FOREST HEALTH CONCEPTS AND THEIR APPLICATION TO MANAGING IDAHO FORESTS

Jay O'Laughlin

ABSTRACT

Forest health is a condition of forest ecosystems that sustains their complexity while providing for human needs. Definitions, however, are not as important as the concerns they represent. Forest health is part of the larger idea of managing forest ecosystems in a sustainable manner. Judgments about forest ecosystem health are subjective because the health concept involves different perspectives and values, including political, social, scientific and professional.

Forest ecosystem health assessment is a fledgling science without an adequate model for guidance. Except for the tree component, data are insufficient for large scale assessments of forest ecosystems. Existing forest growth and mortality data can be used to assess forest conditions at a state or regional level. Analysis of these data show changes in species composition throughout Idaho and higher than expected levels of mortality in Idaho's national forests. The principal reasons are both ecological and managerial. Fire has been excluded from performing its natural role. Cuttings or thinnings between stand establishment and final harvest that could mimic fire effects are not practiced. National forests are two-thirds of Idaho's forests, and they will continue to experience high mortality unless management action is taken. Intensively managed private forests do not exhibit similarly high levels of mortality as nearby public forests.

Intensive care can help remedy these forest stand conditions. That is, practices such as thinning dense stands, the use of prescribed fire where fuel loads are not hazardous, and regeneration of more resistant and resilient tree species can help restore healthy conditions on lands suitable for timber production. Forests are ecosystems and complete knowledge of the interactions of forestry practices with wildlife, water quality and other forest resources will always be incomplete. That is insufficient reason for inaction. Fire exclusion has altered the composition and structure of Idaho's national forests, creating stand conditions that place all forest values at risk from the likelihood of high-intensity wildfires.

Keywords: forest health, forest management, forest inventory, Idaho

INTRODUCTION

If forest health is a statement about trees at risk of mortality from insects, diseases and wildfire, then much of Idaho's forest land is either unhealthy or on the verge of poor health, especially in the national forests that represent two-thirds of the state's timberlands. Past management practices, specifically timber harvesting and fire suppression, have created different kinds of forests than were here before European settlers arrived. Pines have been replaced by dense stands of firs. Prolonged drought in southern Idaho has weakened trees, making them even more susceptible to insect epidemics and wildfire. Annual mortality exceeds annual growth on the Boise and Payette National Forests, i.e., trees are dying faster than they are growing. In northern Idaho, root diseases are affecting the growth potential of mature stands. Too many dead trees promote catastrophic wildfires that can adversely affect not only timber resources, but also wildlife habitat, water quality and public budgets for fire control to protect private property adjacent to public forests.

Some people may call these conditions unhealthy. Others suggest that all this is just one more change in natural ecosystem dynamics. It is not possible to overemphasize the role of wildfire in creating and maintaining forests in Idaho. By effectively suppressing fire and excluding it from performing its natural role, Idaho's forest composition and structure has been altered to the point where these forests cannot be considered natural, if natural means unaffected by humans.

This paper describes the concepts, methods and results of an effort by the University of Idaho to assess forest conditions in Idaho (O'Laughlin et al. 1993), and the reactions that people have had to the results as presented in a variety of forums.

What Is the Policy Analysis Group?

To understand how the University of Idaho's Policy Analysis Group (PAG) approached its analysis of forest health, some background on the structure and function of the PAG is helpful. The PAG was created by the Idaho legislature in 1989 as a research unit of the University of Idaho's College of Forestry, Wildlife and Range Sciences. The PAG's mandate "is to provide timely, scientific and objective data and analysis of resource and land use issues of general interest to the people of Idaho" (Idaho Code § 38-714). The "timely" requirement generally limits PAG research to analysis and synthesis of existing data.

As required in the enabling legislation, a 9-member advisory committee is appointed by the dean of the college to suggest candidate issues for analysis and narrow the scope of inquiry by

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

suggesting a set of questions to focus each analysis. The committee meets four or five times per year. Its membership currently includes the directors of three state agencies (Lands, Fish & Game and Commerce), a USDA Forest Service (Forest Service) representative (the supervisor of the Boise National Forest), a member of the Idaho Travel Council, the president of the Idaho Farm Bureau Federation, a member of the Idaho Recreation Initiative and representatives from the forest products industry and the citizen conservation/environmental community.

CONCEPTS AND METHODS

The PAG's advisory committee suggested analyzing forest health for three reasons. First, tree mortality on the Boise National Forest was at alarming levels. Second, operations for salvaging dead and dying timber in national forests are controversial with environmental groups. Third, several committee members felt it inappropriate to approach these issues without considering that forests are ecosystems in which trees and timber are only one of many components. This additional dimension raised the complexity of analysis considerably. There is a lack of data to make assessments of all the important components of forest ecosystem health at the state-wide level, as was our charge. Existing data at that scale are limited to tree growth and mortality, which has been estimated by the Forest Service's Forest Inventory and Analysis research work unit since 1952.

The focus of the analysis suggested by the advisory committee was to answer two questions: (1) Is there a forest health problem in Idaho? (2) If so, what can be done about it, and if not, what can be done to prevent it? To answer these two focus questions, it was necessary to define forest health and then determine how forest ecosystem health could be measured with existing data.

Defining Forest Health

Aldo Leopold (1949a) issued the challenge to consider the health of forests and other ecosystems:

> 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 preserve this capacity.

Forest health is a multidisciplinary concept rarely mentioned in forestry literature before 1990. Waring (1980) and Smith (1985) were two of the first forest scientists to use the concept. The Forest Service (1988, 1993) wholeheartedly embraced the concept in its strategic plan for integrated pest management, but the agency has not yet arrived at a single definition of forest health. Instead of one definition, there are many (O'Laughlin et al. 1993, appendix A). Charged with selecting indicators to measure forest ecosystem health, U.S. Environmental Protection Agency scientists (Riitters et al. 1990) said, "No widely accepted definition of forest health exists."

Nonetheless, there are some generally agreed-upon forest health principles. A healthy forest is resilient, i.e., it has the ability to respond quickly to natural and human-caused disturbances such as fire, insects, diseases, climate change, air pollution and timber harvesting, and recover to some desired condition or state. A healthy forest is sustainable, i.e., it is capable of meeting peoples' present needs and aspirations without compromising the ability to meet those of the future.

Although the analogy with human health is imperfect, forest health is a useful communication device for focusing attention on (1) the prevention of socially undesirable forest conditions by integrating the various concerns of protecting the forest from insects, diseases and wildfire in an ecological framework, and (2) the restoration of socially desired forest conditions.

Sustaining forest health is a principal component of the evolving concept of ecosystem management. The Forest Service Eastside Ecosystem Assessment (Everett et al. 1994) defined forest health as a sustainable ecosystem. Although a healthy forest is sustainable, forest health does not determine what a forest should sustain. What should forests sustain? Gale and Cordray (1991) provided eight answers ranging from dominant products, communities and human benefits, to a variety of ecosystem protection strategies, some more allied with human needs than others.

Because of the lack of a widely accepted definition of forest health, we were forced to develop our own: forest health is a condition of forest ecosystems that sustains their complexity while providing for human needs. This definition was drafted by the six co-authors of the Forest Health Conditions in Idaho report (O'Laughlin et al. 1993), improved by the 12 reviewers of that report, and further refined at a forest health workshop (Sampson et al. 1994) attended by 35 scientists and resource managers. In total, more than 50 scientists and professionals from a variety of disciplines had an opportunity to influence this definition, which is purposely concise yet broad in scope (O'Laughlin 1994a).

Definitions are a necessary first step in assessing forest health (Smith 1990), but definitions are not as important as the concerns they represent. As is true in other health contexts, it may be easier to identify when a forest is unhealthy than it is to define exactly what healthy means.

Measuring Forest Ecosystem Health

Aldo Leopold (1949b) challenged scientists when he said, "The art of land doctoring is being practiced with vigor, but the science of land health is yet to be born." The first step in developing such a science is measurement. More than forty years later, Leopold's challenge is now being answered.

