

# Socioeconomic Barriers and the Role of Biomass Utilization in Southwestern Ponderosa Pine Restoration

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## ABSTRACT

There is general consensus that ecological restoration of southwestern ponderosa pine systems is necessary and there exists ample ecological science suggesting that it is physically attainable. However, the pace of restoration has been noticeably slow and is far from approaching the landscape level. We conducted a review of published journal articles, book chapters, and proceedings on the restoration of ponderosa pine forests in the Southwest in order to identify and examine the primary socioeconomic barriers that are impeding the progress of ecological restoration in the region. The role of small-diameter wood utilization in the southwestern United States is highlighted as an example of broader, divergent socioeconomic contexts needing reconciliation if restoration is to expand to the ecosystem scale. A synthesis of opportunities for overcoming barriers and furthering the progress of forest restoration is provided.

**Keywords:** biomass, ecological restoration, ponderosa pine (*Pinus ponderosa*), restoration economics, small-diameter wood utilization

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In the Southwest, multiple scales of restoration planning are being advanced and implemented by agency and university researchers (Friederici 2003, GFHC 2007) and community-based organizations (Friederici 2003, Lenart 2006), supported through a variety of federally appropriated programs (Moote 2003). While these efforts have had access to voluminous amounts of scientific information on historic conditions, treatment effects, fire behavior, and other relevant topics, the pace of implementation has often been alarmingly slow. For example, after ten years the Greater Flagstaff Forests Partnership has accomplished only one-third of the restoration acreage target it set out in 1996. The Blue Ridge Demonstration Project in eastern Arizona treated only a fraction of the acres proposed for restoration (Lenart 2006), and restoration

projects in parts of New Mexico have been scaled back or canceled altogether (Moote 2003, Burns 2003).

Across the Southwest, and in other parts of the nation as well, restoration practitioners are experiencing the effects of economic and social challenges that are complicating science-based restoration efforts. The physical possibilities of restoring these ecosystems are clear, but it has become increasingly apparent that science is a necessary, but insufficient, component of restoration implementation. While attention to the economic feasibility and social acceptability legs of the proverbial three-legged stool is necessary, there is also a pressing need to reconcile the historic and contemporary contexts within which restoration practices occur. This includes broader implications of public perspectives on the relationship between humans and nature. The ability to economically prosper while enhancing the environment contrasts starkly with classical views of economic activity, particularly commodity-based forest

extraction. This dichotomy is problematic for integrating economic feasibility with restoration and is arguably at the root of much of the current social conflict over forest management. The impediments to project implementation stemming from this contrast are highly evident in the restoration of southwestern ponderosa pine (*Pinus ponderosa*) and, in particular, the utilization of forest biomass and small-diameter wood removed via restorative treatments.

We pursued a literature review on southwestern ponderosa pine restoration in order to examine socioeconomic barriers hindering the progress of restoration, illustrate the management implications of these barriers, and highlight ways in which forest restoration can be achieved in the Southwest and other regions of the United States given these obstacles. We focus on the issue of biomass and small-diameter wood utilization, as it exemplifies the often contentious and seemingly unpredictable socioeconomic context present in southwestern



Eager South, Apache-Sitgreaves National Forest, in eastern Arizona. The development of small-diameter wood markets and processing infrastructure is needed to help restoration efforts in southwestern ponderosa pine expand to the landscape level. Photo courtesy of the Ecological Restoration Institute

forest restoration. If ecological restoration is to expand to a meaningful landscape level, greater attention will be needed on the economic and social factors that influence progress and provide motivation to see projects through.

