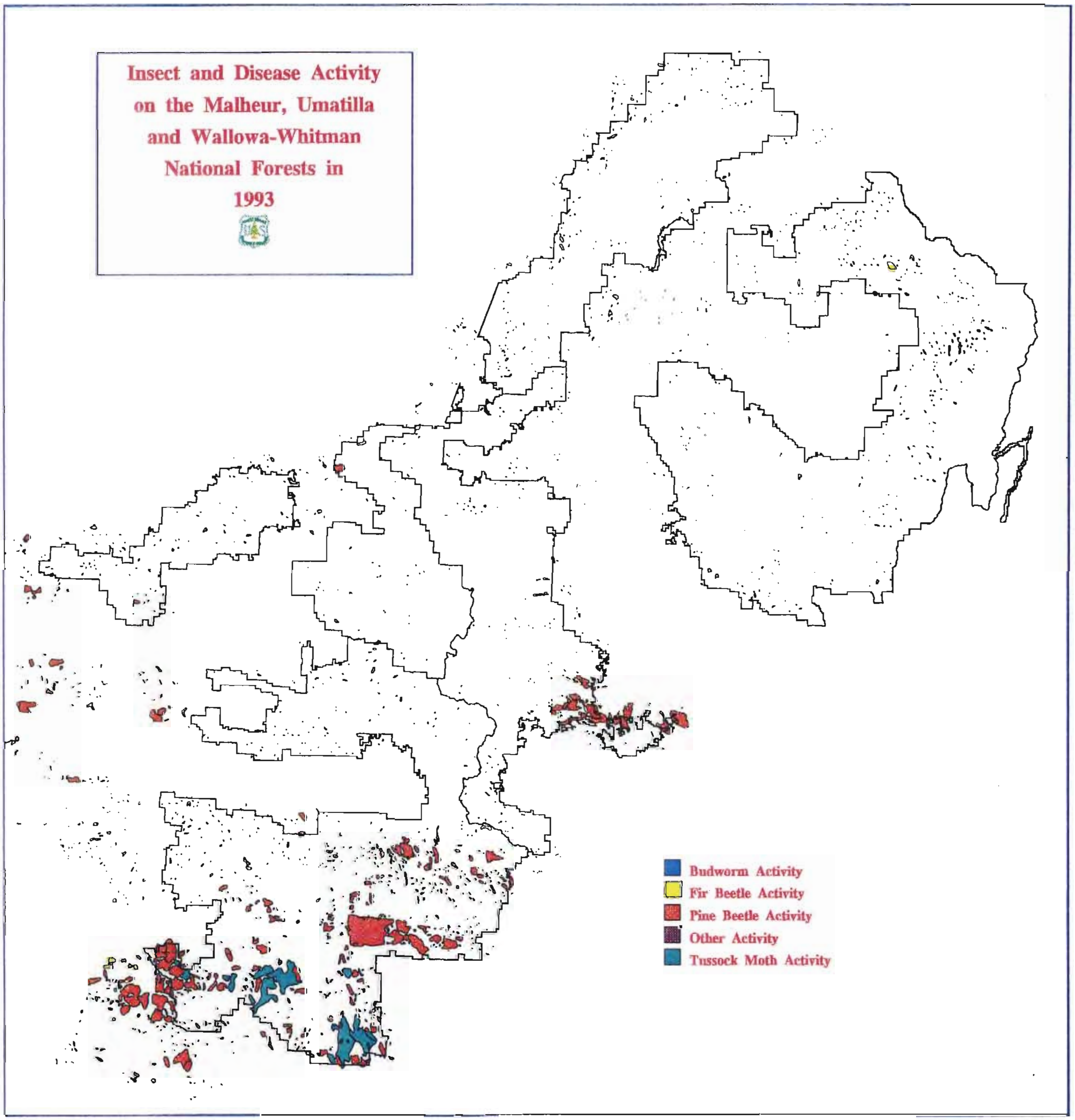
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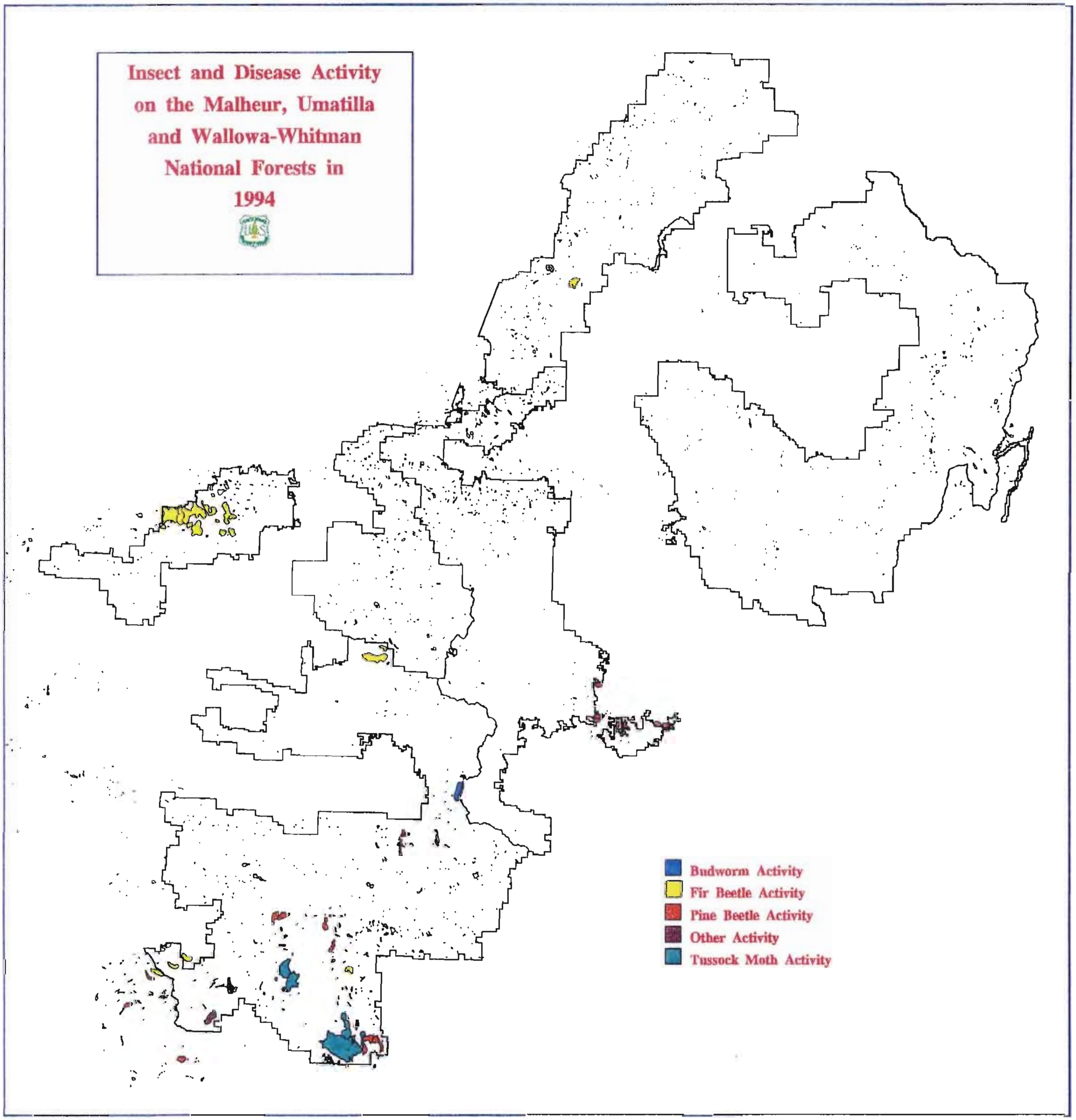

Insect and Disease Activity on the Malheur, Umatilla and Wallowa-Whitman National Forests in 1994
Budworm Activity
Fir Beetle Activity
Pine Beetle Activity
Other Activity
Tussock Moth Activity

P1. The Study Team: Front row (l to r) - Norm Johnson, Steve Tesch, Jim Sedell, Tim Schowalter; back row - John Beuter, Loren Kellogg, Jim Agee, Bill McComb, Bob Beschta, Stan Gregory.

P2. Paula Burgess (Governor's Advisor for Natural Resources) and her daughter, Sasha, with Jim Agee on the Malheur NF in front of a typical thicket containing a few large pines and many small grand fir and Douglas-fir.

P3. Large crown fire from a few years ago near Burns on the Ochoco NF. High intensity fires like this one are more common now than in the past on lower elevation, drier sites because of a build-up in fuels.

P4. Recent fire at mid elevation on the Malheur NF.

P5. Steve Tesch walks through a part of a recent fire that burned in a spotty fashion (Malheur NF).

P6. Concentrations of dead trees from attacks a few years ago by spruce budworm and other insects (Umatilla NF).

P7. Tim Schowalter (cowboy hat) explaining how and why insects killed these grand fir and Douglas-fir (Umatilla NF). Accumulating biomass in such stands increases competition for water which, when exacerbated by recent drought, stresses the least drought-tolerant trees (grand fir & Douglas-fir) and increases their susceptibility to insects and pathogens. Patches of dead timber, such as these, can be seen in many parts of the Blue Mountains.

P8. While most of the insect outbreaks occurred a few years ago, insect attacks (here Douglas-fir beetle) continue sporadically, especially in overly-dense stands (Wallowa-Whitman NF).

P9. Watershed of the middle fork of the John Day River on the Malheur National Forest. Most of the forest is alive, although much of it may be at densities that create stress, especially during drought.

P10. This open pine stand represents conditions which were widespread before fire suppression. Low intensity ground fires burned every 10 to 20 years, reducing fuel loads and limiting regeneration of trees.

P11. Without regular low intensity fires, regeneration of ponderosa pine develops beneath these large old trees. This natural process occurs over many more acres than it did historically.

P12. Before fire suppression and timber harvest, this stand was dominated by both western larch and ponderosa pine that retained their dominance in the stand as a result of regular fire. Without fire, the previously open understory has become much more dense and now includes Douglas-fir and grand fir that are prone to insects and disease.

P13. On more moist sites, without low intensity fire, ponderosa pine can be replaced by Douglas-fir or grand fir. Due to absence of fire, this old pine stand has developed a second layer of 80-year old Douglas-fir. A fire in this stand can now burn into the pine crowns via the "ladder" of Douglas-fir, in some cases killing old trees that could have survived low intensity fires of the past.

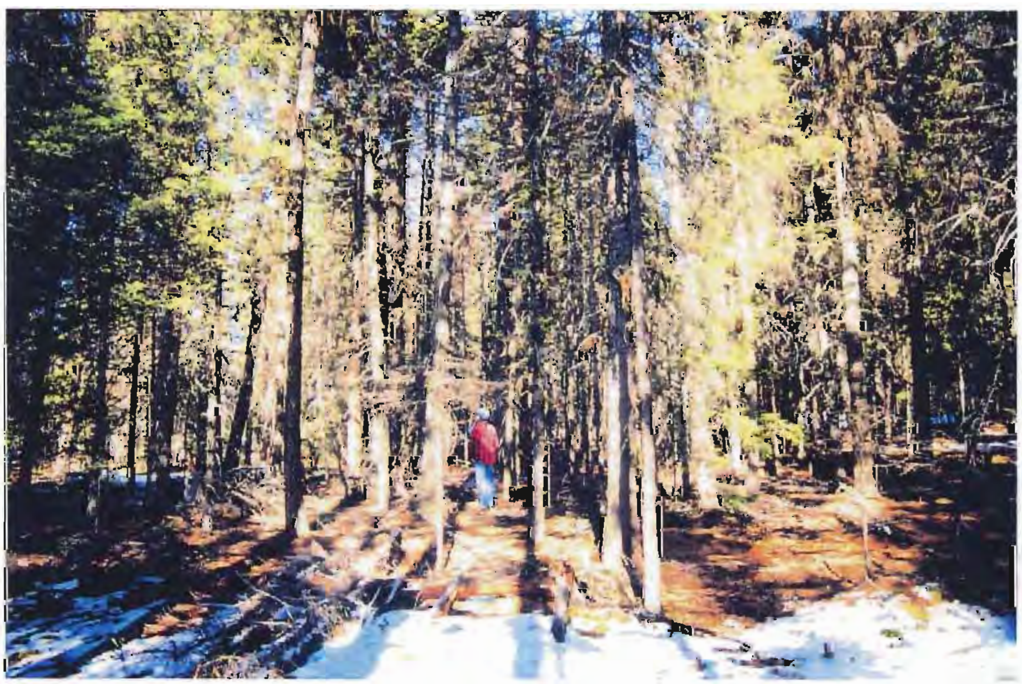
P14. Old ponderosa pine surrounded by a dense younger layer of more shade-tolerant species that have invaded in the absence of fire. Snags greater than 15 inches dbh are important nest sites for cavity-nesting birds in these forests. Retention and management of snags for these species should be considered during development of prescriptions.

