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Forest Health in the Blue Mountains: The Influence of Insects and Disease

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Forest Health in the Blue Mountains: Science Perspectives

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Abstract

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A science perspective of forest health in the Blue Mountains is summarized by using both historical and biological information. Many of the current pest problems are related to human activities that have occurred over the last 90 years. The almost complete loss of periodic low-intensity fires since 1900 plus extensive logging of pine have resulted in many thousands of acres of fir occupying pine sites. These fir forests are highly susceptible to pests and to catastrophic forest fires. Some long-term management strategies are now needed to alleviate the problems. Research recommendations also are suggested as part of the long-term solution.

Keywords: Insects, forest diseases, fire, grand fir, Douglas-fir, ponderosa pine, silviculture, landscape ecology.

Preface

The Blue Mountains of northeast Oregon and southeast Washington are composed of a complex mix of ecosystems, habitats, landforms, and economies. Several consecutive years of drought, epidemic insect infestations, and catastrophic fire are threatening the natural resources and the social and economic systems within the Blue Mountains. The general health of the forests is not good, and may be worsening. A primary factor that has led to the current deteriorated condition of the forests has been the exclusion of fire. Past timber management practices also have contributed.

This publication is part of a series on forest health in the Blue Mountains. The purpose of this series is to provide a discussion of the forest health issues from various science perspectives: insects and disease; economic and social issues; fish, riparian areas, and water quality; ecology, fire, and range; wildlife; and a summary of forest health public forums held throughout the Blue Mountains.

The Blue Mountains Natural Resources Institute has been the focal point for much of the discussion regarding the science issues associated with forest health. This organization, which includes over 60 partners, has broad representation and a strong interest in restoring health to the forests and communities of the Blue Mountains area. The institute has fostered publication of these papers as one more step in the long process of restoring health to east-side forested landscapes.

Thomas M. Quigley

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Introduction

Tuesday, September 6, 1853 - Left the Grande Ronde about 7 o'clock this morning, Mrs. Dix on horseback, the rest of us on foot. We have come 15 or 16 miles today. We have walked full half of it. The horses have had all they could do to draw the carriage up the hills. Our road has been nearly the whole day through the woods, that is, if beautiful groves of pine trees can be called woods. Stopped for dinner on Grande Ronde River. The grass has been fine all the way except just where there had been a camp. Wherever there were, we found wagons or baggage of some kind left, showing the teams were giving out and people had to get along the best way they could.

Left Mr. Hine's company this morning looking over their loads, preparing to leave a good part. After dinner, when we had ascended the first hill, we looked back upon the country we had passed through. I can almost say I never saw anything more beautiful, the river winding about through the ravines, the forests so different from anything I have seen before. The country all through is burnt over, so often there is not the least underbrush, but the grass grows thick and beautiful. It is now ripe and yellow and in the spaces between the groves (which are large and many) looks like fields of grain ripened, ready for the harvest. We had a very fine view of the Grande Ronde after gaining the top of the high hill which led us out of it. This was beautiful indeed, with the river winding through it, all skirted with trees. We are encamped for the night right among the trees, without water and with the prospect of being without it till late in the day tomorrow. We can do very well to night, but I expect we shall be hungry and thirsty tomorrow before we get our breakfast

This excerpt from the 1853 Journal of Miss Rebecca Ketcham (1961) describes the country as their party was leaving the Grande Ronde River at the site of Hilgard State Park. It is far different from the site today along Interstate 84 from Hilgard to Meacham. Now, there are thickets of sapling and pole-size fir that are severely defoliated by western spruce budworm, scattered Douglas-fir and grand fir being killed by bark beetles, pockets of root disease that are killing fir, and scattered second-growth ponderosa pine that are often infected with dwarf mistletoe.

Almost every pioneer journal from the 1850s describing the Blue Mountains portion of the Oregon trail has noted and marveled at the tall, "magnificent" pines, large grassy openings, and lack of underbrush (Evans 1990). Those traveling in September and October also noted the smokey conditions from many underburnings and forest fires (Evans 1990). Why have our forests in the Blue Mountains changed so dramatically over the last 140 years? We now have few large pine; instead there are dense stands of immature pine, Douglas-fir, and grand fir, and insects and disease are decimating these replacement stands.