### Southwestern Ponderosa Pine Restoration

Following more than a century of intensive logging, grazing, and fire suppression, southwestern ponderosa pine forests are now well outside of their natural range of variability and are consequently subject to disease, insect epidemics, and uncharacteristically intense and destructive wildfires (Covington and Moore 1994). Approximately 1.3 million hectares of ponderosa forests in Arizona and New Mexico are classified as Fire Regime Condition Class 3, which is to say that there is a departure of multiple fire-return intervals from the historic range, and forests are at high risk of losing key ecosystem components. Another 2.3 million hectares

of ponderosa pine are classified as Fire Regime Condition Class 2, signifying a departure of at least one fire-return interval from the historic range (Schmidt et al. 2002). Historic conditions were characterized by tree densities ranging from 50 to 150 mature trees per hectare, a diverse understory of grasses and forbs, numerous openings or lightly forested areas, and frequent low-intensity fires (Cooper 1960, Covington et al. 1997, Moore et al. 1999). Current conditions are regularly characterized by tree densities approaching 2,500 or more trees per hectare, diminished understory productivity and species diversity, few forest openings, and infrequent but high-severity fires (Covington and Moore 1994, Moore et al. 1999, Allen et al. 2002).

In response to the imperiled state of southwestern forests, scientists, practitioners, and community groups have advocated for some level of human intervention, whether in the form of structural manipulation through mechanical treatments or the reintroduction of natural or prescribed fire to

achieve restoration objectives (Allen et al. 2002, Schumann 2004, Lenart 2006). For the purpose of this analysis, we consider actions intended to reduce tree density or hazardous fuel loads through mechanical treatments and the application of fire to be acts of forest restoration in the Southwest, recognizing that these actions are often initial, necessary steps toward broader ecological restoration.

### Socioeconomic Barriers to Ponderosa Pine Restoration

In order to identify the salient socioeconomic barriers to forest restoration, we conducted a review of journal articles, book chapters, and published conference proceedings that primarily focused on the restoration of ponderosa pine forests in the Southwest. We then narrowed our review to writings focused on economic or social issues in ponderosa pine restoration or that included a significant discussion of economic or social issues, thereby eliminating numerous studies focused on strictly ecological aspects. Through this filtering, we compiled 21 case studies, summarized in Table 1. As restoration efforts in the Southwest are relatively recent, all literature reviewed came from the last decade.

Our review identified three primary barriers: 1) insufficient funding for ponderosa pine restoration; 2) social conflict over restoration meanings and values; and 3) a lack of accounting for the nonmarket benefits of ponderosa pine restoration. Within the first two categories, three specific obstacles were consistently identified: a) the lack of an appropriately-scaled, wood products infrastructure; b) an inconsistent supply of wood; and c) a distrust of commercial enterprises leading to harvest restrictions. Other less frequently identified barriers included poor policy design, human health and aesthetic objections, and insufficient public outreach.

**Table 1. Most frequently cited socioeconomic barriers to southwestern ponderosa pine restoration from a review of 21 case studies. In addition to the example references, the review included: Allen et al. 2002, Marzluff and Bradley 2003, Friederici 2005, Lenart 2006, Ostergren et al. 2006, Sisk et al. 2006, Hjerpe and Kim 2008, and Lowell et al. 2008.**

Restoration barrier	Times referenced	Example references
Lack of funding	18	Daugherty and Snider 2003, Lynch 2001
-Lack of small diameter utilization infrastructure	14	Larson and Mirth 2004, Fight et al. 2004
-Inconsistent supply of wood	9	Larson and Mirth 1998, Lynch et al. 2000
Conflict over restoration meanings and values	14	Friederici 2003, Moote 2003, Ostergren et al. 2008
-Harvesting restrictions and market distrust	8	Abella et al. 2006, Larson and Mirth 2001
Lack of accounting for nonmarket benefits	7	Daugherty and Snider 2003, Romme et al. 2003, Snider et al. 2006

### **Lack of Funding for Ponderosa Pine Restoration**

Insufficient funding was the most prevalently cited socioeconomic barrier to southwestern forest restoration progress (e.g., Larson and Mirth 1998, Lynch 2001, Daugherty and Snider 2003). Owing to the abundant public acreage in a degraded state, restoring southwestern forests is an expensive venture. The cost of mechanical thinning throughout the Southwest ranges from \$750 to \$1,750 per hectare (Larson and Mirth 2004, Lenart 2006, Hjerpe and Kim 2008) depending on site-specific tree densities and access.

