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### Recommended Citation

McCool, SF. 2001. Quaking aspen and the human experience: dimensions, issues, and challenges. WD Shepperd et al (compilers). Sustaining Aspen in Western Landscapes: Symposium Proceedings. Proceedings RMRS-P-18. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins, CO.

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# Quaking Aspen and the Human Experience: Dimensions, Issues, and Challenges

Stephen F. McCool<sup>1</sup>

**Abstract**—Humans assign four types of meanings to aspen landscapes: (1) instrumental meanings dealing with the attainment of a goal—such as production of pulp or provision of recreation opportunities; (2) aesthetic meanings; (3) cultural/symbolic meanings dealing with spiritual and social attachments to landscapes; and (4) individual/expressive meanings derived out of interactions with aspen landscapes at the personal level. The amount of knowledge available for each meaning varies, with most knowledge developed for instrumental meanings. Management of aspen occurs within a dynamic social and political context, with greater emphasis being placed on the latter two meanings, but without the empirical, positivist basis to support actions. Therefore, a change in the planning paradigm used to develop decisions is needed.

I wonder about the trees.  
Why do we wish to bear  
Forever the noise of these  
More than another noise  
So close to our Dwelling place?

*Robert Frost, The Sound of the Trees*

## Introduction

While the hike had been long, it had not been that arduous. The North Fork of the Sun River with its large meadows and hilly eastern skyline provided the beauty that overshadowed distance as the hikers moved toward their favorite campsite. It was a crisp and sparkling September day, the mountains were brilliant, with abundant herds of elk moving through the clones of yellowing aspen. A slight breeze fluttered the leaves, as if nature had to inform the hikers of the source of the aspen's scientific and common name. It was the time of the fall that the clones could be distinguished by variations in leaf color, and the view from a distance could only be termed magnificent. In a sense, the aspens here represented the oncoming of fall, the predecessor to those long Montana winters. Seeing the turning of colors provided some reassurance that nature was alive, dynamic, and aesthetic; yet as the hikers recollected previous winters, they remembered aspen as a kind of warning sign of what would be coming in very short order.

Their camp was not far from an aspen clone across the river, and it seemed to amplify and reflect the golden rays of the setting sun back to them. Bugling elk complemented the aspen as the hikers ate their dinner, suggesting not only a sense of remoteness, but also an impression of tranquility. Aspen, their color and trembling leaves, promoted a feeling of peacefulness, one that was consistent with a wilderness experience, one that was not only uplifting, but encouraging as well, and one that stimulated thought and introspection.

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As experienced hikers, they knew there was more to aspen than its use as pulp; it was not only essential to their experience, but as wildlife habitat as well. They felt that aspen must have played an important, if symbolic, role in Native American relationships with the land.

They understood that there were problems in the reproduction of aspen, and they felt that some type of action was needed. Their discussion around the campfire that night led them to a number of questions, most without easy answers. How is the condition of aspen related to larger scale biophysical processes? What factors are leading to declines in aspen stands, and how can managers influence them? How do these declines relate to the broad range of landscape values associated with aspen? How are these important values protected in a restoration strategy? What is the range of values? How are they mapped and measured? How do they differ in various regions of the mountains? What restoration practices are appropriate and where? Do land management agencies have the capacity to conduct comprehensive analyses of the values potentially compromised before restoration occurs? How adequate is the science supporting calls for more active management and restoration of aspen in the West?

The hikers knew that restoration of a system that has been damaged is a long-term process. Will the institutional and political systems that govern restoration practice tolerate experiments for which there may be few results in the short term? Will the biologists that design restoration initiatives be around in a decade or so to see what transpired? Will they establish monitoring programs that will demonstrate whether the restoration was successful?

These are profound questions—among many others—for today's land managers. They exist within a context of changing land management paradigms, decreased institutional capacity for management, a paradoxical increase in calls for both scientifically based decisions and public participation in them, and an increased demand for a widening array of goods and services from the nation's public lands.

