# *Forest Health in the Inland West*

## *A Symposium*

June 1-3, 1993

The Red Lion Riverside

Boise, Idaho

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# *Abstracts of Presentations*

## Forest Health and It's Relationship to Ecosystem Management

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The demands on federal lands are ever increasing and dramatically changing. Yet some of these same lands are under severe stress. For example, a half million trees have been killed by bark beetles since 1988, a quarter million trees were defoliated by Douglas-fir Tussock moth, and 56,000 acres per year since 1986 were destroyed by wildfire when only 3,000 acres per year were lost to fire in the previous two decades on the Boise National Forest. And the Blue Mountains ecosystem in the Northwest is in a severely stressful situation as well.

Perspectives and methods of the past have led us to approach these types of crisis situations on a species-by-species basis or through the lens of just fire or disease or insect infestation. After several years of thoughtful investigation and testing, the U.S. Forest Service adopted a policy of ecosystem management in June, 1992. For the Forest Service, the term ecosystem management is defined as an ecological approach to multiple use management of the National Forests and Grasslands that blends the needs of people and environmental values in such a way that the National Forests and Grasslands represent diverse, healthy, productive, and sustainable ecosystems.

Ecosystem management is a developing concept. It requires an understanding of the interaction and influences of all species and all natural phenomenon in a particular ecosystem along with understanding of human interests as well. It requires, too, that we take into account a much longer view of time along with larger scale considerations. Is there a foundation for this new policy? The answer is yes. Although implementing ecosystem management will require much experimentation and learning as we go, there is sufficient science to initiate this approach.

Since ecosystem management is such a new concept in terms of large scale application, we must develop organizing principles to think past traditional approaches--to develop a systematic way of considering what we must to meet the challenge of integration and interrelationships that ecosystem approaches demand of us. Traditional definitions of forest health have often led is to narrow, ineffective and challenged approaches in the past. The first question that might be asked is 'what is the desired future condition for this ecosystem?'. In answering that essential question, we must look through the dual lens of the interactions of nature and the interactions of the public.

An ecological definition of forest health would include plant and animal communities and the cycling of nutrients and water within and between its living and non-living compartments maintain an equilibrium between production and growth and mortality. Reproduction of the plant and animal systems would be sustainable.

But where do we start in defining this balance? The definition assumes the following concepts:

- Forests within healthy ecosystems will continually evolve and change and that rates of change vary depending on species and geographic and topographic location and are variable due to stress events.
- Those forests will naturally sustain the optimal diversity of species and life forms.
- Those forests have a inherent high degree of diversity that support their resistance and resilience.

- It is expected that stress factors such as fire, insect and disease outbreaks and droughts will occur in natural healthy forest ecosystems and that some mortality may result depending on the intensity.
- Stress events are an important influence on composition, form and structure and by their effects regulate rates of successional change.
- Death of trees is expected and a desirable condition that indicates cycling processes are occurring.
- Not all seral stages are resilient to disturbance.
- Because of previous historic use some forests will require restoration and more intensive management.

Answering the question of desired future condition through the framework of managing natural interactions is challenging particularly when we assess the tools available to get there. We need to know far more than we already do about the interactions of species, of stress occurrences and geography, topography and scale. In taking the longer view that ecosystem management requires, we must look at the peaks and valleys of forest condition on a broader basis than our traditional approach to 'fixing' the current condition. To achieve these goals, more focused research will be directed to filling the information gaps.

Answering the challenge of ecosystem from the human dimension is even more difficult. Many of the more vocal publics are limiting our options and tools. If nature is dynamic and messy, some would limit us to 'picture postcard' standards of acceptability that may not be biologically feasible. Also, some views have been legislated such as the Endangered Species Act and wilderness designations on the federal level.

Involving individuals and groups in collaborative information sharing and decision making is critical if we are to pursue an ecosystem approach and continue to manage our forests and natural resources. We must keep as many tools and options available to us as possible. New and viable partnerships will be essential as we identify management options. Since all forests are not at the same ecological condition, an array of new and old management options are available. We can open ourselves to new approaches and new mixes of concepts.

Moving to the level of thinking that ecosystem management requires of us will not be easy. The switch from a single to a multiple approach and from the stand to the landscape focus requires the pursuit of new bodies of knowledge and new approaches. Yet we cannot wait until we have all the answers; we must act. And thus we will make mistakes while we are learning and developing the concept. Ecosystem management cannot be 'seen'. It is a philosophy of thinking and acting that will take time and courage. But it is the road we must take in managing natural resources.

## Exploring the Definition of Forest Health

*Jay O'Laughlin, Idaho Forest, Wildlife and Range Policy Group, University of Idaho, Moscow, ID*

The dictionary (Random House 1971) provides four definitions of health. All but one definition of health applies to the general condition of the human body and mind. The fourth and broadest definition of health is simply "vigor; vitality: *economic health*." If an economy can be described as healthy, surely a forest can, too.

The following quotations are state-of-the-art definitions of forest ecosystem health. The listing illustrates how the concept has developed chronologically. Forest health, health, or ecosystem health are emphasized.

The conclusion [regarding "The Health of the Forests"] can be briefly expressed. The function of forestry is to produce not just crops of timber, but crops of healthy timber. Forest pathology in its relation to forestry shares an interest and responsibility towards this objective in all that is comprised under the appellation "healthy" (Faull 1930).

A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity (Leopold 1949a). A science of land health needs, first of all, a base datum of normality, a picture of how healthy land maintains itself as an organism (Leopold 1949b).

[M]ost forest ecosystems lead long, productive lives.... [I]nflictions of old age, environmental stress, or unwelcomed visitors produce unhealthy ecosystems.... In recognizing that forests and other ecological systems provide irreplaceable services, when these systems are threatened, we must administer aid (Waring 1980).

[T]he effects of regional and global air pollution on forest ecosystem health are difficult to quantify.... Sensitive and practical methods must be developed and implemented in order to monitor and predict forest health (Smith 1985).

The phrase *ecologically healthy* refers to the functions affecting biodiversity, productivity, biogeochemical cycles, and evolutionary processes that are adapted to the climatic and geological conditions in the region (Karr et al. 1986).

In the search for the causes of pine growth reduction [in the Southeast], all hypotheses need testing, and all aspects of forest health need monitoring (Sheffield and Cost 1987).

A desired state of forest health is a condition where biotic and abiotic influences on the forest (i.e., insects, diseases, atmospheric deposition, silvicultural treatments, harvesting practices) do not threaten management objectives for a given forest unit now or in the future. Forest health is a complex subject with both real and perceived problems which can arouse strong emotions. Such problems justify nationwide concern. The actual problems are the product of events occurring over a long period of time. The perceived problems reflect an incomplete understanding of forest ecosystems, the biological processes operating within them, and alternative views of the purposes to be served by the forest (USDA Forest Service 1988).

No widely accepted definition of forest health exists (Riiters et al. 1990).

The public perception of a healthy forest as one that can recover from insect infestation, disease, and other natural factors is one component of the "sustainability" value. But a term such as sustainability can have different meanings in the scientific community, and therefore it is difficult to determine what to measure.... Individuals will always have different perceptions of forests, and thus of how to describe their condition. For now, analysts must be sensitive to these differences; ultimately, we may be able to identify a set of values that relates to everyone's perceptions of forests (Riiters et al. 1990).

Definitions are critical in any assessment of forest health.... Tree or forest decline is a wide-spread decrease in the health and vigor of a forest tree or groups of trees, respectively, due to disease or injury.... Until we become serious about long-term forest health assessment, we will not know whether the health of forest systems is improving, stable, or declining (Smith 1990).

[U]nderstanding ecosystems ... will provide the scientific basis for addressing health and productivity issues (USDA Forest Service 1991a).

Forest health is the condition of the forest based on diversity of natural features of the landscape, distribution of plant communities exhibiting various stages of succession, and the degree to which naturally occurring fauna occupy habitats that are varied and equitably distributed across the landscape (USDA Forest Service 1991b).

Resilience is the ability of an ecosystem to absorb change without major loss of function. Sites vary in their natural resilience. The maintenance of long-term productivity correlates strongly to ecosystem resilience. An important way to reduce loss of resilience is to manage for biological diversity; i.e., diversity of species, successional stages, and openings across the landscape. This will help retain the functional relationships that lead to resilience in the first place. We are a long way from full understanding of the resilience of forest ecosystems (USDA Forest Service 1991b).

A 'healthy ecosystem' is one in which the physical, chemical, and biological mechanisms of ecosystem recovery are operating at rates that are characteristic of that ecosystem.... The individual/ecosystem analogy is imperfect, however. Ecosystems do not die in the sense that an individual organism dies. Ecosystems will always recover either partially or completely from even severe disturbance if the processes of recovery are permitted to operate (Kimmins 1992).

Ecosystem health is a normative concept: a bottom line. It represents a desired endpoint of environmental management, but the concept has been difficult to use because of the complex, hierarchical nature of ecosystems. Without an adequate operational definition of the desired endpoint, effective management is unlikely.... [T]he concept of ecosystem health is a comprehensive, multiscale, dynamic, hierarchial measure of system resilience, organization, and vigor. These concepts are embodied in the term 'sustainability,' which implies the system's ability to maintain its structure (organization) and function (vigor) over time in the face of external stress (resilience). A healthy system must also be defined in light of both its context (the larger system of which it is part) and its components (the smaller systems that make it up) (Costanza 1992).

Since fast-changing human cultures are embedded in larger-scale, slow-changing ecological systems, we must develop policies that allow human cultures to thrive without changing the life support functions, diversity, and complexity of ecological systems.... Defining ecosystem health is a process involving the identification of important indicators of health (such as a species or a group of species), the identification of important endpoints of health (such as relative stability and creativity), and, finally, the identification of a healthy state incorporating our values.... The workshop participants arrived at a working definition of ecosystem health that incorporates most of the considerations just listed. It defines health in terms of four major characteristics applicable to any complex system: *sustainability*, which is a function of *activity, organization,* and *resilience*. Thus they concluded: "An ecological system is healthy and free from 'distress syndrome' if it is stable and sustainable—that is, if it is active and maintains its organization and autonomy over time and is resilient to stress" (Haskell et al. 1992).

In the ecological realm, one generally confers the connotation of "health" to a state of nature (whether managed or pristine) that is characterized by systems integrity: that is, a healthy nature exhibits certain fundamental properties, of self-organizing complex systems.... [W]hat is "desired" or "healthy" must also take into account social and cultural as well as ecological values. These values may differ markedly among various segments of society. Native peoples, for example, value the integrity of the forest as a "cultural home," one that permits the survival of traditional ways of gathering food, spiritual life, and the like. Foresters value forests quite naturally in terms of its productivity of merchantable timber. Consequently, the health status of forested ecosystems transformed through harvesting and other means will be assessed in very different ways depending on cultural and social values (Rapport 1992).

How can we create a practical definition of system health? First, an adequate definition of ecosystem health should ... be a combined measure of system resilience, balance, organization (diversity), and vigor (metabolism). Second, the definition should be a comprehensive description of the system. Looking at only one part of the system implicitly gives the remaining parts zero weight. Third, the definition will require the use of weighting factors to compare and aggregate different components in the system.... And fourth, the definition should be hierarchial to account for the interdependence of various time and space scales (Costanza 1992).

By ecosystem management, we mean that an ecological approach will be used to achieve the multiple-use management of the National Forests and Grasslands. It means we must blend the needs of people and environmental values in such a way that the National Forests and Grasslands represent diverse, healthy, productive, and sustainable ecosystems (USDA Forest Service 1992).

'Forest health' has become a buzzword among timber state lawmakers, but the sound grates on the ears of environmentalists like a chain saw. Francis Hunt, lobbyist with the National Wildlife Federation, described forest health "as nothing more than a thinly veiled attempt by industry to increase the timber cut and weaken environmental laws" (Swisher 1992).

The vast majority of residents (85%) consider insect infestations and disease in Idaho forests a problem, most of which feel it is a serious problem. In fact, only 5% of respondents say insect infestations and disease in the forests is not at all a problem (Dan Jones and Associates 1992).

The heart of an ecologically healthy watershed is the riparian forest (Naiman et al. 1992).

Forest health can be defined as the ability of a forest to recover from natural and human-caused stressors.... Over time, single or multiple stressors may alter trees to a point where they can no longer recover and begin to "decline," exhibiting crown dieback and deterioration. This decline may be reflected by changes in rates of succession, forest composition and structure, or general productivity. Large outbreaks of insects and disease do not automatically indicate a deterioration in forest health.... It is desirable to establish and maintain forests that are as resilient as possible to natural and human-caused stressors, while meeting the values, needs, and expectations of society (USDA Forest Service 1993a).

How to sustain the health of forest ecosystems has emerged as a key challenge for the forestry profession, along with the traditional (but no less profound) questions about how to provide for the production, use, and enjoyment of forest resources.... Forest health is a particularly complex topic.... Forest health is reflected in how the forest responds or is able to respond to stress.... Forests can be considered healthy when there is an appropriate balance between growth and mortality... Having the resilience to react and overcome various stressors is a key indicator of health, and is a key objective of ecosystem management.... [E]cosystem management is an ecological approach to forest resources management. It attempts to maintain the complex processes, pathways, and interdependencies of forest ecosystems and keep them functioning well over long periods of time, in order to provide resilience to short-term stress and adaptation to long-term change. Thus, the condition of the forest landscape is the dominant focus, and the sustained yield of products and services is provided within this context (Society of American Foresters 1993).

