New Approaches to Forest Management

Background, science issues, and research agenda

This first of two parts examines the scientific, management, and social factors that have contributed to the need for rethinking some basic precepts of forest management. The second part will outline a framework for research and suggest some directions and approaches that must be more fully developed by scientists from many disciplines.—Ed.

Part One of Two Parts

Forestry appears to be in the midst of a revolution. Literature describing the changing perceptions of forest scientists and changing practices of forest managers is burgeoning, and little is in traditional, peer-reviewed journals. Much of the interesting literature is not in journals at all. The USDA Forest Service has begun a national New Perspectives for Management of the National Forest System, and federal, state, and private land managers are establishing areas demonstrating "New Forestry." The flurry of activity around forest management issues certainly suggests that something is happening.

But whether these new approaches represent genuinely new thinking about forest management is not clear. What are these new perspectives, and what is new about New Forestry? No clear consensus exists as yet among scientists or natural resource managers about what these terms mean, or about what exactly is new. For such a consensus to evolve requires clear definition of the issues faced by forest management in the 1990s.

Social and Political Context

Public perceptions, public debate, and public policy have been shaped since the early 20th century by observations of unintended and irreversible human impact on the global environment and the need to control the type and scale of human activity In many ways, the essential components of emerging issues in forestry are neither unique nor new; similar concerns are reflected in debates over agricultural policy, agricultural science, and, viewed more broadly, in energy, industrial, and environmental policy. Neither are these concerns new; intensified debates about forest management on public land in the western United States coincide with the 20th anniversary of Earth Day—an expression of popular awareness of the impact of humans on the environment.

Two factors dominate the social changes that challenge forest management. First is the increased recognition that growth in both population and resource use is reaching—or exceeding—rates that can be maintained without degrading natural systems. Although no consensus has been reached about specific limits to human exploitation of natural systems, few deny these limits exist.

At the same time, however, the list of commodities and services people want (or expect) from natural systems, and perhaps especially from forests, gets longer. In addition to traditional forest-based commodities (timber, water, wildlife, forage), society increasingly values forests for such things as age, absence of human disturbance, biological diversity, and their role in regulating and mitigating climate change. Many of these newly emphasized values depend on an intact forest rather than on products, such as timber, that can be removed. It is important to recognize that these "new" emphases are, at their core, still utilitarian and therefore in keeping with the traditions of forest management. But forest managers are understandably frustrated by the challenge of balancing and satisfying these diverse and often mutually exclusive expectations.

Forestry Context

Forest management science has always relied on an understanding of forest ecosystems. But the nature and depth of this traditional understanding of ecological processes, and the uses to which it is applied, are being critically examined.

From the turn of the century through the late 1960s, forestry in the United States was largely directed towards relatively simple, utilitarian goals—primarily the production of wood fiber. Most timber managers have practiced some form of "scientific forestry"—applying the tools of modern crop science (genetics, fertilizers, pesticides, pruning, thinning, prescribed fire, replanting) to produce rapidly growing, healthy stands of commercially valuable trees, often as monocultures. Managers determined desirable amounts of growing stock, the best time for harvesting, and whether to control forest stand or tree characteristics or to capture mortality before final harvest. Forest science and management tried to establish the response of single trees and groups of trees to various management actions. Some forests—mostly public—were managed for purposes other than timber production, but often only to the degree that these goals did not

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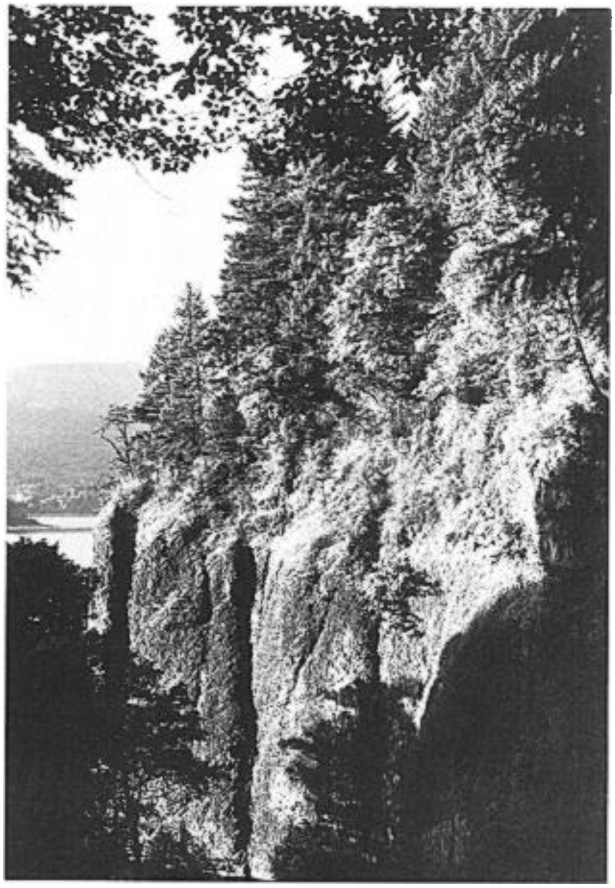
Zane Cornett

The effects of forest management need to be evaluated over a range of spatial and time scales.

conflict with the primary goal of timber production.