Management of aspen could only be described as a messy problem—a situation where goals are vague (at best) or contested (at worst) and where our understanding of cause-effect relationships is incomplete. Human interactions with aspen—and the meanings that result from them—exist within and involve this dynamic context and are the subject of this paper. More specifically, this paper has three principal objectives. First, using a framework based on human-environment transactions and landscape meanings, I will present a classification of human dimensions of aspen. This discussion will help establish a foundation for understanding that there are multiple such dimensions that are often not subject to classical positivistic appraisal, yet fundamental to understanding the social benefits of aspen. Second, I will briefly examine some of the institutional issues associated with aspen management. This context is a vital component of management; how it is structured and how it operates influence management decisions. Finally, I review some of the challenges associated with management of aspen that arise in the social domain. This argument suggests that management and restoration practices based on limited, narrow definitions of the “aspen problem” incompletely specify the costs and benefits of aspen in the Western landscape and potentially marginalize the participation of important segments of the population in developing and implementing restoration practices.

## Charting the Human Dimensions of Aspen in the Western Landscape

Aspen is a ubiquitous, highly visible attribute of the Rocky Mountain landscape. Understanding the human dimensions of aspen, as defined by people, is a vital component of any strategy to manage it. While aspen has important and well-known instrumental and aesthetic values, there may be others as well. In this section, I will present a framework based on the notions of environmental transaction and place meanings that suggest what those dimensions may be. I begin first with a general description of the framework and then move to a more specific discussion of how it applies to quaking aspen.

Human dimensions may be perceived as a set of meanings people place on the environment and its attributes. These meanings derive from the types of transactions between people and the environment that occur (Ittelson 1973). Meanings are influenced not only by the specific physical attributes of aspen, but also by the larger biophysical and cultural contexts, managerial settings in which they occur, and by the individual viewer's background characteristics (Ittelson 1973).

In the case of aspen, these transactions involve visual perception—the stem and leaf color and texture, stem density, clumpiness of clones, and the shimmering of leaves trembling in a breeze. Such transactions also include the sounds of leaves quaking in the breeze. These characteristics combine to provide a special sense of place as articulated in this comment by a naturalist in Montana: “There may be no finer place than an aspen grove in the fall,” according to Ellen Horowitz. “Once you learn the sound of the aspens,” she says, “you can go into the woods and close your eyes and be able to pick out the voices of the trees. Aspen groves are special places” (quoted by Jamison 1999).

At close distances, the special character of aspen clones, in terms of the density, size, color, and shape of individual sprouts within a forest context, help form meanings and expectations. This series of transactions occurs over time in a variety of settings, and over time people learn from these transactions. This learning leads to the sight of aspen symbolically representing certain specific meanings to an individual as well as a group. These meanings may vary spatially and temporally.

These meanings can be described by characteristics such as their tangibility, commonality, and emotionality (Fournier 1991). Tangibility refers to whether the meaning can be assessed objectively, measured according to some independent scale, or whether the meaning is held within the mind of the viewer. Thus, the cloning of aspen, and their distinction, particularly in early fall or spring, is a highly tangible characteristic. Commonality is a characteristic that indicates the extent to which a meaning is widely shared or, conversely, unique to an individual. The aesthetic value of aspen in the fall is not only tangible, but widely shared among many Americans. Emotionality refers to arousal or depth of attachment. A rural farm or home in the West may have an excellent view of a particular aspen clone. The family within that home may find itself deeply bonded to it.

Variations in such characteristics lead to spaces becoming places—spaces with social definitions. The meanings attached to places may be classified according to a typology put forth by Williams and Patterson (1999). They

suggest four types of meanings: (1) instrumental; (2) aesthetic; (3) cultural/symbolic; and (4) individual/expressive. Instrumental definitions develop out of an environmental attribute's ability to promote a specific behavioral or economic objective. Environmental attributes "become" resources because of their utility for economic and production systems. The meanings here are tangible and widely held, yet they normally do not carry much emotional significance. Because of their relevance to the material needs of society, the mechanisms for measuring and understanding these definitions are well developed and fit nicely into scientific-based, expert-driven models of decisionmaking.

Aesthetic meanings reflect an emotional, somewhat tangible interpretation of the environment as scenic or beautiful. Interpretations of selected environmental settings as scenic, beautiful, or inspirational are widely held and often form the basis for much of the tourism industry, particularly in the Western United States and Canada. Such meanings are frequently expressed in artistic impressions—primarily through paintings and photography but also in poetry such as that of Robert Frost—of the environment. Systems for measuring and mapping aesthetic attractiveness and managing scenic beauty have been developed over the last 30 years and are integrated into federal public land management planning processes (Litton 1979; USDA Forest Service 1995).