Can forest health be measured? In its National Forest Health Monitoring Plan, the Forest Service (1992, emphasis added) said, "Although forest condition can be specified and measured objectively, forest health carries an element of subjectivity, as it is a value judgement." At least three judgments need to be made: (1) selecting representative indicators—as a minimum, vegetation, water and wildlife; (2) developing standards for using indicators to assess conditions; and (3) resolving value conflicts regarding these judgments. O'Laughlin et al. (1993, chapter 13; also O'Laughlin et al. 1994) described the leading indicators suggested in the literature.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

The defining characteristic of a forest ecosystem is its trees. Without trees, there is no forest. An essential approach for measuring forest ecosystem health is determining the condition of stands of trees. More effort has been applied to this ecosystem component than any other and two data bases exist. First, the general condition of forests can be assessed by measuring the visual symptoms of foliar damage, accomplished primarily by state-wide aerial surveys. Second, the productive efficiency of forests can be assessed by periodically measuring forest growth and mortality, which is done at the state-wide level by continuous forest inventories. The Research division of the Forest Service has the responsibility for this task in its Forest Inventory and Analysis research work unit. These two data bases represent two of the three high priority forest ecosystem health response indicators identified by the Environmental Protection Agency. The third indicator is relative abundance of wildlife (Riitters et al. 1990).

A forest is more than just stands of trees, it is an ecosystem. Eventually forest health assessments must take into account other forest components. People are particularly interested in water and wildlife, but a conceptual foundation for incorporating these components as indicators of ecosystem health needs to be developed if the fledgling science of ecosystem health is to progress. In other words, operational models for assessing forest ecosystem health do not exist (see Riitters et al. 1990; Costanza et al. 1992). Another major problem is the lack of existing data bases for developing health measurement standards for water and wildlife ecosystem components at large geographic scales over adequate time periods. Yet another problem is selecting and validating representative wildlife species for monitoring ecosystem conditions (see Riitters et al. 1990; O'Laughlin et al. 1993, chapters 12 and 13; also O'Laughlin et al. 1994).

Determining Forest Health Condition

Four items are needed for determining forest health condition. First, a representative set of indicators is needed. Second, baseline data for the indicators is necessary to establish standards of comparison by which judgments about current conditions can be made. Such criteria, then, are the third requirement. Fourth is a monitoring program for collecting current data to compare against the criteria.

Forest Health Indicators

The fledgling science of forest ecosystem health has not yet agreed on a representative set of indicators. We have suggested vegetation, water and wildlife as the minimum essential forest ecosystem components. Only one, vegetation, has data at the state-wide level for assessing forest health, and in Idaho only forest inventory data goes back more than 15 years in time.

O'Laughlin et al. (1993, chapter 14) also analyzed the 15 years of data on visual symptoms of foliar damage, but extreme variation in the data precluded establishing a baseline. We therefore focused on the productive efficiency of trees. The Society of American Foresters Task Force Report on Sustaining Long-term Forest Health and Productivity (Norris et al. 1993) said, "Forests can be considered healthy when there is an appropriate balance between growth and mortality." Forest growth and mortality data are available in published reports dating from 1952-1987.

Baseline Data

The following analysis uses one indicator (the relationship between tree growth and mortality) to assess forest health conditions in Idaho. The analysis serves as an example of how data for any indicator may be used to develop a baseline for assessing forest ecosystem health. Scientists have not addressed how different indicators—such as water quality, fish and wildlife, and soil—can be integrated to represent the condition of a complete forested ecosystem.

The starting point for this analysis of forest health is time series data relating forest mortality to forest growth. Because forests in Idaho are similar to those in Montana and the eastern portions of Oregon and Washington, these three adjoining areas, together called the Inland Northwest region, are portrayed in Figure 1.

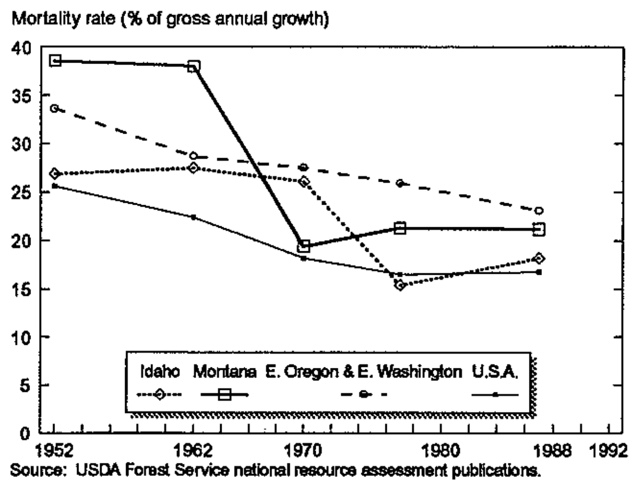


Figure 1.—Annual mortality as a percentage of gross annual growth: Inland Northwest regional trends, with the U.S.A. for comparison, 1952-1987.

A regional range can be developed from the high and low data points at each interval between 1952 and 1987. Estimates ranged from 38-15%, with a generally downward trend reflecting increased growth rather than declining mortality. Forests in the region are almost exclusively softwoods. Comparable data for softwoods across the entire United States are also depicted in Figure 1, and mortality (expressed as a percentage of growth) is generally higher in the Inland Northwest than in the nation as a whole.

The regional range is used as a baseline in Figure 2 for comparison with growth and mortality data contained in the formal plans for Idaho's national forests produced under the National Forest Management Act of 1976.

It is appropriate to begin the analysis with the national forests because they represent 67% of the timberlands and 72% of the timber volume in Idaho (Waddell et al. 1989). National forest

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

lands are 40% of the entire state of Idaho, far outstripping all other states. Oregon's national forests place second with 25%. More than 60% of Idaho's national forest lands are reserved from or classified as unsuitable for timber production. Timber resource inventories on national forests are taken only on suitable timberlands. The Boise National Forest was the only one of the ten Idaho national forests to provide time series growth and mortality data in its forest plan. Figure 2 illustrates that tree mortality rates on the Boise and Payette National Forests were almost double the regional range, warranting further investigation.

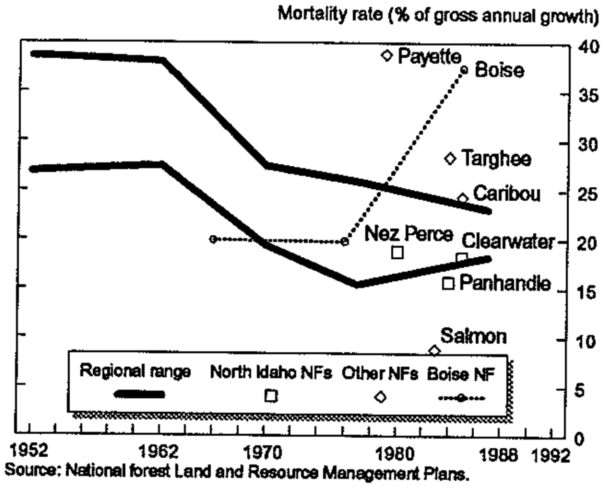


Figure 2.—Annual mortality as a percentage of gross annual growth: Inland Northwest regional range, 1952-1987, and data from Idaho's national forest plans.

Data for the Boise and Payette National Forests in southwestern Idaho were also collected in the early 1990s and are depicted in Figure 3. The reason for elevated mortality (expressed as a percentage of growth) on both these National Forests is a function of both a decline in growth and an increase in mortality. Both these National Forests had a substantial increase in mortality in the early 1990s, and both are in a situation where mortality exceeds gross annual growth.

How these new data compare to the regional trend and forest plan data in Figure 2 is illustrated in Figure 4. It was necessary to change the scale on Figure 4, so the regional range appears more compressed than it does in Figure 2. The data in Figure 4 illustrate that mortality rates on these two national forests were 4 to 5 times higher than the past range of variability for the region. Mortality on the Payette National Forest was primarily the result of insect activity in the late 1980s. On the Boise National Forest, roughly half the mortality was from insect activity and half from wildfires in the 1988-1992 period.

Also displayed in Figure 4 is recent inventory data for private and other public forests (i.e., non-national forests) in northern Idaho. These forests represent 24% of the timberland and a like amount of the timber growing stock volume in Idaho. Mortality rates are within the regional range.

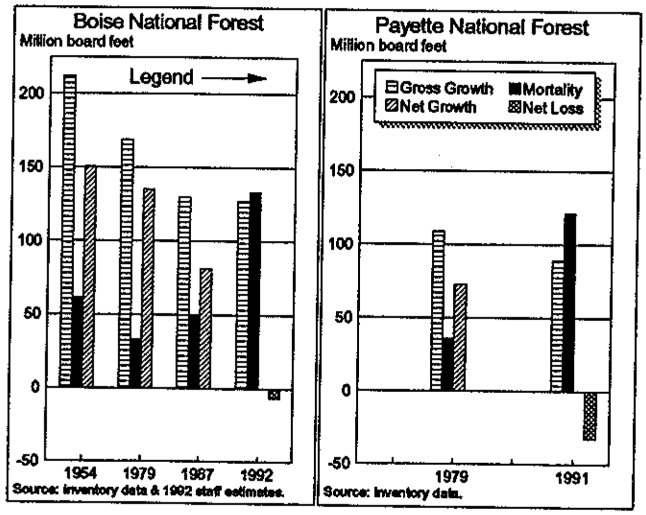


Figure 3.—Trends in annual growth and mortality, southwestern Idaho National Forests, 1954-1992.