The rise of the environmental movement in the late 1960s and early 1970s, and the dramatic increase in recreational use of forests, presaged a growing concern with managing forests for purposes other than timber production. The National Forest Management Act of 1976 (NFMA) reinforced this view by mandating that managers of national forests analyze the impact of forest planning decisions on all forest resources, not just timber. The response of land managers has been to develop a lexicon of "outputs" and to define the value of nontimber forest resources in relation to commodity outputs forgone. In national forest plans, for example, alternatives are generally described as trade-offs among outputs such as board-feet, user-days of recreation, pairs of pileated woodpeckers, and tons of sediment. Predictably, applying these approaches and tools divides the forest into special use areas such as wilderness, wildlife habitat, and riparian buffers within a framework of land managed for timber production.

Inducements to Change

Perhaps the first major impetus to reexamine some of the basic tenets of forestry, and also perhaps the origins of the approaches we now label new, occurred in the mid-1980s. It began with the recognition that certain types of problems were not being addressed by segmented, pattern-insensitive approaches to forest management.

Some issues are strongly influenced by the actual pattern of managed forest stands: the viability of certain wildlife species; loss of general ecosystem diversity (species as well as physical or ecological characteristics); effects on watersheds (emphasizing connective movement of water, sediment, wood, and energy); susceptibility and response to pathogens, insects, and natural disturbances; and potential forest decline or change from slowly developing factors such as atmospheric pollution and climate change (see Forman and Godron 1981, Harris 1984, Franklin and Forman 1987, Hanson et al. 1990, Swanson et al. 1990).

Many of these problems only became apparent as forests were increasingly fragmented by widely dispersed logging and associated activities. Dispersed harvesting was itself a response to the negative impact on forest ecosystems of extensive, contiguous harvest blocks. The identification of such problems, direct consequences of effects cumulating over decades, reflected advances in understanding forest ecosystems. The scope and pace of timber harvesting in the Pacific Northwest—the focus if not the origin of many of these issues—is probably no more extensive or rapid than that in other regions in other eras. What is different in the Pacific Northwest is that harvesting effects have coincided with public and scientific recognition of forests as the source of things other than timber. These issues can only be addressed by explicitly recognizing the importance of forest pattern at a spatial scale larger than is typical of forest management.

A second impetus for new approaches to forest management comes as forest ecologists recognize the complex interactions in forests, and the importance of biological and physical diversity in maintaining healthy forest ecosystems. Recent studies document the importance of key attributes of natural forests. Woody debris, in all forms, perform multiple functions; "legacies" from previous stands maintain site productivity and regenerative capabilities; and complex interactions among organisms (such as rodents and spiders) and among tree species maintain site productivity and resilience in response to infestation or disease (Maser et al. 1988, Franklin 1989, Franklin et al. 1990, Swanson and Sparks 1990). New information has contributed to decreased support for traditional forest practices in the Pacific Northwest such as complete clearcutting, burning all residual material, removing woody debris from streams, and planting single species. More important, these results of forest science recognize the importance of considering conditions over multiple rotations, and have fostered a sense of humility about our current understanding of ecosystem dynamics.

A third inducement to develop new approaches has been the advent of computer-based technologies suitable for handling multiple resource problems over large spatial and time scales. Advances in geographic information systems, for example, have dramatically increased the capacity of resource managers and researchers to manipulate, model, and monitor representations of forest landscapes. This ability to inventory the spatial distribution of multiple forest resources and attributes over an entire landscape has changed the scope of questions that can be asked. Questions having to do with forest pattern are now not just relevant; now they are also approachable.

Political Climate

Social and political factors have also

motivated change. Prolonged and acrimonious public debate among forest users—the public, organized interest groups, forest managers, and scientists—underscores conflicting values and changing expectations for forest resources (Daniels 1987, Behan 1990). These conflicts are revealed in discussions about whether to harvest old-growth forests, whether (or how) to preserve species of plants and animals, and the role of forests in regulating or mitigating global climate change. The increasingly polarized prescriptions of special interest groups have paralyzed the political process. These debates also suggest that interested parties are no longer willing to let a narrowly trained group of experts (forest managers, planners, and scientists) prescribe forest practices in isolation. In this polarized environment, the concepts of New Forestry are appealing because they seem to embrace ecological values without rejecting commodity production.