A description of what was happening to the "magnificent" pine forests shortly after the turn of the century, or about 50 years after the Oregon Trail pioneers, was recorded by the first forest entomologist working in the Blue Mountains (Burke 1989):

An infestation of the mountain pine beetle found near Joseph, Oregon, was one of the starting points of the great northeastern Oregon epidemic which killed millions of lodgepole and yellow pines during the next five years

The Northeastern Oregon Forest Insect Control Project really started August 17, 1907, when at the request of Supervisor Howard O'Brian of the Imnaha [Wallowa] N.F., I examined dying lodgepole and yellow pine [ponderosa pine] on the divide between Little Sheep and Big Sheep Creek near Joseph, Oregon. The mountain pine beetle was found to be the main depredator, but the western pine beetle was

also present in the yellow pine. During the preceding three years, 90 to 95 percent of the lodgepole and much of the yellow pine had been killed on an area of over 100,000 acres. By July 1 [1910], it was determined that the infestation was widespread, involving at least 2,000,000 infested trees, and the infesting insects were so far advanced that no effective control work could be done on the 1909-1910 infesting broods.

The bark beetle infestation just described resulted in the first large-scale cooperative bark beetle control project funded by Congress in the Western United States (Wickman 1987). From 1910 through 1913, thousands of pine trees infested with bark beetles were felled and burned on what are now the Wallowa-Whitman and Ochoco National Forests (Burke 1989). This project, called the Northeastern Oregon Project, was only the beginning of a series of projects that later extended south to northern California and continued into the 1930s (Craighead and others 1931, Miller and Keen 1960, Wickman 1987). At this time, a combination of factors was coalescing to begin the degradation of the magnificent pine stands in the Blue Mountains.

First, from 1887 through 1890, one of the worst droughts in recorded history to that time occurred in eastern Oregon (Keen 1937). A series of alternating moist, dry, and normal years followed until 1917. From 1917 through the 1930s, a period of critically subnormal precipitation and ponderosa pine growth occurred thereby resulting in large bark beetle outbreaks in old-growth pine throughout the interior West (Craighead and others 1931, Keen 1937, Miller and Keen 1960). Second, lodgepole pine in many stands were overmature and overstocked, ripe for mountain pine beetle infestation and forest fires. The combined effects of drought and old age were causing widespread mortality of pine. This mortality was unrelated to the Forest Service management practices just getting under way.

Also, logging of virgin pine stands in the West was greatly accelerated during this period. New railroads made many stands more accessible to sawmills and markets, and forest owners wanted to harvest the pine in high-hazard areas before they became infested by bark beetles. This was the heyday of railroad logging and large sawmills geared toward the clear pine lumber market. Lumber was needed for mining, shipping boxes for agricultural products, and ironically, for railroad ties for the expanding rail system in the West. In 1906, the USDA Forest Service in their new role as protectors of the National Forests started their policy of fire suppression whenever and wherever possible, which also contributed to future forest conditions.

These events set the stage for the next generation of trees on millions of acres in the interior West. Unfortunately, many of the replacement stands in the Blue Mountains were not ponderosa pine and western larch, but instead were more shade-tolerant species like true fir and Douglas-fir. Without periodic light ground fires to reduce their stocking, the shade-tolerant species proliferated under the remaining mature ponderosa pine stands (Hall 1980, Williams and others 1980). These replacement stands of fir also were highly vulnerable to several types of pests not previously mentioned as being a problem to trees in old Forest Service reports. By the late 1940s and 1950s, much of the remaining pine overstory was logged, the fir trees were growing rapidly, and canopy biomass was sufficient to maintain increasing populations of insect defoliators. In 1947, a series of Douglas-fir tussock moth outbreaks began and have continued to the present (Scott 1989, Wickman and others 1973). In 1947, a series of western spruce budworm outbreaks also began and became a serious problem by defoliating millions of acres of fir stands (Dolph 1980). The current outbreaks of spruce budworm are continuing into

the 1990s with apparent increasing intensity in some stands. Attempts to control these two pests have resulted in millions of acres of aerial treatment with chemical and biological insecticides since 1948, costing well over \$50 million. This is a big escalation from the \$25,000 appropriated by Congress to conduct the 1910-11 bark beetle project (Burke 1989).

In addition, bark beetles have killed many weakened trees after the outbreaks (Wright and others 1984). Salvage operations undertaken by local sawmills resulted in several entries into stands that resulted in harmful effects on soils which we are just beginning to understand (Geist and others 1989).