Prescribed burning costs in the Southwest range from \$250 to \$500 per hectare (Larson and Mirth 2004, Hjerpe and Kim 2008), while administration costs for thinning and burning have been estimated at \$250–\$375 per hectare (Larson and Mirth 2004, Hjerpe and Kim 2008). Comprehensive restoration of ponderosa pine ecosystems also includes a number of other activities such as road deconstruction and riparian realignment, but the costs for these enhancements are highly variable and not consistently tracked. Combining thinning, burning, and administrative costs yields an average of \$2,000 per hectare to achieve a basic level of restoration.

This cost can be considered a minimum, as it does not account for additional ecosystem enhancements that are often included in southwestern forest restoration.

Extrapolating the per-hectare cost to the 3.6 million hectares determined by Schmidt and others (2002) to be out of the natural range of fire-return intervals produces an overall price tag of \$7.2 billion. Costs for any future maintenance needs are not accounted for in this price estimate. Restoring only the ponderosa forests deemed to have missed multiple fire-return intervals (Condition Class III) would cost approximately \$2.6 billion (1.3 million hectares at \$2,000 per hectare); this assumes that restoration treatments could be conducted on steep, sometimes inaccessible terrain. Both of these sums dwarf previous levels of federal funding for forest restoration. In addition, much of the existing funding is directed toward keeping communities and structures safe from the threat of fire. Even with a narrow focus of treating forests only in the wildland-urban interface, federal funding remains inadequate (Prestemon et al. 2008). Combining community protection with myriad other federal fiscal responsibilities such as national defense, education, infrastructure, and disaster relief efforts

leaves little for preventive treatments such as ecological restoration. While a rational argument can be made for federal investments of billions of dollars directed toward ponderosa restoration in the Southwest (Snider et al. 2006), the national trend in recent years has been declining funding for public land management in general and for restoration specifically. Furthermore, because benefits accrue to the general public and are hard to quantify, it is difficult to determine how restoration should be paid for, the distribution of benefits, and which areas should be restored first (Holl and Howarth 2000).

### **Conflict Stemming from Divergent Meanings and Values**

Conflict over mechanical harvesting and prescribed burning is common in the Southwest. The region's complex cultural history and its transition from a resource-extractive economy to an amenity-driven economy, along with its significant percentage of public lands and a history of escalating wildfires, have contributed to social discord regarding restoration activities. While most scientists and restoration practitioners agree on the basic tenets of southwestern ponderosa pine restoration, such as the fact that current forest conditions include too many trees (particularly in the smaller diameter classes) and that the dominant structure leaves forests susceptible to uncharacteristic fire behavior and insect epidemics (Covington and Moore 1994, Allen et al. 2002, Schumann 2004), agreement on specific restoration prescriptions and techniques has been elusive. By its very nature, ecological restoration touches on fundamental questions about the relationships between people and the natural environment, and is therefore fertile ground for conflict. Social discord has been a common ingredient in planned restoration projects across the Southwest (e.g., Friederici 2003, Moote 2003, Lenart 2006) and is often manifested in the form of legal challenges (appeals and litigation),

attempts to sway members of the public or elected officials, and in some cases, direct physical confrontation (Burns 2003).

One of the most persistent and seemingly intractable debates in ecological restoration concerns what exactly is meant by the term "restoration." Academics and practitioners have defined it in a variety of ways (Jackson et al. 1995, Higgs 1997, Noss et al. 2006), and regional scientists have specifically defined restoration for southwestern ponderosa pine (Moore et al. 1999, Allen et al. 2002). Even when focused on just ponderosa pine systems, "restoration" can be used to describe a variety of management actions, from tree thinning for purposes of wildfire protection to attempts to re-create presettlement forest structure, or the removal of roads and cattle and reintroduction of large predators (Moore et al. 1999, Allen et al. 2002). Public understandings of forest restoration are further complicated by widespread conceptions of both fire and tree removal as powerful symbols of environmental degradation (Shindler 2007). In a series of interviews with southwestern forest stakeholders, Abrams (2005) found that a lack of clarity on the definition of restoration was perceived as a major impediment to moving forward with management activity.