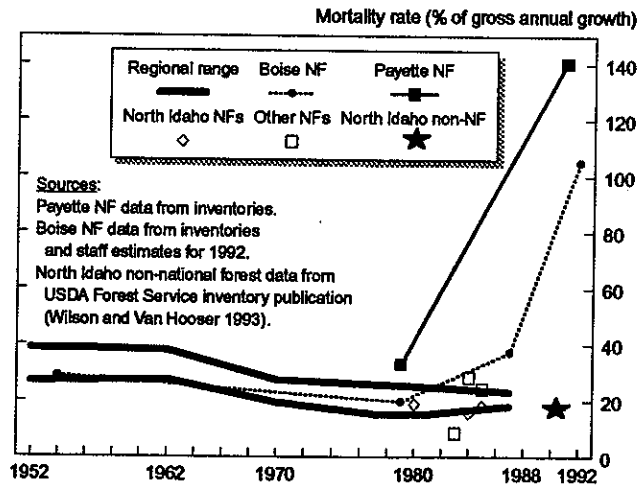


Figure 4.—Annual mortality as a percentage of gross annual growth: Inland Northwest regional range, 1952-1987, and most recent data for 91% of Idaho timberlands.

Forest Health Criteria

Norris et al. (1993) stated, "Forests can be considered healthy when there is an appropriate balance between growth and mortality." However,they did not indicate what an "appropriate balance" might be. There is little guidance from other published sources.

The Blue Mountains Forest Health Report (USDA Forest Service 1991) defined catastrophic pest damage as "a level of insect- or disease-caused tree mortality and/or damage, such that resource management goals are significantly hindered, and desired future condition described in forest plans cannot be achieved." This is a qualitative criterion based on management goals when quantitative standards based on physical measures are called for.

In its first resource assessment after World War II, the Forest Service (1958, emphasis added) defined catastrophic timber

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

mortality: "Losses are considered catastrophic if annual mortality was greater than the net annual growth of the affected state or region." This definition fits the situation on the national forests in southwestern Idaho. In fact, those forests are worse because annual mortality exceeds gross annual growth.

Several possibilities exist for using growth and mortality baseline data to establish criteria. First, the ratio of mortality to growth may be used as an index. When mortality exceeds growth, as it does on the Boise and Payette National Forests, there is definitely some kind of forest health problem. These forests are dying faster than they are growing. This is not a sustainable forest condition in the short term. Second, the historic range of variability can be used as a standard. If current conditions are outside the historic range, then there may be a forest health problem.

Monitoring

The Forest Service has been monitoring the condition of the nation's timber resources since the early 1950s. Published data can be used to reveal changes in species composition, as portrayed in Figure 5. In 1952, firs represented 42% of the timber volume in Idaho; in 1987 that increased to 49%. Pines declined from 39% to 27% of the volume.

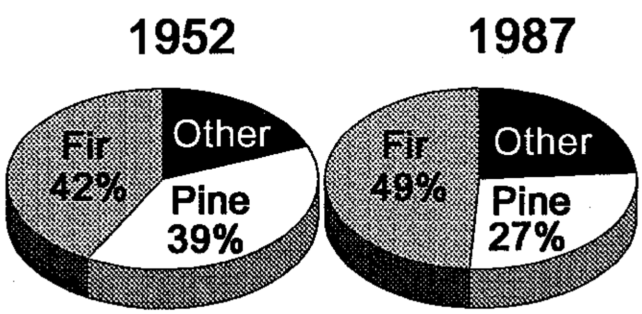


Figure 5.—Growing stock volume changes on Idaho's timberlands by species group, 1952-1987 (percent of total).

Figure 6 provides more detail than Figure 5. Western white pine and ponderosa pine each declined by roughly two billion cubic feet. Firs offset the decline in pine volume, with true firs (primarily grand fir) increasing by 3 billion cubic feet and Douglas-fir by one billion cubic feet. The increases in lodgepole pine, Engelmann spruce, western larch and other softwood species represent a net gain of roughly 3 billion cubic feet (or 12% of the total growing stock volume) since 1952.

Perhaps the most important information to be gained from monitoring is how unforeseen forest condition changes reveal themselves. The shift from pines to firs has causes and consequences. The cause is fire exclusion. One consequence is reduced productivity. Fire exclusion has helped root disease become a major forest health problem in northern Idaho (Hagle et al. 1992; Hagle and Byler 1993; Byler et al. 1994).

Hagle (cited by Hayes 1993, and personal communication) estimated mortality to average 3-4% per year (as a percentage of growing stock volume) in stands 60 years and older throughout the northern Idaho national forests. This is many times in excess of the 35-year range of variability of 0.4-0.7% mortality (expressed as a percentage of growing stock volume) in the Inland Northwest region (O'Laughlin et al. 1993, chapter 14).

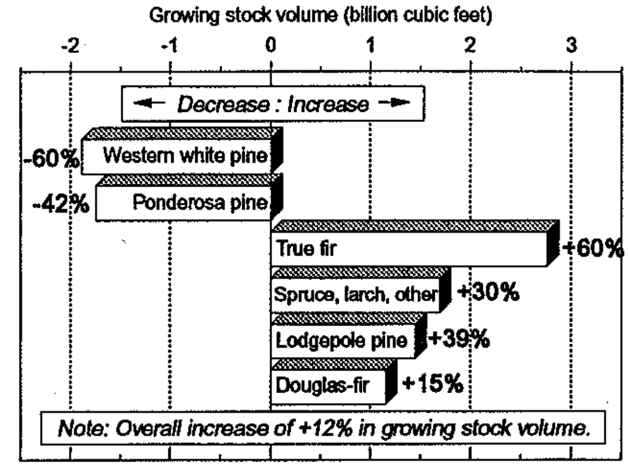


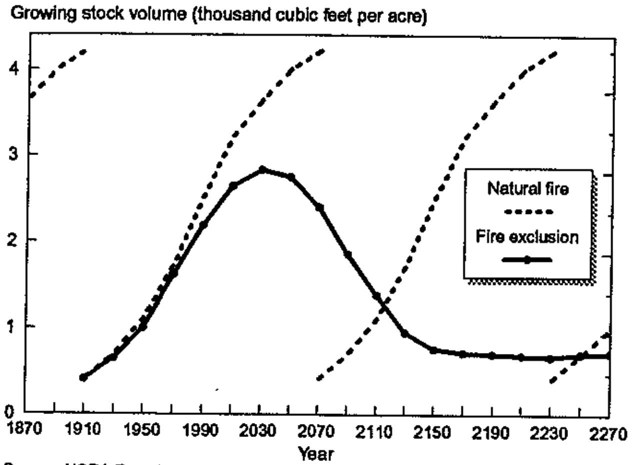
Figure 6.—Growing stock volume changes on Idaho's timberlands by species, 1952-1987 (billion cubic feet).

One example of productivity decline from root disease is portrayed in Figure 7. Preliminary modeling results reported by Hagle and Byler (1993) indicated significant losses in future productivity in seral ponderosa pine forests in northern Idaho. (Seral refers to a biotic community that is in a developmental or transitional stage.) These projected losses result from the combined effects of fire exclusion, species conversion and root disease.

The two fire regimes in Figure 7 are, first, stand-replacing fires every 160 years (labelled natural fire), with intermittent low-intensity fires that favor ponderosa pine rather than Douglas-fir. This regime models "natural" fire frequencies and intensities. The second fire regime (labelled fire exclusion) is the end result of wildfire suppression. Seral ponderosa pine forests succeed to Douglas-fir without periodic low-intensity "thinning" fires. Productivity is reduced because Douglas-fir is chronically affected by root disease on many sites in northern Idaho, and ponderosa pine is not.

The difference in productivity is projected to be dramatic. Figure 7 illustrates what happens to two stands—one with fire suppression and one without—established in 1910, when severe wildfires swept through more than two million acres of forests in northern Idaho. In 1990, the stand in which periodic low-intensity fires were allowed to burn had 12% more timber volume than the stand where fire was excluded. By the time 160 years has elapsed and another stand-replacing fire may be expected (approximately the year 2070), the difference in productivity is 43%. By the time two such cycles have run their course (approximately the year 2230), the productivity loss from the effects of fire exclusion is a staggering 92%.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.