P15. Death of understory Douglas-fir and grand fir results in improved water availability to surviving trees, a process similar to that occurring in the center of this photo. Subsequent harvesting of the dead trees provides no further water-related benefit to the large, old, overstory trees, although salvage of the dead understory can reduce fuels and the risk of crown fire.

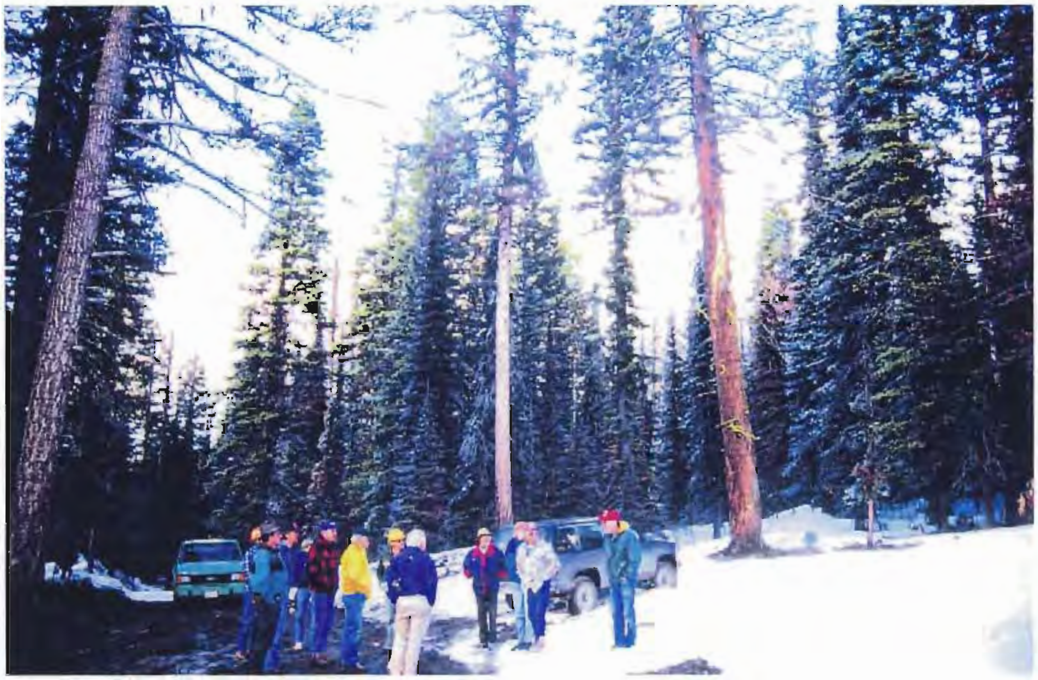
P16. A common management objective is to promote the occurrence of resilient, open stands with little understory and hence less risk of severe crown fires. Thinning to remove the dense understory, as is shown in this photo after completion, can be an effective treatment regardless of whether the understory is alive or dead. Then, prescribed burning may be introduced into the stand to maintain its open character.

P 17/18. Many acres of dense, young pine stands occur in eastern Oregon as a result of past stand-replacing fires or harvest. Thinning of such stands can increase the vigor of remaining trees, reduce the incidence of insect attack, and reduce the risk of crown fires.

P 18a. On moist sites, dominance by grand fir and Douglas-fir is common in mature stands. Recent insect- and drought-related mortality has left some stands with few living mature trees. Natural regeneration of these species is usually abundant on these sites. If increasing the resiliency of future stands to fire and pests is an objective, promoting establishment of pine and larch, perhaps through site preparation and planting, may be desirable.



P 18b. In dense, young stands dominated by Douglas-fir and grand fir, thinning can improve the vigor of remaining trees and increase their chances of surviving future defoliation. At the local level, thinning is unlikely to prevent future budworm outbreaks, but widespread thinning across the landscape, especially where interspersed with non-host pine/larch stands, could reduce the scale, intensity, and duration of outbreaks.



P 19. High elevation true fir forest in which infrequent stand-replacing fires were a dominant part of the historic disturbance pattern. Here the ecosystem benefits of understory thinning would be more problematic.

P 20. The Grande Ronde River, home to spring chinook salmon listed as endangered under the Endangered Species Act. The best remaining spawning and rearing habitat on the river is located on the Wallowa-Whitman N.F.

P21. Results of a fire in the headwaters of the Grande Ronde River. Any salvage harvest in this draw would have the objective of maintaining or improving aquatic and riparian habitat and would only be done after a detailed watershed assessment.

P22. Streamside forest with large trees and down wood that help create a healthy stream environment (across the road from the burned riparian area above).

P 23/24. Dead trees adjacent to the stream create and provide structural complexity for stream habitats. PACFISH, a plan adopted by the Forest Service to protect and restore aquatic and riparian resources, calls for buffers of 50-300 ft., depending on stream category, until more detailed analysis is done.

P 25. An intermittent stream flows through a stand of grand fir/Douglas-fir that has been heavily impacted by insects during the recent drought. The adjacent forest interacts with small intermittent streams and wet draws by shading them and falling into them. Treatment of riparian management areas, including harvest, may be necessary on many of these streams on gentle topography in the Blue Mountains to restore the pine and larch forest and provide ecological functions several decades into the future. For many intermittent streams, a small buffer (less than PACFISH widths) of large trees will provide for aquatic and wildlife habitat while the remaining riparian management area and larger landscape are restored to their historic condition.

P 26. Example of a high-density road system on the Malheur NF made visible by a recent fire. The extensive road systems of the Blue Mountains provides access for salvage, thinning, and other treatments. They also cause concern as potential sources of accelerated sediment input into streams and of other environmental impacts.

P 27. Road closure and waterbars on old roads in the Blue Mountains can help reduce sediment production from the road system. Salvage, thinning, and other treatments potentially could provide the funds for this work, if they more than pay for themselves.

P 28. Low-soil impact mechanical equipment (single-grip harvester) for felling, limbing. bucking, and piling small logs on the 1994 Deerhorn Project southwest of Ukiah, OR. This machine cuts and processes trees in the forest and places tree limbs and tops on equipment trails. The limbs and tops provide a cushion as the machine travels over the ground which in turn reduces soil compaction and rutting.

P 29. Low-soil impact skyline yarding system at the landing on the 1994 Deerhorn Project. Small logs, as shown in this picture, can be economically harvested with these low-impact logging systems.

P 30. Logs partially suspended above the ground with a skyline logging system on the Deerhorn Project to reduce ground disturbance.

Current Condition of Forests, Streams, and Watersheds

1. The east-side forest health issue is real, but the majority of the forest in the Blue Mountains is not dead or dying.

a) Sizable amounts of individual species such as Douglas-fir and true firs have died as a result of overcrowding on drier sites, exacerbated by drought conditions. Historical fire suppression and harvesting practices have been primary contributors to this situation by allowing fire intolerant species to more fully occupy these sites. Sizable patches of these trees have been killed recently through a combination of drought, insects, and other causes. Dead trees are especially prevalent between Pendleton and John Day. Most of these trees appear to have died 2-5 years ago. See Figures 2-5 (placed just after the section of color pictures above) for the extent of attack by western spruce budworm and other insects in the last 4 years.

Budworm populations also were elevated in west-side forests in the vicinity of Santiam Pass from 1987-1992. Population densities were measured in 1992 at 3.5 larvae/kilogram of foliage (causing about 4% defoliation) in 100-150 yr. old mature Douglas-fir (forests with structure similar to east-side fir forests) at the H.J. Andrews Experimental Forest near Blue River (Schowalter 1996). These populations declined to 0 (no larvae in samples) by 1994 just as they did in east-side forests, suggesting that drought abatement rather than exhaustion of tree resources was responsible for the decline. In other words, renewed drought conditions could trigger resurgence of budworm populations in stands where dense fir understories remain and would be stressed again.

Fifteen to twenty percent of the standing forest on the National Forests in the Blue Mountains was dead according to a recent (1994) inventory, with about half of the dead occurring in the last five years. Most of the dead trees were grand fir or Douglas-fir. Many acres have relatively little standing dead, while other acres have significant concentrations. Ironically, some areas may be deficient in the sizes (> 15" DBH) of dead trees needed to meet the goals for wildlife trees in the Forest Service's current management guidelines. Ponderosa pine snags are especially scarce (Johnson and Cousar 1995).

b) Large stand-replacing wildfires have recently occurred in forests where that type of fire behavior was historically rare. These low- to mid-elevation forest types historically had low severity fire regimes, where fire was frequent but generally not intense (Agee 1993, Maruoka and Agee

1994). Small understory trees were removed by such fires, but the fire-tolerant large pines and larches were not damaged. Tree densities were low and grassy understories were common (Agee and Maruoka 1994). Selective logging of large trees and large increases in tree density after fire exclusion changed the nature of these forests (see pictures at the front of this document). Current forests, with lower average tree diameters and crown heights, support higher severity fires. The effect is region-wide, and not just a problem in the Blue Mountains.

High severity fire regimes have always existed in the region and the Blue Mountains. In the Blue Mountains these regimes were primarily in the subalpine fir zone and upper (moist) grand fir zone. Fewer acres per year may be burning in wildfires in the Blue Mountains than historically, but the severity of these fires, once overwhelmingly dominated by low severity, is now dominated by high severity fire (Agee, in press).

Dead and dying trees can increase the severity of a wildfire by increasing the residence time of fire and supplying higher amounts of dead (and therefore drier) fuel to the flaming passage of the fire. Removing this material can lessen potential fire intensity and severity and create conditions for higher probability of wildfire control.

c) Overall, much of the forest is alive. The forests of the Blue Mountains have made a recovery from the spruce budworm attacks of the early 1990s when much of the forests there appeared to be defoliated. Recent inventories substantiate that a significant majority of the standing forest is still alive and that insect infestations have dramatically declined in the last two years (See Figures 2-5 and Johnson and Cousar 1995).

2. A major portion of the live forest is under stress because stands are too dense, especially the Douglas-fir and true fir understories beneath pines and larch, which increase the likelihood of future mortality in both the understory and overstory. Past practices, such as fire suppression and overstory removal, have made the historical pine/fir forests vulnerable to fire, insects, and disease--the ecosystem's natural mechanisms for controlling forest structure. What we are now seeing, in part, is the ecosystem's biocontrol of an invasive component of the native flora. With competition from invasive Douglas-fir and true firs reduced via drought induced mortality, the health of surviving pines and larches, which are tolerant of growing conditions on these sites, should improve.

Two factors are commonly credited as responsible for the poor condition of many east-side forests. These are a) the dramatic shift from forest types once dominated by seral stands of ponderosa pine to successionally-advanced stands Douglas-fir and true fir, and b) the overstocking of millions of acres with more trees than the typically moisture-limited sites can support (Mason and Wickman 1994).

The result of human-induced changes, specifically fire suppression and partial harvesting, on east-side ecosystems is that large areas are now in a condition which is considered to be outside the range of natural variability of healthy ecosystem processes (Caraher et al. 1992). For example, sixty years ago, 74 percent of the commercial forest land on the east side was classified as ponderosa pine timber type, much in old-growth condition (Cowlin et al. 1942). Through natural succession, aided by fire suppression and harvest, a significant portion of this landscape has been replaced by stands classified as mixed-conifer timber type, frequently with an overabundance of the tolerant species (Anderson et al. 1987). On drier sites where clearcutting or stand replacement fires occurred, the old-growth ponderosa pine type has been replaced with frequently overstocked stands of second-growth ponderosa or lodgepole pine that are periodically attacked by mountain pine beetle (Gast et al. 1991).

Desirable large, old trees are often very sensitive to competition from developing understory. In multi-layered stands on poorer sites, many large, old ponderosa pine trees are weakened by understory competition and die from insect attack. Some mortality can be avoided by removing understory biomass. After mortality, growing replacement large diameter trees will be a very slow process in densely-stocked stands of smaller-diameter trees. Prescribed burning or thinning regimes that provide growing space for individual trees can speed up diameter growth in those stands.

The role of insects and disease

Insects and disease are an integral component of forest ecosystems and a major component of biodiversity (Schowalter 1994)--they are not the cause of decline in east-side forests. Healthy trees produce various chemical defenses that deter or kill insects and pathogens. These defenses cost the tree energy and nutrients that otherwise would support growth and reproduction. As a result, healthy trees and forests support small populations of insects and pathogens (see references in Schowalter 1994).