In the Southwest, value conflicts commonly arise over the definition of ecological restoration, but also over the removal of large trees and the economic benefit derived from restoration byproducts. For example, during deliberations over planned restoration demonstrations in northern Arizona, at least three distinct restoration approaches were advocated by different interests: university scientists wanted to implement treatments based on the principle of ecological fidelity to historic (pre-Euroamerican settlement) conditions; environmental interest groups were concerned about the subsequent commercial incentives derived from these restoration

treatments and thus advocated for removing only the smallest low-value trees; and finally, some community officials wanted to focus primarily on hazardous fuels reduction with little consideration for ecological restoration criteria (Friederici 2003).

### ***Lack of Accounting for Nonmarket Benefits of Restoration***

Restoration of southwestern forests produces numerous ecological and social benefits that are often not accounted for or fully recognized. The effort to offset the high costs of ponderosa pine restoration has been aimed at utilizing thinned small-diameter wood and biomass. The sale of these products offers one type of economic benefit. Other economic benefits such as air, soil, and water quality improvements, along with the provision of recreational opportunities, are non-market in nature. A range of possible economic benefits derived from related restoration activities includes regional employment- and income-multiplier effects, direct- and indirect-use values, avoided costs, ecosystem service enhancements, and option and bequest values (Box 1). When fully incorporated into a comprehensive land-management accounting system, these values can provide avenues for recouping treatment costs and recognition for the full suite of economic benefits associated with ponderosa pine restoration projects.

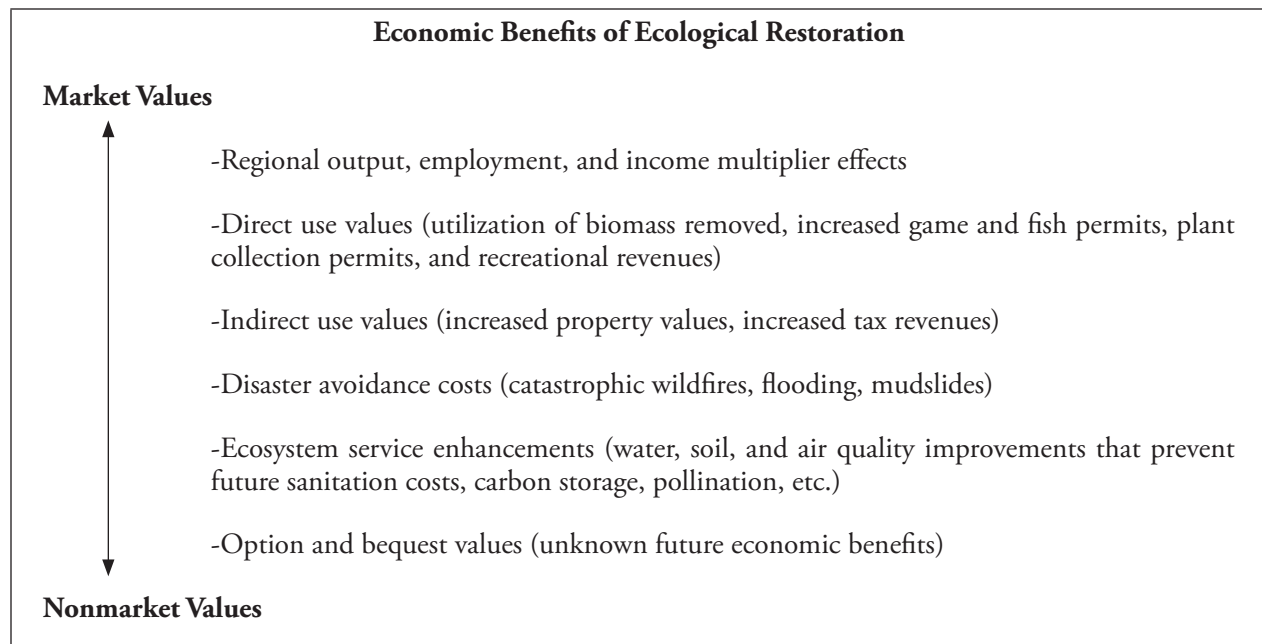
Some economic benefits, like the sale of thinned ponderosa pine material, provide revenue to landowners and businesses that may sustain further investment in restoration activities. Regional benefits can be generated in the form of output, employment, and income, which in turn may stimulate investment in the skills, infrastructure, and equipment necessary to process byproducts of restoration or to carry out restoration activities. Restoration employment and income benefits also accrue to secondary businesses supporting employees' basic living needs,

providing a multiplier effect in terms of benefits generated (Hjerpe and Kim 2008).