Changes in federal land management agencies, most notably the USDA Forest Service, also promote a new agenda. Widespread dissension within the agency over appropriate objectives and priorities parallels the contentious public debate. Low agency morale, in large part because of employees' sense of being caught in the middle of a no-win debate, contributes to a willingness to seek alternatives to current policies and practices. The creation and growth of organizations such as the Association of Forest Service Employees for Environmental Ethics suggests both discontent and a willingness by managers to act.

The Role of Science

Along with management changes, a fundamental shift is also taking place in the role of forest scientists. This discipline has traditionally offered managers tools to control systems; the practice of this science depended on thorough, controlled experiments and effective transfer of proven techniques to forest managers. Scientists must now identify uncertainties and point out the complexities of systems. This science must be conducted within limited time frames, with limits to certainty, and in the presence of contentious debate.

Changes in the burden of proof and standards of evidence for decision-making may be more significant than the change in focus (i.e., away from timber production). Current management policies and practices have ecological, economic, and social consequences that benefit some and harm others. Increasingly, advocates of intensive forestry must prove these practices are benign, while in the past critics were forced to prove them harmful (to wildlife, for example). In addition, confusion among members of the public and conflict within the scientific community frequently arise from the use of different standards for gathering, evaluating, and drawing conclusions from data. Determining who sets the standards and who must meet these standards is as important to the outcome as is the nature of scientific hypotheses. A further complication is differing opinions on the type and distribution of risks that are seen as acceptable.

Management Precepts

The issues discussed here require broad changes in the philosophy of forest management, not merely a particular set of prescriptions. The new approach is developing from a set of hypotheses about how natural systems operate and appropriate human use of forested ecosystems. Testing some of these hypotheses, in the strict scientific sense, may be difficult or impossible because they may more properly be viewed as premises, assumptions, or statements of value. Distinguishing those assumptions that can be tested and determining how to test them are major challenges to the science community.

Several significant tenets or guiding principles underlie these issues:

1. Forest management decisions must be based on an ecosystem perspective. In this view, forests are composed of organisms hierarchically organized into functional groups, linked through complex processes to their physical environment and to each other. An ecosystem perspective recognizes the need to design practices that are sensitive to the balance among various components of the forest This is not a matter of managing ecosystems for their own sake, but recognizing the context within which objectives can be pursued. Management decisions must also take into account uncertainty about our understanding of the system and about future conditions.

2. The effects of forest management need to be evaluated over a range of spatial scales. Properties at a variety of scales (microsite, forest stand, watershed, landscape, and region) influence ecosystem response; these properties must be considered when examining the effects of human activities or natural disturbances The threat to the spotted owl population is an example of what happens when spatial scale is not considered; landscape fragmentation over a large area over time conflicts directly with the habitat requirements of this species.

3. The effects of these decisions must be evaluated using ecologically relevant time scales. As with spatial scale, extending the time scale over which effects of forest management are considered causes new issues to emerge—questions about long-term site productivity, resilience of forest ecosystems in the face of changing climate or other disturbances, and the long-term viability of populations. These time frames might include the period of vegetative succession, cycles of major and minor disturbances, and the life cycle of dominant ecosystem components and organisms. The cumulative effects of policies and practices must be assessed at a scale of space and time consistent with a fully developed forest ecosystem; this

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period extends well beyond typical planning horizons, even those of public agencies.

4. Future options must be maintained. Because of unresolved societal debates about the role of the forest, uncertainty about future climates, and lack of understanding about basic ecosystem processes, the wisest approach to forest management is to avoid foreclosing future opportunities by hasty and irreversible decisions. Instead, decisions must maintain as many future options as possible. Making sound choices requires consideration of how present actions will affect future forest pattern, species composition, susceptibility to a wide range of disturbances, and present and future economic opportunities.

5. The full range of forest users must be encouraged to participate actively as equal partners in forest planning decisions. Clearly, the current polarized climate hinders reaching workable compromises and clear directions for forest management. Full participation by all those affected requires developing creative and sincere partnerships among forest users, including commercial interests, environmentalists, recreationists, and scientists. Such participation is essential in reaching agreement on management objectives, in evaluating the consequences of specific practices, and in making difficult choices when values conflict or resources cannot satisfy all users.

Conclusions

We reject the notion that the changes and troubles faced by forest managers have emerged only recently and are the product of an unappreciative public stimulated by "radical environmentalists." Rather, forest managers must recognize that the findings of forestry science, cumulated over 20 to 40 years—and closely associated with results in other areas of science—are forcing us to rethink our approaches to management.

Forest managers are not alone in needing to reexamine and rethink the way that they approach the forest. Next month we will outline a framework for research that takes these developments into account ■

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