Stressed trees are a natural component of every forest and provide refuges for many insects and pathogens that maintain small, scattered populations on these trees. As long as such trees remain isolated over the landscape, insects and pathogens dispersing from these trees have limited capacity to locate other stressed trees, and populations remain small. Only when unfavorable growing conditions stress large numbers of trees can insect and pathogen populations grow (Schowalter 1994 and references therein). In fact, leaving some dead and dying trees is necessary to provide refuges for the diversity of insects and pathogens that contribute to ecosystem structure and function as well as for cavity nesting birds and other species that prey on insects.

Epidemic insect or pathogen populations can overcome the defenses of relatively healthy trees. In other words, when outbreaks develop on landscapes populated primarily by stressed trees, even trees growing under favorable conditions are exposed to tree-killing numbers of insects or pathogens. For this reason, budworm and bark beetle outbreaks generated by stressed understory firs on upland sites spread to firs in riparian and high elevation forests and kill trees that would otherwise have been resistant to insects and diseases.

Dense forests are most vulnerable to outbreaks of insects and pathogens adapted to detecting and reaching scattered, isolated, stressed hosts. When closely spaced hosts are stressed by increasing competition for water and nutrients, especially when water becomes less available due to drought, these insects and pathogens have shorter distances to travel, lower mortality rates en route, and higher survival and reproduction on the new host. These factors lead to rapid population growth (Schowalter 1994, Schowalter et al. 1986). Although drought conditions currently have abated, leading to reduced budworm and bark beetle populations, stands with dense fir understories will inevitably become stressed again, as growth increases demands and competition for water and nutrients and/or drought conditions return.

In other words, the forest health problem has not gone away (the insects and pathogens were not the cause of declining conditions in the first place), and the current health problem will persist (though mortality to remaining trees may be slowed in the immediate future as long as moist conditions prevail) until the fir understory is removed (either by insects or thinning).

3. Riparian/aquatic systems have been substantially altered in many places.

a) Because riparian/aquatic systems occupy relatively low topographic portions of the forest landscape, they are easily affected by a wide variety of upslope or near-stream activities. Acre-for-acre, the highest concentration of use has often occurred in riparian influence zones. Activities such as road and home location, logging, recreation use, and cattle use have often concentrated near streams. While many of those practices have been stopped or modified to have less impact, a legacy of past practices remains with us in many cases.

Because historical management practices were directed at controlling ground fires and selectively removing overstory trees while retaining relatively dense stands of understory trees, the likelihood of severe burns for many portions of east-side forests has increased in recent years (Agee 1990). Where severe burns occur, they may result in significant increases in the delivery of sediment to stream systems and undesirable impacts to aquatic resources particularly in high-density roaded areas (Beschta 1990). Such a situation recently happened on the Wallowa Whitman National Forest when a thunderstorm that occurred immediately following the Tanner Gulch Fire greatly increased sediment loads in the upper Grande Ronde River and caused serious impacts on the fisheries in the roaded portion of the drainage. In yet other situations on east-side forests, road networks may significantly increase instream sedimentation above background levels (see point #4).

While erosional responses from site disturbances typically decrease over time (McNabb and Swanson 1990), continued road construction, inadequate road maintenance, increased frequency and severity of wild fires, or ground-based harvesting of erosive sites can perpetuate higher levels of sediment production from mountain watersheds. Furthermore, long-term grazing in riparian systems (see point #20), while a direct impact to riparian/aquatic ecosystems of east-side forests, can also exacerbate deleterious aquatic habitat effects of sediment production from upslope sources.

b) Loss of large pools is a special cause for concern. For a number of Northwest streams, researchers have compared the number of large deep pools per stream mile--a primary indicator of high quality, in-channel habitat condition--to the number documented during surveys conducted between 1935 and 1945. For the Grande Ronde River, as an example, they found a loss of 2/3 of its large pools in the last 50 years (McIntosh, et.al. 1994)

c) The listing of some fish stocks that use the streams of the Blue Mountains under the Endangered Species Act, and the consideration of others for listing there, will require special consideration of any activities that might effect these species or their habitat.

The National Marine Fisheries Service has determined that the Snake River fall and spring/summer chinook salmon is endangered pursuant to the provisions of the Endangered Species Act based on projected decline in adult Snake River chinook salmon abundance. Spring chinook use the Grande Ronde River system and all Forest Service activities in that drainage that might effect the habitat of the chinook, or the fish themselves, require consultation with NMFS.

In addition, bull trout are being considered for listing by the USFW. Within the Blue Mountains, habitat for these trout generally exists on mid-to high elevation sites on the National Forests. Many stream systems on these National Forests, including the Middle Fork of the John Day river contain bull trout habitat.

4. High road densities, in conjunction with historical location, design, construction and maintenance practices, have contributed, and are contributing, to sedimentation rates above background levels.

Of all the possible precursors to increased sediment production from forested watersheds, perhaps none are more important than roads (Furnish et al. 1991). Historically, many National Forest roads were built along stream systems because these locations provided relatively "easy" construction sites and convenient access to various subbasins within a watershed. Such roads often occupied a sizable portion of the riparian area, locally caused the permanent removal of streamside vegetation, altered moisture pathways from hillslopes to channels, provided direct sources of sediment from road surfaces, and sometimes necessitated channel straightening and filling.

For unsurfaced haul roads, especially those with relatively steep road gradients and significant amounts of vehicular use, erosion from the road surface represents an important concern. And unsurfaced haul roads are the most common type of road in the National Forests of the Blue Mountains. Similarly, where road drainage systems are largely nonexistent, or have been inadequately installed or maintained, the potential for erosion increases. Because of the ease of roading on east-side forests and the logging systems that were used, road densities are some of the highest in the Pacific Northwest; in some instances they may exceed 10 miles of road per square mile of watershed area (Henjum et al. 1994).

The Forest Service is currently attempting to reduce the potential erosional impacts associated with roads by a variety of techniques (e.g., obliteration, closures, drainage improvement, relocation of "drawbottom" roads, improved maintenance). Because existing road networks are extensive, prioritizing sediment abatement projects is necessary to address those road segments having the highest probability of delivering increased sediment loads to stream systems. While erosion from certain roads represent an important concern to the quality of aquatic habitats, it is important to recognize that many of the existing roads may not be significant contributors to sedimentation. Thus, blanket prescriptions intended at reducing or minimizing road-related sediment production should not be simply applied to all roads; road-specific assessments and prescriptions will likely be the most efficient means of reducing road-related sediment production.

5. A wide variety of practices and policies have created the forest health problems in eastern Oregon including fire suppression, harvest practices, road practices, recreational use, cattle management, and channelization and other watershed management practices.

The forest health issues currently faced by east-side forests are not the result of a single management practice operating over a short period of time. Instead, a variety of practices and policies over a period of decades have culminated in creating the current situation. Thus, alteration of only a few management practices for a short period of time is unlikely to provide an immediate solution to forest health problem(s). Many relevant practices (e.g., roading, harvesting, grazing) must be considered if we wish to restore functional forest ecosystems. Even then, it will be many years before wide-spread improvements of many forest health issues will begin to emerge.

Human-Forest Relationships

6. Forest resources contribute significantly to the economies of eastern Oregon.

a) The economies of eastern Oregon have been traditionally rooted in natural resource-related industries, including timber, ranching and other agricultural production, and secondary wood products. Some of these economies have also been partially reliant on employment and income from the presence of land management agencies and from activities related to recreation.

The timber industry has long been an important part of the economy in many parts of eastern Oregon. The economic overview for eastern Oregon in "Timber for Oregon's Tomorrow" focused on contributions of the timber industry to the region's economies in 1988. The economic sectors included in the assessment were logging, sawmilling, plywood and veneer preparation, pulp and paper, and other wood products manufacturing. Throughout eastern Oregon in 1988, timber-related industries employed 14,500 people, representing approximately 12% of wage and salary workers and 12% of wage and salary payrolls (Sessions et. al. 1991). About half of the timber industry employees were in the Bend-Redmond-Prineville area.

The 1991 report went further by estimating the amount of wage and salary employment and income that is "timber supported" to be 19% and 13% of the region's totals, respectively (Sessions et. al. 1991). In 1988, therefore, Sessions et al estimate that approximately 31% of employment and 25% of wage and salary income in eastern Oregon were directly or indirectly dependent on the timber industry.

Since 1988, the proportionate contribution of the timber industry to wage and salary employment has dropped somewhat but the proportionate contribution to wage and salary income has remained relatively constant (as of 1993) (See Aldred Check and Johnson 1995 for more information on the economic importance of the timber industry).

For perspective, wage and salary workers make up about 3/4 of the total work force in Eastern Oregon. Other workers include "self-employed", which in eastern Oregon involves many people in ranching and farming, retail, and other occupations and unknown number of people in the timber industry. Wage and salary income makes up about 2/3 of total income with the rest coming from the self-employed and dividends, rents, retirement income, and related sources.

b) Resource-based recreation now makes a significant contribution to the economies of eastern Oregon. Throughout Oregon, outdoor recreation/tourism plays a notable role in the economy. Eastern Oregon has a diverse set of outdoor recreation assets, including the Columbia Gorge, downhill ski areas, wildlife refuges, numerous rivers and lakes, and Crater Lake National Park. A 1995 input-output study (Johnson, et al 1995) using data from various land management agencies estimated that outdoor recreation in eastern Oregon supported over 20,000 jobs and over 400 million dollars in personal income when all direct, indirect, and induced impacts are considered. A number of these jobs are part-time. The Bend-Redmond area had half of these jobs and income closely followed by the Blue Mountains (See Aldred Cheek and Johnson 1995 for more discussion).

c) Eastern Oregon continues to grow economically, even through the timber industry is stable or slightly declining, although the growth is concentrated in a relatively small area. Overall, employment and personal income in eastern Oregon experienced steady growth during the 1970s, felt a major recession in the early 1980's, and has been growing since that time.

Much of the growth in real income in the last decade in eastern Oregon has come from a state economic region formed by Crook, Deschutes, and Jefferson county, especially the Bend-Redmond area. This increase in personal income was fueled by sharp increases in non manufacturing earnings and other income (especially retirement income), while manufacturing earnings were relatively flat. Deschutes county's per capita personal income in 1992 was greater than that of the state's other metropolitan areas, except for Portland.

In the last decade, eastern Oregon outside of the Bend-Redmond area has experienced sluggish growth associated with stable or declining manufacturing earnings (compared to 1979), including timber industry earnings, and relatively slow growth in other earnings and other personal income. The Blue Mountains exhibited this pattern, except that the timber industry remained relatively stronger there than elsewhere. This may have been due to the wood available from private forests.

A 1990 report to the Joint Legislative Committee on Trade and Economic Development (Miller, 1990) described what has been called "The Two Oregons." One Oregon is concentrated around urban areas, trade and distribution centers, and universities. Its economies are rapidly growing. Another Oregon lies in mostly rural areas and counties. Its economies exhibit much slower economic growth.

We see this division in eastern Oregon with one rapidly growing region (centered in the Bend-Redmond area), which has been successful in attracting high tech, service industries, and retirees, versus other, more rural, regions of eastern Oregon which are showing much slower economic growth. The latter regions retain much of their historic reliance on industries related to natural resources including timber, wood products, ranching, other agriculture, and recreation. Some like the Klamath-Lake region are showing recent strength in attracting new industries. Still, for much of eastern Oregon, sharp, sudden contraction in the natural resource industries would certainly set back the economies there (see Aldred Cheek and Johnson 1995 for more discussion).

