RESTORING OAK SAVANNA TO OREGON'S WILLAMETTE VALLEY:

USING ALTERNATIVE FUTURES TO GUIDE

LAND MANAGEMENT DECISIONS

by

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"Restoring Oak Savanna to Oregon's Willamette Valley: Using Alternative Futures to Guide Land Management Decisions," a thesis prepared by Jennifer R. Garmon in partial fulfillment of the requirements for the Master of Science degree in the Environmental Studies Program. This thesis has been approved and accepted by:

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Innovative strategies are needed to restore imperiled Oregon white oak savanna in Oregon's Willamette Valley. Stakeholders representing a variety of relevant backgrounds and perspectives were brought together to create of a set of alternative land management scenarios designed to restore oak savanna and reduce fire hazards. The resultant set of five scenarios applies to a variety of site conditions and ownership types, and represents contrasting values, approaches and priorities. The ultimate use of these scenarios will be to enhance and empower decision making by forecasting and comparing their effects on the landscape**.** A further value of the scenario development process was the meaningful engagement of stakeholders and the articulation of key forces driving land management decisions. This project represents an adaptation of alternative futures analysis toward the

specific needs and goals of land management and restoration, resulting in a transferable framework applicable to a wide range of conservation planning projects.

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TABLE OF CONTENTS

LIST OF FIGURES

Figure Page

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Once widespread in the Willamette Valley, Oregon white oak savanna is now one of the most endangered ecosystems in the United States (Noss 1995). While oak communities have been identified as conservation priorities, those working to conserve and restore oak savanna face significant challenges (Oregon Biodiversity Project 1998; Oregon Department of Forestry 2001). Conifer invasion due to fire exclusion, urban and rural residential development, agriculture, and invasive exotic species have all been identified as key factors in the decline of oak savanna (Agee 1993; Baker et al. 2004; Fuchs 2001; Vesely and Tucker 2004).

Because of reduced fire frequencies relative to historic levels and the invasion of exotic species, oak savanna requires active management. However conservation and restoration strategies are generally not well developed or standardized. This poses particular challenges because most remaining oak habitat in the Willamette Valley is located on privately owned lands. Restoring Oregon white oak savanna will require immediate implementation of innovative and effective strategies.

Fire hazard reduction is another pressing environmental and social issue in the Pacific Northwest. The decades of fire suppression that threaten oak savanna have also led to a build-up of hazardous fuels, increasing the threat of high intensity wildfires. This is a particular concern in the wildland-urban interface, where many homes are being built without consideration of fire hazards (Pacific Northwest Wildfire Coordinating Group 1999). The U.S. Forest Service has recognized that restoring healthy ecosystems and reducing the build up of hazardous fuels through vegetation removal, prescribed fire and other means are important components of a wildfire management strategy (Laverty and Williams 2000).

Restoration of oak savanna, a fire-adapted ecosystem, can lower fuel accumulation and create conditions that decrease the risk of intense fires. The widely dispersed trees of a savanna make it less capable of carrying a crown fire than a forest, and, while a fire can easily be started in the herbaceous ground layer of a savanna during the hot summer months, it can also be easily extinguished. Furthermore, certain characteristics of oaks themselves make them less prone to spread wildfire than conifers. Their wood and leaves contain less flammable resin, and their branch structure reduces ladder fuels by creating vertical separation between layers (Vesely and Tucker 2004).

The conservation and restoration of oak communities has become a high priority in the Pacific Northwest (Oregon Biodiversity Project 1998; Oregon Department of Forestry 2001). However, many of these projects are focused on site-specific needs and conditions that may not be transferable to other sites. The site-by-site approach that has generally characterized oak savanna restoration efforts has resulted in the lack of a coordinated, comprehensive strategy.

Alternative futures analysis, a process that allows comparisons of the effects of different land use options, may offer useful tools for planning efforts to link oak savanna restoration and fire hazard reduction. For this study, I adapted the approach of alternative futures analysis toward developing and prioritizing a set of alternative land management scenarios with the dual goals of restoring oak savanna and reducing fire hazard in Oregon's southern Willamette Valley. The following questions guided this study:

1. What are the key issues driving oak savanna restoration and fire hazard reduction in the southern Willamette Valley, according to the stakeholders involved in such efforts?

