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Challenges and Opportunities in Forest Restoration Outreach: The Example of Southwestern Ponderosa Pine Forests

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Abstract

The majority of forest managers, informed policymakers, and educated members of the public agree that restoration of dry, fire-adapted forests of western North America is a critical ecological and social need. A large body of scientific research documents how forests that were once open and parklike have grown dense with small trees, resulting in significant increases in fire hazards and declines in ecological values.

It has been difficult, though, to convert even detailed scientific understanding into effective results on the ground. Reasons include numerous economic and social hurdles, but also difficulties in translating research results into tactics applicable in the field. Ecologists often require many years before they are willing to identify causal relationships between specific restoration treatments and identifiable ecological results. Managers often demand immediate answers to ecological questions so that they can make pressing real-time decisions. Policymakers and the public are often unwilling to wait for peer-reviewed scientific results and want to know quickly whether economic, political, and social investments in restoration work are warranted.

This paper uses the example of the Ecological Restoration Institute's (ERI) outreach program to assess the difficulties and opportunities inherent in translating science into action. The ERI maintains a broad effort aimed at publicizing timely yet scientifically rigorous information about the restoration of Southwestern ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) forests. Through an ever-evolving combination of print and electronic publications, public outreach activities, and land manager workshops, we attempt to keep varied audiences abreast of the latest developments in the science and application of restoration work. This paper outlines a broad restoration outreach strategy and discusses challenges encountered as those working to improve the health of public-lands forests continue to expand the audience for their work.

Keywords: Forest restoration, ponderosa pine, Southwestern United States, outreach.

Introduction: The Complexities of Restoration

Ecological restoration is a fast-growing approach to the management of forests and many other ecosystem types in North America, and throughout the world (Arno and Fiedler 2005, Jordan 2003). Restoration, according to the Society for Ecological Restoration International (SERI), is "an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability. . . . Restoration attempts to return an ecosystem to its historic trajectory" (SERI 2004). Restoration can simultaneously return ecosystems to greater ecological health, make a positive contribution to the human economy, and enable people to actively participate in the management of natural areas near their homes. Yet, it is also a complex and often contentious endeavor (Jordan 2003).

Restoration is complex for several reasons: the scientific information on which it is based is always incomplete;

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and restoration is largely an effort to guide future management through knowledge of past conditions. Although researchers have many tools for plumbing the ecological past, our understanding of that past is always partial and often biased by preconceptions (Egan and Howell 2001, Landres et al. 1999). Even our understanding of how ecosystems work in the present moment is always incomplete. Managers seldom know as much as they would like to know about interactions among plants, animals, climate, geology, human activities, and other factors that affect ecological circumstances and, hence, their management decisions.

Restoration also is not a matter solely for scientists and for professional land managers. Rather, it engages broad segments of the public who are interested in conservation, recreation, resource-based industries, even the safety of their homes and neighborhoods (Cortner 2003). That breadth of interest can bring wide support to restoration projects but also instill a great deal of controversy when forest managers propose such actions as mechanical thinning or prescribed burning (Allen et al. 2002, Cortner 2003, Friederici 2003). The social landscape in which restoration takes place is often as complex as the ecological landscape. Restoration touches on questions of policy, economics, decisionmaking processes, and ultimately on the deep-seated values that people perceive in forests and other landscapes (Jordan 2003, Oelschlaeger 2003). For these reasons, restoration advocates cannot work in isolation; rather, they have a critical need to focus on outreach to the varied audiences and many people who are interested in the topic.

Case Study: Southwestern Ponderosa Pine Forests

In no landscape ought it to be easier to engage residents in the process of restoration than in the dry, fire-adapted forests of western North America, and especially in the ponderosa pine (*Pinus ponderosa* Dougl. ex Laws) forests of the Southwest (Arizona, New Mexico, and southern Colorado and Utah). Many lines of historical evidence have shown that these forests were once subject to frequent low-severity fires that maintained an open forest structure and a diverse understory of grasses, forbs, and shrubs (Allen et al. 2002, Covington and Moore 1994, Swetnam and Baisan 1996). With the advent of intensive livestock grazing, logging, and fire suppression in the late 19th and early 20th centuries, the regular cycle of frequent fires was broken. Fires vanished from many parts of the forest landscape for decades.