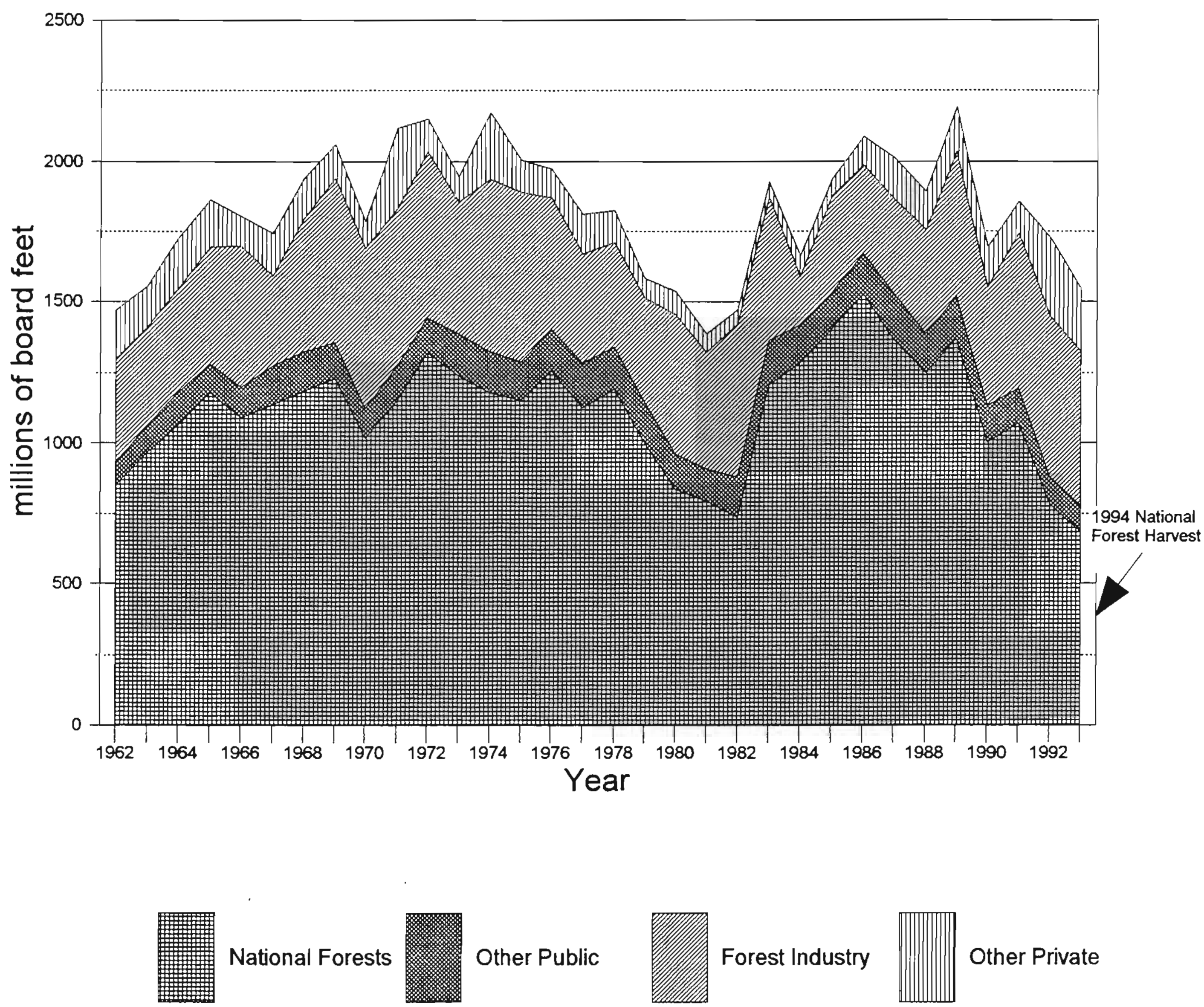
7. The National Forests have long dominated wood supply in eastern Oregon. The timber industry in eastern Oregon is highly dependent on the National Forests for logs that can be processed into solid wood products. According to Sessions et al. (1991) and Greber, et al (1992), over 2/3 of the recent harvest in Eastern Oregon has come from the National Forests (see Figure 6).

8. The availability of timber and wood fiber from the National Forests of eastern Oregon has dropped dramatically in the past few years. The Forest Plans adopted in the late 1980s and early 1990s by the National Forests, project timber sales of over a billion board feet for the National Forests of

Figure 6.

Timber Harvest in Eastern Oregon

(source: Oregon Dept. of Forestry)



the eastern Oregon, almost 500 million of which would come from the Blue Mountains. In the last few years, sales from the National Forests of the Blue Mountains and all of eastern Oregon have dramatically declined from those estimates (Source: Regional Office, USDA FS Region 6):

	Year				
	1990	1991	1992	1993	1994
	----Millions of bd ft of "sale accomplishment"--				
	Blue Mountains				
Salvage	211	188	104	24	33
Green	381	127	86	112	23
Total	592	315	189	136	56
	Eastern Oregon				
Salvage	434	432	203	262	135
Green	804	287	186	174	64
Total	1238	719	389	436	199

Obviously the sale levels projected in the Forest Plans are not being achieved. In addition, there has been a significant shift from green (live tree) volume to salvage volume.

Proposed salvage sales for the Blue Mountain National Forests for this year suggest that salvage volume offered for sale might rise slightly above 100 million board feet. This level of salvage sales would only put a small dent in the many hundreds of millions of board feet of dead timber on the National Forests in the Blue Mountains.

Information on proposed live tree sales for the next two years was not available. The planning and replanning associated with issuance of the East-side Screens and PACFISH has not yet produce stable estimates of live tree sales.

a) As the supply of timber from the National Forests has decreased because of environmental concerns, sawmills have gone to private lands and other states for interim supplies. With this recent cutoff of timber sales on federal land, mills have brought timber in from federal lands in Idaho and from ranches in Montana and Utah--at best, a stop-gap measure. Also, private owners in Eastern Oregon have recently increased their harvest (Figure 6). Lettman (1995) results suggest that recent harvest levels on private land in eastern Oregon may be above sustainable levels, that private inventory has declined (as a function of harvest and slowed growth and mortality), and that there has been an increase in stands that may not be manageable because of low stocking.

b) As part of their attempt to survive, many mills have retooled to use a wide variety of species and sizes of sound logs. Sound logs of almost any species and size can be utilized by the mills, including material that just a few years ago had little or no value.

c) Improved markets for wood chips enable the forest industry to profitably process trees and logs they previously would have left. Chip prices have increased from the recent past making it possible to profitably chip dead and down material that would previously have been left on-site. On the other hand, lumber prices have recently decreased. These constantly changing prices for wood chips and lumber make it very difficult to estimate the extent of economically available salvage.

9. Forest conditions which increase the risk of costly catastrophic wildfires and insect attacks threaten human values and alter forest ecosystems. The forests of eastern Oregon provide a wide variety of goods and services that humans value highly including wood products, recreation, water, aquatic habitat, and the general quality of life in the region. Threats to these forests are, in turn, threats to these values.

We believe that salvage and ecosystem restoration activities discussed in the next section could reduce risk to human values in the long run, while providing economic return in the short run. It should be noted, however that they do not guarantee that large crown fires or insect outbreaks will not occur. We will discuss approaches to creating fire- and insect safe forests, not fire- and insect proof forests. Under extreme weather and climatic conditions, fires and insects can still ravage stands.

10. Time is of the essence if we wish to economically utilize dead timber in eastern Oregon's National Forests. Most of the standing dead timber was killed at least 2-5 years ago. Since that time, both the amount of merchantable sawlog volume and its quality have declined and continue to decline. Deterioration of the sapwood is especially rapid; thus the younger trees loose their merchantability much faster than the older ones. This is especially true for grand fir, the most prevalent mortality volume. For a time, trees too deteriorated to be used as sawlogs can be chipped for pulp.

While chip prices have risen, they still are still below the prices for sawlogs. (See Snellgrove and Fahey 1977, Willits 1990, and Perry (In progress) for discussions of deterioration of dead timber).

It should be noted that most of the employment in the forest industry of eastern Oregon comes from processing sawlogs. Chips for pulp generally leave the region.

Steps That Can be Taken to Restore Ecosystem Functions in Forests, Streams, and Watersheds

11. Active forest management over a long period of time (several decades) can help restore components of these ecosystems and develop forest conditions closer to the historic range of variability while producing timber volume. Scientists offer several strategies for restoration of east-side forested landscapes back within healthy ranges of variability in species composition and structure (USDA For. Serv. 1993, Tesch 1995).

Restoration efforts have the potential to reduce stress on the forest, reduce the forest's susceptibility to insect attack, reduce the likelihood of crown fires, and accelerate the recovery of riparian areas. Many of these efforts involve the harvest of trees which can, in turn, supply local mills.

We do not know if the efforts listed below will restore the ecosystems of the Blue Mountains in its entirety--knowledge is lacking in too many areas to know for sure. We do, though, believe that there are risks from inactivity and that we can suggest actions that have a high probability of pushing these ecosystems back toward their historic conditions and reducing their vulnerability to fire, insects, and disease.

a) Reducing the density of living trees within overstocked stands is the most effective way to minimize stress for the typically moisture-limited east-side forests. Salvaging of dead trees does little in this regard, but may reduce the threat of future fires in some situations.

Removing the fir understory from pine and larch sites will reduce stress on overstory trees. If firs are removed from these sites, a more diverse landscape pattern that includes scattered large firs on drier sites and fir-dominated stands on moist sites, riparian areas, and higher elevations will be less likely to support large-scale insect outbreaks. Such conditions would also reduce the risk of large-scale stand-replacing fires.

Reducing fire danger

1) Forests at highest risk are primarily in the low and moderate severity natural fire regimes (ponderosa pine, Douglas-fir, and dry grand fir types). Here fires historically perpetuated relatively stable species composition and structure, with almost complete overstory survival after fires. These forests are the most altered ecosystems in the Blue Mountains, and reduction in live tree density and fuel loadings, concentrating on the smaller live tree component (low thinning), will lower catastrophic fire potential and restore more natural conditions while providing economic benefits. The more "boom and bust" type of forest dynamics were naturally a part of the cooler, higher elevation ecosystems that had high severity fire regimes, with stand-replacing fires every 100-300 years. Recent "damage" in these ecosystems from fire or insects is more within the range of natural variation, and intensive treatment here may actually move the ecosystems away from natural (historical) conditions.

2) The low and moderate severity natural fire regimes have high risk of future fire whether treated or not. However, restoration should concentrate here because of future fire risk (occurrence of fire) and the current high potential for severe fires.

3) Reduction in live tree density and fuel loadings lowers the potential for damage from future fires. Lack of treatment can create (a) higher fire intensity, if a wildfire or prescribed fire occurs, so overstory trees and regeneration will have lower fire survival probability, and/or (b) more smoldering of decaying logs, which lengthens fire duration and can kill trees at the base or kill roots of trees.

The increased risk of stand replacement fire that is observed on many sites is associated with the distribution of live fuels from forest floor to the canopy, not just the presence of dead trees from insects, disease, and drought. Removing ladder fuels can be effective in reducing risk crown fires that tend to kill overstory trees.

4) Current "screens" for east-side forest treatment mistakenly include multi-layered canopy as a criterion for classification as old growth in all forest types. If acres of old growth in a watershed are below historical levels, these types cannot be entered. Old growth in ponderosa pine and some Douglas-fir and grand fir forests, though, was historically without such multi-canopy structure because of frequent fire (see Figure 10.6 in Agee (1993)). Its presence is a major cause of forest health problems in these old forests. Restoration of sustainable, healthy old growth structure in these stands will require entry to remove the understory by low thinning via harvest or prescribed fire (Agee 1993, Agee and Maruoka 1994, Agee in press).

Reducing the danger of insect attack

Prior to fire suppression, a combination of drought, fire and insects and pathogens restricted Douglas-fir and the true firs to moister sites in riparian zones and higher elevations where favorable growing conditions for these tree species largely prevented population outbreaks of insects and pathogens. Fire suppression allowed these species of firs to invade drier upland forests and establish a dense understory where the long-term biomass carrying capacity of the site is exceeded. The firs are then stressed by insufficient water. A combination of high density and insufficient quantities of the trees' internal chemical defenses has permitted populations of budworms, bark beetles and root diseases to reach tree-killing levels (e.g., Hagle and Schmitz 1993, Schowalter and Filip 1993).

Health of old-growth pine and larch forests is being restored, de facto, by death of competing understory firs. Hence, insects and diseases are not causing forest decline, but rather are agents of restoration (Schowalter 1994). Furthermore, bark beetle attack and inoculation of attack sites with saprophytic microorganisms weakens the bole and increases the rate of bole snap and decomposition. This effect will bring most standing dead trees to the ground in a relatively short period of time.

Further restoration through forest management activities should concentrate on removing the fir understory from drier upland forests and promoting pine and larch on these sites. Scattered large firs on upland sites and relatively denser fir in moister riparian and higher elevation forests will likely provide insufficient resource concentration for continued support of epidemic insect and pathogen populations (e.g., Schowalter 1994).

b) Reducing density could be accomplished through reintroduction of low intensity fire or thinning programs (Mason and Wickman 1994). Removing understory trees favors larger overstory dominants, especially of residual intolerant species that can serve as seed trees. Thinning will promote individual tree vigor and reduce mortality among all residual size classes.

Substantial problems exist with the reintroduction of fire for this purpose. First, there is social resistance to the risks of escaped prescribed fire, as well as the air quality problems associated with smoke. Massive acreages would have to be burned to accrue desired landscape-level benefits (Arno and Ottmar 1994). Such programs are also difficult to implement because ecosystem conditions have changed in the absence of fire and fire behavior is potentially extreme now where it would have been less intense in the past (Agee 1994). A mixture of thinning and other treatments over time may be required to condition stands for regular underburning.