Ecosystem management ... rests on six principles. [The first is] sustainability. Restore and maintain diversity, health, and productivity of forest and grasslands. Provide commodities and uses consistent with sustained vitality and resiliency of ecological systems (USDA Forest Service 1993b).

Managing for healthy ecosystems will promote biological diversity and sustainable development (USDI Bureau of Land Management 1993).

Ecosystem management is in vogue. It's a new means of natural resource management. I concur and I applaud that move because addressing one species at a time is leading us both to an exhaustion of patience and resources. However, that approach is not going to be simple, it's not going to be cheap. One of my heroes said, "Ecosystems are not only more complex than we think, they're more complex than we can think" (Thomas 1993).

Regardless of what we are doing, our efforts [to resolve the "logjam" or gridlock in the forests of the Pacific Northwest] must be guided, it seems to me, by five fundamental principles. First, we must never forget the human and the economic dimensions of these problems. Where sound management policies can *preserve the health of forest lands*, sales should go forward. Where this requirement cannot be met, we need to do our best to offer new economic opportunities for year-round, high-wage, high-skill jobs. Second, as we craft a plan, we need to *protect the long-term health of our forests, our wildlife and our waterways*. They are, as the last speaker [Ted Strong, CRITFC] said, a gift from God and we hold them in trust for future generations. Third, our efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible and legally responsible. Fourth, the plan should produce a predictable and sustainable level of timber sales and non-timber resources that will not degrade or destroy our forest environment. And fifth, to achieve these goals, we will do our best, as I said, to make the federal government work together and work for you (Clinton 1993, italics added).

SUSTAINING ECOLOGICAL SYSTEMS: GOALS - Caring for the land by sustaining healthy ecosystems. CONCEPTS: HEALTH - An ecosystem is healthy if it maintains its complexity and capacity for self-organization (resiliency) (USDA Forest Service 1993c).

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## The Concept of Health: Trees, Stands, and Ecosystems

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Generally when we think of health, we think of objective, scientific measures of individual organisms--usually human beings. We can generally agree on what constitutes a healthy human. We might express it in terms of body fat, cholesterol level, pulse, body temperature, iron concentration of the blood, time in a 10-kilometer race, or mobility of a joint. Note that each of these is a quantitative measurement that would be compared to a standard. If too high or too low, we would define a person as unhealthy. Alternatively, we might define health of the human individual as freedom from disease, specifically, the lack of large populations of pathogenic microorganisms in the body.

The health of individual trees could likewise be assessed. We would currently have to express it in terms of growth rate or nitrogen concentrations because these are among the few measurements for which we have broadly sampled forests. But someday we will measure the physiological equivalents of pulse, cholesterol, and body fat in a tree. These will be things like leaf area, Waring's vigor index, starch concentrations, phenol:sugar ratios, chlorophyll fluorescence, or stable isotope composition. Physiologists know how to do these things. We have just never had the funding to do it on a large scale. Alternatively, we could define tree health in terms of freedom from large populations of microorganisms or insects. Insofar as we know these characteristics to be related to the probability of early mortality we can objectively describe them as indicators of health.

One of the reasons the idea of health works so well for individual organisms is that individual organisms are highly co-ordinated, goal-seeking entities with limited lifespans. Generally speaking, one part of an organism does not begin to grow out of control at the expense of other parts--if such a thing does happen, the organism is likely die. One form of uncontrolled growth observed in humans is cancer. Part of the reason the idea of health works so well with individual organisms is that natural selection has tended to disfavor individuals who exhibit lack of control over their metabolism.

When we move to discussing the health of a stand of trees, however, the situation becomes somewhat more difficult. After all, within any stand there will be substantial variation among individuals. Furthermore, individuals must compete against one another. Unlike an organism, a stand has no discernible goals and therefore we have no reason to expect coordinated behavior. There is no mechanism operating at the stand level to select for coordinated behavior. Finally, statistical descriptions of populations can be slippery. For example, if the least healthy individuals in a stand are killed, the average health of the stand will be improved--even if no individual tree is actually better off. The improvement is simply due to loss of those individuals at the low end of the curve.

In spite of these difficulties in dealing with the health of populations, we can return to the human health model for methods. Public Health deals with characteristics of human populations: birth rates, death rates, epidemiology. Cultures and societies can thus be compared using such variables as average life span, infant mortality rate, etc. These ideas are easily imported into forestry and already lie at the heart of fisheries and wildlife management; they work in part because populations can be wiped out, can "die."

It is when we begin to discuss the health of an ecosystem, however, that the usefulness and objectivity of the idea of health is lost. In practice, the health of one component of the ecosystem is often maximized by decreasing the health of another component. To use an example that's close to home, we might look upon the insect outbreaks on the Boise as indicators of poor health due to the excess mortality of trees. On the other hand, an objective ecosystem ecologist with no predetermined ideas about the relative value of one species vs. another might note that the populations of tussock moths and bark beetles are very healthy indeed. And presumably the organisms that feed on tussock moths and bark beetles are in pretty good shape as well. How much tussock moth feeding is "good" for the ecosystem? There is no scientific way to say. Moreover, I know of no way to "kill" an ecosystem short of methyl bromide or nuclear war. Where there is no death there can be no "health." At this point the scientist must hand off to the politician to consider the relative values of trees vs. bugs and birds. With such information we can decide how much tussock moth feeding we want. But it's a political issue, not a scientific one, and not related to ecosystem health, whatever that is.

In my view, the idea of health cannot be very useful if we allow it to be defined politically, or tied to management objectives, as some have proposed. The utilitarian view of ecosystem management, which would state that a healthy forest is one that is capable of doing what we want it to, is not acceptable to a large portion of the public because it is too easily manipulated to yield preordained outcomes, i.e. it is not objective. Using such an approach it would be possible to define a forest as healthy or not by simply changing your mind about what you want do with it. For example, the area damaged by smelter activity near Kellogg, Idaho could thus be defined as healthy forest, provided you want to use it as a ski area. How useful can such a definition be?

Some, including some scientists, would have us believe that the parts of an ecosystem are so tightly connected that the ecosystem functions as a coordinated and goal-seeking unit. One of the extreme proponents of this view, Clements, discussed ecosystems as "superorganisms," whose parts had evolved as a unit and were so intertwined that removal of one part would result in collapse of the whole, much like removal of your heart will kill you. Clements's ideas have not been supported by most subsequent research specifically designed to test them. Pollen data from lake bottoms shows clearly that the species we see occurring together today have not always been together. Furthermore, removal of the chestnut and the elm in the east, and of white pine in the west, did not lead to collapse of the ecosystems in which they occurred. Nonetheless the idea of the superorganism refuses to die, and has reappeared most recently in James Lovelock's Gaia hypothesis, which states, more or less, that the earth is actively maintained and regulated by the life on its surface to keep it comfortable for living organisms. The problem with this idea is similar to one mentioned earlier, that different organisms have different requirements; a change in the environment that is good for one is often bad for another--especially if one organism is feeding on the other!

This is not to say that the parts of an ecosystem do not interact; they do, and strongly. It is to say that the parts of an ecosystem behave primarily as individuals, that their interactions are more often competitive than cooperative. The emerging view of ecosystems is that they exhibit much less systematic or coordinated behavior than we observe within an organism. One colleague has suggested that to eliminate confusion we should perhaps call them "ecoheaps." I'll not go that far, but will argue with anyone who maintains that ecosystems are as integrated as organisms, or even that they're close.

The idea of health fails when used to describe a whole ecosystem because it is not possible objectively to define what constitutes a healthy ecosystem, given that one organism's gain is often another organism's loss. Populations of a given kind of organism can be described as healthy, although the idea becomes a little fuzzier. The term applies well to individual organisms, with their physiology tightly constrained by the good of the whole organism, where the good is defined by some goal--generally survival and reproduction. Methods of measuring the health of individual plants and populations are available and ready for importation into forestry and other fields of ecosystem management.

## Fire's Role in Inland Forest Ecosystems

*Stephen F. Arno, USDA Forest Service, INT Fire Sciences Lab, Missoula, MT*

For thousands of years fire shaped the composition and structure of North American forest, woodland, shrubland and grassland ecosystems (Pyne 1982). The Boise National Forest and other mountainous areas of the inland Northwest have abundant vegetation, long dry summers, and frequent lightning storms--all the ingredients necessary for fires that spread across vast areas of the landscape. Early journalists, including explorers Lewis and Clark (1805-06) noted that large areas of the landscape were burning or had recently burned (Gruell 1985). Fire history has been reconstructed based on dating the annual growth rings associated with fire wounds on surviving trees. In the lower elevation forests and on dry sites at middle elevations where ponderosa pine was once the major forest component, fire intervals averaged 6-35 years Steele et al. 1986, Arno 1988). These fires burned in the understory and perpetuated open park-like stands with grassy undergrowth. These stands were dominated by the fire-resistant pine and, on wetter sites, western larch. Nineteenth century travelers report riding horseback or even pulling wagons for miles through these open forests (Wickman 1992).

In the higher elevations and on moist sites at middle elevations, fire played a more complex and variable role in forest structure. Here it left a mosaic of lethal forest burning mixed with non-lethal underburning and unburned areas. Fire intervals were longer, probably between 40 and 200 years, but again fire-adapted tree and undergrowth species prospered. These included western larch, lodgepole pine, and whitebark pine, evergreen ceanothus and a number of other wildlife forage species. The variable pattern of burning was virtually assured by the landscape mosaic of vegetation and fuels. This resulted from differences in topography, microclimate, soils, past fire mosaics, and changing weather and fuel moistures that occurred as the fires burned unchecked through summer and early autumn.

By the early 1900's a drastic change in the ecology of these ecosystems had begun with the attempt to exclude fire (Agee 1990). The complex ecological role of fire was not recognized, and many educated people considered fire to be a scourge introduced by human negligence. Organized fire suppression became increasingly efficient and was able to extinguish all low- and moderate-intensity fires (Agee 1990). However, fuels--including forest floor duff, dead woody material, and dense conifer thickets--soon began building to alarming levels. Since the late 1970's an abundance of large, severe wildfires in the inland West suggests that attempts to eliminate fire have simply led to a pattern of large severe fires burning in heavy fuels (Arno and Brown 1991). Moreover, dense stands of stagnating trees developed as a result of fire exclusion, and these stressed forests are dying over large areas because of insect and disease epidemics.

Although this situation is now widely recognized, its solution is elusive. Simply letting natural fire regimes return is unworkable because of the threats of uncontrolled fire to private property including rural homes and communities, and to forested lands which now support unnatural accumulations of fuels. Even in the fire-adapted ponderosa pine types, fuels have often built up to such an extent that ancient trees that survived many fires in past centuries are killed in modern fires. Also, because of fire exclusion and selective logging, modern fires may not restore the historic seral vegetation types, such as ponderosa pine.

A strategy to maintain forest health will require that former ponderosa pine forests, for instance, be managed to develop and perpetuate open stands of seral, fire-resistant pine and larch. This could be accomplished using restoration forestry involving a combination of silvicultural thinning of stagnating stands and prescribed burning to control the understory and allow regeneration of seral species. Numerous alternatives are available, but there is an urgent need to replace fire exclusion with ecologically-based management of fire and fuels.

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## The Role of Insects and Diseases - Past, Present, and Future

*Alan E. Harvey, USDA Forest Service, INT Research Station's Forestry Sciences Lab, Moscow, ID*

Forests of the Inland West and Northern Rocky Mountains generally occupy precarious environments. The region represents rugged, mountainous terrain with diverse, often young geological origins and variable climates. In most the climate is summer dry (moisture limiting) and variable. Most moisture arrives as winter snow. In recent geological time, major disturbances have been common. Ash depositions from Cascade volcanoes, for example the deposition of Mt. Mazama ash 6,600 yrs ago, and the close proximity of continental glacial ice near Spokane, Washington, only 10,000 yrs ago, are representative. The ash depositions increase soil moisture storage in some of the region. This allows vegetation more characteristic of a wet climate to occupy these sites but at high risk during extended dry periods. Glacial scouring of valley bottoms created many thin, compacted soils. Glacial melting indicates a warming climate over the last 10,000 yrs. In short, these are constantly changing relatively infertile environments where vegetation is often near environmental limits for at least some species in most forests.

Also characteristic are temperature and moisture patterns (wet but cold winters and warm dry summers) that are severely limiting to biological decomposition. This allows accumulations of plant debris which, when combined with frequent lightning in summer rainstorms (that yield little water), repeatedly sets the stage for wildfire ignition. These fires are important, in their absence critical nutrients are tied up in plant debris so the site becomes nutrient limited. Thus, forests are dependent on a combination of biological (primarily microbes and insects) and fire decomposition to regulate nutrient availability and cycling. Which dominates is dependent on site and climate. For example, fire dominates and occurs frequently in ponderosa pine, to a lesser extent in Douglas-fir forests, whereas biological decomposition dominates more in cedar/hemlock forests where fires occur less frequently.