As a result, many of these forests grew dense with thickets of small trees. Today these stands and their associated large trees are at risk of severe stand-replacing crown fire that threatens human communities and the ecological integrity of the forest. They also are subject to severe bark beetle (*Dendroctonus ponderosae*) attacks. Other ecological values are at risk, too. Overly dense stands lose much of their herbaceous understory and, with it, the wildlife species that rely on it (Covington 2003). When dense ponderosa pine forests burn, stands are often replaced across hundreds or thousands of acres, causing erosion, loss of soils and wildlife habitats, and possibly long-term changes of vegetation type (Savage and Mast 2005).

Restoring these forests is, on the one hand, quite simple. They are still forests. Unlike the tallgrass prairies of the Midwest, to cite one example, most of them have not undergone a type conversion. Although some nonnative, invasive plants are a problem, most of these forests are still dominated by native species. Development connected with the region's quickly growing population is a concern, but vast acreages of dry forest will remain in public ownership and will likely continue as open space in the long term. Most Americans recognize their value for lumber production, for livestock grazing, for healthy watersheds, for recreation, for aesthetics, and perhaps, above all, for local economies that are increasingly based on natural amenities.

In addition, scientific understanding of the past structure of these forests is remarkably robust. These forests were settled

relatively late in the history of the United States. Good records-written and photographic-exist of their condition prior to alterations by novel land-use practices in the 19th century. In addition, the region's dry climate has preserved a great deal of physical evidence-such as stumps, fallen logs, living trees, and soil phytoliths-that documents historical forest conditions (Covington 2003, Fule et al. 1997).

The management techniques required to return contemporary forests to conditions similar to those of the past are also relatively well understood. More, of course, always remains to be learned, but the effects of the two most commonly implemented restoration treatments prescribed fire and mechanical thinning-have been heavily studied for years. Perhaps most important, restoration of these forests is quite consonant with human needs and desires. Unhealthy dry forests are prone to enormous and dangerous crown fires that are detrimental to both ecological and human values. Healthy ponderosa pine forests burn frequently, but they burn at a low level of intensity that typically does not threaten human lives or property or such ecological values as the healthy functioning of watersheds. In addition, research on aesthetic preferences has shown that people tend to like the open-structured, spacious appearance of ponderosa pine forests resembling those that preceded the Euro-American settlement of the West (Daniel and Boster 1976, Ulrich 1993). This fortuitous coincidence means that managers of ponderosa pine forests can shape the landscape into what most people want to see even as they improve its ecological health. Managers of western landscapes with very different fire regimes, such as lodgepole pine (*Pinus contorta* Dougl. ex Loud) forests or California chaparral, are not so fortunate. In such places, where severe, standreplacing fires are naturally evolved, managers may need to make difficult choices between ecological integrity and public safety.

Despite the widely agreed-upon need for restoration, and despite the identification of enormous acreages of dry forest in need of restoration in the interior West (GAO 1999), the pace of work done has been slow. Why is this? Some of the most significant reasons for that failure are matters of policy and economics. Studies have shown that investing relatively small amounts of money in restoration can avert the spending of much larger amounts of money on fire suppression (Romme et al. 2003, Snider et al. 2003). But the federal government, which manages most of these forests, has generally been loath to invest federal funding in the precautionary restoration of forests before they burn, and indeed has at times taken money from fuels reduction projects that might contribute toward restoration and used them for fire suppression (GAO 2004).

As a result, restoration work has generally been completed only when some grant funding is available (as, e.g., through New Mexico's Collaborative Forest Restoration Program) or when private contractors are able to remove enough products of value from the forest (especially larger trees that can be turned into lumber) to compensate for the time they spend in removing the large numbers of small-diameter trees that make up the primary fire threat but are generally unmerchantable. The logging of larger trees almost inevitably stirs public controversy. In many places, as in Arizona, infrastructure is insufficient in the form of logging companies and mills to accomplish restoration work at even a slow pace.