Source: USDA Forest Service, adapted from Hagle and Byler (1993).

Figure 7.—Effect of fire exclusion on forest productivity in northern Idaho areas with moderate to severe root disease, ponderosa pine type on Douglas-fir habitat.

The projections in Figure 7 are based on computer simulations using measurements taken in 10 ponderosa pine stands on Douglas-fir habitat type where fire has not been suppressed and 10 similar stands where fire has been excluded. These are preliminary results by Hagle and Byler (1993) using the Prognosis growth projection model (Stage 1973; Wykoff et al. 1982) and a variant of the model for root disease effects (Stage et al. 1990).

RESULTS

Forest growth and mortality data can be used to make some judgments about forest conditions, which in turn suggest some management implications based on current conditions. Summaries of these judgments are presented in this section in two tables from O'Laughlin et al. (1993), with only minimal explanation.

Are Idaho's Forests Healthy?

Some forests in Idaho appear to be healthier than others. Table 1 summarizes what can be said about the condition of Idaho's forests using available data and the criterion of productive efficiency, or the relationship of forest growth and mortality.

We conducted a case study of how the Boise and Payette National Forests have dealt with their forest health situations, and compared their approaches to that of Boise Cascade Corporation. The company owns 190,000 acres of timberlands in the vicinity of these two National Forests. These industrial forests have not experienced the same mortality situation as the national forests (Blatner et al. 1994; also O'Laughlin et al. 1993, chapter 16).

The following points summarize the conclusions from Table 1 as the author has presented them to many audiences:

- Problems exist throughout the state, mostly in the national forests.
- Cause—fire suppression and timber harvesting have changed forest composition and density.
- Effect—elevated levels of timber mortality.
- Remedy—intensive forestry.
- Barriers—public policy and public trust.

To summarize the results of this analysis in one sentence, managed forests in Idaho appear to be healthier than unmanaged forests.

Management Implications

Due to fire suppression and timber harvesting, firs have replaced pines on many sites, often in dense stands that may exceed the historic range of variability in forests where moisture is a limiting factor, as in southern Idaho. Drought and insect outbreaks result in dead trees that increase fuel loads. The root disease implications in Figure 7 also involve more than just productivity loss. Dead trees will accumulate in northern Idaho forests, and in the absence of frequent low-intensity fires, increase the potential for high-intensity large-scale wildfires.

Table 2 summarizes possible strategies for dealing with forest health problems on the four major classifications of forest lands in the national forests.

Several questions were raised at the Spokane symposium regarding what this author means by "intensive forestry." Intensive forestry is the opposite of extensive forestry. These are two of five possible management strategies, the other three being adaptive forestry, ecosystem management and no management. Extensive forestry uses low-level applications of operating and investment costs to a forest property. Intensive forestry uses high levels of capital and labor inputs to sustain a high volume and quality of timber by applying the most appropriate management techniques and silvicultural practices. Environmental concerns operate as constraints (O'Laughlin et al. 1993, chapter 1). Another difference is that intensive forestry is management effort applied across the entire forest property, whereas extensive forestry is only practiced on certain parcels, usually those where reforestation is the goal following timber harvest. Intensive forestry may involve silvicultural treatments between the establishment and final harvest of a stand; extensive forestry will generally not include these intermediate treatments designed to improve the condition of a stand.

In the health vernacular, intensive forestry means intensive care and involves site-specific prescriptions to prevent unhealthy forest conditions. Prescriptions should have a scientific basis that puts forest protection in an ecological framework (for example, see McDonald in this proceedings). The goal is to restore species and numbers of trees best suited to specific conditions. Means to accomplish that will include the whole range of silvicultural practices, including prescribed burning (after heavy fuel loads are reduced), thinning and regeneration of resistant species (pines and larch) to replace less well-suited species (grand fir and Douglas-fir).

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

Table 1.—Forest health conditions in Idaho.

Region and Ownership Category	% of Idaho Total		Forest Condition (expressed by forest growth and mortality)
	Timberland	Forest Volume	
Northern Idaho National Forests	29%	43%	No problem apparent in mid-1980s forest resource inventory data. Forest pathology surveys taken since 1985 indicate elevated levels of mortality in mature stands due to root disease and 40% reductions in productivity (S. Hagle and J. Byler, personal communication and unpublished papers).
Northern Idaho Other Public & Private Forests	24%	24%	No problem apparent in early 1990s forest resource inventory data.
Southwestern Idaho (mostly national forests)	19%	15%	Annual mortality exceeds gross annual growth. On average, on suitable timberlands, forests are dying faster than they are growing on both the Boise and Payette National Forests. Intermingled industrial forests do not have similarly elevated mortality levels.
South Central and Southeastern Idaho (mostly national forests)	28%	18%	The Targhee and Caribou National Forests had slightly elevated mortality/growth ratios in the mid-1980s. A recent inventory on BLM forests in southeastern Idaho showed high levels of mortality.
State of Idaho Total	100%	100%	Forests throughout southern Idaho are suffering elevated levels of mortality from forest structure problems (species composition and stand density) exacerbated by drought. National forests in northern Idaho have elevated mortality levels from root diseases that threaten long-term productivity; inventory data show other public and private forests do not have elevated mortality/growth ratios.

Source: Forest Health Conditions in Idaho (O'Laughlin et al. 1993).

REACTIONS TO RESULTS

The results of the PAG report have been presented to a variety of groups, including the following:

- Forest health symposium, American Forests partnership, Boise, Idaho (June 1993).
- Forest health workshop, American Forests partnership, Sun Valley, Idaho (November 1993).
- ROOTS (Resource Organization on Timber Supply), forest health lectures, Lewiston, Idaho (January 1994).
- Idaho legislature, Boise (two presentations, February 1994).
- Governor of Idaho, Boise (press conference, March 1994).
- The Wildlife Society, Idaho Chapter annual meeting (March 1994).
- Society of American Foresters, Inland Empire section annual meeting (March 1994).
- Inland Empire Tree Improvement Cooperative annual meeting (March 1994).
- Intermountain Forest Industry Association executive committee (March 1994).
- National Academy of Sciences, National Research Council Committee on Environmental Issues in Pacific Northwest Forest Management (April 1994).

Many people in each of these audiences seemed very interested in the findings. During opportunities for comments and questions, several themes surfaced more than once. New data and analysis not published in O'Laughlin et al. (1993) or elsewhere are presented here in response to these concerns.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

Table 2.—Possible forest health management strategies on national forest land area classifications.

National Forest Land Classification	National Forest Lands		National Forest	Management Strategy
	% of Acres	as % of Total	Forest Health Idaho Total	
Wilderness,	4,037,270	20.0%	0% (a)	Control wildfire, and possibly insects and diseases, designated to prevent spread to adjacent lands and protect the full range of wilderness values—recreational, scenic, scientific, educational, conservation and historical use.
Wilderness, recommended	1,292,006	6.4%	(b)	
Unsuitable for timber production	6,941,043	34.3%	12% (c)	Control wildfire, and possibly insects and diseases, to prevent spread to adjacent lands. Forestry practices are inappropriate for enhancing timber production, but may be appropriate for protecting and enhancing wildlife, water shed and scenic values.
Roadless: suitable for timber production	2,066,500	10.2%	14%	Control wildfire, and possibly insects and diseases, to prevent spread to adjacent lands. Prescribed burning (and possibly salvage logging and thinning by helicopter) may be appropriate to promote forest health, and other values placed at risk by unhealthy forest conditions, without jeopardizing wilderness suitability.
Roaded: suitable for timber production	5,886,943	29.1%	41%	Control wildfire, and possibly insects and diseases, to prevent spread to adjacent lands. Forest health can be restored, and unhealthy conditions prevented, by using intensive forestry practices. These include thinning, prescribed burning, fertilization and regeneration of resistant and resilient species—especially genetically improved varieties. Intensive forestry is preferable to extensive forestry for promoting healthy forests in many situations. If healthy and sustainable forest ecosystems are a desired goal, intensive practices can be compatible with ecosystem management, especially with an adaptive management strategy.
All national forest lands	20,223,762	100%	67%	Keeping forest lands in healthy condition is an appropriate strategy to sustain forest ecosystems.