Direct-use values can be traded in the market, as in the case of byproduct utilization such as thinned biomass and small-diameter logs. Other direct-use values might include game and fish habitat improvements resulting in more hunting and fishing permits sold, increases in plant collection permits, and increased recreational revenues from enhanced ecological services in high-amenity locations. Groups dependent upon habitat for recreational fishing or hunting may also be willing to fund forest restoration projects, as occurred recently when the Rocky Mountain Elk Foundation contributed funds to the implementation of the White Mountain Stewardship Contract in eastern Arizona.

Indirect use values are values that typically accrue near or adjacent to the site being restored, such as an enhanced fishery resulting from restoration of freshwater spawning grounds. In the context of southwestern ponderosa pine restoration, Kim and Wells (2005) used a simple hedonic price model to illustrate a significant increase in property values for homes located close to forests that received restorative treatments. Ponderosa pine restoration can also be used as a preventive measure for reducing the damage and intensity of catastrophic crown fires. Recent conflagrations throughout the West are larger and burn at a greater intensity than wildfires of the past (Schoenagel et al. 2004). In the highest risk forests, restoration can avert fatalities, structural losses, timber losses, rehabilitation costs, and enhance future existence values. Combining averted costs with other economic benefits has been estimated to produce some \$3,500 per hectare in net benefits (Mason et al. 2006). Avoided costs can be substantial and, if reasonably estimated, can offset restoration costs via revenue transfer mechanisms.

## Box 1. The economic benefits of ecological restoration arranged from market values to nonmarket values.



Water, soil, and air quality improvements, the reestablishment of biological diversity, and increased carbon storage capacities are all ecosystem service enhancements that may provide further economic benefit. By restoring the ecological integrity of forests in the Catskill Mountain watershed, for example, New York City averted an \$8 billion cost for new sanitation facilities and saved an estimated \$6 billion (Chichilnisky and Heal 1998). Option and bequest values, or the full range of resource opportunities provided by healthy ecosystems to future generations, provide additional benefits. Passing on healthy ecosystems to future generations will preserve many economic possibilities that may be linked to forthcoming technological advancements, medical discoveries, and new energy sources.

### **Biomass and Small-Diameter Wood Utilization**

Biomass and small-diameter wood utilization offers one way in which the costs of forest restoration activities in

the Southwest may be reduced. The social complexity of small-diameter stand management rivals that of the associated technical and ecological issues (Findley et al. 2001), but the result of byproduct utilization may prove beneficial in terms of bringing together traditional adversaries, merging competing perspectives of land uses, and helping to fund restoration activities including the monitoring of treatment effects.

While efforts have been focused on increasing awareness and garnering greater federal appropriations, most southwestern community organizations and regional forest-health strategies have placed increasing emphasis on utilizing restoration byproducts in hopes of ameliorating the high financial burden (Friederici 2003, Lenart 2006, GFHC 2007). Revenues generated from the sale of restoration byproducts can reduce dependency on federal coffers for financing southwestern forest restoration. Unlike traditional forest products-based extraction, the forest products economy emerging in the Southwest is

focused on the utilization of biomass and small-diameter wood from restoration treatments, with recognition that restoration—not utilization—is the driving force (Lynch et al. 2000, Daugherty and Snider 2003). Ecologists and many environmental advocates in the region second the need for byproduct utilization to fund restoration (e.g., Allen et al. 2002, Romme et al. 2003). The challenge is that the economic and social infrastructure of the region is not adequately aligned with the capacity to harvest, process, market, and sell small-diameter ponderosa pine.