Cultural/symbolic meanings attached to landscapes derive from transactions with landscapes at a group level. While these meanings may result from a significant cultural event—such as a battle or the birthplace of an important individual—they may derive from beliefs about the natural world, how it operates, and its influence over human life. Mythologies may be associated with specific biophysical characteristics or a unique site, such as Devil's Tower in Wyoming. Such meanings are not necessarily tangible, but are shared among individuals within a specific family, clan, tribe, community, or society. For example, Devil's Tower National Monument was established because it represents an outstanding and unique geological formation, clearly a meaning that is instrumental at its foundation. Early Western visitors often climbed to the top, beginning a tradition that has lasted over 75 years. Defining Devil's Tower as a place to climb represents an instrumental meaning. Yet, such climbers—and the managing agency—were unaware that to Native American tribes of the northern Great Plains, Devil's Tower represents an important environmental feature that is spiritually significant to those tribes. These two meanings came into conflict as Native Americans voiced their values and preferences and attempted to restore long-held spiritual practices at the monument, compelling the National Park Service to attempt to reduce climbing near the time of the summer solstice, and leading to a new management regime.

Cultural/symbolic meanings are emotionally arousing; Williams and Patterson (1999, page 148) state, "...emotion is a relatively enduring affection for a place built up through a history of experiences in the place. In this case, the emotion is not the result of any particular experience of the place, but involves some level of emotional investment in the place built up over time."

The move to ecosystem-based management has generally led to recognition that ecosystems provide a wider range of goods and services than the commodity-based, multiple-use approach of the past. The recognition that cultural/symbolic values exist is an important component of this new approach, but also one that is not easily linked to specific, spatially identifiable characteristics of landscapes. These meanings cannot be easily measured in the same sense as board feet of timber.

Individual/expressive meanings also derive from a socially constructed view of environmental values, but at the individual level. Such meanings are highly intangible, not shared—except perhaps within a family—and strongly emotional in character. To many people, landscapes help provide their sense of identity. Williams and Patterson (1999, page 148) suggest that such meanings attached to landscapes “help communicate...who we are.” A favorite campsite located along a bubbling stream that has been the location for family reunions is an example of a place defined by individual/expressive mechanisms. A particular place evokes memories, recollections, and events that are specific to an individual. Because such meanings are expressive at the individual level, and thus idiosyncratic, they cannot be linked to spatially identifiable landscape characteristics.

This framework provides a policy-relevant approach to understanding human dimensions of aspen and its management. Enhancing our understanding of meanings can not only reduce conflict about how to manage places where aspen occurs, but also better understand the consequences of various management strategies and suggest ways in which meanings can be protected and enhanced. Unfortunately, the literature about the social meanings of quaking aspen is not only diminutive but varies considerably from category to category, so what follows may be more speculative and tentative than grounded in formalized research and technical analysis. Nevertheless, the discussion indicates that there is much we need to know about aspen before we make irreparable decisions about its management.

Instrumental meanings, such as the value of aspen for pulp, flakeboard, and furniture, tend to be tangible and widely shared, particularly in the north-central region of the United States. Aspen meanings, in fact, are usually defined and measured in purely instrumental terms. For example, Einspahr and Wyckoff (1990) define the “aspen wood resource” in such terms as cords per acre and billion cubic feet of volume. When discussing utilization, they refer solely to manufacturing wood products and pulp. They conclude that “Only a minor amount of the aspen resource in the western United States is being utilized” (page 169), when in fact, much of it is the source of noninstrumental utilization and meaning.

Aspen sometimes served as a source of medicine for Native Americans (Willard 1992). Preparations made from bark were often oriented toward relief of symptoms from fever, rheumatism, arthritis, colds, and other indications. Recreationists frequently camp in public campgrounds located within aspen clones; but the actual significance and preference for aspen-dependent experiences is not known.

Emerging instrumental meanings of aspen concern its utility for wildlife and the role of fire in maintaining the presence of aspen in the landscape; yet these meanings may be held only by a small group of scientists, with little emotional attachment to specific places containing aspen clones. Little is known about recreation as an instrumental meaning of aspen. Ways of measuring and mapping instrumental meanings of aspen are well developed in the literature and practice.