2. Can these issues be incorporated into a small set of alternative land management scenarios that both (1) encompass the range of site conditions and management needs in the southern Willamette Valley, and (2) represent contrasting values, approaches or priorities to allow useful comparisons?

3. How might this framework for alternative land management scenarios be transferable to other restoration planning projects?

To answer these questions, a stakeholder group was formed to help identify a set of land management scenarios to accomplish both oak savanna restoration and fire hazard reduction, with the overall goal of developing a transferable framework that may be applicable to other types of restoration projects. In the remainder of this chapter I provide a general background for this project, an overview of alternative futures analysis, and a brief description of relevant ecology and history of Oregon white oak savanna and challenges to its restoration. The methodology used in this study is described in chapter II. Chapter III provides the results of the research. Chapter IV addresses the three questions posed above, considers how this research may inform oak savanna and fire hazard reduction planning efforts in Oregon's Willamette Valley, and makes recommendations for future applications of this research.

Project Background

This section discusses the challenges to restoring oak savanna, and the potential to adapt and apply alternative futures analysis to address these challenges. To provide context and facilitate an understanding of how alternative futures analysis might apply to Oregon white oak savanna, an overview of the ecology and history of Oregon white oak savanna is also presented. For the purposes of this study, conservation is defined as maintaining existing landscape conditions, and restoration refers to returning ecological functionality to a landscape, using historical conditions as a reference.

Status of Oak Savanna in Oregon's Willamette Valley

It is estimated that when Euro-Americans settled in Oregon's Willamette Valley in the mid-nineteenth century, oak savanna covered much of the valley floor and foothills (Baker et al. 2004; Habeck 1961; Hulse, Gregory, and Baker 2002; Sinclair 2005; Vesely and Tucker 2004). Oregon white oak savanna is generally described as a scattered tree canopy of large and open-grown trees, dominated by Oregon white oak (*Quercus garryana*), but also with ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii)*. Trees are in a matrix of a mostly continuous herbaceous ground layer of primarily grasses and forbs (Agee 1993; Hulse, Gregory, and Baker 2002; Peterson and Reich 2001; Vesely and Tucker 2004).

It is estimated that less than one percent of the Oregon white oak savanna and forests found in the Willamette Valley in pre-Euro American settlement times remains today (Hulse et al. 2000; Oregon Biodiversity Project 1998; Vesely and Tucker 2004).

Given that over 200 wildlife species use oak savanna and woodland communities, including eight species listed as threatened or endangered, its imperiled status could have serious effects on local and regional biodiversity (Chiller, Veseley, and Dean 2000; Oregon Biodiversity Project 1998; Oregon Natural Heritage Information Center 2004; Vesely and Tucker 2004). Accordingly, Willamette Valley oak savanna has been designated as a conservation priority by the Oregon Biodiversity Partnership, a coalition of conservation groups, and the Oregon Department of Forestry (Oregon Biodiversity Project 1998; Oregon Department of Forestry 2001).

Challenges to Oak Savanna Restoration

As noted above, efforts to restore oak habitats must address a number of challenges. As a fire-adapted community, oak savanna cannot simply be set aside in reserves and left alone. To persist, oak savanna requires active management on all but the harshest sites where conifer succession appears to pose less of a threat.

Further complicating these issues is the fact that an estimated 98% of the Oregon white oak habitat remaining in the Willamette Valley is on private land (Oregon Biodiversity Project 1998). While restoring fire or an alternative disturbance regime to reduce conifer encroachment may be feasible on some publicly owned sites, private landowners may not have the interest or resources to undertake active management. Furthermore, while the reintroduction of regular fires to oak restoration sites might be an effective management technique, it is not always feasible or desirable, due to site constraints, concerns about smoke, air quality and safety, and the potential to exacerbate the spread of invasive species. Compliance with Oregon's Forest Protection Act, which requires replanting of trees removed, permits for prescribed fires, and other requirements can also impede oak savanna restoration efforts. Such regulations can burden private landowners and dissuade them from engaging in restoration projects.