(a) 3,051,000 acres of forest land that meet the physical definition of timberland have been legally or administratively reserved and are no longer subject to timber harvesting or considered as timberlands.
(b) Acreage and percentage undetermined, but included in "unsuitable for timber production" percentage.
(c) 1,751,557 acres of "unsuitable" and "recommended wilderness" lands are classified as timberlands.

Source: Forest Health Conditions in Idaho (O'Laughlin et al. 1993).

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

Quality of Inventory Data

Concern about the quality of forest resource inventory data covers several dimensions, including vegetation, wildlife and water quality.

Vegetation

Although there is a great deal of vegetation-related data, it is collected by different organizations for different purposes, making comparisons problematic.

Foliar damage is assessed by visual inspection, with observers flying over forest areas searching for discolored foliage and recording what they find. Efforts are made to ascertain the insect or disease responsible for the discoloration. Depending on the agent, data are expressed as acres affected or number of trees killed. A major problem with this approach for defoliating insects is that even though defoliated trees suffer growth loss, not all of them may die.

Tree growth and mortality is estimated by establishing and remeasuring a grid-based system of permanent plots. The Forest Service' Research division has the responsibility for collecting and analyzing data on all ownerships other than the National Forest System. Individual national forests collect their own data for timber management and forest planning purposes and provide it to the Research division for further analysis and compilation into regional and national resource assessments and reports. The quality of National Forest System inventory data is sometimes questioned (see, for example, Sonner 1992, Jackson 1994).

Mortality estimates are notoriously difficult to make, and likely are underestimated by inventory crews (Partridge and Bertagnolli 1993; J. Byler, personal communication). Because a variety of root disease organisms are prevalent throughout the northern Rocky Mountains, beginning in 1985, National Forest System scientists established their own stand-based sampling system to estimate the extent and severity of root diseases in the national forests (see Hagle et al. 1992; Hagel and Byler 1993; Byler et al. 1994). The comparability of this data to grid-based timber mortality estimates is questionable.

Wildlife and Water Quality

The quality and quantity of wildlife inventory data is inadequate for assessing forest ecosystem conditions at a state-wide level. Harvest trends for a few game species are available and may represent gross trends in populations. However, different species respond differently to changing habitat conditions. In addition, forest compositions and structures that promote insect and disease outbreaks may provide for some needs of wildlife, such as hiding cover, but not other needs, such as forage. The annual census of birds by citizens has not been linked to ecosystem conditions, and only tallies resident species. Annual breeding bird surveys are conducted by the U.S. Fish and Wildlife Service, but trend data for half the species in Idaho are lacking. Existing data cover only a 9-year period, and are inconclusive. A few species show significant declines, and a few show significant increases. Each national forest has a number of wildlife species identified as management indicator species (see O'Laughlin et al. 1993, chapter 12), but these species have not been monitored.

The assessment of aquatic ecosystem health is perhaps further along than other systems because the federal Clean Water Act was passed more than 20 years ago. Indicators for linking aquatic ecosystem conditions to forest conditions are known (see O'Laughlin et al. 1993, chapter 13; also O'Laughlin et al. 1994). Although data linking water quality to general forest conditions may be available for a few streams, water quality data for making forest ecosystem health assessments at the state-wide level have not been compiled.

Mortality by Age Class and Ownership

Regarding the conclusion that managed forests in Idaho appear to be healthier than unmanaged forests, some people have commented that managed forests are generally younger than unmanagedforests and would therefore be expected to exhibit lower mortality rates. However, as the data in this section reveal, it is growth in relationship to mortality that makes younger forests healthier than older ones, not mortality alone.

Forest inventory data for 1980 and 1987 are used in this section to compare national forests to other ownerships. The report with 1980 data (Benson et al. 1987) is much more detailed than those with the 1987 data (Waddell et al. 1989; Waddell 1992), leading the author to conclude that forest inventory data provide a source that could reveal much more about forest conditions than the analyses published by the Forest Service.

Forest Extent and Volume

Idaho is a public lands state, with only 21.3% of the timberlands in private ownership (Figure 8). National forests dominate timberland ownership, with two acres for every one held by any other owner. The 14.5 million acres of timberland account for 28% of all land in Idaho. Another 13% of the state is covered by forests that either do not meet the timberland productivity criterion of 20 cubic feet of wood per acre per year (4.2 million acres), or are reserved from timber production by statute or administrative designation (3 million acres). These reserved or unproductive forest lands are not part of published timber inventory data.

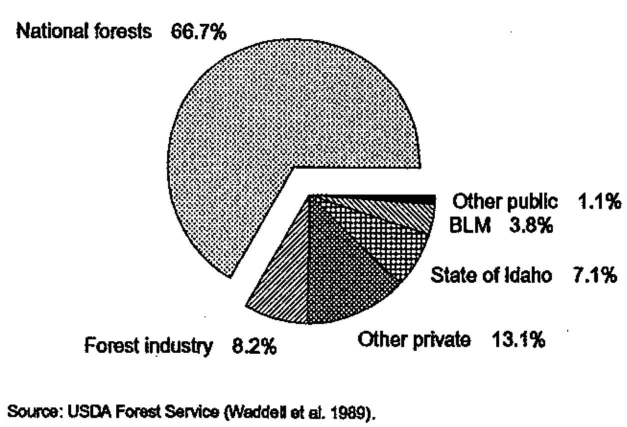


Figure 8.—Idaho timberland ownership categories, 1987.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

Quality of Inventory Data

Concern about the quality of forest resource inventory data covers several dimensions, including vegetation, wildlife and water quality.

Vegetation

Although there is a great deal of vegetation-related data, it is collected by different organizations for different purposes, making comparisons problematic.

Foliar damage is assessed by visual inspection, with observers flying over forest areas searching for discolored foliage and recording what they find. Efforts are made to ascertain the insect or disease responsible for the discoloration. Depending on the agent, data are expressed as acres affected or number of trees killed. A major problem with this approach for defoliating insects is that even though defoliated trees suffer growth loss, not all of them may die.

Tree growth and mortality is estimated by establishing and remeasuring a grid-based system of permanent plots. The Forest Service' Research division has the responsibility for collecting and analyzing data on all ownerships other than the National Forest System. Individual national forests collect their own data for timber management and forest planning purposes and provide it to the Research division for further analysis and compilation into regional and national resource assessments and reports. The quality of National Forest System inventory data is sometimes questioned (see, for example, Sonner 1992, Jackson 1994).

Mortality estimates are notoriously difficult to make, and likely are underestimated by inventory crews (Partridge and Bertagnolli 1993; J. Byler, personal communication). Because a variety of root disease organisms are prevalent throughout the northern Rocky Mountains, beginning in 1985, National Forest System scientists established their own stand-based sampling system to estimate the extent and severity of root diseases in the national forests (see Hagle et al. 1992; Hagel and Byler 1993; Byler et al. 1994). The comparability of this data to grid-based timber mortality estimates is questionable.

Wildlife and Water Quality

The quality and quantity of wildlife inventory data is inadequate for assessing forest ecosystem conditions at a state-wide level. Harvest trends for a few game species are available and may represent gross trends in populations. However, different species respond differently to changing habitat conditions. In addition, forest compositions and structures that promote insect and disease outbreaks may provide for some needs of wildlife, such as hiding cover, but not other needs, such as forage. The annual census of birds by citizens has not been linked to ecosystem conditions, and only tallies resident species. Annual breeding bird surveys are conducted by the U.S. Fish and Wildlife Service, but trend data for half the species in Idaho are lacking. Existing data cover only a 9-year period, and are inconclusive. A few species show significant declines, and a few show significant increases. Each national forest has a number of wildlife species identified as management indicator species (see O'Laughlin et al. 1993, chapter 12), but these species have not been monitored.

The assessment of aquatic ecosystem health is perhaps further along than other systems because the federal Clean Water Act was passed more than 20 years ago. Indicators for linking aquatic ecosystem conditions to forest conditions are known (see O'Laughlin et al. 1993, chapter 13; also O'Laughlin et al. 1994). Although data linking water quality to general forest conditions may be available for a few streams, water quality data for making forest ecosystem health assessments at the state-wide level have not been compiled.