But the slow progress of restoration can also be ascribed in part to shortcomings in education. The term "restoration" has entered the language of forest management and is often used to describe any activity that reduces wildfire danger or improves forest health-even if it does not truly restore natural conditions. As a result, managers often fail to take steps-such as seeding native grasses or conducting regular maintenance burns-that contribute to holistic restoration and can lower fire danger in the long term. Many homeowners who live adjacent to public forest tracts, assuming that the responsibility for avoiding fire lies entirely with public land managers, neglect simple steps that can contribute to the reduction of fire danger on their own property.

Policymakers who must try to balance manifold demands for attention and limited resources are seldom sufficiently informed about forest issues to make wellinformed decisions. And members of the general public may be concerned, or simply confused, about the value of such restoration techniques as thinning and prescribed burning, both of which do carry negative side effects.

It is for these reasons that the ERI at Northern Arizona University (NAU) has implemented a broad outreach program.

Different Audiences, Different Learning Styles

A great variety of groups are engaged in forest restoration in the Southwest. In many places, restoration projects have been conducted as exercises in broad-based collaboration that involve not only traditional land managers but such stakeholder groups as environmentalists, industry groups, community groups, fire departments, and others (Friederici 2003, Kusel and Adler 2003, Moote 2003). In addition, restoration can be a wide-ranging, holistic, and interdisciplinary endeavor that engages the skills and imaginations of many people and organizations (Light 2000). Restoration advocates who seek to influence the debate about such projects must recognize that members of these disparate groups are accustomed to learning in different ways because of their background, educational training, and professional culture (app. 1). It is to match those different learning styles that the ERI has generated a variety of publications and educational outreach events.

Academic Community

Members of the academic community are more likely than members of other groups to educate themselves through reading-in-particular, they constitute the only audience likely to spend much time reading primary research results presented in professional journals. The ERI has maintained a robust research program that has resulted in numerous publications in the pages of professional journals, conference proceedings, and books. It has also organized professional conferences for the dissemination of new research results. In addition, ERI faculty educate the next generation of forest researchers by teaching undergraduate and graduate classes in restoration through the NAU School of Forestry.

Land Managers

Typically strapped for time, land managers are unlikely to closely read professional journals, but they do have an interest in research results. The ERI synthesizes those results into short, easy-to-read publications called working papers (app. 2). Each one summarizes lessons learned by researchers and practitioners working on restoration projects. Each includes readily usable tips for improving project planning and implementation. In addition, the ERI conducts workshops and classes, both in the classroom and in the field, that give practitioners a firsthand look at forest restoration concepts, strategies, and techniques.

Policymakers

Policymakers have even less time to devote to researching issues than land managers do. They require very short summaries of issues requiring their attention. The ERI has prepared a series of fact sheets, generally one page long, on such issues as fire behavior and variable ecological responses to different thinning treatments. The impact of such materials has been greatly enhanced through personal contacts with decisionmakers. Such venues as field trips offer an excellent opportunity to convert forest restoration from an abstract issue discussed in black and white text to a visible management strategy that affects how real forest stands look and interact with their surroundings.

Community Groups

Throughout the West, many community groups and other stakeholders who are not professional land managers are engaged in restoration efforts. Their involvement may range from providing input into desired future conditions to active participation in the work of thinning, prescribed burning, seeding, or monitoring. Their level of education in forest ecology may be high or low. The ERI reaches such audiences through such publications as its working papers and a detailed series of handbooks about monitoring strategies and methodologies. In addition, it maintains a large Web site that provides a wide range of information, at varied levels of detail, about restoration ideas and methods. The ERI staff members also actively participate in the meetings of a number of collaborative community-based restoration efforts in Arizona and New Mexico.