Oak savanna restoration efforts face other societal barriers as well. The removal of Douglas-fir and other trees is often crucial to restoring oak savanna. However, forests have become a highly valued landscape in the Pacific Northwest. Removal of encroaching trees could be perceived negatively by certain stakeholders who may be unwilling to support restoration if it involves cutting trees. On a more philosophical level, some people question the value of restoring a community such as oak savanna that requires a high degree of human intervention to sustain it.

Even assuming a public willingness to restore oak savanna, restoration strategies are complex and pose difficult trade-offs. One challenge is the general lack of experience with and knowledge about successful restoration techniques for oak savanna. Questions about the most effective short- and long-term management strategies, as well as competing interests and values, complicate restoration efforts.

To date, these challenges have not been explored systematically. Like many other conservation projects, oak savanna restoration efforts in the southern Willamette Valley have occurred mostly on a case-by-case basis without coordination or consideration of landscape-level applications. There has been no systematic inquiry about how to restore oak savanna to optimize benefits and minimize costs at site or landscape scales. This is especially troubling given the ownership patterns of remaining savanna. Private landowners are unlikely to be willing to initiate restoration efforts on their lands if substantial uncertainty exists about restoration and management strategies and costs. Clearly, decision-making tools to help landowners and managers navigate these complex issues would be highly valuable.

Alternative Futures Analysis

> Planning for conservation is a process that uses scientific data, but that ultimately depends on the expression of human values. Science can help inform citizens about the basic patterns and processes of natural systems, but citizens must express personal values to determine which end-points are most desirable. Scientists should not offer answers. Instead, they should press citizens to articulate their values and goals for the landscapes where they live. (Theobald et al. 2000, 43)

The types of challenges faced in conserving and restoring oak savanna are not unique. "Policymakers and stakeholders are under pressure to promote both environmental restoration and land development plans that address present concerns, while having limited knowledge of the long-term impacts of these decisions on the regional system" (Berger and Bolte 2004, 342). Alternative futures analysis has emerged as an approach to empower land use and conservation decision-making in the face of such challenges.

Although alternative futures analysis has typically been applied to comprehensive land-use planning, it approaches could be adapted toward comparing alternative land management approaches to achieve a specific conservation or restoration goal, such as oak savanna restoration. To begin an exploration of this idea, I will first provide an overview of the history and application of alternative futures analysis.

Overview

The use of alternative futures analysis "allows stakeholders and decision-makers to assess the relative impacts of several alternative sets of options and thus provides an important tool to help make better informed choices for an informed future" (Kepner et al. 2004, 26). Decision makers have used scenario analysis of possible futures since the 1950s (Shearer 2005). Recently, alternative futures analysis has been used to help integrate science into land-use decision making and to meaningfully engage stakeholders (Baker et al. 2004; Baker and Landers 2004; Berger and Bolte 2004; Hulse, Branscomb, and Payne 2004; Kepner et al. 2004; Nassauer and Corry 2003; Peterson, Cumming, and Carpenter 2003; Steinitz et al. A delicate balance: Conservation and development scenarios for Panama's Coiba National Park 2005). One particular application has been the analysis of alternative land-use planning and development scenarios for regions experiencing high population growth and development pressure, such as the Mojave Desert (Hunter et al. 2003) and San Pedro (Kepner et al. 2004) in California; the Willamette Valley in Oregon (Baker et al. 2004); Monroe County, Pennsylvania (Steinitz and McDowell 2001); Wisconsin (Peterson et al. 2003); a national park in Panama (Steinitz et al. A delicate balance: Conservation and development scenarios for Panama's Coiba National Park 2005); La Paz, Mexico (Steinitz et al. A sustainable path? Deciding the future of La Paz 2005) and the Northern Mediterranean region (Kok, Rothman, and Patel 2006). Alternative futures analysis has been used specifically as a tool to assess potential impacts to biodiversity on a landscape scale from various land uses (White et al. 1997).

Alternative futures analysis can guide land-use decisions in two respects: by incorporating ecological knowledge about landscapes and how they change over time into sociopolitical land-use decision-making processes; and by forecasting the on-the-ground effects of implementing different land use and management options (Baker et al. 2004; Hulse, Branscomb, and Payne 2004).