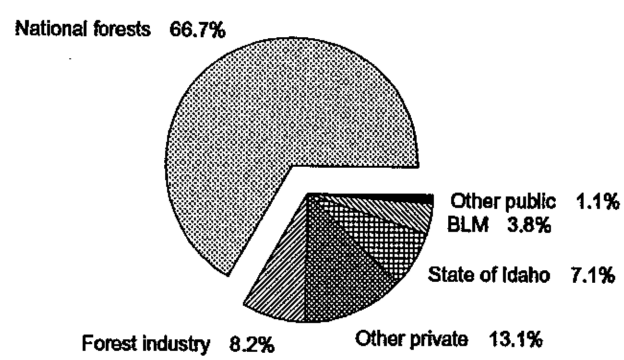
Mortality by Age Class and Ownership

Regarding the conclusion that managed forests in Idaho appear to be healthier than unmanaged forests, some people have commented that managed forests are generally younger than unmanagedforests and would therefore be expected to exhibit lower mortality rates. However, as the data in this section reveal, it is growth in relationship to mortality that makes younger forests healthier than older ones, not mortality alone.

Forest inventory data for 1980 and 1987 are used in this section to compare national forests to other ownerships. The report with 1980 data (Benson et al. 1987) is much more detailed than those with the 1987 data (Waddell et al. 1989; Waddell 1992), leading the author to conclude that forest inventory data provide a source that could reveal much more about forest conditions than the analyses published by the Forest Service.

Forest Extent and Volume

Idaho is a public lands state, with only 21.3% of the timberlands in private ownership (Figure 8). National forests dominate timberland ownership, with two acres for every one held by any other owner. The 14.5 million acres of timberland account for 28% of all land in Idaho. Another 13% of the state is covered by forests that either do not meet the timberland productivity criterion of 20 cubic feet of wood per acre per year (4.2 million acres), or are reserved from timber production by statute or administrative designation (3 million acres). These reserved or unproductive forest lands are not part of published timber inventory data.



Source: USDA Forest Service (Waddell et al. 1989).

Figure 8.—Idaho timberland ownership categories, 1987.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

From a forest health standpoint, it appears that in 1980 in Idaho, mortality affected all diameter classes at approximately the same rate of 0.3-0.4% and, with the exception of the largest diameter classes, didn't vary much across ownerships (Figure 11).

Expressed as a percentage of growing stock volume (as in Figure 11), mortality in all Idaho forests declined slightly as trees got larger. Published data for other years are not available that can confirm this relatively constant rate of mortality across diameter classes in Idaho. Data indicate substantial variation by species, however.

Figure 11 portrays mortality by ownership as it is available in published sources. Mortality as a percentage of growing stock volume ranges from 0.3-0.4% in all diameter classes in the national forests, with some variation in the other ownership classes beyond the 18-inch class. The species most affected in the 24-inch class were Douglas-fir and western larch.

Tree mortality is only half of the forest health criterion suggested by the Society of American Foresters. The other half is tree growth. Together, these two measures can be used as a large-scale measure of tree growth efficiency—one of the U.S. Environmental Protection Agency's three high priority indicators of forest ecosystem health.

Figure 12 depicts mortality as a percentage of gross annual growth, this is the combined effect of mortality and growth across age classes. Estimates indicated a steady increase from 5% mortality in the 6-inch class to 20% in the 16-inch to 20-inch classes to almost 30% in the 29+ inch class. The larger trees have a higher mortality rate—not from substantial increases in mortality, but from substantial decreases in growth.

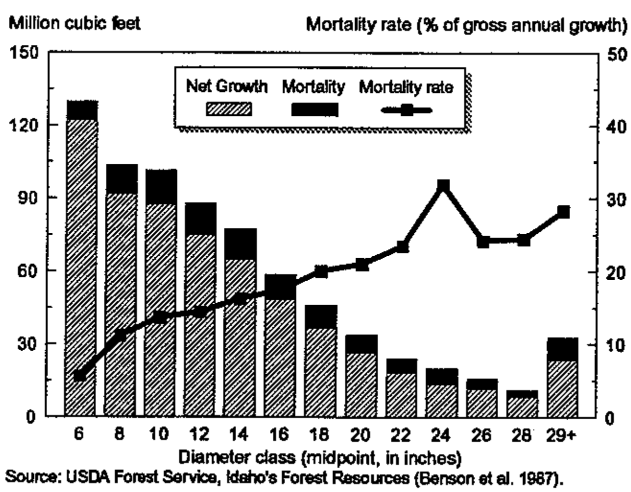


Figure 12.—Gross annual growth (net growth plus mortality) and annual mortality as a percentage of gross annual growth, Idaho softwoods by diameter class, 1980.

Figure 13 depicts the same mortality rate as a percentage of gross annual growth across diameter classes as in Figure 12, and breaks it down by ownership. For trees in the 6-inch to 8-inch classes (poletimber or pulpwood size), the difference in mortality rates between ownerships is not statistically significant. However, in the 10-inch to 18-inch classes, the difference is highly significant (t=14.67, p=0.0001), with an average rate of 17.8% in the national forests compared to 13.2% for the other forests. These five diameter classes represent almost half (48.9%) of the total growing stock volume in Idaho in 1980 (Benson et al. 1987). Beyond 20 inches, data are highly variable and when aggregated, there is no statistically significant difference in mortality between national forests and other owners in the large diameter classes.

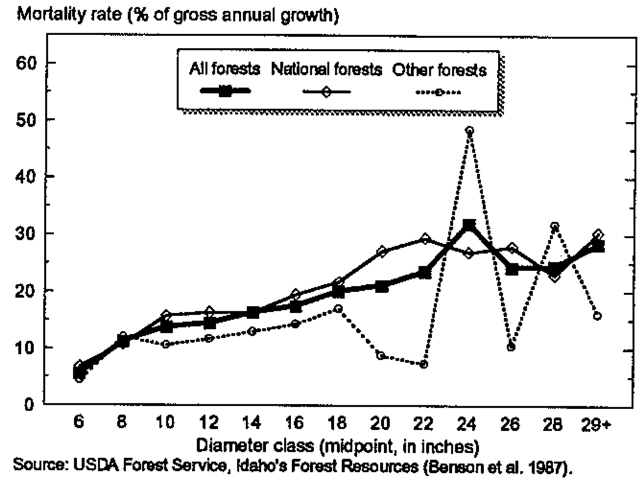


Figure 13.—Annual mortality as a percentage of growing stock volume, Idaho softwoods by ownership and diameter class, 1980.

Summary

Table 3 summarizes the differences between national forests and other public and private forests in Idaho in the 1980s. In 1980, national forests had less growth and more mortality per acre than other forests, resulting in 60% higher mortality (as a % of growth) in the national forests than other forests. In 1987, national forest growth improved, but mortality worsened, the net result being 53% more mortality in the national forests than other forests.

If 1980 and 1987 data are used as time series data points, timber volume per acre was significantly greater on the national forests (t=33.7, p=0.02) and so was the rate of tree mortality (% of gross growth, t=15.0, p=0.04).

Is the relationship of tree growth and mortality a good measure of forest ecosystem health? Consider that three of the four dictionary definitions of health apply to the general condition of the human body and mind. The fourth definition of health is simply vigor or vitality. One definition of vigor is "growth ... as a plant." Trees in Idaho's national forests are perhaps as vigorous as in other forests (13% less growth per acre in 1980 and 3% more in 1987). Among other definitions, vitality means "power to live" (American College Dictionary, Random House). Trees in Idaho's national forests have less vitality than in other forests (38% more mortality per acre in 1980 and 56% more mortality in 1987). In Idaho, national forests are therefore not as healthy as other forests.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

From a forest health standpoint, it appears that in 1980 in Idaho, mortality affected all diameter classes at approximately the same rate of 0.3-0.4% and, with the exception of the largest diameter classes, didn't vary much across ownerships (Figure 11).

Expressed as a percentage of growing stock volume (as in Figure 11), mortality in all Idaho forests declined slightly as trees got larger. Published data for other years are not available that can confirm this relatively constant rate of mortality across diameter classes in Idaho. Data indicate substantial variation by species, however.

Figure 11 portrays mortality by ownership as it is available in published sources. Mortality as a percentage of growing stock volume ranges from 0.3-0.4% in all diameter classes in the national forests, with some variation in the other ownership classes beyond the 18-inch class. The species most affected in the 24-inch class were Douglas-fir and western larch.

Tree mortality is only half of the forest health criterion suggested by the Society of American Foresters. The other half is tree growth. Together, these two measures can be used as a large-scale measure of tree growth efficiency—one of the U.S. Environmental Protection Agency's three high priority indicators of forest ecosystem health.

Figure 12 depicts mortality as a percentage of gross annual growth, this is the combined effect of mortality and growth across age classes. Estimates indicated a steady increase from 5% mortality in the 6-inch class to 20% in the 16-inch to 20-inch classes to almost 30% in the 29+ inch class. The larger trees have a higher mortality rate—not from substantial increases in mortality, but from substantial decreases in growth.