General Public

Most restoration efforts take place on public land, and many are set in or near wildland-urban interface areas where many people live. Public involvement is crucial to the success of most restoration efforts, yet public understanding of the rationales for and effects of restoration work is often lacking. The ERI attempts to reach the public through the publication of brochures aimed at such groups as homeowners who live in forest settings. In addition, it has participated in numerous festivals, Earth Day and Firewise events, school science presentations, and other special events. Outreach to newspapers, radio, TV, and other local, regional, and national media is also important in reaching both the general public and decisionmakers.

Note that tailoring a message is a matter of adjusting **form** rather than **content**. Successful targeting of different audiences is not a matter of telling different stories, but rather of telling the same story in different ways. Summarizing what is known about historical fire regime patterns, for example, requires an entirely different vocabulary in an academic journal article and in a newspaper article. Awareness of those differences before setting out to write can save a great deal of time in rewriting-or trying to rectify miscommunications later.

An Example of Restoration Outreach

Since the mid-1990s, the USDI Bureau of Land Management (BLM) has been conducting large-scale experimental restoration treatments near Mount Trumbull in far northern Arizona. Scientists from the ERI, Arizona Game and Fish Department, and other institutions have monitored the effects of those treatments on understory plant species, wildlife, fire behavior, and other variables. Those studies have provided great insight into the theory and practice of forest restoration and can inform future work if they are sufficiently publicized. How can this best be done?

The ERI has produced a variety of outreach materials intended to bring these results to the audiences listed above. We have done so by producing a hierarchy of publications that reflect the expectations of different readers. The first level of publications, arguably the most important, consists of peer-reviewed articles that present primary field research to a scientific audience (summarized in Waltz et al. 2003). These articles appear in journals such as *Restoration Ecology*, *Forest Ecology and Management*, and others. Such articles have wide currency in the academic community, yet those periodicals are generally not accessible to the general public and policymakers, and often not to land managers.

To reach land managers and members of other groups particularly interested in forest management-such as environmental organizations and regional community groups focused on ecology and economics-the ERI has produced several working papers that summarize lessons learned during the course of restoration research at Mount Trumbull. In some cases, those lessons

have been based on experimental studies; in others, they have been based on anecdotal observations made about operational successes and failures. For example, measurement of the effects of a prescribed fire that killed an unexpected number of old trees resulted in recommendations to be careful about burning on volcanic cinders, which were published both in a journal read by fire professionals and in a working paper distributed to practitioners in the region in both print and electronic formats (Fule et al. 2002, Minard 2002). Full citations of the primary literature are provided in the working papers so that readers can look up the original, peer-reviewed research.

Other publications address readers who would not read even a working paper. The ERI has prepared a number of one- or two-page fact sheets that summarize research results for time-strapped policymakers. These, too, include citations that enable readers to understand where the data mentioned come from.

In addition, the ERI has published a brochure for the general public that the BLM has distributed at its field office and at the restoration site. It provides a general overview of the work being done and explains what viewers may see as they tour the site.

All these publications represent efforts to bring relevant research to audiences in appropriate forms. It is important to note, too, that this hierarchy of publications is not confined to print only. Much of the same material is available on our Web site, from downloadable copies of original journal articles to short, illustrated descriptions of research sites and projects that might appeal to the general public. The same hierarchy of outreach styles applies in presentations as well: a presentation of research results to an academic audience at a professional conference will differ in style from a presentation to a community group or a group of regional decisionmakers such as state legislators or county supervisors-even if much of the content is the same.

The Challenges of Using Science in Policy

Moving between one audience and another, though, presents significant challenges. Some of the thorniest challenges in educating varied audiences about a complex land management practice such as restoration stem from the different expectations to be found among those audiences. Ecologists, for example, are notoriously cognizant of the complexities of the systems they study (Noss et al. 1997). They are acutely aware that it can take years of study to construct even simplified models of ecological processes; that forest dynamics may be very different at different sites; that the effects of interannual variability in climate (which can be severe in the Southwestern States) can easily mask the effects of restoration treatments or any other forest management practices; that whatever variables are under study are inevitably affected by another set that is not being monitored. They may be reluctant to draw inferences about other sites from their study of one locale; they may point out that the complexities of ecological interactions make it difficult or impossible to draw precise cause-and-effect conclusions from even years of study.