Those sites regenerated by pine after logging and earlier bark beetle mortality and stand replacement fires became overstocked at 80 or more years of age and suffered a large mountain pine beetle outbreak in the 1970s (Dolph 1982). Additionally, root diseases are becoming a serious problem in young, mixed-conifer stands and in older, partially logged stands of pure fir (Filip and Schmitt 1990). Mistletoe is becoming a problem in young Douglas-fir and in stands managed under uneven-age systems.

The increasing tree mortality, top kill, and growth loss caused by various pest agents, singly or in combination, have led to drastically declining productivity of Blue Mountain forests. This is affecting timber harvest goals projected by forest plans; it also is increasing the fire hazard and has contributed to several recent catastrophic forest fires. It is changing wildlife habitat on a landscape level: The Blue Mountains are suffering declining forest health on a landscape scale.

What can be done from a pest management perspective to make these forests healthy and productive again?

Current Knowledge

Forest insects, particularly the Douglas-fir tussock moth and western spruce budworm, have been studied in the Blue Mountains since 1948 (Dolph 1980, Wickman and others 1973). The population dynamics of these two insect species are well understood (Carolin and Coulter 1975, Mason and Wickman 1988), as is the damage they cause (Wickman 1978, Wickman and others 1980, Williams 1967). A major 5-year research, development, and application (RD & A) program was begun in 1974 to study and develop management techniques for the Douglas-fir tussock moth (Brookes and others 1978). From that effort and continuing research afterward, an early warning technique emerged that uses pheromones to detect rising populations (Daterman 1978), new sampling methods (Mason 1977, 1979, 1987), and an understanding of the population dynamics and silvicultural management (Mason and Wickman 1988).

The western spruce budworm was the focus of a 7-year RD & A effort called the CANUSA Program (Canada-United States Spruce Budworm Program). There were some study areas from that program located in the Blue Mountains, and valuable information was obtained on population dynamics, especially predation processes (Campbell and others 1983, Torgersen and others 1990) and sampling techniques (Srivastava and others 1984). More recently, sampling techniques have been improved with a lower crown method (Mason and Beckwith 1990, Mason and others 1989). Studies of the long-term effectiveness of chemical treatment programs are nearing completion.¹

¹ Torgerson, Torolf R.; Powell, D.C.; Hosman, K P.; Schmidt, F.H (In review). Western spruce budworm population behavior and tree growth response after treatment with carbaryl: a 7-year analysis
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Silvicultural methods involving thinning and fertilization show promise for reducing the damage from budworm outbreaks (Mason and others, in press; Wickman and others, in press). New, large-scale studies are under way to assess the effects of fertilizing in reducing impacts from western spruce budworm and other pests.

Tree diseases have not been studied as intensively as insects in the Blue Mountains. Many pathological problems are more recent and have developed after logging or in the more shade-tolerant species. A good synthesis of grand or white fir disease problems and management options in Oregon and Washington including the Blue Mountains was recently published (Filip and Schmitt 1990). There are other publications on disease biology and management in the Blue Mountains in process, and many studies are currently under way.

The Future

If we have learned so much in the past and are learning more currently, then what is the problem? Why can't we make Blue Mountain forests more vigorous and resistant to pest outbreak? I think the primary reason is that we have not integrated our studies on insects and diseases with those of plant ecologists, wildlife biologists, economists, and silviculturists; and we have not taken a long-term forest management approach to pest management.

We must stop trying to treat symptoms and instead make forests more resistant to pest outbreaks through vegetation management projects on a landscape level.

Future research and pest management needs can be addressed in the context of short-term tactical approaches and long-term strategies. The two approaches should be integral with short-term actions carried out with long-term objectives in mind. This rarely has been the case in the past where pest management activities were mainly oriented toward maintaining the forest status quo by temporarily reducing pest damage.

Short term: In the short term, we need to utilize much of the timber presently nearing harvest without sacrificing the long-term health of the forests. This should be done with minimal impact to soil and nutrients and with a goal of enhancing ponderosa pine and western larch wherever possible. Many thousands of acres of true fir and Douglas-fir are on sites originally occupied by pine. Much of this fir occurs in young, mixed-conifer stands nearing harvest age. These stands also protect watersheds and riparian zones and provide big game habitat. They have aesthetic value as the only forest cover most users of the Blue Mountains have ever seen. To most people who do not have a historical reference to the past, what they see now is normal to them. Unfortunately, these forests are unhealthy and dying from pest influences. Forest managers should recognize the multiresource values at risk in their short-term activities.