Aesthetic meanings of aspen are commonly held, relatively tangible, and probably evoke a moderate level of emotionality or attachment. Its visual appearance, clumpy distribution, and contrast with surrounding vegetation make aspen landscapes not only distinctive, but visually attractive, particularly during the autumn when colors of aspen clones differ from the surrounding

landscape. Such values of aspen are frequently displayed in artistic photography, such as that by Ansel Adams. Adams was a master of understanding landscapes, of interpreting the aesthetic meaning of combinations of mountains and trees, water and ice, clouds and sky, sun and shadow. He was equally a master of the technical process of manipulating and displaying such images in print. Equipped with both skills, he captured these forms and patterns like no other on black and white film. His attention, while frequently focused on the mountains and forests of the Sierra Nevada, occasionally turned to other subjects and locations. For example, his image “Aspens, Northern New Mexico” emphasizes the pattern and form of aspen stems in the immediate foreground, bringing out in rich detail and contrast their aesthetic value. While Adams used black and white photography, a variety of others have attempted to capture aesthetics of aspen, particularly in two books by Colorado photographer John Fielder (*Colorado: Images of the Alpine Landscape* and *Colorado Aspens*). Fielder captured through color the full dimension of aspen aesthetics, less interpretive than Adams’ approach, but just as dramatic.

The landscape dominance elements of form, line, color, and texture (Litton 1979; USDA Forest Service 1974) can be used to describe these aspen stands and may serve as the foundation for actions that reduce the visual intrusiveness of management. The aspen landscape occurs in a variety of forms: small independent clumps, a series of different clones juxtaposed, large portions of mountains covered with aspen, and a linear form found along streams of the Rocky Mountain Front in northern Montana. The seasonally dynamic character of aspen can also be described by these landscape dominance elements, as the color changes in their form become more recognizable; in the winter, the dominance element of line is more visible. This dynamic character of aspen suggests the basis for its aesthetic value changes over fairly short temporal scales.

High levels of aesthetic attachment to specific clones may exist for some small communities and families with aspen clones nearby that provide aesthetic values. The literature shows little research on aesthetic preferences for aspen, although the methodology for aesthetic mensuration is well developed in general.

Aesthetic meanings of aspen may lead to important economic benefits as tourists flock to communities adjacent to aspen stands during the fall, thus extending the tourism season. Frequent use of such aesthetic meanings may lead to new cultural/symbolic and instrumental meanings of aspen as communities exploit growing public interest in aesthetics to bolster their tourism industries. In urban and suburban settings, aesthetic meanings of aspen are identified through its frequent use as a horticultural element in commercial and residential landscaping.

Cultural/symbolic meanings derive out of transactions that interpret the meaning of specific environmental attributes to a group; as such, these meanings may vary from one group to another and are not necessarily shared among groups. Our knowledge about cultural/symbolic meanings of aspen are poorly developed and understood. In Western society, these meanings are often recognized through formalized boundary setting, as when Congress establishes a national monument or historic site. Aspen may have served as the basis for a variety of Native American tribal stories and mythologies, such as a Blackfoot story about how aspen came to tremble. Briefly,

One day, the aspens got together and decided that Napi (the Blackfoot man/god/clownster) wasn’t all that important, so they agree that they would not bow down for him, next time he was around. True to their word, the next day when Napi came walking by, they just stood there indignantly. Well of course Napi didn’t like this. In a tantrum, he

started throwing lightning bolts at them, almost scaring the leaves off their branches. To this very day, the aspens are so scared that every time they hear someone walking in the woods, they tremble their leaves in fear it might be Napi (Willard 1992, pages 65-66).

There may be other cultural/symbolic and individual/expressive meanings. For example, the turning of colors symbolizes the oncoming of fall and winter, serving to suggest that people have one more chance to engage the landscape on a personal level and then prepare for the difficulties of living in a northern climate. Returning to naturalist Horowitz: “When fall comes on, I want to put away some food, gather some wood; I want to get ready to winter well. That fall light still has a powerful pull on all of us. I can feel it all the way through” (Jamison 1999).