Harvesting, even of small-diameter material in thinnings, has also met substantial social resistance in some areas. Positively, new harvesting equipment and better markets for small-diameter material provides opportunities for some economical thinning regimes where they did not exist in the past.

c) Preserving a seed source for seral species on mixed-conifer sites maintains flexibility for perpetuating more fire- and insect-resistant forests over time through natural regeneration.

Thinning to remove living grand fir or Douglas-fir understories from beneath large, older larch or ponderosa pine benefits the overstory trees for a variety of reasons, including that they may better survive fire, insects, and drought over time, but an additional benefit is that vigorous overstory trees tend to produce more cones and viable seed (Mason and Wickman 1988, Wickman 1992).

d) On either moist upland sites or in riparian areas that tend to be dominated by grand fir or Douglas-fir, and where seral species are not present as a result of past harvesting, recent drought- and insect-related mortality may leave few functional living trees. Silvicultural treatments may be beneficial in accelerating the redevelopment of more fire- and pest-resistant stand structures. In these situations, natural recovery of degraded mixed-conifer stands will likely result in perpetuation of dominance by shade tolerant species. Such species may not be the preferred choice for rapid growth, future fire- or pest-resistance, or long lasting snags or coarse woody debris. Without a seed source, natural regeneration of seral species is not possible; planting of these species with associated competition control, protection from animal browsing, and provision for adequate growing space is a prerequisite to ensure their functional role in future mixed-conifer stands.

e) Restoration of forest ecosystem functions will rarely be augmented by harvesting live old-growth pine and larch in mixed pine/fir stands. These species are the most tolerant of fire and drought, dominate the overstory so are not light-limited, and are not being killed by insects and pathogens, except where dense regeneration or fir understories are causing competitive stress (Hagle and Schmitz 1993). In general, cutting these trees to justify salvage of dead understory firs would be counterproductive, although there may be some locations where relatively high densities of overstory pine/larch would allow for some removal.

f) In pure second-growth pine stands, thinning will reduce the probability of beetle attack. Bark beetles are among the easiest forest insects to manage because of their demonstrated sensitivity to tree spacing. Western pine beetle, mountain pine beetle and southern pine beetle all have been subjects of thinning experiments. All results show beetle population growth only when average host spacing is less than 20 ft. (Amman et al.1988, Sartwell and Stevens 1975, Schowalter and Turchin 1993). Although thinning works best in reducing initial population growth and development of outbreaks, thinning has proven useful in slowing tree mortality and spread of outbreak populations. Population growth of other insects also has been shown to reflect host spacing. Western budworm and sawfly populations on the Westside (in the vicinity of Santiam Pass) were concentrated in dense second-growth Douglas-fir forests (Schowalter 1996).

g) Active management can help recreate the historical mosaic of stands in different conditions that offers natural firebreaks and less concentrated food sources for insects. Past prescriptions, such as fire suppression and overstory removal have increased the uniformity of these forests. The current guidelines ("East-side Screens") that emphasize the diversity of the presettlement forest should help ensure that future forests will become more heterogeneous across the landscape as a result of active management.

Priorities for treatment should begin in upland zones and work down to lower priority riparian zones. It is clear that productivity and fuel loading may be highest in the riparian zones, but these zones are also generally of higher moisture and typically have had longer fire return intervals (Agee 1994). The plan in general might be to treat the more fire-prone portions of the landscape in order to protect historical refugia. We do not know how much of the landscape needs treatment to break up the current continuity of fuels sufficiently that major catastrophic fires can be significantly reduced. Historically, almost all of the low severity fire regimes had a great majority of the area in this "firesafe" condition (80+ percent?). Although, fires generally burned up to the riparian corridors, usually as low intensity fires, and often went out, they were sometimes more intense in riparian corridors (Agee 1994). If the upland landscapes can be restored to a more sustainable character through thinning and prescribed burning, wildfires can be largely controlled before they have much chance to burn riparian zones.

In landscapes where fire suppression and partial cutting have reduced the fine-grained mosaic that historically occurred, prescribed burning and/or thinning might be initiated in locations that begin to reintroduce the previous landscape heterogeneity. At the landscape level, work can be done to reestablish a mosaic of age and size classes to reduce the continuity of food source for defoliating insects (Mason and Wickman 1994) and to provide natural fuelbreaks (Arno and Ottmar 1994).

Generally suppression of low intensity fires has acted to homogenize the east-side landscape, especially portions within the mixed-conifer forest type at mid-elevations (Lehmkuhl et al. 1994). Selective harvesting has also contributed to this trend by removing the large, older intolerant ponderosa pine and larch within this type. Larger contiguous areas of older, mixed conifer forest are subject to larger scale, more prolonged outbreaks of insect epidemics than historically documented (Hessburg et al 1994). Where defoliator insects and bark beetles historically impacted patches, their impacts are much more likely at the landscape level now.

Without major landscape-level efforts to restore a balanced mosaic of vigorous stands of fire- and insect-resistant tree species, it is likely that insect and disease outbreaks will continue to increase in frequency, severity, and length (Lehmkuhl et al. 1994). Wildfires will be large, difficult to control, stand replacement in intensity, and with potentially greater watershed consequences (Arno and Ottmar 1994).

h) Trends in urban development on the east-side will increasingly complicate forest management (Arno and Ottmar 1994). Several areas are already reputed for their urban sprawl into fire-prone forests. Such development tends to shift forest management objectives and values towards protection rather than management.

This trend will complicate efforts to actively manage east-side forests through prescribed fire or harvesting to restore healthy conditions. Substantial public education and involvement will be necessary to enlist societal support for implementing ecosystem restoration and management strategies, regardless of their scientific merits.

12. During the implementation of forest management activities, care must be taken to retain and nurture dead wood as snags and down logs. Many bird species and ants rely on dead wood for part or all of their life history needs. Leaving large dead wood after salvage can help to ensure viable populations of these predators. Retention of large green trees also provides a source of future large snags and logs for these species as well.

Birds and ants can have a controlling effect on populations of spruce budworm and Douglas-fir tussock moths. Under endemic levels of the insects, these two groups of predators exert significant influence on the populations of their prey (Cabell et al 1983). While they cannot control population eruptions, they can contribute to maintaining populations at low levels for long periods of time.

The East-side Screens call for maintaining 100% of the biological potential of snags (standing dead trees) for cavity nesters. This goal has been estimated to require at least 3 snags per acre over 15" in DBH on a continuous basis (Marcot, 1991). Based on this criteria, some of the forest in eastern Oregon is snag deficient and a focus of restoration will be to protect the large snags that exist and create more snags (see Johnson and Cousar 1995 for details). Restoration treatments that include thinning will increase the diameter growth rate of residual green trees and thus hasten the development of large trees that can be used for snags.

13. Orienting forest management on the National Forests to ecosystem restoration will substantially alter the mix of available wood products from the recent past and the Forest Plans.

a) Small grand fir and Douglas-fir, once of low value to the industry, will provide the majority of the available harvest volume. Density reduction in live stands will focus on removing grand fir and Douglas-fir in the DBHs of 4-20 inches where these species are concentrated (Johnson and Cousar 1995). Also, removal of live trees over 21" is prevented by the East-side Screens in many cases. Salvage of dead timber will focus on small grand fir and Douglas fir, the most prevalent dead species (Johnson and Cousar 1995), as many of the bigger dead trees will be retained for wildlife snags. The Forest Plans for the National Forests of eastern Oregon called for about 40% of the harvest to come from these two species in the 1990s; based on our analysis of the Blue Mountain National Forests, the actual percentage harvested could easily approach twice that.

b) Old-growth ponderosa pine harvest, the past mainstay of the forest products industry in eastern Oregon, will be significantly lower. From 1983-1987, approximately 700 million board feet of volume was harvested per year from the National Forests of eastern Oregon--about half of the total harvest there--with most of that volume coming from mature and old growth trees. The Forest Plans for the National Forests of eastern Oregon projected approximately 500 million board feet per year of ponderosa pine during the 1990s, about 35% of the total harvest, mostly from mature and old growth stands. (Sessions, et al 1991).

Under a policy of reducing the density of live trees and fuels, little mature and old growth ponderosa pine will be harvested. Density reduction in live stands will focus on removing grand fir and Douglas-fir while conserving and restoring ponderosa pine (and larch). Salvage of dead timber will focus on grand fir and Douglas fir, the most prevalent dead species, and conserve ponderosa pine for snags. Much of the ponderosa pine that is offered will come from young growth thinnings of overstocked ponderosa pine natural stands and plantations.

14. In some cases, active management can help restore management areas, but these practices must take unique riparian functions and structure into account.

Historical management practices (e.g., overstory removal of larger trees, suppression of all ground fires, ground-based harvesting through intermediate channels) of some upslope and riparian forests may have contributed to degradation of riparian/aquatic habitats. In perhaps the vast majority of situations, the best restoration approach is to preclude additional management activities along stream, especially for the short-term (Kauffman et al. 1993, Beschta In Press), thus allowing natural disturbance regimes and processes to have a primary role in the restoration of these systems (Hill et al. 1991). However, in some instances, a more proactive approach may be necessary, such as the removal of certain drawbottom roads, improved road drainage, or the replanting of conifers to ensure rapid recovery of shade and future sources of large woody debris. Where previous management activities have accelerated sediment production, practices which can reduce on-site erosion or the delivery of such sediments to stream systems should be considered. However, in nearly all instances the primary concern should be the restoration of riparian/aquatic functions that can be naturally sustained over long periods of time (Sedell and Beschta 1991, Beschta 1991).

15. Commercial timber operations offer an opportunity to reduce stand densities, reduce fire danger from live and dead timber, reduce the intensity of insect outbreaks, and create the funds for overall restoration. Sales can be planned to allow use of timber sale revenues to treat a broad range of restoration problems. So far, federal forest managers in the Blue Mountains have had little success in securing appropriated funds for such treatments; little in the current budget environment suggests that appropriated funds will be available for forest ecosystem restoration.

16. A program of restoring desired forest conditions (e.g., increased amounts of large trees, reduced likelihood of stand replacing fires and epidemic insect attacks) has relatively little ecological risk within the context of the Forest Plans, watershed analysis, East-side Screens, PACFISH, and an active monitoring/oversight program.

The National Forests of Eastern Oregon adopted new forest plans in the late 1980s and early 1990s. They were mandated by the National Forest Management Act of 1976 and took over 10 years to complete. They attempted to bring management of the National Forests in to line with the requirements of NFMA. In many ways, they increased the level of protection for environmental resources on these lands. They were an evolutionary, rather than revolutionary step in land management. Projected timber sale levels in these plans were generally less than those of the previous decade, and wood production shifted somewhat from ponderosa pine to Douglas-fir and true fir. Under these plans, though, old growth trees and stands were still an important part of the timber supply.

The East-side Screens and PACFISH are two recent additional sets of guidance to forest management activities on the National Forests of Eastern Oregon (USDA FS Region 6 May, 1994, USDA FS/USDI BLM Feb. 1995). They have been added to the Standards and Guidelines in the recently completed Forest Plans in an attempt by the Forest Service to avoid appeal and litigation. The East-side Screens provide guidelines to protect habitat for old growth species and preserve options until completion of the East-side assessment and plan being constructed by scientists and managers of the Interior Columbia Basin Ecosystem Management Project (ICBEMP) in Walla-Walla, Washington. PACFISH provides guidelines to protect anadromous fish habitat and, through regional office extension, to protect all fish habitat.

There is considerable debate about how long the East-side Screens will apply. At first, they were to apply to 12-18 months, a time period that is near expiration. Now it appears they may be needed for another 2-3 years (USDA FS June 1995). Given the time it takes for a new plan to be developed or implemented under ICBEMP, they could easily be in place past the year 2000.

Our assignment is to help Governor Kitzhaber understand the prospects for environmentally-sound timber harvest for the next few years. Therefore, we assume that the East-side Screens and PACFISH will apply during that period. Anyway, without some major scientific breakthrough, we would expect that similar guidance would be forthcoming out of the east-side assessment and plan.

These two sets of guidelines call for a much higher level of protection for old growth species and aquatic habitat than did the Forest Plans. In addition, they define an ecological vision of the future forest, based on returning the forest to historic conditions, that differs significantly from the vision in the Forest Plans, especially in the "General Forest" area that was the major source of wood products in the Forest Plans. Finally, they call for assessment of conditions and plans for action to be designed at the watershed and landscape level--a significant move toward use of ecological areas for assessment, planning, and management.