We need good early detection and hazard rating systems for pest outbreaks and better methods of predicting when and where to use direct suppression techniques. We will need to use environmentally safe pesticides, pheromones, and silvicultural methods that can carry some of these forests to harvest and protect other resource values. Mentioned earlier were the studies on fertilization, which shows promise as a silvicultural method of helping some stands survive an outbreak. In both the short term and long term, we need to conserve as many of the remaining old-growth ponderosa pine and mixed-conifer stands as possible. We need them for their gene pool, as seed sources, for biological diversity, and as living examples of our long-term objectives.

The judicious use of the early ponderosa pine risk-rating systems and sanitation-salvage techniques may be valuable for maintaining the health of remaining old-growth ponderosa pine stands. The results of research at Blacks Mountain Experimental Forest in northern California indicate that by cutting the high-risk trees (about 15 percent of the stand), the remaining stand has remarkably lower tree mortality from bark beetles than the uncut stand. These beneficial results continued for over 22 years (Wickman and Eaton 1962).

Long term: The long-term approach is now becoming obvious to many forest managers, but it is also the most complex and difficult to achieve. Conversion of fir stands back to serai species like pine and larch on drier sites has been mentioned by many people as the ultimate solution (Mason and Wickman 1988). This is going to be difficult biologically, operationally, economically, and socially. It will require drastic steps on a landscape level over a long period—perhaps 100 years. There also are multiple-resource values at short-term risk if we convert forests too rapidly on such a large scale. In some cases, we may have to trade short-term benefits to achieve long-term objectives. We also have little or no research or management experience to guide us in landscape-scale operations. So, where do we start? We first must educate ourselves and the public to the role of insects and disease as part of the functional dynamics of ecosystems, which play an important role in decomposition, nutrient cycling, and plant succession (Klock and Wickman 1978, Mattson and Addy 1975, Wickman and others 1986).

Long-term monitoring of insect herbivores and their effects on stands is revealing not only the intrinsic dynamics of individual pests species, but, in terms of spatial and temporal patterns, is telling much about forest community dynamics as well (Mason and Wickman 1988). In the long term, for instance, severely defoliated forests in the Blue Mountains often grow faster after a Douglas-fir tussock moth outbreak than undefoliated forests because of a thinning effect and increased nutrient cycling (Wickman 1986). After heavy tree mortality in a mixed-conifer forest, the natural regeneration can swing back toward serai species (Wickman and others 1986). Some of these long-term benefits may accrue for up to 50 years according to outbreaks studied in other areas (Wickman and Starr 1990).

Research results are giving us a clue that we should try using so-called pests as biological agents to control unwanted vegetation, namely fir. That idea may be difficult to sell to forest managers and the public, but in an ecological perspective, it is what nature is doing anyway. We have short-circuited the system with past fire policy (Pyne 1981) and by trying to prevent fir mortality by repeatedly spraying large areas from the air. The positive economics of a vegetation biocontrol approach should become obvious after another spray project or so.

We need to understand and enhance natural processes, not fight them. We can help by devising silvicultural methods to aid in postoutbreak cleanup, learning to plant the right species on the right sites, using prescribed fire and appropriate mechanical means to maintain the desired vegetation, and conducting fundamental studies of how nature functions on a landscape basis. By restoring natural stand structure and species composition, we will enhance the retention of biodiversity and possibly prevent the inadvertent extinction of vertebrate and invertebrate species, some of which are yet unknown to us. We need to constantly reevaluate what we learn and keep our long-term objectives in sight. We will not achieve healthy forests overnight. As many ecologists have pointed out, "there will be no free lunches"; we now must pay for the billions of board feet of

cheap pine logged early in the 20th century. We will pay and pay and probably see little or no return on our investments in our lifetimes.

The alternatives are not encouraging. We can continue to spend millions of dollars in 5- to 10-year cycles on large, pest management projects, have larger and more disastrous fires to fight, and yet see the health of forests decline even further as the specter of global climate change looms on the horizon. Fighting fires and spraying bugs does have temporary positive inputs for local economies, but future generations are not going to be happy with the Blue Mountain forests we leave to them.

A final caveat is appropriate given the complexity of forest health. Presettlement natural systems also suffered major pest outbreaks. It may not be possible to create and force "converted" landscape level forest communities into long-term stable states given the unknowns of future resource demands, economics, climate change, and tree and pest coevolution.