Describing the environment permits analysis of past roles for insects and diseases. To reemphasize, historical environments were diverse, constantly changed, biological decomposition was constrained but recycling assured (fire), and fire-resistant species dominated sites where it visited often. Most native pests were (are) stress sensitive, ie., they tended to attack unthrifty or stressed individuals. This likely generated high mortality in the poorest adjusted vegetation, an obvious benefit. With fungal pathogens, it accelerated decomposition. Localized centers of insect and disease activity created diversity in forest structure and species composition. All these were beneficial to long-lived (250-400yrs) tree communities (not individuals) that occupied climatic and nutrient limited sites that changed over time lines that varied from days to thousands of years. Pests were integral to the development and function of these ecosystems!

In the present day world several things alter normal development and function of these forests. Perhaps most importantly, the numbers and types of disturbances are changing. Fires are extinguished quickly so are less frequent but can be severe in the presence of accumulated fuels. As a result, representation of fire-adapted trees in forest communities have been reduced, non fire-adapted species are invading areas not historically available to them and total numbers of trees are exceeding historical levels. Disturbances in the absence of fire (harvesting) are increasing and may include soil compaction, dislocation or organic matter loss. Tree removals associated with harvests have probably not improved adaption of the community to the site though they may not have reduced it. In white and sugar pine country, a disease introduction (blister rust) early in the century reduced representation of these pines in many forest communities to less than half of what they were even 40 years ago. Fire-adapted species (ponderosa pine and western larch) and white and sugar pine tend to be broadly adapted species relatively tolerant of most native pests, other tree species were (are) neither.

The ecosystems have responded appropriately, they are not broken. Faced with reduced nutrient cycling, increased tree density, less broadly adapted, pest tolerant species and reduced vegetation adjustment to site conditions than in the past, activities of "pests" have increased. Ecosystems are accommodating conditions with the tools still at hand...insects, disease, microbial decomposition and sporadic, often severe wildfire. If forest changes can remain within reasonable natural variation and do not continue to accelerate, the ecosystems will eventually discourage pest activities as part of their adjustment. If we want to facilitate that process we must adjust current disturbances to simulate those of the past. No action, so long as fire regimes are not restored, will only serve to accelerate pest impacts. Thus, current high levels of pest activities have many causes. They are a problem primarily because they are extensive. Without modification of current conditions time lines for recovery will be long.

In the future, we may have another problem, global climate change. In any case, forests will continue to change and pests will continue to function. Depending on the nature of change (amount, direction, duration), pest actions can either stabilize or destabilize forest ecosystems. Human interaction with forests will make a difference. Our actions should simulate natural disturbances or the effects they imposed during forest evolution. Current "out of phase" forests should be returned (probably gradually) to more natural conditions. Future forest management should highlight these manipulations as keys to returning regional forests to a more natural state. Insects and diseases should be recognized as an important part of ecosystem dynamics. They can be valuable indicators of vegetation, soil, environmental imbalances and will be useful to as well as a problem for the natural resource managers of tomorrow!

FOR MORE DETAIL SEE: Baker, W.L. 1991. **Effects of settlement and fire suppression on landscape structure.** Ecol. 73:1879-1887. Burdon, J.J. 1991. **Fungal pathogens as selective forces in plant populations and communities.** Aust. J. Ecol. 16:423-432. Habeck, J.R., and R.W. Mutch. 1973. **Fire-dependent forests in the northern Rocky Mountains.** Quat. Res. 3:408-424. Harvey, A.E., G.I. McDonald and M.F. Jurgensen. 1992. **Relationships between fire, pathogens, and long-term productivity in northwestern forests.** In: Kaufman, J.B., et al. coord. Fire in Pacific Northwest ecosystems: exploring emerging issues. Portland, OR: Jan. 21-23. 1992. Corvallis, OR: Oregon State University. pp. 16-22. Harvey, A.E., et al. 1993. **Biotic and abiotic processes in eastside ecosystems: the effects of management on soil properties, processes and productivity.** In: Eastside ecosystem health assessment. Everett, R.L. et al. coord. USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR: In press. Monnig, G., and J. Byler. 1992. **Forest health and ecological integrity in the Northern Rockies.** USDA, Forest Service, Northern Region, FPM Rep. 92-7, 7p. Olsen, J.S. 1963. **Energy storage and balance of producers and decomposers in ecological systems.** Ecology 44:322-331. van der Kamp, B. 1991. **Pathogens as agents of diversity in forested landscapes.** Forest. Chron. 67:353-354.

## We're Harvesting The Effects of Both Harvesting and Not Harvesting Our Forests

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This title sounds a little like the familiar idiomatic expression "we're darned if we do and darned if we don't." But does this idiom really hold true for our forests? This paper addresses some of the forest health issues associated with various past management practices in Inland West forests. Particular emphases will be on how proactive and inactive management practices relate to forest health problems, particularly those problems associated with native insects. The common denominator--forest succession--will be emphasized. This will illustrate that the idiom "we're darned if we do and darned if we don't" can but doesn't have to fit the scenario in our western forests.

Insects like western spruce budworm and tussock moth and diseases like dwarfmistletoe and Armillaria root rots are all native to western forests and have a definite niche in forest health. They share many associations and commonalities in their successional roles and are usually associated with late successional stages. The following describes some of the precursors of forest health.

Two major management practices in this century have largely shaped the character of our Inland West forests--exclusion of most of the naturally frequent ground fires and economic selection harvest cutting practices. Although these practices were vastly different, both accelerated the march toward increasing proportions of shade-tolerant species such as interior Douglas-fir, subalpine fir, grand fir, and white fir.

Because these shade-tolerant species have low resistance to fire, their numbers were intermittently reduced by the frequent fires prior to this century. Seral species such as western larch and ponderosa pine were more fire resistant and regenerated well on seedbeds prepared by fire. As a result, most virgin forests in the Inland West prior to this century had a large component of seral and a small component of climax species. Fire exclusion reversed that equation.

Economic selection harvest cuttings during much of this century had essentially the same effect as fire exclusion--it decreased the proportion of seral and increased the proportion of shade-tolerant species. These partial cutting practices usually removed most of the more valuable seral species, left an inadequate seed source, and did not create seedbed conditions suitable for regenerating seral species. The shade-loving climax species thrived with these conditions and soon fully occupied the sites.

Thus, the stage was set. This shift in species composition toward more shade-tolerant species, the resulting continuous lateral and vertical stand structure, and increased stand density created forests almost tailor-made for those native insects and diseases that require these conditions.

Thus, the title of this paper becomes a bit more clear: "We're harvesting the effects of both harvesting and not harvesting our forests". We need to use prescribed fire and appropriate silvicultural practices that reverse the trends of this past century. Prescribing what changes are needed to reverse this trend is quite clear--implementing those changes is the challenge.

## Have Past Management Practices Affected Forest Health?

*Julie Weatherby, USDA Forest Service, Forest Pest Management, Boise, ID*

Over the past 4 years approximately 230,000 acres on the Boise National Forest were defoliated by the Douglas-fir tussock moth. The extent and intensity of this outbreak was unprecedented in the recent history of the Boise National Forest. Was the extent and intensity of this outbreak somehow related to our past management practices?

Case Study: For the purposes of this presentation I will take you on a brief tour of the Squaw Creek Planning Unit on the Emmett Ranger District.

Hypotheses: Past management practices designed to suppress fire, harvest timber, and manage and maintain existing grand fir cover have influenced the over-all susceptibility of the Squaw Creek Planning Unit to infestations of western spruce budworm and Douglas-fir tussock moth.

Background Information: Western spruce budworm and Douglas-fir tussock moth are insect defoliators which have been a part of this ecosystem for thousands of years. Populations fluctuate from very low levels to extremely high levels. The conditions which cause or release outbreaks are not well understood but once released the populations can only survive in the presence of adequate food and habitat. Highly susceptible stands provide that habitat. Areas which are highly susceptible must be heavily stocked with preferred hosts, namely Douglas-fir, grand fir and subalpine fir. Have past management practices used in the Squaw Creek Planning Unit significantly influenced the vegetation making these areas highly susceptible to western spruce budworm and Douglas-fir tussock moth? Let's take a look.

Management History: What are some of these past management practices and how have they influenced vegetation changes?

Historical fire frequencies in the Squaw Creek Planning Unit have not been well studied or documented. But it is likely that fire frequencies were variable. Some stands growing on grand fir habitat types probably escaped frequent hot fires and grand fir old-growth developed with few setbacks caused by fire. In other stands on grand fir habitats fires probably setback succession by killing the shade tolerant grand fir leaving a canopy of more seral ponderosa pine and Douglas-fir. Of all of the management practices used within the Squaw Creek Planning Unit fire suppression has probably influenced succession more than any other management practice. Fire suppression has tended to accelerate succession toward climax vegetation.

Timber harvest began in earnest during the 1950's and 1960's. During this period large diameter commercial species, namely ponderosa pine and Douglas-fir, were removed. These selective harvest activities continued to remove more and more of the seral component. The reduction of seral components resulting from selective harvests and the increase in climax components as a result of fire suppression gradually began to convert much of the area to predominately grand fir stands.

In the mid 1960's even-aged management systems became the preferred strategy. Clearcutting and conversion to ponderosa pine was practiced. This practice was essentially stopped by the mid 1970's probably in reaction to the clearcutting controversy on the Bitterroot National Forest and the new

Squaw Creek Land Use Plan. The Land Use Plan encouraged maintenance and management of grand fir on highly productive grand fir habitat sites. During this period a western spruce budworm outbreak heavily defoliated much of the area. The interdisciplinary team formed to evaluate the budworm situation recommended a silvicultural alternative which emphasized liquidation of old growth grand fir and conversion to seral species as long as it was in compliance with the Land Use Plan. The Land Use Plan did not really address this practice but rather recommended the maintenance of the grand fir component and selective harvests. As a result little of the old growth grand fir was liquidated and converted to seral species.

In 1985 the new Forest planning effort was underway and it became more and more apparent that the new Land and Resource Management Plan would recommend even-aged systems. As a result a series of timber sales was prepared which attempted to maintain and/or regenerate the sale areas to seral ponderosa pine and Douglas-fir rather than maintaining a high component of grand fir.

In summary, fire suppression has tended to accelerate succession. Vegetative changes influenced by timber harvest practices are somewhat less easily interpreted. The early selective practices during the 1950's and the attempts to maintain and manage grand fir with uneven-aged practices during the mid 1970's and early 1980's tended to accelerate succession toward climax. However even-aged practices in use between the mid 1960's and early 1970's and between the mid 1980's and early 1990's liquidated some of the areas of climax vegetation and regenerated these areas to earlier successional species. As a result of these flip-flops in management direction, some areas probably became more susceptible to defoliator infestations while other areas became less susceptible.

Conclusions: Succession is a series of changes in vegetation which occurs within an area overtime. These changes occur because of biotic and abiotic, and direct and indirect influences. The current approach is to try to describe succession without the influences of modern society. The implication of this approach is that conditions prior to settlement by peoples of European origin were better or more natural than conditions created after settlement. The more we study patterns of current vegetation the more we realize that modern society and its management practices exert tremendous influences of change upon the forest. The extent and intensity of the latest tussock moth outbreak is evidence that the Squaw Creek Planning Unit is highly susceptible to defoliator infestations. It is highly susceptible because of ALL of the influences of change acting overtime upon the vegetation. Would the area have been any less susceptible had modern society not influenced succession? Usually the conclusion is yes. But a forest without the influences of modern society does not exist.

*Craig Gehrke, The Wilderness Society, Washington, D.C.*

There isn't much doubt that past management practices on the national forests have contributed to the current poor health of the forests. The highgrading of ponderosa pine and larch, and more importantly, the suppression of fire, has changed the composition of our national forests. Nature now is trying to rectify our past mistakes by through insect infestations and large-scale fires.

Having acknowledged that mistakes may have been made, it's time to move on and learn from those mistakes. Public foresters must keep in mind, as they set about trying the manage our national forests back to health, that at the time they were practiced fire suppression and high grading were acceptable forest practices. No one thought of the long-term consequences of suppressing a natural force-fire- which had been a part of the ecosystem of the forests of the Northern Rockies for thousands of years. As it turns out, fire is necessary to keep forests healthy and now managers are seeking to incorporate fire back into management regimes.

Too often humans think they know exactly what to do to successfully manage our public resources, and almost every time our mistakes soon become painfully obvious. It wasn't that long ago that government managers implemented an aggressive campaign to eliminate the wolf from Yellowstone National Park, believing that doing so would result in healthier populations of "good" animals, that is, elk. Now we are struggling to reintroduce the wolf in to Yellowstone National Park, recognizing that the wolf has a role in our ecosystems. Not long ago an aggressive campaign to combat another forest health problem was to pull up gooseberry bushes to control blister rust, which we later found didn't work. Not many years ago old growth forests were thought to be essentially biological deserts, and now we find those same forests to be some of the most diverse ecosystems on the planet. And don't forget how the supporters of the hydroelectric dam complex in upper Hells Canyon swore that the fish ladders would keep the salmon coming back to Boise, Payette, and Weiser Rivers. Have you seen any wild salmon in those rivers the past few decades?