For others, aspen may represent the Western landscape. And there may be another symbolization that aspen serves particularly relevant to this conference. The fire exclusion and grazing that has left much of aspen territory without adequate reproduction may lead at least some people—particularly citizens, scientists, and managers interested in resource management in the West—to view aspen as a symbol of the continuing human interference in natural processes. Just as white bark pine tends to symbolize remote, rugged, and wild landscapes (McCool and Freimund 2000), aspen may come to represent landscapes where natural processes have been disturbed.

Meanings of aspen at the individual level contain high emotionality, low commonality, and low tangibility. Examples include use of individual clones for traditional family celebrations such as reunions, use for personal introspection, reflection, and prayer, and the view of a clone from a ranch house. Such attachments are difficult to describe and are not spatially differentiated across a landscape, leading such common analysis tools as geographic information systems to be inadequate. One of the paradoxes faced here is that while people may become attached to such clones, the dynamic character of landscapes means that such clones will eventually disappear as others appear. The relatively short life span of individual stems means that such changes may be visible within a human generation.

Place meanings may differ temporally (Lee 1972), with different groups assigning meanings to the same space over a day, season, or year. Different definitions of place may be the source of conflict over that place’s disposition. For example, a campsite in an aspen stand that has long served as the location of family reunions over decades may be viewed by a biologist, not in individual/expressive terms, but in very instrumental ways, such as decadent and in need of restoration treatment. Thus, meanings of a specific space may differ from one group to another; the primary meaning is constructed by the dominant social group using a place.

## **Management and Restoration of Aspen: Institutional Issues Related to Social Uses, Values, and Processes**

There apparently is no longer a question about the status of aspen in the Western landscape: it appears to be declining in its spatial distribution, although there is significant variation in the potential decline from one locale to another (Debyle 1990). The causes of such declines seem to be most frequently attributed to fire exclusion and grazing by both domestic livestock and wild ungulates, but definitive answers remain elusive. This decline seems to be



widespread in the Western landscape, suggesting the temporal and spatial pervasiveness of these human-caused disturbances.

These findings suggest that aspen in the future may be a less common element of the landscape than it is now. Assuming a goal of sustaining aspen, at least in some type of dynamic way, what are the institutional issues associated with management and possible restoration actions? Such issues are important because institutions—laws, agencies, managerial cultures—associated with land management form a strong paradigm that determines what decisions will be made, how, and by whom. The management of aspen may be constrained or enhanced in this respect.

Natural resource planning is dominated by a rational-comprehensive or synoptic style of planning that places great emphasis on scientific expertise, establishment of goals, consideration of all possible alternatives, systematic evaluation of alternatives, and choice of a preferred course of action. This planning tradition emphasizes formalized information, quantitative modeling of biophysical systems, and assumes that problems are well defined and that planners will have perfect information and unlimited time in which to conduct analyses and recommend decisions (Forester 1989). Synoptic planning does well in situations where scientists agree on cause-effect relationships and the goals of management are left uncontested.

However, when these two contextualizing factors take on different characteristics, synoptic planning is ill-suited to its task. Such formalized planning systems neither represent the current situation in natural resource planning nor are they particularly well equipped to incorporate cultural/symbolic and individual/expressive landscape meanings. More typically, scientists disagree, and the public has not come to a consensus about goals. Often, conflicts in values (representing cultural and individual meanings) are at the heart of environmental disputes. Problems may not be well defined, or at least managers may be confronted with multiple and competing definitions. There may be structural distortions in access to information and decisionmakers. Political power is nonrandomly distributed.

The application of a synoptic planning process in such a setting miscasts the goal of planning. Rather than selecting the most efficient alternative to a given end, planning must be focused on determining which of several plausible futures are desirable and on understanding the relationships among various causal factors and their effects. This “messy” situation requires styles of planning that emphasize consensus building and learning, recognize various forms of knowledge as legitimate, understand that some values and uses cannot be directly measured and mapped, and incorporate a diversity of the affected publics so that consensus can be created. Thus, science helps to facilitate a decisionmaking process, just as the emotional and experiential knowledge of the public and the administrative experience of the manager does. Emotional and experiential forms of knowledge are particularly useful in identifying the cultural/symbolic and individual/expressive meanings for which synoptic style measures do not exist and cannot be spatially modeled.