### **Lack of Appropriately Scaled Infrastructure**

The most widely referenced barrier to funding ponderosa pine restoration is the lack of infrastructure for logging, manufacturing, and marketing (Table 1). Much of the traditional infrastructure has been dismantled following federal land management changes over the past 20 years (Fight et al. 2004). Furthermore, remnant harvesting, hauling, and processing

technologies are mostly ill-suited to the task of adding value to the type of material removed from restoration treatments. Much of the existing infrastructure will need to be retooled in order to efficiently remove and utilize the variety of small-diameter trees and biomass from brush and harvest residues common in southwestern forest restoration scenarios.

Trees to be removed under a restoration approach are primarily small diameter, placing wood-products businesses at a disadvantage due to increased costs of handling logs and substandard physical characteristics. This disadvantage is increased by the availability of cheaper, larger-diameter wood from other parts of the United States, Canada, South America, and New Zealand. Larger-diameter ponderosa pine is better suited for structural building applications (Hernandez et al. 2005) and is generally cheaper to harvest and process (Fight and Barbour 2005). Despite these economic disadvantages, however, biomass and small-diameter wood represent usable resources that offer entrepreneurial opportunities. Market development is occurring in areas of roundwood construction, landscaping applications, densified fuels for heating, biochemical extraction, electricity generation, and engineered lumber and panels (Spelter et al. 1996, Friederici 2003, Lenart 2006).

### ***Inconsistent Supply of Wood***

Another funding barrier is inconsistent supply. Supply transfers and contractual requirements are more rigorous for prospective wood processors in national forests than in private forests, leading to inconsistent and unpredictable supply, and complicating financial planning (Lynch et al. 2000, Mater Engineering 2004). Erratic and unpredictable supply of public timber is caused by delays in National Environmental Policy Act (NEPA) analysis, archaeological site considerations, litigation, seasonal restrictions, staff limitations, and budget appropriations. Without consistent supply

upon which to develop viable business plans, even with the abundance of material proposed to be removed, estimated at 283 million cubic meters of material 13–41 cm dbh for 0.9 million hectares of at-risk ponderosa in the Southwest (Larson and Mirth 1998), businesses are unable to predict payments for contracts to repay investment loans. Multiyear stewardship contracts, where the sale of material is used to offset treatment costs and where wood supply is somewhat more predictable, have shown promise as a tool to attract industry investment.

### ***Social Conflicts***

Much of the debate in the Southwest concerning ponderosa pine restoration is the result of conflicting perspectives on the role of wood utilization in the context of forest restoration and, in particular, the role of commercial enterprises profiting from restoration efforts and the removal of large trees (Table 1). The removal of large trees is indicative of the debate over definitions of restoration, and there are several reasons for this. The recent flurry of restoration activity on public lands follows decades of national and local campaigning by wildlife, conservation, and environmental organizations to reduce or eliminate commercial timber harvesting on public lands (Clary 1986, Durbin 1996, Nie 2003). At the same time, much of the recent population boom in the region consists of exurbanites for whom natural amenities are a major attraction (Marzluff and Bradley 2003). The idea of cutting down trees, particularly large trees, in the name of restoration can be anathema to those who moved to be “closer to nature.” Yet, for the most part, the contemporary debate is not whether to thin but rather what trees to thin and where (Allen et al. 2002).

Distrust of commercial enterprises and profit motivations has, in many places in the Southwest, led to a restriction on the size of trees that can be harvested, often referred to as diameter caps. A diameter cap provision is

often added to projects at the insistence of environmental groups, based on their fear that forest restoration could simply be a ruse for commercial logging and on a belief that larger trees are needed to replace presettlement trees lost through previous timber harvesting activities. Some scientists and restoration practitioners support the diameter cap concept in southwestern forest restoration (Allen et al. 2002), while others find that it has the potential to prevent the achievement of restoration objectives by leaving too many trees and failing to re-create historic openings (Abella et al. 2006). Collaborative partnerships and multiparty monitoring efforts that work to provide the social license for experimentation and adaptive management may offer opportunities to move beyond diameter cap conflicts (Lenart 2006).

Conflicts over diameter caps are inextricably linked to issues of trust and judgment regarding the appropriateness of different forms of human intervention in natural systems, including the appropriateness of blending economic motives with restoration principles in order to pay for the necessary treatments. The diameter cap issue not only has implications for social conflict, it also has ramifications for restoration economics through its effects on the type of wood byproducts that are produced during restoration activities.