There are two things that federal managers can do that most likely are the worsts thing they could do for our national forests, and more and more I see them doing exactly those two things. First is to assume that we now know exactly what to do to "fix" the forest health problem, and start running around the national forests helter-skelter salvaging and thinning trees like crazy while they smile at the TV cameras and assure the public they know exactly what they're doing. All I can say is the managers didn't know what they were doing by suppressing fire and highgrading commercially valuable species, so why should the public believe them now?

Second, the Forest Service continues to portray large fires as "catastrophes" that must be prevented. Again, while the TV cameras are rolling, Forest Service managers may agree that things like fire, insects, and dwarf mistletoe are all components of natural forest ecosystems, their on-the-ground practices still reflect a mentality that such natural agents are really sinister agents of destruction which must be stopped at all costs. This bureaucratic overreaction to natural forces is of course reinforced by agency budget structures, the timber industry, and of course politicians.

Although the Forest Service professes a desire to incorporate fire back into management practices, their public statement present the dead opposite viewpoint. The current fuel loads on the national forests took over 80 years to accumulate. The Forest Service cannot "manage" these fuel loads away overnight. We are going to have fires - large ones most likely - on the national forests. The Forest Service needs to discard its pretentious self-image of guardians of the national forests and accept that large fires will burn. The best that can be hoped for is that the agency can protect private property threatened by these fires. Again, for the Forest Service to think that it can begin rushing about the national forests hoping to undo 80 years of fire suppression over a few seasons is vain and laughable.

For the past few years the Forest Service in the Intermountain West has implemented an aggressive policy of salvage logging. First portraying it as a remedy to forest health problems, most managers now admit that salvage is really only just that - salvaging commercial values of trees that have died. Most conservationists remain unconvinced that salvage logging makes an overall healthier forest. Time will tell.

The forest health issue is a great opportunity for the Forest Service to institute meaningful ecosystem management programs. Forget salvaging commercial values of trees and think for a minute about the entire forest ecosystem - the soil, the wildlife, the watershed, the fisheries, etc. This ecosystem is likely significantly stressed at this point, and a quick and dirty fix of salvage and thinning might very well be the last thing these resources need.

There has been some success in challenging the Forest Service to expand their thinking a bit and not attempt to implement on a wide scale a cacophony of forest health practices i.e. salvage and thinning everywhere. Our main argument has been to leave roadless areas alone and to largely concentrate the management activities to the commercial, roaded forest base. Timber industry boosters will argue that conservationists just want roadless areas left alone to preserve de facto wilderness. Those comments I relegate to the same intelligence level as the shortsighted congressman who protested the establishment of Yellowstone National Park in 1872, arguing that "no one would ever go there." It's becoming more clear that those who argue loudest for widespread salvage are mostly interested in the size of their wallets and less interested in forest health, particularly forest health expanded to include watersheds, wildlife, etc.

To ensure a stop the practice of using salvage logging to "get the cut out," a rigorous set of restraints should be imposed on the Forest Service. Up to this point salvage logging has been a quick and dirty way to avoid EISs, get the cut out, go into roadless areas, and especially avoid timber sale appeals. At a minimum, salvage sales should be governed by these regulations:

- All revenue generated by salvage sales, except for the payment to counties, should be returned to the Treasury. In other words, do away with the salvage sale fund which can be used by individual national forests as a way to increase their budgets without going to Congress for the appropriation.

- All salvage should be charged against the allowable sales quantities.

- No salvage logging on lands deemed unsuitable for timber harvesting by the forest plan.

- No road construction for salvage sales.

- No salvaging in inventoried roadless areas.

- Trees to be salvaged should be marked by the Forest Service or an independent contractor, cut, and sold to purchasers from standing log decks. This eliminates the incentive of actual timber purchaser from marking and cutting trees which may not actually be dead.

- Only dead trees taken in salvage operations. No more cutting trees that are "likely to die, at future risk of dying," etc. Stands can be subsequently checked and more material removed if die-off is greater than originally expected.

We will not know for several decades whether or not the practices now being touted as forest health measures will indeed make our forests healthier. I firmly believe that left to its own devices nature will show us what healthy forests should look like. This is the information we can glean from roadless areas. Anyone who's taken high school chemistry or biology knows that one of prerequisites for valid experimentation is a control by which to measure the effects of experimentation. Those "controls" on the national forests are roadless areas.

Past management mistakes have contributed to the current forest health problem. Rather than dwell on those mistakes, all efforts must be made not repeat them. That is, the real lesson here is learn from the forests and stop trying to control them.

For once in their lives federal managers should acknowledge up front that they are in a new field - ecosystem management, forest restoration, whatever you want to call it - and proceed cautiously with a generous margin for error. Managers should put the notions of Germanic forestry aside for once and try to learn something about natural processes from our national forests. Eighty years from now lets see what tracts of forest lands are healthier - our wilderness and roadless lands where nature manages the forests or our commercially-managed forests where man is in charge. Given the past record, I'm betting on Nature.

## Climatic Changes: Are They Affecting Forest Health

*Ronald P. Neilson, USDA Forest Service, Corvallis, OR*

Forests throughout the interior west are undergoing severe dieback and disease. Formerly open, ponderosa pine stands have responded to fire suppression by filling in, often with different species, such as Douglas fir and incense cedar. These new stands have exhibited a high susceptibility to infestation and drought stress, resulting in large areas of dead or dying forests. I will present the hypothesis that these dying stands could be an accurate analog of the potential response of temperate and boreal forests worldwide to increased global warming induced by anthropogenic emissions of greenhouse gases.

Ecosystem theory states that most ecological systems should tend to maximize their leaf area, such that soil water is just barely depleted by the end of the growing season. If the stand leaf area index (LAI) were below the maximum, then plant available water would remain in the soil root zone and growth would continue from year to year, causing LAI to increase. If LAI was too high, then soil water would be depleted before the end of the growing season, causing drought-induced LAI decline.

The theory was tested by examining continental transects of precipitation and runoff over the conterminous U.S. Precipitation and runoff transects were graphically analyzed for both seasonal and spatial trends by plotting the precipitation or runoff on graphs of latitude (or longitude) and months. Thus, the major water-determined biome boundaries were revealed as coinciding with steep gradients in the seasonal rainfall patterns. The corresponding runoff transects exhibited steep spatial gradients in seasonality at the same locations as the precipitation gradients. However, the seasonality of the runoff was quite different from that of the precipitation. Summer runoff is drawn down to within 5 to 25 mm/mo during the hottest summer month in all forested areas of the U.S., regardless of whether summer rainfall is abundant or sparse. Since forests typically transpire about 4 to 8 mm per day during the heat of the summer, only a few days of residual moisture remains in the soils of most forests in the U.S. during the growing season. These observations lend strong support to the concept that forests tend to maximize their LAI.

Natural fires, particularly ground fires, act as natural thinning agents that should tend to keep the forest LAI below maximum level. As soon as ground fuels build up (and LAI builds up) a ground fire would typically come through and reduce the fuels and LAI. The reduced LAI should prevent forest water use during the growing season from approaching critical depletion and subsequent drought-induced LAI reduction and render the forest more robust against variable rainfall patterns. However, with fire suppression, stand LAI has increased throughout the interior west. The more dense forests should use most of their available water and should reside very near a drought threshold, simply due to the increased stand density. Natural year-to-year variability of weather would occasionally drought stress these more dense forests, rendering them susceptible to insect attack. Disease-driven reductions in LAI will tend to overshoot the LAI reductions that would have occurred from drought stress alone.

Fire suppression began in the early part of this century. Over the intervening years the northern hemisphere has warmed about 0.50 C. The increased temperatures should have lengthened the growing season and increased transpirational demand during the growing season. So, as LAI was increasing due to fire suppression, the demand for moisture from those forests was likely increasing.

In the last few decades, I hypothesize that the forests began to reach the critical thresholds of water use and drought stress, triggering a nearly synchronous, regional dieback.

A new ecosystem model, MAPSS, has been constructed to test these hypotheses in the context of climatic change. The primary simulation result, using five different General Circulation Models, is that most temperate and boreal forests throughout the world should experience about a 30-40% reduction in the maximum LAI that can currently be supported. This prediction represents a far greater reduction in LAI than has likely occurred for western forests over the last century. The minor changes of the past are producing widespread forest death. What will the much larger, anticipated changes of the warmer future impart to our remaining forests?

## Are Current Conditions Temporary Departures From Long-Term Natural Conditions?

*Geral I. McDonald, USDA Forest Service, INT Research Station, Moscow, ID*

Many stands of conifers in the western United States show high rates of mortality caused by a variety of agents. In general, action of these agents indicate hosts out of balance with available resources. Do these conditions result from temporary aberrations or permanent adjustments? Analysis requires explicit definitions of forest health, a look at weather and other physical factors, and a historical look at how each condition formed. Conditions can be described for habitat types grouped by a system that uses climax conifer species to describe temperature gradient and understory vegetation to describe moisture gradient. Sixteen forest health ecoclasses cover the range of forest types found in the western U.S. Four pests of interest are white pine blister rust (BR), spruce budworm (SBW), mountain pine beetle (MPB), and Armillaria root rot (ARR).

BR, a disease of five-needle pines, occurs in most ecoclasses. The introduced obligate parasite causing this disease interacts with its hosts during narrowly defined periods favorable for infection and by specific genetic interaction between pathogen and host. BR is not a stress-mediated disease. It impacts ecosystem dynamics by changing roles of conifer species which are severely impacted by stress-mediated ARR. In the cedar-hemlock/moist-forb ecoclass, western white pine was a major seral perpetuated in nearly pure and healthy stands by a 200 year fire interval. Severe reduction of white pine stocking by BR opened the door for Douglas-fir and grand fir to function as major seral components. Before BR these species were heavily impacted by root rot. To date, BR introduction and clear-cutting have been the major changes in this ecoclass. If western white pine had been available to replant clear-cuts when created, most north Idaho stands would not be exhibiting forest health problems today. Thus, one major forest health condition in the west was caused by the accidental introduction of a forest pest and could be reversed by aggressive management of that pest. If such management is not instituted, a new equilibrium based on a 100 year fire interval is likely.

ARR, SBW, and MPB are significant problems in fewer ecoclasses than BR but they encompass a larger land area. Climate, fire control, and vegetation have interacted to produce separate forest health conditions that are indicated by each pest. To better understand the role of climate, minimum and maximum temperature and total precipitation for crop years (August 1 through July 31) were calculated from daily weather records obtained from the National Climatic Data Center (CD-ROM prepared by Earth Info, Boulder, CO). Crop-year totals, grouped by half-decades (1901-1905, 1906-1910, etc), over the period 1896 to 1990 for stations located at Vancouver, WA; Spokane, WA; and Moscow, ID were plotted as the percent of warmest or wettest period. Maximum and minimum temperatures showed no variation and could not contribute to current forest health conditions. Pattern of precipitation showed period to period variation and strong time x space interaction for nonforested stations. Records for two stations located in forested areas (Idaho City, ID and Wickiup Dam, OR) did not show time-space interaction and these records exhibited little period to period variation up to 1960. Large period to period variation was evident from 1960 on. Forested areas may dampen period to period variation and beginning about 1960 forested regions of the inland western United States entered into increased variation of crop-year precipitation over time. Overall, changes in climate have not been substantial over the last 100 years.

Most of the western forest health problems are occurring in ecoclasses characterized by 10 to 30 year fire return intervals. Major ARR in wild stands is found in moderately dry Douglas-fir and true fir ecoclasses with about 30 year intervals. These stands show some SBW and MPB but the most significant condition is root rot on Douglas-fir and true fir. SBW is a serious problem in dry Douglas-fir and dry true fir ecoclasses on the climax species and MPB reaches its most serious impact on ponderosa pine in the ponderosa pine climax ecoclass. These ecoclasses have a 10 to 15 year fire return interval. Most serious impact of MPB on lodgepole pine is in the dry Douglas-fir ecoclass which has a 10 year fire return interval. The common threads in these situations are hosts growing at their maximum drought tolerance in stands overstocked by historical standards. One situation that does not follow the above line is the complex interaction for Douglas-fir and grand fir in the cedar-hemlock/moist-forb ecoclass of north Idaho.

Sessile organisms are known to utilize a large amount of phenotypic plasticity in selection of habitats. Sapwood: heartwood and root: shoot ratios are two such phenotypically plastic traits that allow plants to adjust to low moisture. Frequent fire controlled competition and complemented these acclimative responses to allow ponderosa pine to thrive on dry sites. In the absence of fire, true fir and Douglas-fir have invaded these dry sites and established new conditions of competition. Too many and/or the wrong plants growing on these sites have led to acclimative responses that created unbalanced carbon metabolism. Then, as systems accommodated to new environments created by long-term absence of fire, stress-mediated agents (ARR, SBW, and MPB) began removing individual hosts not tuned to their particular resource availabilities. Global change could have much larger impacts. Outcome of these adjustments can not be predicted until we understand the acclimative and adaptive rules by which each host species plays the competition game. If trees currently on these sites have made irreversible acclimative adjustments to the absence of fire, then current conditions are not temporary departures from long-term natural conditions and a cautious response is necessary.