These issues suggest that one needs to be careful not to underestimate the complexity of the aspen management question. A substantial argument can be mounted that the context within which management of aspen is ill-structured and messy, and that there may be tendencies to define aspen restoration as “just like” the question of white bark pine restoration, a major issue across the West as well (McCool and Freimund 2000).

The types of meanings assigned to aspen carry significant ramifications for management. These implications involve (1) how such meanings are measured,

mapped, and inventoried and (2) how they are evaluated and weighed in decisionmaking and incorporated into management actions for multiple-value settings. Inventory systems have been developed to identify, measure, and map aesthetic and various instrumental landscape meanings. A variety of scientists have contributed to increased understanding of the landscape elements that lead to evaluations of whether a particular place is scenically attractive. Management systems that protect or enhance scenery have been developed. These systems fit well into management because they are consistent with the positivist tradition of synoptic, scientific-based, expert-driven approaches to decisionmaking. However, cultural/symbolic and individual/expressive meanings are not easily measured and mapped, are identifiable generally through nonpositivistic approaches to landscape assessment, but yet may be the most significant meanings attached to a landscape feature and, therefore, those most affected by management actions. The state of knowledge of these values is limited, and their relationship to aspen is generally unknown.

## Restoring Aspen: Challenges From the Social Domain

As a system that is potentially in decline, management of aspen represents a series of important, but thorny, human issues for restoration ecologists and land managers. It is not clear if there is unanimous agreement among scientists about the causes of aspen decline or how the decline should be addressed, nor is it clear that objectives for restoration and maintenance of aspen in the region are well accepted by affected publics. Given the variety of institutional overlays on public lands, management must vary from place to place, and in wilderness, questions about restoration as an act of trammeling are raised (McCool and Freimund 2000). Finally, it is not at all clear how aspen management (outside of commodity production), particularly restoration, may have consequences of significance for humans.

Decisions about aspen, including the decision to do nothing, reflect fundamental values and ethics of land managers charged with the responsibility for the stewardship of natural resources. The statement that aspen is in decline is only a *descriptive* statement; the suggestion that something ought to be done about it is a *prescriptive* statement. To sustain aspen in the Western landscape, both decisions—one based in science, the other in ethics—must be made. In this section, I review the different challenges to decisionmakers and scientists that derive from the decision to restore, including the ethical framework itself. There are a variety of challenges that may be briefly termed decisional, definitional, contextual, epistemological, and ethical.

### **Decisional Challenges**

While it is clear that restoration of aspen will be driven by societal concerns about the condition of the natural environment (in general and public lands more specifically) and shifting demands for goods and services from ecosystems, actual restoration decisions are influenced by specific legal mandates and institutional directives. This institutional context is increasingly complex and confusing, as experience in the Pacific Northwest with northern spotted owls, marbled murrelets, and anadromous fisheries demonstrates. The resulting bureaucratic environment is a complex and frequently confusing web of regulatory agencies, federal land management agencies (e.g., Forest Service),

court jurisdictions, unwieldy processes, funding sources, and oversight responsibilities (Congress). While it is difficult to foresee that such a similar bureaucracy will develop with respect to aspen itself, such questions may eventually involve aspen management as an important habitat for other endangered species.

Such a heterogeneous decision setting, with agencies operating under differing objectives (at best) or conflicting ones (at worst), agendas, and cultures, tend to be puzzling, confusing, and unresponsive to rapidly changing and spatially differentiated social preferences and environmental conditions. Institutional structures and processes for decisions differ among agencies. Mythologies and perceptions about what decisions, mandates, and strategies must be followed abound. Social and biophysical processes operating at different scales are not particularly well understood.

Managers of aspen and the landscapes embedding it will be making several decisions such as: What goods and services should this landscape be managed for? What actions are needed to produce, maintain, restore, or enhance those values? If restoration is needed, what should be restored? How should restoration occur? Where should restoration occur and when? These are important decision points that involve ecology but affect the meanings that people assign to landscapes.