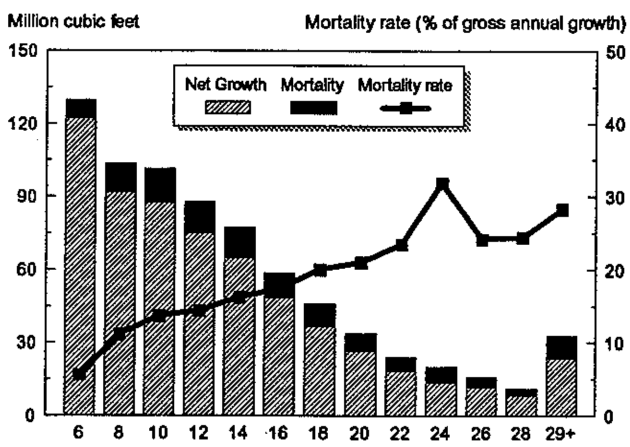


Figure 12.—Gross annual growth (net growth plus mortality) and annual mortality as a percentage of gross annual growth, Idaho softwoods by diameter class, 1980.

Figure 13 depicts the same mortality rate as a percentage of gross annual growth across diameter classes as in Figure 12, and breaks it down by ownership. For trees in the 6-inch to 8-inch classes (poletimber or pulpwood size), the difference in mortality rates between ownerships is not statistically significant. However, in the 10-inch to 18-inch classes, the difference is highly significant (t=14.67, p=0.0001), with an average rate of 17.8% in the national forests compared to 13.2% for the other forests. These five diameter classes represent almost half (48.9%) of the total growing stock volume in Idaho in 1980 (Benson et al. 1987). Beyond 20 inches, data are highly variable and when aggregated, there is no statistically significant difference in mortality between national forests and other owners in the large diameter classes.

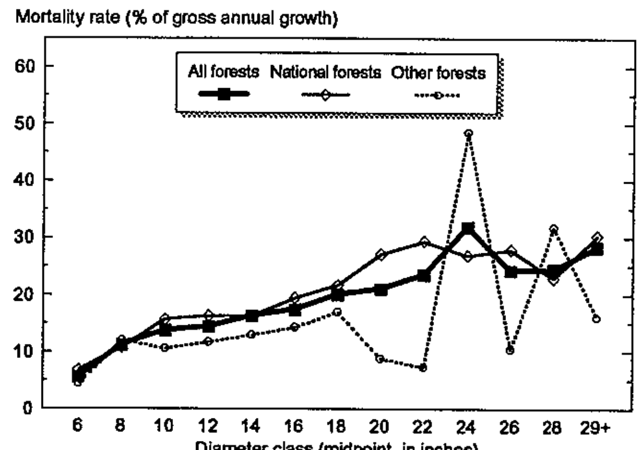


Figure 13.—Annual mortality as a percentage of growing stock volume, Idaho softwoods by ownership and diameter class, 1980.

Summary

Table 3 summarizes the differences between national forests and other public and private forests in Idaho in the 1980s. In 1980, national forests had less growth and more mortality per acre than other forests, resulting in 60% higher mortality (as a % of growth) in the national forests than other forests. In 1987, national forest growth improved, but mortality worsened, the net result being 53% more mortality in the national forests than other forests.

If 1980 and 1987 data are used as time series data points, timber volume per acre was significantly greater on the national forests (t=33.7, p=0.02) and so was the rate of tree mortality (% of gross growth, t=15.0, p=0.04).

Is the relationship of tree growth and mortality a good measure of forest ecosystem health? Consider that three of the four dictionary definitions of health apply to the general condition of the human body and mind. The fourth definition of health is simply vigor or vitality. One definition of vigor is "growth ... as a plant." Trees in Idaho's national forests are perhaps as vigorous as in other forests (13% less growth per acre in 1980 and 3% more in 1987). Among other definitions, vitality means "power to live" (American College Dictionary, Random House). Trees in Idaho's national forests have less vitality than in other forests (38% more mortality per acre in 1980 and 56% more mortality in 1987). In Idaho, national forests are therefore not as healthy as other forests.

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgartner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.

> The direct use of wildlife as indicators of ecosystem health is difficult because of the diversity of wildlife species, their different habitat requirements, and lack of sufficient knowledge about these requirements.

Perhaps the most frequent criticism of the Policy Analysis Group's approach to forest health is that the focus of the analysis is on trees. The author makes no apologies for that. Trees are the defining characteristic or component of forest ecosystems. But that is not to say they are the most important component. It is a value judgment by the author to say that stands of trees suffering growth decline and uncharacteristically high mortality rates constitute unhealthy forests. A woodpecker would feel otherwise!

Reaction of Citizen Conservationists

A number of comments questioning the utility and validity of the forest health concept have surfaced in the literature (see O'Laughlin et al. 1993). These concerns are summarized by journalist Larry Swisher's (1992) statement: "*Forest health* has become a buzzword among timber state lawmakers, but the sound grates on the ears of environmentalists like a chain saw." When the forest health issue is reduced to salvage logging, as it sometimes has been, a negative reaction is perhaps to be expected. Timber salvage is only a small part of forest health, characterized by Filip and Schmitt (1990) as a band-aid approach. Sometimes surgery may be needed instead.

Some people believe that if you leave the forest alone it will heal itself. Hargrove (1992) called this idea "therapeutic nihilism" in an ecosystem health context, an idea from the earliest days of western medical science when the cure prescribed by physicians was sometimes worse than the disease.

This author has not had many opportunities to discuss forest health issues with citizen conservationists. Because an obvious solution to forest health problems in Idaho and throughout the Inland West involves more intensive management of public forests, it is understandable that environmentalists are wary about embracing the concept of forest health.

This author is of the opinion that everyone desires healthy forests. A healthy condition is more likely to sustain forests than is an unhealthy one. In response to this presentation at the Spokane symposium, Rick Brown, a spokesman for the National Wildlife Federation in Portland, Oregon, agreed that forest health is a useful concept for communicating forest management concerns. The fundamental problem with the forest health concept today seems to be the lack of agreement on appropriate ways to measure forest ecosystem health.

CONCLUSION

Data indicate that in Idaho, overly dense forests can be a problem. Aldo Leopold (1949b) said, "The irruption of [plant and animal species] as pests despite efforts to control them must, in the absence of simpler explanations, be regarded as symptoms of sickness in the land organism." Fire suppression has led to an irruption of trees in Idaho's national forests, and unhealthy conditions as a result.

Covington and Moore (1994) documented modern changes in northern Arizona forest ecosystems, including increased stand density, timber volume and fuel loading, accompanied by reduced herbage production, stream flow and scenic beauty. They said, "To restore the forests to more natural conditions, it may be necessary to thin many trees, remove heavy fuels and reintroduce periodic burning." Furthermore, they pointed out in their conclusion the irony that "many individuals who now recognize the harmful effects of irruptions of dominant wildlife species in the absence of predators find it difficult to see the analogy of tree irruptions in the absence of fire." The common denominator in forest conditions from Arizona to Idaho is absence of fire.

Many people apparently feel that because ecosystems are complex and we don't completely understand how ecosystems work, we should leave them alone. Virtually every speaker at the Spokane symposium used the word complexity to describe forest ecosystems and ecosystem management concerns. This author also invoked complexity, but took a different approach and cited the poetry of Ross Whaley (1993):

> The more complex the issue,
> The more immature the science which tries to
> understand it,
> The more that my understanding is tied to the manipulative powers of interest groups,
> The more difficult to resolve the issue.

The value of the forest health concept is to relate complex ecological and managerial issues to something people can understand. Forest health has so far served as a useful catalyst, causing resource managers, researchers, policy-makers, and the public to take a critical look at past management practices and their results. Ecosystem processes that were not previously considered now are beginning to drive strategies and policies for correcting these oversights.

In the end, the beginning of the solution to forest health problems is to channel the multidisciplinary interests now evidently concerned about forest health into an interdisciplinary approach. A suggested first task is seeking agreement on measurement methods and standards for identifying ecosystem health problems. That will help the concept of forest health become more useful as a communication device.

ACKNOWLEDGEMENTS

Thanks to Dr. James G. MacCracken for comments on this paper and the statistical analysis in the Reactions section. The five other co-authors and twelve reviewers of the Forest Health Conditions in Idaho report must be acknowledged for making this presentation possible. Thanks also to the hundreds of people in more than a dozen audiences who listened carefully enough to ask the author challenging questions.