**Habitat Types -- Classifying Forests -- Delineating Ecosystems**

*Frederic D. Johnson, Dept. of Forest Resources, University of Idaho, Moscow, ID*

The basic theories of forest community classification are presented. Habitat types as a means of classifying environments using mature communities as indicators are explained. Usefulness of habitat typing wildlands is exemplified by their use now or in the near future by personnel throughout the National Forests of the west. Some specific examples are introduced.

**Management Implications of Forest Succession**
*Robert Steele, US Forest Service, INT Research Station, Boise, ID*

Succession in general is a replacement process; the coming of one thing after another in some kind of order. Forest succession is the replacement of species; an orderly change in species composition. It is the competitive ability of each species that instills order in forest succession and makes successional trends predictable.

Normally, forest succession is initiated by disturbances such as fire or flood. Because these events occur periodically, successions are cyclic and display a normal range of variation for each ecosystem. Ecosystems that experience frequent disturbances such as a 10-year fire cycle have a narrow range of normal variation when compared to ecosystems that experience a disturbance every 200-300 years. When the disturbance cycle is abruptly extended so is the succession cycle and then succession progresses beyond the normal range of plant communities. The potential endpoint of these successions is the climax forest.

Climax forest is not always the same as old-growth forest. Climax forest is a function of succession whereas old-growth forest is a function of age. Climax forest is generally composed of species with the greatest competitive ability which are not necessarily the species having the greatest growth potential or the greatest resilience to stress from extreme variation in moisture or temperature. Climax forests are generally more vulnerable to fire, insects, and disease than some of the successional forests. Because of fire control, more forests in this area are closer to climax now than they were before white man arrived.

Forest successions often span several generations of man which makes it difficult for people to visualize forest dynamics. Yet the forest is constantly changing and forest communities can be characterized most accurately by including their potential for change.

Managing for healthy forests requires that we recognize the normal range of successional variation for each ecosystem and maintain stand conditions within that range. Excess production that would be lost to fire, insects, and disease can be harvested. This is a basic concept of ecosystem management.

## Nutrition and Forest Health

*James A. Moore, Department of Forest Resources, University of Idaho, Moscow, ID*

Current literature suggests that "potassium probably exerts its greatest effect on disease through specific metabolic functions that alter compatibility relationships of the host-parasite environment... The accumulation of inhibitory amino acids, phytoalexins, phenols, and auxins around infection sites of resistant plants is dependent on the level of K and other minerals present." This information led the Intermountain Forest Tree Nutrition Cooperative to examine the results from Douglas-fir and ponderosa pine experiments for a link between potassium nutrition and insect and disease pests. Mortality rates in the Douglas-fir trails were significantly higher in stands with poor pre-treatment foliar K status after application of 400 lb., of N/ac. Interestingly, the most common mortality causes in this K status/treatment category were root rots and bark beetles.

Results from a Montana ponderosa pine experiment showed that N only treated plots experienced higher mortality rates, producing a net loss in volume growth after 4 years. Conversely, N + K treated plots showed less mortality than control plots. The net volume growth effect associated with adding K was highly significant. Mortality on the N only plots was six times as great as control plot mortality; over 80% of it resulting from bark beetle activity. N + K plots showed less mortality than control plots with no bark beetle mortality.

Other investigators have found that rates of infection by *Armillaria ostoyae* were highest in trees that were thinned and fertilized with nitrogen and lowest in trees that were only thinned. Concentrations of sugar, starch, and cellulose in root bark tissue were highest in N fertilized trees and lowest in trees that were thinned but not fertilized. Concentrations of lignin, phenolics, and tannins were highest in root bark from thinned only trees and lowest in root bark from thinned and N fertilized trees. The low sugar concentrations in tree roots growing in thinned only stands may have provided less energy for *Armillaria* to degrade phenolic compounds and lignin, and thereby, successfully invade host tissue. The same researchers also found that the ratio of energy required for phenolic or lignin degradation to the energy available from sugars to *Armillaria* may provide dependable assays of the physiological response of trees to attack by *Armillaria*.

The above results led to initial efforts to test the hypothesis that potassium nutrition affects tree resistance to *Armillaria* (and perhaps other diseases and insects as well) by influencing the concentrations of phenolics, tannins and sugars in tree roots.

## A Short Story of Stand Density and Resilience in the Boise Basin

*Ray Eklund, USDA Forest Service, Idaho City, ID*

This presentation illustrates how the native ponderosa pine and Douglas-fir stands in the Boise Basin have changed from pre-settlement times to the present, and the impact of these changes on today's stand resilience.

The Boise Basin, located in the southwest portion of the Boise National Forest, supports some of the most productive ponderosa pine stands in southern Idaho. This 160,000 acre basin contains relatively contiguous stands dominated by ponderosa pine. Land ownership is mixed and includes National Forest, Idaho Department of Lands, Bureau of Land Management, Boise Cascade Corporation, and individual small private land holdings. Today the basin is essentially all second growth forest seldom more than 100 years old.

Prior to the 1860's the basin was maintained as an open "parklike" ponderosa pine forest of large trees, by frequent low intensity ground fires occurring on a 10 to 20 year cycle. Fires were most likely of lightening and Native American origin.

In 1862 gold was discovered in the Boise Basin and towns quickly sprang up. Early mining was primarily placer using hydraulic pressure to wash away soil and expose mineral deposits. Mined areas were generally stripped of unwanted forest cover and trees were regarded as a hinderance to reaching mineral deposits. Sawmills were established near towns to support the rapidly growing communities, and many nearby stands were essentially clear cut.

Between mining, logging, and slash fires the structure of the basin forests became drastically altered. The heavy forest clearing and site disturbance in the Boise Basin led to the creation of a "new" forest of a much different structure and density. The open old growth stands have been replaced by very dense, nearly pure ponderosa pine stands now 60 to 100 years in age. Ponderosa pine established itself very successfully with very large numbers of seedlings. As these seedlings grew rapidly in a generally favorable environment most stands became overcrowded. As the stands grew in size and age, competition between trees for moisture, nutrients and light markedly increased in intensity.

The recent drought has made dense stands in the basin much more susceptible to insect attack as intensely competing trees have become severely weakened by lack of water. Since 1985, the Boise Basin has been drier than it has been in fifty years. Insects killing stressed trees in the basin are primarily western pine beetle, pine engraver beetle, and Douglas-fir beetle. These bark beetle species have always been present in the basin, but drought has tipped the balance in favor of the beetles. Drought coupled with overstocked stands of suitable host tree species, plus longer, warm summers during this period has supported an epidemic build up of bark beetles.

High stand density has also had a marked influence on tree growth and form. Over dense stands have developed small crowns, are poor in vigor, slow growing, and are structurally weak and vulnerable to weather related damage.

The role of fire in regulating stand structure and composition has also changed during the last 100 years. Due to fire protection measures, a build up of ground fuels has occurred. These additional fuels, plus a much less fire resistant stand structure of dense poles has favored fires of a more stand replacing nature than of stand thinning.

Short and long term objectives on National Forest lands are to move stands more toward their original structure, density, and composition, and to re-introduce light fires into the ecosystem. Silvicultural treatment of overstocked stands on National Forest lands in the basin the past 20 years has primarily been thinning. Stands that have been thinned have better survived the recent bark beetle epidemics than those that were not thinned. Thinning on National Forest lands in the basin is usually from below, meaning the weaker, smaller trees are targeted for removal, and the larger, more vigorous and better formed trees and retained in the stand. Thinning lessens catastrophic fire risk by opening the canopy, and reducing and re-arranging fuels. In many thinned ponderosa pine stands, low intensity fire can be re-introduced without significant tree damage. Thinning supplies needed wood products while still maintaining forested tree cover. Aesthetic values and wildlife cover needs can be better met over time. If stand rotations are based on tree vigor or maximizing wood volume, rotations can be lengthened. This means a more resilient stand of older, larger trees can be grown compared to an unthinned, overstocked stand.

In summary, today's ponderosa pine and Douglas-fir forests in the Boise Basin are not "natural" in the sense that they are the product of man created events such as mining and logging, and man's control of wildfire. Old growth, pre-settlement forest structure will not develop from existing overstocked stands in the basin without thinning. Nature is trying to restore equilibrium in the ecosystem by reducing tree stocking, but we may not like the way or results that she now chooses.

With the highest snowfall in southwest Idaho in recent years, is the current drought ending? If the climatic trend lapses into a moister cycle, overstocked stands will likely increase in density with little immediate detriment. But what about the next drought cycle? With less growing space and a higher water demand, over dense stands will be at even greater risk to future drought driven bark beetles epidemics. What if global warming is true? If so, even greater water deficits for overstocked stands can be expected.

The results of not thinning stands in the Boise Basin will ultimately lead to a loss of silvicultural options. Stand regeneration by clearcutting, insect devastated stands, or catastrophic wildfires are likely alternatives. Thinning will maintain a wider array of silviculture options for the future, including both even-age and uneven-age strategies.

Is density management of stands in the Boise Basin necessary for future stand health and resilience? YES!!

**Stocking and Species Control on Managed Uneven Aged Forests**
*Herbert S. Malany, Boise Cascade Corporation, Emmett, ID*

The presentation discusses:

A comparison of the stand structure on unmanaged stands before fires were controlled - 100 years ago - and today.

Problems in unhealthy forests caused by pine beetles in pine stands and defoliators in mixed conifer stands.

The lessons learned when forests are not managed to maintain health and resiliency.

Management recommendations that are economically acceptable to forest land owners and that provide the amenities demanded by the public demands from forests lands.

## Influence of Density and Species Composition on Susceptibility to Western Spruce Budworm and Other Forest Pasts

*Clinton E. Carlson, USDA Forest Service, Forestry Sciences Lab, Missoula, MT*

Western spruce budworm is a defoliating insect indigenous to the western USA and southwestern Canada. Common host conifers on which the budworm relies for nutrition are grand fir, Douglas-fir, alpine fir, white fir, and Engelman spruce. All of these species are shade-tolerant and can reproduce successfully in the shade of overstory trees. Budworm feeds on western larch, but not to the extent that it does on other hosts. Ponderosa pine, lodgepole pine, white pines, cedar, and hemlocks seldom are nutritional substrate for budworm.

Budworm female moths lay eggs in late July to early August each year. The eggs soon hatch, and tiny first instar larvae crawl about in search of overwintering sites such as bark crevices, lichen mats, and other suitably protective habitat. Unstable, windy weather can dislodge the larvae while they are exposed and transport them considerable distance; if they are lucky, the larvae are deposited in favorable habitat and successfully overwinter. The following spring, about mid-May, the larvae molt and emerge as second-instars. At this stage they are still very small and may again be dispersed considerable distance by wind. This is a passive redistribution of larvae. There is an active part of dispersal in which the larvae move vertically within tree crowns on a silken thread they leave as they move in search of food. In any case, larvae must land on suitable host foliage or they are doomed. Successful larvae go through six instars before they pupate, emerge as adults, and start the cycle again.

Species composition and stand density significantly influence success of budworm populations. Multi-storied, dense stands composed mostly of host species maximize the probability of success, whereas single or two-tiered stands composed mostly of non-host are detrimental to budworm populations. In general, increasing basal area and host foliage biomass increases probability of budworm success by providing more overwintering and feeding sites for dispersing larvae and more sites on which adults can lay eggs. Also, dense, over-crowded stands of host species are often stressed for moisture and nutrients and may have a foliage chemistry (food quality) better suitable to budworm. Complex vertical stand structure composed of shade-tolerant host species increases the survival probability of later instars as they spin downward in search of food.

Overcrowded, stressed stands composed of shade-tolerant species also are high risk for root disease, Douglas-fir tussock moth, and Douglas-fir dwarf mistletoe (Douglas-fir stands only). Forest health can be regained by converting species composition to shade-intolerant seral species (ponderosa pine, western larch, lodgepole pine, rust-resistant western white pine) and maintaining spacing to reduce moisture and nutrient stress. In many cases, periodic application of light ground fires can be efficiently invoked to regulate spacing and enhance nutrient turnover. In other cases, mechanical thinning along with fire may be appropriate. A strong, advocative management is necessary to return northern Rocky Mountain forests to good health in order to provide the array of values expected by the public.

## Unnatural Stand Density and Species Composition: Affecting the Resilience of Ponderosa Pine in a Fire Environment

*Robert W. Mutch, USDA Forest Service, INT Fire Sciences Lab, Missoula, MT*

### INTRODUCTION

A forest health emergency exists in parts of the West: "Federal forests on the east side of the Cascades are perhaps hardest hit. Insects and disease have killed trees across millions of acres in eastern Oregon and Washington. Similar problems extend across a much larger area, south into Utah, Nevada, and California, and east into Idaho" (Gray 1992). These forests have been struck by a forest health problem of unprecedented proportions. Several factors have coincided to produce massive forest mortality. The immediate causes are prolonged drought and epidemic levels of certain insects and diseases. Beginning in the 1980's, large wildfires in the dead and dying forests have accelerated the rate of mortality, threatening people, property, and natural resources. These wildfires also have emitted large amounts of particulate matter into the atmosphere.