We have outlined below the guidelines for forest management in the "General Forest" under the Forest Plans and under the East-side screens and PACFISH. We chose the General Forest for the comparison because, as mentioned above, this allocation in the Forest Plans would have been the source of most activity and timber harvest under the Forest Plans.

Comparison of Forest Plan Standards and Guidelines with East-side Screens + PACFISH (USDA Forest Service May, 1994, USDA FS/USDI BLM March, 1995).*

Issue	*East Side Screens*	*Forest Plans*		
		W-W	Umatilla	Malheur
Snags % of bio. Potential	100	40	40	40
Stream buffers (classes I-IV)	I/II -- 300' III -- 150' IV -- 50 - 100'	I/II -- 100' III -- 100' IV -- none	I/II -- 50' III -- 50' IV -- none	I/II -- 100' III -- 33-66' IV -- none
Old Growth Protection -- Stands	Reserve old growth stands within watersheds whose old growth level falls below the historic range of variability	Reserve some old growth stands		
Old Growth Protection -- Trees	Maintain all trees over 21" in watersheds deficient in old growth.	No special protection beyond needs for snag recruitment		
Connectivity	Pathways required between old growth stands	Minimal requirements		
Target Forest	Species/structures/ densities within historic range of variability	Rotation age at culmination of mean annual increment; species, structures, and densities to produce industrial products and promote forest health		
Silviculture/ priorities for harvest	Thinning small material to move stands back to HRV; some regeneration harvest for same purpose. Pine/larch preferred species to leave.	Regeneration harvest to convert old, slow growing, and diseased stands to faster-growing young growth. Thinning of overly dense stands. Much old growth pine to be taken.		

* Stream buffer distances in the Forest Plans reflected the average of expected buffer widths that would be developed through site-specific analysis in the field. Some timber production is expected from some of the buffers especially those for the class III streams. Other standards and guidelines provided added constraints on the type and amount of harvest near streams.

17. Forest management efforts must continue to be planned from larger-scale perspectives--landscapes, basins, river networks, biophysical regions. The Forest Service has undertaken significant amounts of planning and assessment (e.g. forest plans, watershed analysis, planning under the East-side Screens and PACFISH) and has the interdisciplinary expertise to evaluate the consequences of forest management efforts although the continued loss of experienced and knowledgeable personnel may be having a major impact on the magnitude of effort that can be expected from the agency (see point # 24 below). This recent planning and assessment enable an establishment of priorities for initiating forest treatments.

The necessity of watershed assessment and ecosystem management at landscape scales has been recognized only in recent decades, and current approaches and methods are developmental and unproven. While we strongly advocate continued application of these landscape management techniques, we emphasize that these efforts must be closely linked to continuing monitoring and evaluation so that truly adaptive management is possible (see point # 22 below).

Restoration of forest ecosystems at the scale required in the east-side forests will involve innovative principles and practices, many of which lack comprehensive tests of their ability to restore ecosystems. Resource protection screens that have been established recently are based on concepts developed from research results over the last several decades, but their effectiveness has not been evaluated. The characteristics of current resource management, including the East-side Screens and PACFISH, emphasize the importance of landscape management and assessment processes that are now emerging. These larger scale perspectives strengthen the efforts at ecosystem restoration but are no guarantee of success. Thus, there is a important role for monitoring and review of these efforts.

18. Timber sale programs and other forest management activities do not need to wait for the East-Side Assessment (ICBEMP) and the subsequent Land Management Plan to be completed and implemented (perhaps after the year 2000). Timber sale projects and other actions can proceed under the interim guidance, and ecological protection, provided by the East Side Screens and PACFISH. It is not necessary or desirable to stop these activities while waiting for the results of the East-side Assessment. Risk of catastrophic fire remains high until tree densities are reduced.

19. The knowledge and technology exists to road and harvest most forested areas with little impact on soil condition and sediment production. Logging is often presented as a high impact forest operation. However, this need not be the case today in most situations. Considerable changes over past operations have been made, and new applications of low impact logging technology, careful planning, and quality control during logging reduce impacts (see Appendix B for more details).

a) Sediment production from existing and new roads can be greatly reduced in the Blue Mountains. Many of the sediment problems associated with existing roads are a legacy of past practices. For these roads with continuing environmental problems, obliteration, closure, improved road drainage, surfacing, improved maintenance, and other practices can be utilized to reduce sediment production. However, moving from the existing road inventory to a more desirable one may require considerable effort and funding by the National Forests.

For new roads, careful location, design, construction and maintenance should eliminate many of the sedimentation problems associated with existing problem roads. Modern harvesting technology allows for lower road densities than past practices because longer logging distances between roads are practiced. However, because current road networks are generally quite extensive, and the need to reduce sediment production from problem roads is a high priority, restoration efforts and future harvests should minimize road construction and encourage road reductions where environmental damages are occurring.

Also, lowering tire inflation has been shown to significantly decrease road wear and sediment production (Moore, Foltz, and Cronenwett 1995). Use of central tire inflation (CTI) technologies is now becoming more widespread. A major forest industry firm now employs CTI on one of its tree farms. Also, the Boise National Forest recently sold a 12 million board foot timber sale with requirements for reduced pressure on log truck and heavy truck traffic to reduce sediment into streamcourses and protect the resident Bull Trout population.

b) Use of modern logging techniques can greatly reduce site disturbance and compaction from logging. Helicopter logging can remove logs with the least site disturbance of any logging technique. The costs involved can be high, though, especially for the relatively low-value material attained in understory removals and salvage (See Appendix B for details).

Ground-based methods of yarding with equipment trail designation (designated skid trails) and aerial cable methods remove low-value material with only a modest increase in site disturbance over helicopters. Considerable research and practical experience has occurred with low ground pressure machines, designating equipment trails to minimize the compacted area, and tilling severely compacted soils where needed. (See Appendix B for more details). In addition, new mechanized logging equipment such as the single-grip harvester and forwarder provide soil protection by leaving tree branches and needles over the forest floor for the equipment to travel over. Other new technologies that combine ground and aerial cable methods have been demonstrated in the Blue Mountains to move wood to the landings with minimal site disturbance. (Kellogg and Brown 1995).

c) The challenge now is ensure that low-impact logging and roading methods are employed on a broad scale in treatment strategies. Restoration of the Blue Mountains could require silvicultural treatment over a large area as discussed earlier in this report. Ensuring that this work is done without unacceptable levels of site disturbance, compaction, and sedimentation is a crucial ingredient in these treatments being successful. Given the existence of knowledge and technology to control sediment and other environmental effects from road work and logging, the issues shift to implementation of this knowledge and technology. Incorporating these new technologies into design of timber sale contracts, and monitoring their use and their effects will be needed. In addition, educating operators about the new technologies and obtaining the needed capital investment is important to successful implementation.

d) Environmentally sound harvesting requires a commitment to site-specific analysis, planning, scheduling, and quality control within a context of achieving broader ecosystem goals. This is particularly true in watersheds inhabited by threatened or sensitive fish stocks. The willingness of east-side forest personnel to undertake project assessment in a watershed context will be a key component in this analysis.

20. Attention must be given to managing cattle in forested ecosystems; rehabilitation of riparian systems will call for changes in cattle use from the past. While there is much concern regarding the historical and current contributions of various forest practices (harvesting, roading, fire management, etc.) upon the health of eastern Oregon's forests, there is a corresponding concern regarding the effects of long-term grazing practices upon the quality of riparian/aquatic systems (Platts 1991, Elmore 1992, National Research Council 1992, Kauffman et al. 1993, Henjum et al. 1994, Johnson 1994). Because many of the perennial and lower gradient streams potentially represent some of the highest quality and most productive fish habitats on National Forest lands in eastern Oregon, and because the effect of long-term grazing has often been to degrade the quality of these habitats, cattle management must be considered an integral part of forest restoration activities. To attain improved riparian/aquatic habitats, cattle grazing must be managed in ways that promote recovery of riparian plant communities. In-other-words, the establishment, growth and succession of riparian dependent plants is a high priority for nearly all riparian systems that have experienced long-term grazing. It is unrealistic to assume that these riparian systems and their aquatic habitats can be improved solely through improved forest management/protection practices.

21. Monitoring and external review of environmental effects are essential components of any ecosystem restoration strategy.

In point #16, we state that there is relatively little environmental/ecological risk from salvage and restoration treatments undertaken in the context of Forest Plans, watershed analysis, East-side Screens, PACFISH, and an active monitoring/oversight program. The purpose of this section is to explain what we mean by a "monitoring/oversight program" and why we feel it is a crucial ingredient in ecosystem restoration of the Blue Mountains.

Major goals often cited for monitoring and review are to ensure activities are undertaken as planned, that ecosystem restoration practices achieve their goals, and that we as a society can learn from this effort. We subscribe to these goals and the Forest Service has committed to them in a series of recent plans and decisions.

The Forest Service is undertaking monitoring at some level, although it appears to be done in a somewhat piecemeal fashion. We are concerned about the continued commitment to broad-scale, long-term monitoring, beyond that of commodity outputs, in a time of shrinking budgets. Our comments in this section support both short-term and long-term monitoring of environmental effects as an essential element in ecosystem restoration and provide some observations and recommendations about the approaches that might be taken.

In this report, we endorse silvicultural treatment, and other types of treatments, as important elements in restoration of Blue Mountain ecosystems. However, without comprehensive monitoring and review as a parallel effort, we feel that avoiding the errors of the past and achieving successful ecosystem restoration in the future will be difficult indeed.

Our major observations and recommendations about monitoring and review are:

a) Implementation monitoring will be needed of sophisticated treatments being done under the guidelines of the East-side screens and

PACFISH. Traditionally, the Forest Service has focused considerable energy on monitoring success in meeting commodity goals. Restoration treatments in the Blue Mountains will often now emphasize a wide variety of other goals such as number of snags to leave of different sizes, size class distribution of trees to harvest, and size of buffer strips to leave. In addition, there may be limits set on permitted site disturbance and soil compaction. Systematic checking of the success in meeting these goals will be challenging, but is essential to documenting how treatments actually occur.

b) Innovative effectiveness monitoring will be needed at landscape scales, especially watersheds; the research community will need to help design the approach. Much of the monitoring to measure effects of practices appears to have been done at the project level. A classic example of this approach is the placement of water quality monitors on a stream above and below a timber sale. While such work has provided useful information, effects monitoring also needs to be organized to draw conclusions about the effects of practices on watersheds and landscapes.

This monitoring will need to be designed to confirm or reject hypotheses about the underlying processes or mechanisms on which the restoration is based. This will shift the focus from more traditional descriptive studies to experimental approaches.

We realize that concepts and procedures for monitoring, especially effectiveness monitoring are not fully developed. In addition, we realize that some questions will take decades to answer. Thus, we see this broad-scale monitoring charge as much as a challenge to the research community, of which we are a part, as to land management agencies like the Forest Service.

c) Regional agency review will be needed to ensure coordination and consistency. While we were impressed with the dedication of the field people we met on our tour, we also somewhat troubled at the differing interpretations of the guidelines now in place for managing under the East-side Screens and PACFISH. We believe that the Regional Office should take a strong role in identifying successful applications of guidelines, and improving consistency in their application. The recent review of the East-side Screens (USDA FS REGION 6 March, 1995) is an example of the contribution that the Regional Office can make. More of it is needed.

d) Outside review can help evaluate and communicate the success of restoration efforts. Our ability to manage ecosystems on public lands requires effective interaction among scientists, the public, and resource management agencies. We believe ecosystem restoration in the Blue Mountains should be reinforced with scientific and public reviews independent of the agencies required to carry out the management plans. These reviews can help to assess whether 1) the actions being undertaken are consistent with restoration goals, 2) sound monitoring procedures are being employed, 3) the practices are being implemented as designed, and 4) the practices result in a recovery of ecological function and ecosystem structure.

We believe that two general types of review are needed: 1) ***External technical review*** to give a scientific assessment of the approaches to restoration, their effectiveness, and areas for future improvement. 2) ***Public review*** to give the public an opportunity to understand the specific objectives and practices of the restoration efforts and to comment on the strengths, weaknesses, and risks of the on-going program.

We feel that the Forest Service has little to fear and much to gain from these reviews. In our trip to eastern Oregon, we were uniformly impressed with the competence and commitment of the Forest Service employees to restoring the ecosystems there. We also feel, though, that monitoring and outside review of these activities is essential for active management to be a welcomed, positive force in rebuilding the forest ecosystems of the Blue Mountains.