This paper is published as contribution number 725, Idaho Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID 83844-1131.

> The direct use of wildlife as indicators of ecosystem health is difficult because of the diversity of wildlife species, their different habitat requirements, and lack of sufficient knowledge about these requirements.

Perhaps the most frequent criticism of the Policy Analysis Group's approach to forest health is that the focus of the analysis is on trees. The author makes no apologies for that. Trees are the defining characteristic or component of forest ecosystems. But that is not to say they are the most important component. It is a value judgment by the author to say that stands of trees suffering growth decline and uncharacteristically high mortality rates constitute unhealthy forests. A woodpecker would feel otherwise!

Reaction of Citizen Conservationists

A number of comments questioning the utility and validity of the forest health concept have surfaced in the literature (see O'Laughlin et al. 1993). These concerns are summarized by journalist Larry Swisher's (1992) statement: "*Forest health* has become a buzzword among timber state lawmakers, but the sound grates on the ears of environmentalists like a chain saw." When the forest health issue is reduced to salvage logging, as it sometimes has been, a negative reaction is perhaps to be expected. Timber salvage is only a small part of forest health, characterized by Filip and Schmitt (1990) as a band-aid approach. Sometimes surgery may be needed instead.

Some people believe that if you leave the forest alone it will heal itself. Hargrove (1992) called this idea "therapeutic nihilism" in an ecosystem health context, an idea from the earliest days of western medical science when the cure prescribed by physicians was sometimes worse than the disease.

This author has not had many opportunities to discuss forest health issues with citizen conservationists. Because an obvious solution to forest health problems in Idaho and throughout the Inland West involves more intensive management of public forests, it is understandable that environmentalists are wary about embracing the concept of forest health.

This author is of the opinion that everyone desires healthy forests. A healthy condition is more likely to sustain forests than is an unhealthy one. In response to this presentation at the Spokane symposium, Rick Brown, a spokesman for the National Wildlife Federation in Portland, Oregon, agreed that forest health is a useful concept for communicating forest management concerns. The fundamental problem with the forest health concept today seems to be the lack of agreement on appropriate ways to measure forest ecosystem health.

CONCLUSION

Data indicate that in Idaho, overly dense forests can be a problem. Aldo Leopold (1949b) said, "The irruption of [plant and animal species] as pests despite efforts to control them must, in the absence of simpler explanations, be regarded as symptoms of sickness in the land organism." Fire suppression has led to an irruption of trees in Idaho's national forests, and unhealthy conditions as a result.

Covington and Moore (1994) documented modern changes in northern Arizona forest ecosystems, including increased stand density, timber volume and fuel loading, accompanied by reduced herbage production, stream flow and scenic beauty. They said, "To restore the forests to more natural conditions, it may be necessary to thin many trees, remove heavy fuels and reintroduce periodic burning." Furthermore, they pointed out in their conclusion the irony that "many individuals who now recognize the harmful effects of irruptions of dominant wildlife species in the absence of predators find it difficult to see the analogy of tree irruptions in the absence of fire." The common denominator in forest conditions from Arizona to Idaho is absence of fire.

Many people apparently feel that because ecosystems are complex and we don't completely understand how ecosystems work, we should leave them alone. Virtually every speaker at the Spokane symposium used the word complexity to describe forest ecosystems and ecosystem management concerns. This author also invoked complexity, but took a different approach and cited the poetry of Ross Whaley (1993):

> The more complex the issue,
> The more immature the science which tries to understand it,
> The more that my understanding is tied to the manipulative powers of interest groups,
> The more difficult to resolve the issue.

The value of the forest health concept is to relate complex ecological and managerial issues to something people can understand. Forest health has so far served as a useful catalyst, causing resource managers, researchers, policy-makers, and the public to take a critical look at past management practices and their results. Ecosystem processes that were not previously considered now are beginning to drive strategies and policies for correcting these oversights.

In the end, the beginning of the solution to forest health problems is to channel the multidisciplinary interests now evidently concerned about forest health into an interdisciplinary approach. A suggested first task is seeking agreement on measurement methods and standards for identifying ecosystem health problems. That will help the concept of forest health become more useful as a communication device.

ACKNOWLEDGEMENTS

Thanks to Dr. James G. MacCracken for comments on this paper and the statistical analysis in the Reactions section. The five other co-authors and twelve reviewers of the Forest Health Conditions in Idaho report must be acknowledged for making this presentation possible. Thanks also to the hundreds of people in more than a dozen audiences who listened carefully enough to ask the author challenging questions.

This paper is published as contribution number 725, Idaho Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID 83844-1131.

Smith, W. H. 1990. The health of North American forests: stress and risk assessment. J. Forest. 88(1): 32-35.

Sonner, S. 1992. Congressional report study: padded figures pushed timber quotas above capacity. *Lewiston Morning Tribune*, Lewiston, ID, June 16, p. 1A.

Stage, A. R. 1973. Prognosis Model for Stand Development. USDA Forest Service Res. Paper INT-137, Ogden, UT.

Stage, A. R., C. G. Shaw, M. A. Marsden, et al. 1990. User's Manual for the Western Root Disease Model. USDA Forest Service Gen. Tech. Rep. INT-267, Ogden, UT.

Swisher, L. 1992. Commentary: lawmakers debate "forest health." *Lewiston Morning Tribune*, Lewiston, ID. (August 24): 5A.

USDA Forest Service, various. National resource assessment publications:

1958. Timber Resources for America's Future. Forest Resource Rep. 14, Washington, D.C. 713p p.

1965. Timber Trends in the United States. Forest Resource Rep. 17, Washington, D.C. 235 pp.

1973. The Outlook for Timber in the United States. Forest Resource Rep. 20, Washington, D.C. 367 pp.

1982. An Analysis of the Timber Situation in the United States: 1952-2030. Forest Resource Rep. 23, Washington, D.C. 499 pp.

1989. Forest Statistics of the United States, 1987. Resource Bulletin PNW-RB-168, Portland, OR. 106 pp. (usually cited as Waddell et al. 1989).

USDA Forest Service. 1988. Forest Health Through Silviculture and Integrated Pest Management: A Strategic Plan. Unnumbered publication, Washington, D.C. 26 pp.

USDA Forest Service. 1991. Blue Mountains Forest Health Report: "New Perspectives in Forest Health." Unnumbered publication, Pacific Northwest Region, Portland, OR.

USDA Forest Service. 1992. National plan: Forest Pest Management and associated State component, National Forest Health Monitoring Program. USDA Forest Service mimeo, Washington, D.C. 14 pp.

USDA Forest Service. 1993. Healthy Forests for America's Future: A Strategic Plan. MP-1513, Washington, D.C. 58 p p.

Waddell, K. 1992. Forest Statistics of the Western States, 1987. USDA Forest Service unnumbered report, compiled for the Western States Legislative Forestry Task Force, Pacific Northwest Research Station, Portland, OR. 51 pp.

Waddell, K., D. D. Oswald, and D. S. Powell. 1989. Forest Statistics of the United States, 1987. USDA Forest Service Resource Bull. PNW-RB-168, Portland, OR. 106 pp.

Waring, R. H. 1980. Vital signs of forest ecosystems. *In:* Forests: Fresh Perspectives from Ecosystem Analysis. Proceedings, 40th annual biology colloquium, R. H. Waring (ed.). Oregon State Univ. Press, Corvallis, OR. Pp. 131-136.

Whaley, R. 1993. Remarks on the Pinchot Institute for Conservation. *The Conservation Legacy*, Newsletter of the Pinchot Institute for Conservation, Milford, PA. Issue 33: 10-11.

Wilson, M. J. and D. D. Van Hooser. 1993. Forest Statistics for Land Outside National Forests in Northern Idaho, 1991. USDA Forest Service Resource Bull. INT-80, Ogden,UT. 58 pp.

Wykoff, W. R., N. L. Crookston, and A. R. Stage. 1982. User's Guide to the Stand Prognosis Model. USDA Forest Service Gen. Tech. Rep. INT-133, Ogden, UT.

Author

Jay O'Laughlin
Director, Policy Analysis Group
Adjunct Professor, Dept. of Forest Resources
Adjunct Professor, Dept. of Forest Products
College of Forestry, Wildlife and Range Sciences
University of Idaho
Moscow, ID 83844-1134

Published in proceedings of "Ecosystem Management in Western Interior Forests" held May 3-5, 1994, Spokane, WA, USA.
Compiled and edited by Richard L Everett and David M. Baumgártner, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0228. 245 pp.