Both regulatory and management agencies have chosen prescriptive techniques for dealing with habitat restoration when endangered species are involved. Yet, there are often perceptions among agency personnel and publics that these prescriptions do not take into account local conditions and situations. Such rigid approaches to restoration serve as an overwhelming barrier to the practice of adaptive management advocated by many contemporary scientists (see for example, Holling 1978; Gunderson and others 1995). For the learning to occur that is required for policy formulation, the system must be adaptable. Rigid institutional overlays remove the adaptability from the system simply because there is not opportunity to learn from and further experiment with policy (Gunderson 1999). And as Lee (1999, page 1) argues, experimentation and the consequent accrual of knowledge “is likely to be of strategic importance in governing ecosystems as humanity searches for a sustainable economy.”

### ***Definitional Challenges***

Restoration is usually cast as a technical, scientific-based activity dealing solely with ecological function, process, and structure. While there are many definitions of restoration, they tend to center on reestablishment of predisturbance conditions and processes. While there is some dispute about restoration leading to healthy ecosystems or systems with high integrity, such definitions usually focus only on biophysical components of ecosystems.

The Western landscape provides a wide range of human benefits, including their capacity to maintain desired populations of wildlife. These human benefits are impacted when systems are degraded, and impacted as well when restoration practices are implemented. In a sense then, restoration can be defined as management processes that lead to protection or enhancement of the human meanings assigned to landscapes.

As Bardwell (1991) argues, defining the problem appropriately is a crucial precursor of the problem-solving process. Understanding what the problem is and specifying it explicitly is important to development of appropriate solutions. Clearly, restoration can only be defined in relation to the types of values and benefits to be preserved, renovated, or managed. The range of values is broad,

and at some point, all must be addressed or accounted for in planning analyses. Additionally, there may be questions about the generalization of aspen decline, particularly at a regional level (see papers by Kay and Renkins, this proceedings). Thus, there may be a tendency to solve the wrong problem, solve a solution, address a symptom, or attempt to obtain agreement on a solution before the problem is defined as Bardwell argues. Clearly, we need agreement on what should be restored before action occurs. And it is just as clear that what should be restored is as much human meanings as ecological structure and function.

Relationships that exist between humans and their environment, that may have lead to a combined cultural-environmental system, or conditions that may have resulted from pre-EuroAmerican perturbations, are usually neglected in defining the purpose of restoration. Restoration is often defined as repair of systems damaged by human activity. However, as Geist and Galatowitsch (1999) argue, restoration provides a set of benefits distinctly human in nature.

This biotechnical focus of restoration, however, significantly miscasts restoration processes and practices. Human elements permeate restoration, from decisions that the environment needs restoration, through definitions of specific restoration goals, to organizing and scheduling people and materials for the restoration activity, to lobbying and appropriating funds for restoration activity.

### ***Contextual Challenges***

A variety of forces and changes are driving the need for restoration. Briefly, these forces involve a shift in expectations of what goods and services ecosystems are expected to provide, more rigorous standards concerning the acceptability of human-induced changes, and growing scientific-based knowledge about the consequences of human activity. Restoration occurs, moreover, within the dynamic, even chaotic, political and social context alluded to above. In particular, the goals and objectives needed to specify outcomes of restoration are ambiguous or in conflict with other resource management goals. The lack of specific, measurable goals for which a consensus exists hampers evaluation of progress and represents ongoing conflict within the public about both means and ends of restoration. In addition, the science necessary to restore riparian ecosystems is often insufficient to support management decisions, or leads to conflicting conclusions about projected consequences and effectiveness.

### ***Epistemological Challenges***

Action in society requires a variety of actors in different roles with varying capabilities and knowledge (Friedmann 1973). Each actor brings into a problematic situation different forms of knowledge—not only in content (e.g., fisheries, terrestrial ecology)—but different sources as well: science, managerial experience, personal experience, and so on. Each individual also has varying capacity to process different forms of knowledge; some can absorb and process scientific-based knowledge, for example, easier than others. For action to proceed, the different forms of knowledge must be respected by the various actors, even if its content is not completely understood.

The practice of restoration is dominated by calls for it to be “scientifically based.” This bidding is probably rooted in past land management practices that did not exploit existing technical knowledge or were based on political expediency. The underlying and often implicit assumption that scientific knowledge provides answers to restoration questions is often accompanied by explicit

statements that riparian systems are so complex that our current knowledge base is inadequate to the task.