Historically open ponderosa pine, larch, and Douglas-fir forests at lower elevations in the West burned naturally at low intensities every 5 to 30 years, maintaining rather open, fuel-free stands with few fir trees. But in more recent times, the larch and pine overstory was harvested extensively and fire was controlled. In the absence of fire, the composition of the stands shifted toward an unnaturally dense understory of Douglas-fir, grand fir, white fir, or incense-cedar. Spruce budworm, other destructive pests, and forest diseases have been enjoying a steady diet of stressed fir trees, leading to mortality, fuel build-ups, and high-intensity wildfires.

Covington and Moore (1992) carried out a detailed analysis of data from two study areas in the southwestern ponderosa pine type that suggested that average tree densities have increased from as few as 23 trees per acre in presettlement times to as many as 851 trees per acre today. Associated with these increases in tree density are increases in canopy closure, vertical fuel continuity, and surface fuel loadings resulting in extreme fire hazards over large areas never reached before settlement. In addition, they indicated that fire exclusion and increased tree density have likely decreased tree vigor (increasing mortality from disease, drought, etc.), decreased herbaceous and shrub production, decreased aesthetic values, decreased water availability and runoff, decreased nutrient availability, changed soil characteristics, and altered wildlife habitat.

Many of today's significant forest health problems are associated with the long-needled pines. Because this fire regime was characterized by very short fire return intervals, successful fire exclusion over the past 60 to 70 years has disrupted two or more fire cycles, contributing to shifts in species composition, stand density, and fuel accumulations that are undesirable from a forest health standpoint.

### A STRATEGY FOR SUSTAINING, OR RESTORING, FOREST HEALTH

A strategy to maintain forest health on long-needled pine sites involves managing for considerably lower tree densities (Mutch et al. 1993). The desired stands will appear open and park-like, and incidentally will have increased forage production. Achieving this condition will require a combination of silvicultural partial cutting treatments and prescribed fire. Low-intensity surface fires should be prescribed at about 10- to 25-year intervals to coincide with the historical fire regime. The planting of seral species like long-needled pines and larch may be necessary in some areas to re-establish these species on sites where they have been removed through logging and successional replacement. Silvicultural prescriptions need to maintain the fire-dependent seral species in the overstory.

Because many stands now are excessively dense and contain many dead and dying trees, restoration of healthy forest conditions will require different approaches from those used to maintain healthy forests (Mutch et al. 1993). Salvage logging may be necessary to remove unnaturally heavy accumulations of dead and dying trees before extensive prescribed burning programs. Careful salvage will help to mitigate resource damage that might occur from more intense fires. Two or three prescribed fires at higher moisture levels may also be required over several years to gradually reduce the accumulation of fuels. Other strategies to consider might include thinning from below and the closer utilization of biomass. The structural characteristics of stands that promote torching and crowning must be changed. In the 1992 Cleveland Fire in California, for example, ponderosa pine stands survived which had received multiple and compatible fuels management and silvicultural treatments (e.g. thinning and understory burning); but there was little survival of stands where understory burning was done without thinning, or thinning was done without understory burning.

## SUMMARY

Several decades of fire exclusion and timber harvest of pine, combined with drought and insect and disease outbreaks, have shifted a low-intensity surface fire regime to a crown fire regime, dramatically increasing risks to people, property, and natural resources. Now, when wildfires occur in dense stands of fir on these sites, the fire behavior is represented by high-intensity crown fires rather than low-intensity surface fires. For more resilient and healthy ponderosa pine forests, we must drastically control stocking density and species composition on a landscape scale through an integration of silvicultural and fire prescriptions.

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## Payment in Lieu of Taxes and Natural Resource Payments

*Arlene C. Kolar, Boise County and Idaho Assn. of Counties, Boise, ID*

Ninety-two percent of the 729 million acres the United States owns is located in the twelve western states. Idaho is approximately sixty-five percent public land, comprised of approximately 33.8 million acres of federal land and 2.7 million acres of state land.

In 1908, Congress recognized that federal lands were not on the counties' tax rolls and thus did not generate any revenue at the local level. As a result, local governments and schools were permanently given a share of the receipts from natural resources on these federal lands.

This philosophy was strengthened in 1970, when the Public Land Law Review Commission (PLLRC) completed a six year study and reported that "the Federal Government should make payments to compensate state and local governments for the tax immunity on Federal Lands".

In 1976, Congress further confirmed the validity of this concept by adopting four federal land laws that merged a policy toward greater federal control of public lands, national environmental concerns and the recommendations of the PLLRC regarding compensation for burdens. The National Forest Management Act of 1976 changed the ratio of resource sharing from net to gross receipts. The Federal Land Policy and Management Act formally instituted the federal land retention policy and expanded federal control over the mining industry. The Federal Coal Leasing Act Amendment increased the state share of this resource from 37.5 percent to 50 percent. The Payment in Lieu of Taxes Act, commonly referred to as "PILT" payments, added in lieu payments from .10 to .75 per acre to the resource sharing program.

PILT payments to counties are a beneficial source of revenue intended to partially compensate counties for the loss of revenue on public lands. Counties with large acreages of public land but small populations have the onerous task of furnishing extra services to accommodate out-of-county and out-of-state visitors to these public lands (i.e. search and rescue, law enforcement, emergency communications, ambulance and emergency medical services, road maintenance, fire protection, etc.). Idaho counties received 7.5 million dollars in PILT payments in 1990. These funds may be used by the recipients for any government service. All of Idaho's forty-four counties receive a PILT payment.

In 1992 Idaho received 19.4 million dollars in Federal Forest Reserve funds. Idaho Code specifies that these funds are to be distributed with seventy percent allocated to county road departments and thirty percent allocated to school districts, distributed according to average daily attendance. In several of the smaller rural counties in Idaho these funds are identified as the major source of revenue for the road budget. There are very few options available to county commissioners to replace these dollars. Tax receipts in counties levying the maximum amount allowed do not equal half of these dollars. Additional tax increases would place a disproportionate share of the burden on individual private land owners.

Federal Forest Reserve Funds are receipts shared with states to supplement school budgets and county road budgets. The counties in turn help maintain the infrastructure needed to support timber sales on federal lands. The economic benefit accrues to both the Federal Treasury and the impacted states. The counties and schools that would be hurt most from reduction of these receipts are exactly the counties with the least capacity to deal with severe budget cuts. They are the rural counties and schools whose taxable base is limited by federal land ownership. It must be remembered that local entities educate the work force which labors on National Forest Lands and very little, if any, timber moves from the forest to the mill without somewhere being transported across county roads. This same county road system, to a large degree, transports children to their schools.

It should also be remembered that local entities provide vital support for a growing tourism and recreation industry. Without county road maintenance, access to the National Forest for recreational purposes would be restricted in many instances.

PILT and Natural Resources Payments are part of a partnership developed over two hundred years of a federal system of government. It cannot be stressed enough how important these dollars are to local units of government. The loss of any of these receipts would bring rural governments and schools close to bankruptcy.

## The Relationship Between Forest Health and Tourism

*Carl Wilgus, Idaho Dept. of Commerce, Boise, ID*

Idaho economy has been in transition for the past decade, and shows all signs of continuing in that direction for the foreseeable future. One of the reasons that Idaho has been experiencing this robust growth, is in part due to the success in diversification of our economic base. This diversification has come about through the growth of industries like recreation/tourism, high technology, international trade, and value added efforts. Obviously this transition is impacting Idaho's forests too.

The National Forests addressed in part this opportunity with the creation of its Recreation Initiative. This initiative is a result of seeing the opportunity in recreation/tourism as well as addressing the reality that nearly 700 million visitors a year travel to our National Forests. With the mission of "caring for the land and serving people" it is easy to see why a tourism strategy should logically be incorporated by the National Forests along with other traditional strategies.

Recreation/tourism can provide a diversified economic base for support to Idaho's rural communities. It is predicted that by the year 2000 tourism will be the world's largest industry employing 1 in every 12 people in the world. Currently recreation and tourism is Idaho's third largest industry contributing more than $1.5 billion annually to Idaho's economy. Within that is some $115 million in local, state, and federal taxes, and more than 30,000 jobs for state residents. The growth of the recreation and tourism industry over the past six years has been unprecedented growing at more than 11% a year, with a likelihood for it to continue as a sustainable economic development strategy.

At the same time we must guard and protect those natural resources that draw our visitors, because if we lose our natural attractions we most surely will lose our visitors and the economic impact that they provide. The importance of a health forest is critical to Idaho's current success in recreation/tourism and is an absolute must to future success.

Research conducted by the University of Idaho College of Forestry in 1987 indicates that more than 50% of Idaho leisure travelers are drawn to Idaho for its scenic beauty and outdoor recreation. Idaho's attractiveness to potential leisure travelers are largely dependent on the management practices of the federal land agencies who oversee the more than two-thirds of Idaho's 87,000 square miles of land. Reductions in the quality of our recreational experience on forested lands in Idaho will ultimately retard the state's ability to continue to attack visitors.

We know by our own recent history that a diversified economy is a stronger and better economy. So too, it seems with a forest. The more diversified the forest the healthier the forest. The postulate could also be forwarded that responsible shared use of forests for timber, grazing, mining, and recreation/tourism will also be a healthier, more prosperous forest.

## The Impact of Forest Health on Other Resources

*Jerry M. Conley, Idaho Dept. of Fish and Game, Boise, ID*

The Boise National Forest contends that increased timber harvest is needed to keep much of the forest from dying. It's happening because the forest is overstocked and needs to be thinned. By thinning out tree stands to create "a more open and park-like forest," the ecosystem can be brought back into balance without nature resorting to catastrophic fires. This is the Boise National Forest Health Strategy.

Before we madly launch off in this strategy, some basic questions must be asked and hopefully answered. Is the entire forest falling apart? The Boise Forest has described the problem as chronic-to-acute. I recognize that Idaho's seven-year drought has exerted tremendous stress on all biological systems. These systems include trees, fish, wildlife and water quality, which are all dependent on maintenance of critical levels of soil moisture and streamflow.

It appears the prolonged drought is over now. We must be cautious and not base our entire forest management strategy on a dramatic event (foothills fire) and the drought. I'm not convinced that the patient is in an acute condition and that insects and disease are at epidemic levels. Hopefully, the scientists from the University of Idaho will shed light on this question. The recent drought, although it seemed to have lasted a long time in human perspectives, was merely a "blip" in time from the standpoint of ecosystems. If we learn from it, it may have been the best thing that could happen.

The next question that comes to mind is, "are healthy forests open and park-like?" What is health? I'm sure there are many different definitions. A dead tree to a logger is <u>not</u> forest health, but, from a woodpecker's point of view, it is a healthy forest. From an elk's point of view, the Boise National Forest strategy that a healthy forest is open and park-like is very worrisome. This even-strand, monocultural approach makes elk very vulnerable. A healthy forest for elk would have many different appearances or successional stages that include brush, vital security cover. I agree that the Boise Forest strategy is a good <u>tree</u> health program, but more consideration must be given to other values that the forest produces. What effects will this tree health strategy have on wildlife, fish and water quality? I cringe when I hear comments that endangered species, wildlife and water quality are barriers to forest health or, more appropriately, timber supply. This is not an ecosystem approach, in my view.

This view is supported by a recent report from the Society of American Foresters, the world's largest group of professional foresters. The report says that more emphasis must be given to protecting wildlife and diversity in forests. It recommends an ecosystem approach that would base logging on protection of wildlife, water quality and overall ecological health. This concept runs counter to the Boise Forest strategy of "harvesting yourself to forest health."

A timely example is the South Fork Salmon River, which has been mentioned as a candidate for forest health. This system has <u>poor</u> <u>watershed</u> <u>health</u> due to a high sediment load from human-induced causes, primarily past timber harvest. I consider watershed health to be of paramount importance in this drainage, and a problem of such magnitude that it should be solved prior to <u>any</u> timber harvest occurring in the immediate drainage. Under an ecosystem management approach, timber harvest would be deferred until the watershed could support healthy populations of anadromous and resident fish. Our track record on protecting healthy fish populations is not good, with only 11 percent of the traditional range of westslope cutthroat being occupied, bull trout being petitioned for endangered species status, and chinook salmon being listed as threatened.

I submit that ecological health and diversity must be protected across broad landscapes. These landscapes must be managed to produce the one commodity most critical to the well-being of the long-term health of the human race. That commodity is not trees; it is not livestock nor even wildlife. That ultimate commodity is water--water of high quality and purity--water captured in healthy soils that release it slowly.

So where are we? Can the Forest Service harvest its way to "forest health?"

The obvious answer is no and the reason is obvious. Harvest can only remove trees. Removing trees, whether healthy or unhealthy; whether for good motives or bad; whether to restore more natural systems or promote tree farms; must be done judiciously to reduce impacts to watersheds. The openings produced do not intercept rain or snowfall; the vegetation removed can neither slow runoff, nor prevent sediments from entering waterways, nor keep soil temperatures at levels supporting desirable communities of soil organisms. While the conversions that may be required to meet forest health guidelines may be desirable, we didn't arrive in this condition overnight and cannot move into a more stable condition overnight.

The Idaho Department of Fish and Game is not a land management agency, except in a very restricted sense. Our focus is to manage a wide range of biological resources--resources that rely on healthy ecosystems for their survival.