Impediments to Action

23. Difficulty in implementing interim guidelines for management, especially the East-side Screens and PACFISH, can slow restoration efforts

a) Project planning has had difficulty in keeping up with changing guidelines. Project planning on the Blue Mountains takes 1-2 years from start to finish according to the Forest Service employees with whom we talked. Replanning can take almost that long. Without stability to the guidelines for these activities, it has proven difficult to complete a project before a new set of guidelines appears.

Over the last 15 years, project planning on the Forest Service has been occurring in an regulatory environment that has been unstable at best. During the 1980s, this planning was done as the Forest Plans under the National Forest Management Act (NFMA) were being written, released to the public, revised, and often revised again. The degree to which project planning should incorporate the standards and guidelines in the latest version of the Forest Plans was often a topic of debate. When the Forest Plans were finally adopted in the late '80s and early '90s, it had been hoped that the governing rules would stabilize. That did not happen.

Most recently, we see the East-side Screens and PACFISH have been added to guidelines for project planning. These require major changes in project planning, and, no matter what their merits, impede, for awhile, the agency's ability to develop a restoration effort of any size. If the current ICBEMP analysis develops a new and different set of guidelines, we can expect sizeable delays again.

b) The East-side Screens/PACFISH are inherently challenging to implement. The East-side Screens combined with PACFISH develop a sweeping new vision for management of East-side National Forests--one that emphasizes the protection of habitat for old growth species and fish stocks and the maintenance of options for future management. No one can read the documentation on the East-side Screens without being impressed with their breadth and complexity. Their call for connectivity between old-growth areas, as an example, will require innovation in analysis that will take Forest Service planning to, or beyond, the state-of-the-art in planning research. The call for analysis at the watershed level requires enormous creativity by Forest Service planners, including analysis of the historic range of variability at the watershed level and of the adequacy of stream buffers.

We were impressed by the willingness and ability of Forest Service employees in the Blue Mountains to grapple with these complex rules. We were somewhat distressed, though, by the lack of examples and real-life case studies that show how to implement these rules. Without such added guidance, development of a sizeable restoration program will be difficult indeed.

c) Some of the absolute standards in the East-side Screens have the potential to interfere with the goals for which the screens are designed (preserve options, protect old growth species and habitats). These screens were established in the Fall of 1993 to guide management for 12-18 months until the east-side Assessment was completed and implemented. It appears that these screens may be used for a much longer period, perhaps to the year 2000, because of delay in completing and implementing the ICBEMP Project. The absolute restrictions that the Screens place on management action can become restrictive and counter-productive over this longer period. We believe that the East-side Screens should be made sufficiently flexible such that the rules they set can be modified if analysis shows that the goals of the screens would be better met by another course. This would follow the approach in PACFISH.

d) Overly conservative interpretation of guidelines sometimes occurs. The East-side Screens appear, sometimes, to be interpreted as more restrictive than intended. As an example, ephemeral portions of streams are being interpreted in some cases as intermittent streams, thus requiring a buffer. While it is true that sound reasons may exist for moving beyond the environmental protection required in the East-side Screens, these changes should be separately justified.

24. Skilled people needed to carry out design and implementation of the sophisticated restoration projects are being lost from the agency. The Forest Service has lost many skilled people with local knowledge and experience in recent years. Yet the agency needs skilled people in project design and implementation more than ever with the complex treatments that may be required in restoration projects. To undertake restoration projects in a timely manner, it may be necessary to find ways to temporarily hire skilled people from outside the agency, such as ex-Forest Service employees, retirees, consulting foresters, or other resource specialists.

Upgrading in skills will be needed to use the emerging environmentally-friendly harvesting technologies. Combinations of ground and skyline equipment, as an example, offer great promise for timber removal with minimum site impact on both flat and steep land. A concerted effort in education and extension may be needed to improve skills for utilizing this new technology.

25. Under the current layers of regulations, review, appeal, and litigation, it could be difficult for active management, especially commercial timber operations, to play a significant role in ecosystem restoration of east-side forests. The current process of designing and implementing projects, especially projects involving commercial timber harvest, has so many overlapping layers that it is difficult for the Forest Service to be responsive to emerging environmental needs or to be economically efficient. Each "layer" has a laudable purpose, but in combination, they can stifle forest management activities on the National Forest. In addition, the cost of assessments to meet the analysis requirements (Forest Plans, watershed analysis, EIS, ESA, etc.) of each layer is becoming prohibitive. At a minimum it takes 10-12 months from initiation of project planning to awarding of the project; in many cases it takes years. Thus, the ability of the Forest Service to respond to increased levels of dead and dying timber, and to reduce densities of live trees, can be severely restricted.

a) Consultation on listed fish stocks could be more efficient and effective. Although special care is needed before management activities are undertaken in drainages with listed fish stocks, a number of administrative problems make it difficult to implement restoration efforts. Consultations need to be completed in a timely manner and in-the-field reviews should be encouraged during the consultation process. Greater flexibility should be allowed for those projects that incorporate significant monitoring or research efforts.

b) The Environmental Impact Statement (EIS) and Environmental Assessment (EA) procedures of the NEPA process, combined with the Forest Service's interdisciplinary planning process, administrative appeals process, and fear of litigation, could easily overwhelm the Forest Service. The NEPA process provides the important service of requiring the Forest Service to divulge the environmental consequences of propose actions. And the questions raised by appeals of EAs and EISs have often surfaced important issues. The Forest Service now spends considerable time attempting to make their EAs strong enough to survive any appeal. This Forest Service's attempt to make "bullet-proof" EAs (i.e, EAs that will be sure to withstand appeal) can weigh-down projects with the time spent attempting to craft EAs that cannot be successfully appealed, the time and analysis spent responding to questions in appeals that often have no easy answer, and the threat of appeal making project designers extremely cautious in proposing actions to be taken.

Environmental laws, such as National Environmental Policy Act, Endangered Species Act, and National Forest Management Act, have successfully created a new approach to management that increases the likelihood of maintaining and restoring sustainable ecosystems. That achievement should not be overlooked. It is time, though, to place a concentrated focus on determining how to better integrate and streamline the implementation of these laws.

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Appendix A

JOHN A. KITZHABER
GOVERNOR

March 3, 1995

Drs. Robert Bestcha, Steven Tesch,
Loren Kellogg, John Beuter, Dave Perry,
Jim Sedell, Norman Johnson
Oregon State University
Peavy Hall
Corvallis, OR 97331-5710

Dear Scientists:

I want to thank each of you for your participation in the forest health meeting on February 21, 1995. The discussion provided me with a better understanding of the environmental and economic sideboards for federal timber harvest.

Building on the momentum of that meeting, I am asking you to take an additional step in charting a course for this administration. I would like you to participate in a work group over the next five weeks to further define environmentally sound timber harvest. The challenge to the group would be to establish principles for environmentally sound timber harvest, and to propose examples for implementation in the short term. Our goal is to identify specific harvest opportunities under current law that would promote (or at least not substantially degrade) forest health, and provide short term volume.

I have asked Paula Burgess to work closely with you in this effort. In order to provide better coordination than our schedules may allow during the legislative session, however, Norm Johnson has agreed to assist in getting the group started. Please let Norm or Paula know if you will be unable to participate; your expertise is critical, and we will be talking to you about the need for additional members. I understand that Dave Perry will be on sabbatical during this time, and I have asked Jerry Franklin to fill the needed role of ecologist.

Thank you for considering giving your valuable time to this effort. I believe your contribution will be timely and significant, and I look forward to hearing the results.

Sincerely,

John A. Kitzhaber

STATE CAPITOL, SALEM 97310-0370 (503) 378-3111 FAX (503) 378-4863 TDD (503) 378-4859

JOHN A. KITZHABER
GOVERNOR

March 13, 1995

Drs. Norm Johnson, Jerry Franklin, John Beuter
Loren Kellogg, Bill McComb, Bob Bestcha
Steve Tesch, Jim Sedell, Stan Gregory

Dear Scientists:

I am extremely pleased that you are willing to help us address the federal timber harvest issue over the next month. I have outlined a list of tasks that I believe would be valuable in framing a state approach to federal forest management. The initial focus of your efforts should be Eastern Oregon (outside of the President's Forest Plan). We may also ask for help on the west side, but the questions are sufficiently different to warrant a separate process.

Please consider whether you could provide an oral and written report for Governor Kitzhaber by April 7, 1995 describing the following:

1. Principles for environmentally sound timber harvest, and examples for different ecological conditions.
2. Estimates of the number of acres potentially available for this type of harvest in each of the ecological categories.
3. An estimate of the harvest volume in each of the ecological categories.
4. A simple economic analysis of harvest for each of the examples.
5. Obstacles and impediments to harvest, noting if they vary by category.

I will be available throughout the month to participate or to provide access to the Governor. I look forward to working with you!

Sincerely,

Paula

Paula Burgess
Policy Advisor for Natural Resources

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Appendix B

Environmentally and Economically Sound Timber Harvesting in Eastside Forests
Dr. Loren Kellogg

1. Low impact harvesting technology and knowledge that is currently available can be used to minimize the risk of sediment production and soil impacts during harvesting operations.

Logging is often presented as being a high impact forest operation. However this is not the case today in most situations because of considerable changes over past operations with new applications of low impact logging technology along with careful planning and quality control during logging. Ground based logging is often specifically viewed as being destructive to forest soils due to soil compaction. However considerable research and practical experience has occurred with low ground pressure machines, designating equipment trails to minimize the compacted area, and tilling severely compacted soils where needed (Bradshaw 1979, Froehlich et al 1981, Andrus and Froehlich 1983, Froehlich and McNabb 1984, Froehlich and Miles 1984, Hogervorst and Adams 1994). In addition, new mechanized equipment such as the single grip harvester and forwarder provide soil protection by leaving tree branches and needles over the forest floor. Cable systems and helicopter logging can be used on steep terrain with minimal site disturbance and sediment from logging. Summarized below are characteristics of low impact harvesting technology:

<u>Ground Based Machines</u>

- Use of carefully located and previously designated equipment trails reduces soil disturbance and compaction.
- A cable skidder is better than a grapple skidder because cable can be pulled out to logs, rather than the machine moving to logs.
- A swing boom feller buncher is better than a drive-to-tree feller buncher because it eliminates the need to move the machine to each tree.
- A single-grip-harvester/forwarder mechanized system is better than tree skidding machines because limbs and tree tops are left on the equipment trails to protect the soil during machine travel.

<u>Cable Methods</u>

- Eliminates machine travel over the soil and suspends the log partially or fully above the ground.

- A skyline system is better than hi-lead or a jammer system because soil disturbance due to log dragging is reduced or eliminated and logging distances are further (lower road density).

- Skyline systems with the following conditions best reduce soil disturbance: adequate deflection on concave slopes, tailtrees and intermediate supports on constant or convex slopes to achieve adequate deflection

<u>Helicopter</u>

- Reduces road density and fully lifts logs above the ground.

2. **The lowest cost harvesting method, consistent with resource protection needs, should be utilized.**

Harvesting cost increases significantly from ground based machines to skyline methods (eg. + 100%) to helicopter (eg. + additional 100%). Low costing harvesting methods allow for economic operations in small, low value wood where as high costing harvesting methods are often infeasible in this situation. High-costing harvesting technology should not be used if it is not needed to meet site specific resource objectives. Requiring high costing logging methods can lead to deficit sales or no sale bidders. It is important to recognize commonly available logging equipment and expertise from eastside communities and contractors (eg. ground based machines and cable systems). In most cases such equipment and expertise is adequate, given careful planning and quality control. Most silviculture treatment areas in eastern Oregon are already roaded and harvesting activities can be conducted with environmentally-sensitive ground-based and cable logging methods. Helicopter logging can be used on extremely sensitive sites however higher value wood products are needed for economical harvesting. There are also opportunities for non-common (or "new logging systems") in eastside forests however these applications should be viewed as trials similar to other trials (or experiments) in evaluating ecosystem management principles. Examples of "new logging system" applications in eastside forests are a monocable system and skyline yarding on flat terrain.