Research Recommendations

Some specific research and development approaches should include the following:

1. Develop and implement the use of silvicultural and nutrient management techniques, pheromones, and environmentally safe pesticides to reduce impacts on resources in high-value stands.
2. Conserve, to the greatest possible extent, remaining old-growth ponderosa pine in the Blue Mountains. These remaining trees have survived centuries of droughts, forest fires, pest outbreaks, and encroachment of civilization for a reason. They probably have some genetically inherent vigor and survival traits that make their gene pool valuable. We also have lost much of our pine seed source in some stands. Substantial amounts of seed will be needed to undertake a long-term species conversion management approach. We need genetic studies with this material, and we need studies on regeneration biology and techniques, especially with western larch.
3. Undertake, on a landscape level as soon as possible, some experimental stand conversion and maintenance techniques. We should try biological control of unwanted tree species, silviculture and prescribed fire to manage fuel loads and unwanted species, and nutrient management to maintain productivity and successional stability.
4. Study the interrelations of plants and animals, both vertebrate and invertebrate, in the remaining old-growth and re-created stands to make sure we are putting the right pieces back in place and encouraging the major processes under which the presettlement ecosystems evolved. This will minimize the loss of biodiversity and productivity.
5. New long-term studies are needed on the dynamics and relations of soil organisms (particularly arthropods) and canopy-dwelling herbivores to nutrient cycling under different biotic and abiotic conditions. This should be part of soils and nutrient management research and development programs that relate to resource productivity and global climate change.
6. Improve techniques for monitoring pest population and stand health to keep things on track, warn us of impending pest outbreaks and operational failures, and let us know when we are succeeding. We should plan for and fund field monitoring and data collection at the beginning and not leave it to chance.

7. Develop and improve spatial and multipest models that can be used to improve the forest planning process.

As evident from the foregoing recommendations, close attention to the integration of science and management will be needed to build and maintain new, healthy forest structures able to provide both the needed resources and a measure of long-term stability in Blue Mountain ecosystems.

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Appendix

Common and Scientific Names

Common name	Scientific name
Western spruce budworm	<i>Choristoneura occidentalis</i> Freeman
Douglas-fir tussock moth	<i>Orgyia pseudotsugata</i> (McDunnough)
Douglas-fir	<i>Pseudotsuga menziesii</i> var. <i>glauca</i> (Beissn.) Franco
Grand fir	<i>Abies grandis</i> (Dougl. ex D. Don) Lindl.
Ponderosa pine	<i>Pinus ponderosa</i> Dougl. ex Laws.
Western larch	<i>Larix occidentalis</i> Nutt.
Mountain pine beetle	<i>Dendroctonus ponderosae</i> Hopkins

Open, parklike, mixed-conifer stands on the Whitman National Forest in 1910.

Mountain pine beetle outbreaks were widespread in the Blue Mountains from 1907 to 1915. This mountain pine beetle control camp at Badger Creek, Ochoco National Forest, in 1913, is located in the midst of dead and dying lodgepole pine.

Old-growth ponderosa pine stands containing large trees in parklike settings were common east of the Cascades in Oregon shortly after 1900.

After a decade of severe drought in the 1920s, bark beetle outbreaks were extensive in old-growth ponderosa pine stands throughout eastern Oregon.

Currently many mixed-conifer stands in the Blue Mountains have few remaining ponderosa pine and are overstocked with Douglas-fir and true fir which are severely defoliated by western spruce budworm.

There is an urgent need to control the amount of fir understory in stands originally composed mostly of ponderosa pine and western larch by using light, prescribed burns and mechanical techniques. Left picture shows before prescribed fire, picture on right shows after prescribed fire.

Wickman, Boyd E. 1992. Forest health in the Blue Mountains: the influence of insects and diseases. Gen Tech. Rep PNW-GTR-295 Portland, OR'U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station 15 p. (Quigley, Thomas M.] ed., Forest health in the Blue Mountains. the influence of insects and diseases).

A science perspective of forest health in the Blue Mountains is summarized by using both historical and biological information. Many of the current pest problems are related to human activities that have occurred over the last 90 years. The almost complete loss of periodic low-intensity fires since 1900 plus extensive logging of pine have resulted in many thousands of acres of fir occupying pine sites. These fir forests are highly susceptible to pests and to catastrophic forest fires. Some long-term management strategies are now needed to alleviate the problems. Research recommendations also are suggested as part of the long-term solution.

Keywords- Insects, forest diseases, fire, grand fir, Douglas-fir, ponderosa pine, silviculture, landscape ecology.

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