### ***Next Steps***

Our literature review reveals the primary socioeconomic barriers to the restoration of fire-adapted, southwestern ponderosa pine forests. We have examined the relationship between these barriers and the role of biomass and small-diameter wood utilization. We offer the following four opportunities, synthesized from the case studies, for overcoming barriers to large-scale restoration in southwestern ponderosa pine forests. These steps may prove applicable to restoration in other parts of the country.

First, restoring ponderosa pine forests to a level where fire can be safely reintroduced requires the reduction of large quantities of biomass, providing a usable resource for traditional wood products, bioenergy, biofuels, composites, and nontraditional manufactured products. If much of the excess material can be utilized, product sales can pay for a large portion of ponderosa pine restoration costs. The selected case studies suggest that efforts are needed to help develop appropriate markets. These efforts must consider the predictability or consistency of restoration byproducts in order to amortize investment costs and align the necessary human and physical capital with local restoration needs.

Secondly, giving greater recognition to nonmarket benefits of restoration can augment the justification and rationale for restoration and distinguish approaches that provide the greatest return on investment. The reviewed case studies suggest that attention to nonmarket benefits may identify avenues for further funding and for increasing social acceptability. Actions include the quantification of nonmarket benefits, gaining compensation from indirect use beneficiaries, averting future costs through preventive measures, estimating savings yielded from ecosystem service enhancements, and accounting for option and bequest values. Ponderosa pine restoration provides benefits to the general public by way of enhanced ecosystem functions, indirect use values, avoided cleanup costs from catastrophic wildfires, and resources for future economic possibilities. Capturing the value of ecosystem service enhancements may offer the greatest potential for funding restoration projects.

Thirdly, ponderosa pine restoration, unlike traditional commodity-based forest management, offers a unique opportunity to meet divergent interests simultaneously: restoration of degraded landscapes, community development through byproduct utilization, and long-term aesthetic

enhancement. Fully unlocking the potential of these possibilities and incorporating the knowledge, skills, and beliefs of invested stakeholders will require changes on the part of restoration and forest management professionals who may be unaccustomed to the sometimes slow, often delicate processes of trust-building, mutual learning, and shared decision making. It may also require professionals to move past appeals to “science” as a neutral arbiter of environmental conflicts, to confront the complex interplay of values, cultural understandings, and various forms of knowledge that provide the basis for restoration decisionmaking. Inclusive collaboration can thus be used to determine restoration principles, plan for community needs from economic development to wildfire risk reduction, gain the social license necessary to test restoration alternatives, and monitor the effects of restoration practices.

Finally, incorporation of socioeconomic considerations in restoration planning can provide safeguards for business investment. Recently, a group of land management agencies, environmental interests, and commercial enterprises agreed to a set of restoration principles that provide assurances of ecological integrity while also providing financial assurances of biomass supply to businesses over a period of several years (NMBET 2006). Such accords are necessary to encourage investment in appropriately scaled and matched infrastructure and may also reduce conflict by setting acceptable parameters for the type and magnitude of restoration that will be implemented.

## Conclusion

The social context of resource management is as important as biophysical or ecological knowledge (Hull and Gobster 2000, Findley et al. 2001, Shindler et al. 2002). This is particularly true for restoration, where experience shows the peril in implementing projects

without thorough consideration of socioeconomic dimensions (Helford 2000, Nabhan 2003). Whether projects fail or are delayed owing to a lack of funding or litigation, the socioeconomic barriers dominate the outcome. Scientists and practitioners embark on ambitious restoration projects assuming that good science will lead to expected outcomes, only to find a diversity of social values and relationships vastly complicating their efforts. The socioeconomic barriers to forest restoration and small-diameter wood and biomass utilization we have identified in the southwestern United States are indicative of issues plaguing ecological restoration efforts in many parts of the country. By more fully acknowledging the role of socioeconomic values in restoration practice, we can now incorporate economic opportunity and wiser social policies to facilitate restoration.

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