Unfortunately, relying solely on scientific-based information leads to two negative consequences. First, science measures only tangible items of the world, which are not necessarily the most important values of ecosystems (Forest Ecosystem Management Assessment Team 1993). The development of a technocratic administrative service and the dominant rational-comprehensive or synoptic planning processes has exacerbated this problem as noted earlier. Because science measures only a few aspects of ecosystems, those aspects assume an importance, because they can be articulated, beyond what they really may be. Second, the ability of science to measure and describe things in technical language has led to scientific information being privileged in decisionmaking processes. As Friedmann argues, there are significant questions about this privilege (Friedmann 1987). Given these limitations of scientific methodologies and how they are applied in field situations over long-time scales and large spatial scales, this privilege may be unwarranted at best. Thus, biologists, when practicing restoration, must recognize the legitimacy of emotional forms of knowledge, for it communicates the importance of different values and thus provides information about priorities and the impacts of restoration practices.

The net effect of these contextual factors is that restoration decisions are made under the illusion that causes, effects, and consequences are known with certainty, when in fact, restoration decisions are more likely characterized as being made under conditions of risk or even uncertainty. To some extent, the lack of recognition of disagreement on goals may also lead policy makers to make decisions for which there is little broad support, thus endangering restoration and hampering future efforts to organize societal action.

### ***Ethical Challenges***

Restoration practices represent an ethical decision that humans have a responsibility to leave the earth in a “better” condition than what they found, the essence of the concept of sustainability. Yet, there is considerable debate about whether restoring nature is a credible activity: some authors suggest that restoration leads to “fake nature,” restoration encourages more degradation (because of the technological capability to quickly repair damaged systems), restoration represents continued human domination of nature, and ecosystems are simply too complex to be completely restored. The debate on these points is quite serious, with the language at times outright acrimonious. The extreme language is sometimes cited as a good reason why ethicists have nothing to contribute to discussions about restoration.

Yet, restoration ecologists cannot escape the ethical foundation for their activities. Manipulation of nature, for commodity production or restoration, involves application of some kind of ethical framework to the landscape. It reflects how we perceive nature, the relative importance of various human benefits derived from nature, and responsibility toward future generations, all of which are based on a view of nature culturally derived.

### **Conclusions**

Aspen is an important component of the Western landscape, although it has in many places a spotty distribution. Its importance derives not only from its role in the biophysical aspects of an ecosystem, serving critical habitat and forage

functions for some species, but also as a source of fiber for human use, and equally important, in the meanings and attachments people place on landscapes. Quaking aspen also provides aesthetic values critical for the humans that expect to view it every fall. Our knowledge about aspen and how people interact with it is limited, as evidenced by the lack of literature and manuscripts submitted at this conference. The major challenge to aspen management appears to be finding the causes of its decline and correcting them so it retains its appearance in the landscape.

Yet, decisions to restore aspen to its pre-Euro-American abundance and distribution occur under conditions of uncertainty precisely because many socially important meanings of aspen have yet to be documented, researched, or archived. We know neither the distribution of these meanings functionally or spatially, nor do we understand how management and restoration might impact those meanings. To conduct restoration and active management without such knowledge risks losing the values associated with those meanings without understanding what is being lost. This is a paradox, because it appears to be clear that without restoration, we will lose aspen and the values associated with it as well.

It seems important, therefore, to complement the active research program on aspen ecology with one that addresses the recreational, aesthetic, cultural, and individual meanings associated with aspen. Such research would play valuable roles in establishing the basis for potential conflicts, ranking the priority of management actions, and suggesting ways in which landscape meanings and place attachments can be enhanced—such as when aspen stands are carefully managed for their instrumental value as a source of pulp. Research on these meanings can help managers understand what values and meanings are at stake, whose definitions are being impacted, and how and what planning processes may be useful in ensuring that such meanings are not inadvertently marginalized.

Only then can we fully understand what needs to be restored and why. Only then will managers be able to comprehensively document the effects of aspen management. And only then can management proceed with full knowledge of consequences.

The campers on the North Fork of the Sun River raised significant questions around the campfire that evening a few years ago. Scientists, managers, and citizens have important roles in addressing those questions. The human experience of Western landscapes includes the presence of aspen, but that experience is multidimensional, an assertion recognized by those campers. Will the scientific community broaden its scope of interest similarly when dealing with aspen?

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