Example Economic Analysis

An example economic analysis is summarized in figure 1 comparing the cost of alternative logging methods and revenue generated from harvesting. Additional detailed information is presented in the appendix showing harvesting cost, identification of cost sensitive variables and relative soil impacts for each logging method. This economic analysis is based on results from a recently completed study in the Deerhorn Mountains southwest of Ukiah, Oregon (Brown, 1995) and results from a wide range of other studies and industry experiences harvesting smallwood (Born, 1995, Kellogg et al 1992, Kellogg and Bettinger 1994, King, 1995). The example reflects harvesting economics for relatively low-value wood

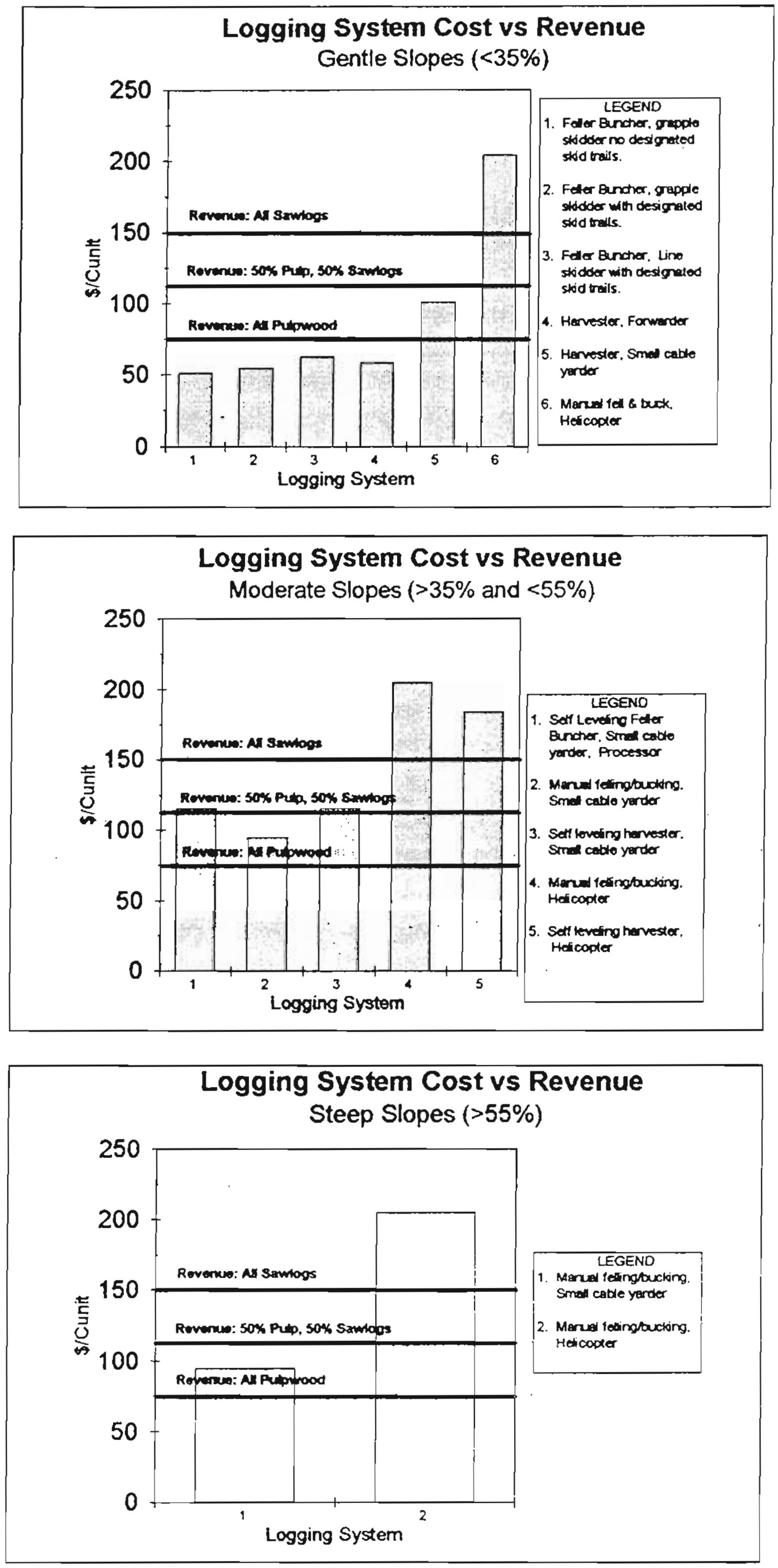

Figure 1. Example economic analysis for different terrain conditions and logging system alternatives for small tree understory removal and salvage harvesting.

Approximate maximum logging distances are compared below for different logging methods:

Logging Method	Maximum Economic Logging Distance
Tractor, Skidder	1,000 - 1,200 ft.
Harvester, Forwarder	1,500 - 2,500 ft.
Cable	
steep terrain	1,500 - 2,000 ft.
gentle terrain	1,000 - 1,200 ft.
Helicopter	3,000 - 4,000 ft.

4. **Environmentally sound harvesting requires a commitment to site specific detailed analysis, planning and quality control.**

   The Forest Service has lost many skilled people in recent years with local knowledge and experience for planning, layout and effective administration of timber sales. This is an impediment to action when complex environmental protection aspects are considered and technical logging techniques are needed (Kellogg, 1994). It may be necessary to find ways to temporarily hire skilled people from outside the agency, such as ex-Forest Service employees, retirees, or consulting foresters. Education and extension efforts would be helpful (also refer to item 5).

5. **A stable timber sale program will help the industry gear back up for the needed logging equipment, people, training and market development to utilize relatively low valued smallwood.**

   While the appropriate harvesting technology and knowledge is currently available, some modest upgrading of skills may be needed for eastside forest applications. This could be accomplished with a concerted effort in education and extension to improve the skills of people involved in both the planning/design and implementation/use of environmentally-friendly technologies.

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Harvesting Economic Analysis (pg 1 of 4)

Partial Cutting of Slopes < 35% (Gentle Terrain)

	Logging System	Prod/hour (ft^3/hr)	Cost/hour	Cost/Cunit (100 ft^3)	Crew size	Slash Location	Soil Impacts Index Disturb (0-10)	Soil Impacts Index Compctn (0-10)
	Tree to tree Feller Buncher,	900	$56.00	$6.22				
	Grapple Skidder, no designated	600	$52.00	$8.67				
1	skid trails				4 - 5	landing	4	6
	Processor/delimber	1000	$76.00	$7.60				
	Hydraulic Loader	1000	$67.00	$6.70				
	Log trucks		$30.00	$15.00				
				$50.82				
	Swing Boom Feller Buncher,	800	$75.00	$9.38				
	Grapple skidder with designated	600	$52.00	$8.67				
2	skid trails				4 - 5	landing	4	4
	Processor/delimber	1000	$76.00	$7.60				
	Hydraulic Loader	1000	$67.00	$6.70				
	Log trucks		$30.00	$15.00				
				$54.44				
	Swing Boom Feller Buncher,	800	$75.00	$9.38				
	Line Skidder with designated	370	$58.00	$15.68				
3	skid trails				5 - 6	landing	3	3
	Processor/delimber	1000	$76.00	$7.60				
	Hydraulic Loader	1000	$67.00	$6.70				
	Log trucks		$30.00	$15.00				
				$62.50				
	Harvester	475	$89.41	$18.82				
4	Forwarder	410	$70.34	$17.16	2 - 3	in unit	3	2
	Set out log trucks		$30.00	$15.00				
	(No loader needed)			$58.63				
	Harvester	475	$89.41	$18.82				
5	Small Cable Yarder	370	$132.72	$35.87	5 - 6	in unit	2	1
	Hydraulic Loader	370	$67.00	$18.11				
	Log trucks		$30.00	$15.00				
				$100.97				
	Manual Felling/bucking	200	$34.77	$17.39				
6	Helicopter & wheeled loader	900	$1,246.00	$138.44	8 - 9	in unit	1	0
	Hydraulic Loader	1000	$67.00	$6.70				
	Log trucks		$30.00	$15.00				
				$204.16				

* Refer to last page for assumptions and explanations.

Index Values: 0=Low, 10=High

Harvesting Economic Analysis (pg 2 of 4)

Partial Cutting of Slopes > 35% and < 55% (Moderate Terrain)

	Logging System	Prod/hour (ft^3/hr)	Cost/hour	Cost/Cunit (100 ft^3)	Crew Size	Slash Location	Soil Impacts Index Disturb (0-10)	Soil Impacts Index Compctn (0-10)
	Self Leveling Feller Buncher	750	$125.00	$16.67				
1	Small Cable Yarder	400	$132.72	$33.18	6 - 7	landing	2	2
	Processor/delimber	400	$76.00	$19.00				
	Hydraulic Loader	400	$67.00	$16.75				
	Log trucks		$30.00	$15.00				
				$115.69				
	Manual Felling/bucking	200	$34.77	$17.39				
2	Small Cable Yarder	400	$132.72	$33.18	5 - 6	in unit	2	0
	Hydraulic Loader	400	$67.00	$16.75				
	Log trucks		$30.00	$15.00				
				$94.66				
	Self Leveling Harvester	350	$125.00	$35.71				
3	Small Cable Yarder	400	$132.72	$33.18	5 - 6	in unit	2	1
	Hydraulic Loader	400	$67.00	$16.75				
	Log trucks		$30.00	$15.00				
				$115.74				
	Manual Felling/bucking	200	$34.77	$17.39				
4	Helicopter & wheeled loader	900	*************	$138.44	8 - 9	in unit	1	0
	Hydraulic Loader	900	$67.00	$7.44				
	Log trucks		$30.00	$15.00				
				$205.01				
5	Self Leveling Harvester	350	$125.00	$35.71				
	Helicopter & wheeled loader	1200	*************	$103.83	8 - 9	in unit	1	0
	Hydraulic Loader	1200	$67.00	$5.58				
	Log trucks		$30.00	$15.00				
				$184.15				

* Refer to last page for assumptions and explanations.

Index Values: 0=Low, 10=High

Partial Cutting of Slopes > 55% (Steep Terrain)

	Logging System	Prod/hour (ft^3/hr)	Cost/hour	Cost/Cunit (100 ft^3)	Crew Size	Slash Location	Soil Impacts Index Disturb (0-10)	Soil Impacts Index Compctn (0-10)
	Manual Felling/bucking	200	$34.77	$17.39				
1	Koller K300 yarder	200	$95.00	$47.50	3 - 4	in unit	2	0
	with landing skidder							
	Self Loading Log Trucks	750/load	$1.2/mile	$19.20				
				$96.70				
	Manual Felling/bucking	200	$34.77	$17.39				
1	Koller K501 yarder	400	$132.72	$33.18	5 - 6	in unit	2	0
	Hydraulic Loader	400	$67.00	$16.75				
	Log trucks		$30.00	$15.00				
				$94.66				
	Manual Felling/bucking	200	$34.77	$17.39				
2	Helicopter & wheeled loader	900	$1,246.00	$138.44	8 - 9	in unit	1	0
	Hydraulic Loader	900	$67.00	$7.44				
	Log trucks		$30.00	$15.00				
				$205.01				

* Refer to last page for assumptions and explanations.

Index Values: 0=Low, 10=High

Harvesting Economic Analysis: Assumptions and Explanations

- The processor/delimber and hydraulic loader production rates are limited by the production of the skidding or yarding components of the logging system unless they are operating on cold decked logs. More than one piece of equipment (ie. skidder) can be used to improve production in order to allow the processor/delimber or loader to work near its full capacity. This practice is common with ground based machines and less common with cable and helicopter systems.
- Trucking costs are based on a 120 mile round trip distance.
- Cost/hour reflects total owning, operating, and labor costs.
- Total logging system cost/cunit have been increased by 15% to reflect profit and risk.
- When dead wood is jack-strawed on the ground, manual processing or the use of a Feller Buncher isn't practical. A Harvester has the best equipment capabilities for working in these conditions.

Example Silvicultural Conditions

- Overstocked stand conditions (approx. 700-1000 trees per acre)
- Low elevation, arid sites
- Small understory tree removal and salvage (avg dbh = 8 inches) to reduce competition to late forest structure species.

Site Specific Variables Affecting Harvesting Economics

1. Tree size
2. Volume per acre
3. Volume removed per acre
4. Proportion of dead trees vs live trees
5. Proportion of sawlogs vs pulpwood
6. Amount of wood on the forest floor
7. Yarding distance
8. Trucking distance

Sawlog - Pulpwood Ratio's Affect on Revenue

	Sawlogs	Pulpwood	Value / Cunit	Value / Mbf	Value / ton
All Pulp	0%	100%	$75.00	$127	$30
	10%	90%	$82.50	$160	$35
	20%	80%	$90.00	$192	$40
	30%	70%	$97.50	$224	$45
	40%	60%	$105.00	$256	$51
	50%	50%	$112.50	$289	$56
	60%	40%	$120.00	$321	$61
	70%	30%	$127.50	$353	$66
	80%	20%	$135.00	$385	$71
	90%	10%	$142.50	$418	$76
All Sawlogs	100%	0%	$150.00	$450	$82

Product Price Assumptions

Pulpwood	$30	per ton
Sawlogs	$450	per Mbf

Unit Conversions

Tons/Mbf pulpwood	4.25
Tons/Mbf sawlogs	5.52
Cunits / Mbf	3.0
Cunits / Ton	0.4