These resources have a direct importance to Idaho's quality of life and economic well-being. The value of watchable wildlife, harvestable fish, and wildlife to Idaho's citizens and tourists cannot be ignored. The trade-offs of these resources have not been factored into the forest health strategy. In much of rural Idaho, it is not the Christmas season that supports small businessmen--it is the elk season. And those economic benefits are reduced by 50 to 75 percent when, because of too many roads or too many openings in the forest, general seasons must be eliminated in favor of limited-entry controlled hunts. This restriction to hunters could very well go hand-in-hand with the proposed forest health strategy. For example, hunting Unit 39 near Boise could become limited-entry and would no longer be among the top five elk units in Idaho. The sustained yield of this unique resource adjacent to Idaho's major metropolitan area would be severely degraded.

In summary, past experience and a sincere desire to implement "good forest management" brought us to our present forest health concerns. We cannot achieve our desired future condition overnight. We need to move slowly and humbly into the future of our public lands.

**Using Fire as a Land Management Tool in Ponderosa Pine, Douglas Fir, and Grand Fir Habitats/Restoring Fire as an Ecological Process**

*Leon Neuenschwander, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, ID*

I. Fire as an ecological process

- A. Fire frequency
- B. Fire intensity
- C. Fire severity
- D. Fire size

II. Historic perspectives

- A. Historic forest composition
- B. Historic fire mosaic
- C. Historic fuel distribution and loading

III. Current conditions

- A. Current forest composition
- B. Current fire mosaics
- C. Current fuel distribution and loading

IV. Future wildfire scenarios

- A. Fire frequency
- B. Fire intensity
- C. Fire severity
- D. Fire size
- E. Stand consuming fires
- F. Non-stand consuming fires
- G. Initial stages of succession following fire

V. Prescribed fire scenarios

- A. Possibility of using prescribed fire
- B. Impossibility of using prescribed fire
- C. Pre-prescribed fire planning and treatments
- D. Post prescribed fire planning, treatments, and management
- E. Initial stages of succession
- F. Fire frequency, intensity, and severity
- G. Prescribed fire prescriptions

VI. Restoring fire and an ecological process

- A. Issues and concerns to be addressed
- B. Challenges and opportunities
- C. The role of prescribed fire

## Can Silviculture Replace the Role of Fire?

*Russell T. Graham, USDA Forest Service, INT Research Station, Moscow, ID*

Silviculture is the art and science of managing forests to meet management objectives (Smith 1962). To accomplish this mission silviculturists developed silvicultural prescriptions to manipulate vegetation using a variety of tools and methods. But, in practice more often than not silviculture was applied at the stand level to produce timber crops, or at least to harvest commodities with minimal impact on other resources. In the early 1900's the Forest Service was directed not to place inferior species (i.e. lodgepole pine, grand fir and western hemlock) on the market. Therefore, management plans and silvicultural practices were developed that discriminated against these species (Foiles 1950, USDA 1926) and caused disproportional harvesting of high value species like western white pine and ponderosa pine (Hutchison and others 1942). The practice of silviculture and silviculturists were constantly challenged to meet the management objectives of society, yet maintain the health and vigor of forests. Many times they succeeded and many times they failed.

Fire in contrast to silviculture does not alter forest structure and composition according to management objectives. Fire is opportunistic and unpredictable. Fire changes forests in a variety of ways by removing high forest cover, thinning of trees and understory vegetation, preparing the forest floor for tree regeneration, stimulating the growth of understory vegetation, cycling nutrients, decreasing the incidence of disease and insects, and maintaining site adapted species. Fire can operate at the stand level, landscape level, and at varying frequencies and with a variety of effects (Arno 1980, Harvey and others 1989, Hungerford and others 1991).

Silviculture and fire can produce similar effects on forests. The practice of silviculture has the knowledge and tools to compliment if not replace many of the processes associated with fire in many forest ecosystems. There is an immense body of knowledge on harvesting, regenerating, and tending forests led by people such as Haig (1941), Pearson (1950), Schmidt (1988), Schubert (1971), Alexander (1977), and Wellner (1970). This body of knowledge has been applied very effectively in tending and producing forest crops (Davis 1942). Silvicultural systems for maximizing mean annual increment, optimizing rotation lengths, and maintaining high value species have been developed and used widely.

The practice of silviculture is just as capable of developing prescriptions to sustain a wide variety of forests and forest amenities as it is in producing forest crops. Nearly all of the effects a fire has on a forest can be accomplished using traditional silvicultural treatments. Silvicultural techniques can remove high forest cover, thin trees, prepare the forest floor for tree regeneration, stimulate the growth of lower vegetation, decrease the incidence of disease and insects, maintain site adapted species, and encourage the cycling nutrients, all without using fire.

The impacts fire has on vegetation can easily be mimicked by silvicultural practices, but beneficial changes to the soil resource may be harder to achieve. Decomposition of organic matter can be encouraged by using practices that increase soil heating, maintain soil moisture, and maintain soil aeration thereby, recycling nutrients and carbon. One effect fire has on forest soils that would be difficult to replace is the long-lasting increase in pH. This fire effect could be very important in a forest that was subjected to acid deposition or naturally developing acidic soils.

Fire exclusion for the past 100 years has led to the development of large amounts of biomass on the forest floor and in dense stands of small and midsized trees throughout the West. In addition many of these forests have been harvested removing many of the large trees that were, fire, disease, and insect resistant. The magnitude of the task of returning these forests to a condition similar to those before fire exclusion is horrendous, but the alternative of not trying will only continue to perpetuate forests prone to insect, disease, and forest replacing fires. This is evident by the major wildfires that have occurred throughout the West in recent years.

Forests can be managed for sustainability and function using silviculture. The total role of fire cannot be replaced, but by innovative use of silvicultural practices such as species selection, thinning, and biomass removal can go a long-way in producing forests that are vigorous and healthy. The technology is available to produce cable yarding equipment that can work on steep slopes and at great distances to remove small diameter material. Bunching of small material with cable machines and using helicopters to remove biomass is also possible. Using these techniques could remove forest biomass with minimum disturbance to the soil resource, the foundation of healthy forest ecosystems.

The cost of developing silvicultural systems for sustaining healthy forest ecosystems and the technology needed to implement these prescriptions will not be cheap. The cost of such forest management practices can not be supported by the amount of products removed at today's stumpage prices. But, as the price of lumber increases and the technologies for utilizing small material becomes more efficient, the utilization of these materials will become more cost effective. Even if the value of the material does not pay for its removal, it will still be a necessary to regulate the species composition and density of western forests. The alternative of no management, with the exception of fire exclusion is unacceptable that maintains dense, insect and disease infested forests awaiting a forest replacing fire.

Instead of attempting to replace fire with other silvicultural tools it would be prudent to fully integrate fire into silvicultural prescriptions for sustaining healthy forest ecosystems. By using innovative techniques of biomass removal and carefully applying fire, it may be possible to keep fire as a viable tool even in areas where smoke emissions are restricted.

Silviculture is the art and science of managing forests to meet management objectives. If society desires forests to be managed for sustainability and function, silvicultural prescriptions can be developed to do so, using many of the tools that produced timber crops.

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## Landscape Ecology and Management for Forest Health

*Wendel J. Hann & Susan K. Hagle, USDA Forest Service, Missoula, MT*

We consider a health forest to be one that is in balance with its natural processes and is sustainable. Native pathogens and insects play an important role (function) in our forest ecosystems. They have played a key part in creating the diversity of forests (composition and structure) that were present on the North American continent at the time of settlement by European cultures.

The problems that have emerged today as a result of unbalanced processes and loss of sustainability are a direct result of management philosophies that came from European cultures. These philosophies include:

1. A site specific (stand) emphasis instead of a landscape emphasis.

2. Control of fire and lack of management of biomass that accumulated as a result of removal of the fire process.

3. Introduction of exotic pathogens and insects.

4. View that all pathogens and insects are pests and a healthy forest is one totally free of pathogens and insects.

In management we need to turn these philosophies around in order to manage for healthy and sustainable forests in the northern Rocky Mountains. This will require an increased emphasis on understanding ecosystem processes, functions, composition, and structure, and how they interact at a landscape level. Examples are provided in this presentation.

# *About the Speakers*

**Moderator**
*Stephen Mealey, USDA Forest Service, Boise, ID*

Steve became the Boise National Forest Supervisor June 16, 1991. He began his career with the Forest Service in 1977, as a wildlife biologist on the Shoshone National Forest in Cody, Wyoming.

In 1980, Steve moved to Fort Collins, Colorado, where he was a Planner on the Arapaho-Roosevelt National Forest. He joined the National Land Management Planning Staff as a wildlife biologist later that year, but was still stationed in Fort Collins. He was promoted to Land Management Planning Specialist on the same staff in 1982. In 1983, he returned to the Shoshone National Forest as Forest Supervisor. In June 1988, Steve was appointed Assistant Chief for Strategic Planning in the Washington Office, and in 1990, became Assistant Director of Wildlife and Fisheries.

Steve received a Bachelor's Degree in political science from the University of Oregon in 1964, and another in forestry from the University of Idaho in 1973. He earned his Master's Degree in wildlife management from Montana State University in 1975.

**Exploring the Definition of Forest Health**
*Jay O'Laughlin, Idaho Forest, Wildlife and Range Policy Group, University of Idaho, Moscow, ID*

Dr. Jay O'Laughlin has an M.S.in Forestry and a Ph.D. in forest policy and economics from the University of Minnesota. Before moving to Idaho in 1989, he was a professor in the Department of Forest Science at Texas A&M University, and has published research on southern pine beetle control policy.

Dr. O'Laughlin is director of the Policy Analysis Group, which was created by the Idaho legislature in 1989 as a unit of the College of Forestry, Wildlife and Range Sciences, and given the charge to provide objective information in a timely manner on natural resource issues of importance to Idaho citizens. The legislation also established an Advisory Committee to suggest issues for analysis, and the appropriate focus of the analysis.

Eighteen months ago, the Advisory Committee suggested a study of forest ecosystem health conditions in Idaho as a high priority item. Since then, Dr. O'Laughlin has led an interdisciplinary team of scientists studying forest health-related policy issues in Idaho. Their findings will be released this summer as a Policy Analysis Group Report.

**The Concept of Health: Trees, Stands, and Ecosystems**
*John D. Marshall, Dept. of Forest Resources, University of Idaho, Moscow, ID*

John Marshall grew up in Michigan and studied Forestry at Michigan State and Oregon State. At Oregon State he worked with Richard Waring, an ecosystem ecologist who was studying susceptibility of trees and forests to insects and pathogens. Marshall was hired by the Research Laboratory at General Motors in 1985 and studied air pollution effects on trees and forests. He left GM in 1988, did a post-doc with a physiological ecologist at the University of Utah, and was hired at the University of Idaho in 1990. He teaches courses in Tree Physiology and Forest Ecosystem

Processes at the U of I and is involved in research with mineral nutrition effects on root disease susceptibility and the use of physiological variables in ecosystem process models.

### Fire's Role in Inland Forest Ecosystems

*Stephen F. Arno, USDA Forest Service, INT Fire Sciences Lab, Missoula, MT*

Stephen F. Arno is a research forester in the Prescribed Fire and Fire Effects research work unit at the Intermountain Fire Sciences Laboratory in Missoula, MT. He received a B.S. degree in Forestry from Washington State University and M.S. and Ph.D. degrees from the University of Montana. He has suited various aspects of forest ecology since 1963, including ecological site classifications, forest succession, fire history, fire effects, and development of strategies for prescribed fire.

### The Role of Insects and Diseases - Past, Present, and Future

*Alan E. Harvey, USDA Forest Service, INT Research Station's Forestry Sciences Lab, Moscow, ID*

Al Harvey is Project Leader for the Intermountain Research Station's unit investigating the ecology and management of native root diseases and the maintenance or restoration of productive soil biological processes after natural or human-caused disturbances. Al received a BS in Biology (College of Idaho, 1960), his MS (University of Idaho, 1962) and PhD degrees (Washington State University, 1967) in Plant and Forest Pathology respectively. He spent a year on sabbatical assignment with the University of British Columbia in 1973. He is a native of the Inland West and has 31 years experience researching forest disease problems in the region. For the last 20 years he has emphasized all aspects of microbial ecology, specifically their roles in the long-term sustainability and productivity of Inland Western forest ecosystems and the effects of disturbances on them.

### Moderator

*David L. Adams, Professor of Forest Resources, College of FWR, University of Idaho, Moscow, ID*

Dr. Adams began his professional career with the U.S. Forest Service in Wyoming. He then moved to college-level teaching and research, having served on the faculty at Colorado State University and Humboldt State University before joining the faculty at the University of Idaho. He has taught and conducted research in silviculture, forest health, and forest management since 1971. A long-time thrust of the work of Dr. Adams and his colleagues has been management aimed at tree and stand vigor -- to avoid the conditions which lead to insect, disease, and animal damage problems.

### We're Harvesting the Effects of Both Harvesting and Not Harvesting Our Forests

*Wyman C. Schmidt, US Forest Service, Forestry Sciences Lab, Montana State Univ., Bozeman, MT*

Dr. Schmidt is a research silviculturist and Project Leader of the Intermountain Station's Research Unit "Ecology and Silviculture of Subalpine Forests". His 30-year research career has focused on the ecology and culture of subalpine forests and the interactions within these forest ecosystems of the insect, animal, water, vegetation, and tree complex. His Research Unit was one of the lead units in the CANUSA Program for budworm. He is presently heavily involved with the international community in Larix and Stone Pine ecosystems.