Yet those conclusions are exactly what land managers, policymakers, and the general public are after. All these groups are under pressure of various sorts to show results on the ground, especially when the issue at play is as attention-getting and volatile as fire behavior in public forests. Under pressure from their own constituents, both land managers and policymakers are apt to ask scientists for precise and prescriptive advice about what to do in the forests. Such advice is precisely what most ecologists are most reluctant to give.

Presenting research results in a timely fashion, and in a format easily accessible to land managers and policymakers, is also often made difficult by the proprietary interest researchers have in their results, which are, after all, the result of a good deal of hard work. Academic researchers, in particular, are under consistent pressure to publish their results in respected, peer-reviewed professional journals. Publication of results in such formats as working papers or general-interest publications is often either frowned upon or entirely neglected when it comes time to review academic records for the approval of

tenure or changes in job status. Most academic institutions are simply not structured to provide quick summaries of current research results to the land managers and other practitioners who have the greatest immediate need for them. Yet publication in peer-reviewed journals can take a long time, and even after publication, results may filter only slowly-or not at all-into formats accessible to those outside the academic community.

It is in large part because ecology is a complex science and drawing precise conclusions from it about management practices is so fraught with difficulty that debates about an endless array of management issues have come to be dominated by competing scientific claims (Cortner 2003). The scientific basis for practicing restoration in Southwestern ponderosa pine forests is excellent, but advocates can often buttress widely competing ideas with findings that seem to support one particular management practice or another. For example, it has been well established that Southwestern ponderosa pine forests burned often before the onset of livestock grazing and widespread fire exclusion (Allen et al. 2002, Covington and Moore 1994, Swetnam and Baisan 1996), yet reputable researchers have questioned the generally accepted methodologies that have helped lead to those conclusions (Baker and Ehle 2001).

Ecologists, like many other scientists, are also often reluctant to enter debates about land management because they are understandably worried about being misquoted or having their work taken out of context. Scientific results are almost invariably skewed or oversimplified when they enter public discourse. Newspaper and television accounts are rife with hyperbolic rhetoric; it is common to hear about enormous acreages "destroyed" by fire when in fact almost all fires bum in a mosaic of different severity levels, and when highintensity fires are in fact crucial to the health of certain forest types (Smith 1992). Politicians and advocates of all positions are apt to oversimplify debates about any land management issue.

In light of this, it is incumbent on those charged with educating any audience about such questions to be both accurate and precise. When discussing forest fire, for example, it is critical to point out that different forest types have very different fire regimes. When discussing historical reference conditions, it is vital to delimit the discussion to the appropriate geographic area or ecosystem type. When deciding what sort of terminology is appropriate, it is important to be very judicious in the use of such politically loaded phrases as "old-growth tree" or "catastrophic fire." In general, it is vital to carefully "translate" precise scientific terminology into language that other audiences can readily understand. Some simplification is generally necessary in order to discuss ecology in a way that is meaningful to land managers or the general public, but too much simplification is a disservice. Finding the right degree of simplification requires finesse and good judgment.

Conclusion

It is certainly possible to provide good information in a way that makes a difference. Our goal, as interpreters of science, should be to disseminate information so that those who make decisions-which in a democracy should include everyone from high officials in Washington, D.C., to professional land managers to lay members of the public-have the best possible background for making their own decisions. The results of those decisions may not always be what we ourselves would have chosen, but if they are based at least in part on good science, they will likely be far better than if they are based on no science at all.

If ecological restoration is a matter of returning an ecosystem to a healthier trajectory, then we might think of science education as the practice of slowly placing public decisionmaking on a trajectory that over time gives more weight to good science. It's an evolving practice, never completed, but one that is crucial to the future health of our lands.

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