### Have Past Management Practices Affected Forest Health?

*Julie Weatherby, USDA Forest Service, Forest Pest Management, Boise, ID*

Ms. Weatherby is an Entomologist with Forest Pest Management (FPM) for the past 13 years. She has regularly visited forested lands under Federal, State and private ownership, being exposed to lots of different management practices and local policies which affect management. She also participates in a wide range of research projects where new ideas can be tried and tested.

*Craig Gehrke, The Wilderness Society, Washington, D.C.*

Mr. Gehrke is a 1980 graduate of the University of Idaho. He worked for the Deerlodge and NezPerce National Forests. He was the Wilderness and Public Lands Coordinator for the Idaho Conservation League 1984-85. He was the forest planning specialist for The Wilderness Society 1985-1988 and is the Regional Director for The Wilderness Society 1989-present.

### Climatic Changes: Are They Affecting Forest Health

*Ronald P. Neilson, USDA Forest Service, Corvallis, OR*

Dr. Neilson received his B.A., M.S., and his Ph.D. (Ph.D. from the University of Utah). He has spent 20 years of research on the causal relations between vegetation distribution and climate, from microhabitat and plant physiology to global jetstream patterns. He oversaw the science in 50 individual studies that went into an EPA report to congress on the ecological effects of global climatic change. He built a mechanistic model of the Earth's vegetation and its distribution for prediction of future vegetation distribution and health under climatic change. He worked for the past six years in the EPA's global climate change program.

### Are Current Conditions Temporary Departures From Long-Term Natural Conditions?

*Geral I. McDonald, USDA Forest Service, INT Research Station, Moscow, ID*

Mr. McDonald has 30 years experience studying genetic and integrated control of blister rust. Currently investigating ecologic aspects of Armillaria/conifer interaction in western forests.

### Moderator

*Dean, College of Forestry, Wildlife and Range Science, University of Idaho, Moscow, ID*

As a forester, dean of a major forestry college and tree farmer who has invested in planting 50,000 trees on the family tree farm the past 6 years, John Hendee has institutional, professional and personal interests in forest health. Dean Hendee recently served on the National Research Council Committee on Science in the National Parks, and chaired the Society of American Foresters National

Wilderness Research Needs Task Force - both of which were partially concerned with natural ecosystems as baseline areas against which to compare the health of forests and other ecosystems.

### Habitat Types -- Classifying Forests -- Delineating Ecosystems

*Frederic D. Johnson, Dept. of Forest Resources, University of Idaho, Moscow, ID*

Fred Johnson has been teaching forest habitat typing through field courses since 1957. He's preached to a wide variety of audiences: summer camp field ecology, professional land managers, graduate students and seasonal forest employees.

### Management Implications of Forest Succession

*Robert Steele, US Forest Service, INT Research Station, Boise, ID*

Since joining the Intermountain Station in 1972, Mr. Steele has concentrated on development of forest habitat type classification, and on classification and management of successional forest communities. He earned a B.S. degree in forest management and an M.S. degree in forest ecology at the University of Idaho.

### Nutrition and Forest Health

*James A. Moore, Department of Forest Resources, University of Idaho, Moscow, ID*

Dr. Moore received his B.S. in 1967 from West Virginia University, M.S. in 1972 from Southern Illinois University and his Ph.D. in 1979 from the University of Idaho. He is currently a professor in the Department of Forest Resources at the University of Idaho (1974 - present).

### A Short Story of Stand Density and Resilience in the Boise Basin

*Ray Eklund, USDA Forest Service, Idaho City, ID*

Mr. Eklund received his AA (1971) from Spokane Falls Community College, and his BS (1974) from Washington State University. He has been a Forest Service Silviculturist for 18 years....northern Minnesota, Washington, and now Southwest Idaho. Fifteen of these years have been working in ponderosa pine, interior Douglas-fir, western larch, and lodgepole pine forest types.

### Stocking and Species Control on Managed Uneven Aged Forests

*Herbert S. Malany, Boise Cascade Corporation, Emmett, ID*

Manager of Boise Cascades Idaho Timberlands for 20 years. Have made all the mistakes and learned the importance of stocking control and an easy touch on the land. Also, the complexities of managing an unevenaged forest that provide a return to shareholders and amenity values the public demands.

**Influence of Density and Species Composition on Susceptibility to Western Spruce Budworm and Other Forest Pasts**
*Clinton E. Carlson, USDA Forest Service, Forestry Sciences Lab, Missoula, MT*

Dr. Carlson has conducted research dealing with effects of stand density and species composition on western spruce budworm for the past 15 years. He has published many articles on silvicultural approaches for managing stands susceptible to budworm, and helped design a system to rank stand susceptibility to budworm. He has investigated relations among stand density, site preparation, tree chemistry, and budworm, success. He was invited in 1991 to discuss at a Symposium in La Grande, OR the role of past silviculture and fire control in the current forest health problem in the Blue Mountains of Oregon. In 1992 he was invited to present a paper on forest health at the Larix Symposium in Whitefish, MT.

**Unnatural Stand Density and Species Composition: Affecting the Resilience of Ponderosa Pine in a Fire Environment**
*Robert W. Mutch, USDA Forest Service, INT Fire Sciences Lab, Missoula, MT*

Bob Mutch fills a technology transfer position established by State and Private Forestry's Fire and Aviation Management Staff and Research. The purpose of the position is to facilitate the timely transfer of new fire research results to interagency and international resource management agencies and organizations. From 1976 to 1991 Bob worked as Program Manager of the Forest Service's Disaster Assistance Support Program that provides support to the Agency for International Development. Earlier assignments included fire management positions in the Northern Region and Lolo National Forest; and Research Forester and Project Leader positions at the Intermountain Fire Sciences Laboratory in the 1960's and early 1970's. Upon completion of requirements for an M.S.F. degree from the University of Montana in 1958, Bob's first permanent assignment was as Superintendent at the Priest River Experimental Forest in northern Idaho. He received a B.A. degree from Albion College in Michigan in 1956.

Since 1990 Bob has been consulting with counterparts in Brazil on the protection and management of their natural resources.

Bob recently has co-authored a paper on a management strategy for fire adapted ecosystems in the Blue Mountains.

**Payment in Lieu of Taxes and Natural Resource Payments**
*Arlene C. Kolar, Boise County and Idaho Assn. of Counties, Boise, ID*

Ms. Kolar has been the Boise County Clerk since 1980 and is the President of Idaho Assn. of Counties. She is a member of Idaho Assn. of Counties Public Lands Committee (since 1984), and has served as Chairman since 1990. She is also a member of the National Association of Counties Public Lands Committee (since 1984) and is serving as Vice Chairman of Community Stability Committee. She is the Project Co-ordinator for "Idaho Counties Pilt and Natural Resource" payments impact statement. Ms. Kolar also testifies at the State and Federal level on Natural Resource payments to Counties, specifically timber receipts.

## The Relationship Between Forest Health and Tourism

*Carl Wilgus, Idaho Dept. of Commerce, Boise, ID*

After finishing an undergraduate degree from the University of Washington in Seattle, Carl began his tourism promotional career as a ski instructor in 1973 on the slopes of world famous Sun Valley. After spending several years as the corporations Winter Sales Manager and Director of Publicity, thirteen years later and still in Sun Valley, he worked himself to the position of Assistant Marketing Director.

Carl moved to the state travel position in the spring of 1987 to oversee the states now $3 million tourism promotional budget, and a staff of eleven people. Carl is committed to moving tourism forward as a recognized industry in his state. He is an active participant in the National Council of State Travel Directors, serves on the Guidance Council for the University of Idaho College of Forestry, Wildlife and Range Sciences, is a board member for the Travel Industry of America Board of Directors, and is a former co-chairman of the Visit U.S. West International marketing organization.

A native of Tacoma, Washington, Carl enjoys golf, snow skiing, and triathalons.

## The Impact of Forest Health on Other Resources

*Jerry M. Conley, Idaho Dept. of Fish and Game, Boise, ID*

Mr. Conley received his B.S. and M.S. degrees from the University of Missouri. From 1966 to 1969, Mr. Conley worked for the Utah Department of Fish and Game and a biologist and later a supervisor. From 1969 to 1977, he was employed with the Iowa Conservation Commission an the assistant superintendent and later the superintendent. From 1977 to 1980, Mr. Conley was director of the Kansas Fish and Game Commission. Currently, (1980 - present) Mr. Conley is the Director for the Idaho Department of Fish and Game.

## Environmentalist View on Forest Health and Ecosystem Management

*Brock Evans, National Audubon Society, Washington, D.C.*

Brock Evans is Vice President for National Issues of the National Audubon Society, with primary responsibilities in the public lands and forest management areas. Before that, he was Northwest Representative of the Sierra Club, based in Seattle (1967-73); and then Director of the Club's Washington, D.C. office (1973-81). In 1990, Evans was honored with an appointment as Fellow of the Institute of Politics at the Kennedy School of Government, Harvard University, where he resided and taught a course on the Politics of the Environment.

A native of Seattle, Mr. Evans received his B.A. degree from Princeton university, and a law degree from the University of Michigan Law School. He has authored many articles and spoken at numerous public appearances and congressional hearings on the subject of forest management, land use, and energy issues. Fore several years he served on the Areas of Agreement Committee, an industry/environmentalist group working for joint funding for forestry. Evans received the Washington Environmental Council's Environmentalist of the year Award in 1972, the Sierra Club's highest award, the John Muir Award, in 1981, and numerous other awards for distinguished service and leadership including New England Environmental Leadership Award (1985), United Nations' Environmental Leadership Award (1985), Idaho Wilderness Leadership Award (1989), and League of Conservation Voters Outstanding Performance Award (1989).

### Using Fire as a Lang Management Tool in Ponderosa Pine, Douglas Fir, and Grand Fir Habitats/Restoring Fire as an Ecological Process

*Leon Neuenschwander, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, ID*

Dr. Leon Neuenschwander is associate dean in the College of FWR and manages the FWR Experiment Station and international programs. He is a professor in Forest Resources and has earned his reputation in fire ecology. For the past seventeen years he has conducted research in the effects of fire on forest and range lands. His specialty is using prescribed fire to meet lands management objectives.

### Can Silviculture Replace the Role of Fire?

*Russell T. Graham, USDA Forest Service, INT Research Station, Moscow, ID*

Mr. Graham conducts research on long-term forestry productivity. He is also involved in Ecosystem Management. He is also involved in the management of forest for the northern goshawk.

### Landscape Ecology and Management for Forest Health

*Wendel J. Hann & Susan K. Hagle, USDA Forest Service, Missoula, MT*

Wendel Hann is the Regional Ecologist for the Northern Region of the USDA, Forest Service. Currently, he is leading a team of people conducting landscape and ecosystem assessments in the northern Rocky Mountains and northern Great Plains ecosystems. He has worked for the Northern Region for the past 12 years. Prior to that he worked in Regions 4 and 6 of the USDA, Forest Service, on the Payette and Mt. Baker/Snoqualmie NF's respectively. During that period he worked in fire, watershed, wildlife, recreation, and range management. Wendel has a Doctorate in Forest, Wildlife, and Range Ecology from the University of Idaho (Moscow), a Master's in Forest and Watershed Science, and a Bachelors in Range and Wildlife Management from Washington State University (Pullman). He has taught at both the University of Idaho and Washington State University, and has continued teaching part-time as affiliate faculty with the University of Montana (Missoula), the University of Idaho, the Glacier Institute, and the Northern Region Training Center. Wendel spent 4 years in the U.S. Navy, was raised on a farm in a small logging and farming community in the state of Washington, and enjoys an array of outdoor recreational activities.

### Forest Health and Ecosystem Management: Where do we go from here?

*R. Neil Sampson, American Forests, Washington, D.C.*

Neil Sampson has been Executive Vice President of the American Forestry Association since July 1, 1984. Prior to that, he was Executive Vice President of the National Association of Conservation

District for six years. From 1960 to 1978, he spent 16 years with USDA's Soil Conservation Service in jobs ranging from soil conservationist in an Idaho field office to Acting Director of the Environmental Services Division in Washington, D.C. Brief stints in private business and state government round out his resume. He holds degrees in Agronomy from the University of Idaho and Public Administration from Harvard University.

He is the author of two books on soil conservation, 20 book chapters in various aspects of resource conservation, and dozens of articles in scientific and popular magazines and journals. His research and writing have concentrated largely on land and water management policy, ranging from pollution control through forestry and resource economics.

He has been very active in analyzing the implications for agriculture and forestry in the event of climate changes caused by rising levels of atmospheric "greenhouse gasses." This has led to development of an international campaign entitled "Global ReLeaf," sponsored by the American Forestry Association, that encourages individuals to begin addressing environmental problems by restoring trees and forests. The public attention generated by the Global ReLeaf campaign has resulted in thousands of community tree planting and improvement efforts, sponsored by hundreds of citizen groups, businesses, and government agencies.

**NOTES**
**FOREST HEALTH SYMPOSIUM**