The key steps in this process are (1) describing how a particular landscape has changed over time, (2) creating a suite of scenarios that embody stakeholder values and land-use options, (3) using the scenarios to spatially depict the future alternatives, (4) analyzing these alternatives for their impacts on various indicators, and (5) synthesizing these effects to allow a comparison of the alternatives (Baker and Landers 2004; Hulse, Branscomb, and Payne 2004). The traditional use of alternative futures analysis for landscape planning has involved the use of Geographic Information Systems (GIS) and the construction of models that simulate key ecological and human processes affecting a specific geographic area. This technology allows the effects of the scenarios to be forecasted and evaluated on the landscape (Kepner et al. 2004).

Construction of Scenarios and Resulting Alternative Futures

Nassauer and Cory describe scenarios as “the different possible stories, or alternative assumptions, that underlie landscape change” (Nassauer and Corry 2004, 344). Scenarios are “plausible, challenging, and relevant stories about how the future might unfold that can be told in both words and numbers” (Kok, Rothman, and Patel 2006, 264). The predicted effects of these scenarios on the landscape are the resulting alternative futures (Nassauer and Corry 2003). In other words, the scenarios are the stories or narratives that describe alternative futures or contrasting trends (Nassauer and Corry 2003). These scenarios can be used by decision makers to decide what to do now, based on the possible futures analyzed (Wollenberg, Edmunds, and Buck 2000).

Rather than representing predictions or preferred policy options, scenarios should be chosen to bracket a range of contrasting, conceivable alternatives to allow the exploration of the unknown consequences of a decision (Baker et al. 2004; Hulse, Branscomb, and Payne 2004; Kok, Rothman, and Patel 2006; Nassauer and Corry 2003; Peterson, Cumming, and Carpenter 2003; Santelmann et al. 2004). Scenarios are not aimed at 'getting it right" (i.e., predicting what will actually happen on every part of a study area at some time in the future) so much as highlighting the major driving forces and how they relate to each other (Wollenberg, Edmunds, and Buck 2000).

Once a suite of alternative futures is identified, the next step is to describe the landscape's current conditions, the plausible future conditions, and the differences between these two conditions (Druckenbrod and Dale 2004). Plausible future conditions should incorporate both ecological considerations and human values, representing an intersection between the needs of the land and the desires and needs of people (Druckenbrod and Dale 2004)

Another important element of scenario analysis is involving stakeholders throughout the process (Kok, Rothman, and Patel 2006). In addition to allowing a comparison of the effects of various pathways or decisions, the scenario development process itself can benefit those involved by helping them better understand the situation and articulate their values and concerns (Nassauer and Corry 2003; Wollenberg, Edmunds, and Buck 2000). Alternative futures analysis projects have incorporated stakeholders to varying degrees. Some efforts have been driven by citizen stakeholder input, generally increasing buy-in and the political viability of the results. At the other end of the spectrum are processes that rely upon the guidance of experts to design scenarios, possibly resulting in more scientifically valid results but less likely to engender widespread public support. Others fall somewhere in between these extremes (Hulse, Branscomb, and Payne 2004).

Alternative Futures Analysis in Restoration Planning

Given the pressing need to apply successful techniques to oak savanna restoration and fire hazard reduction, alternative futures analysis emerges as a promising approach. While this tool has traditionally been applied to land-use planning, the potential for using it to enhance ecological restoration efforts may be significant. In particular, the use of alternative futures could greatly improve the ability of stakeholders to choose effective restoration strategies. I describe below the adaptation of the concept of alternative futures analysis to a research and restoration planning project concerning Oregon oak savanna in Oregon's Willamette Valley.

Research Project: Landscape Level Approach to Fuels Management Through Ecological Restoration

The University of Oregon and U.S. Forest Service, with the help of various landowners, land managers, and other stakeholders, are developing a landscape-level approach for jointly restoring oak savanna and managing wildfire hazard in Oregon's southern Willamette Valley. The project has three primary components: (1) an analysis of the trajectories of ecological change of historic oak savanna, (2) an alternative futures analysis of the potential to integrate oak savanna restoration and fire hazard reduction, and (3) a Geographic Information Systems (GIS) analysis of landscape-level restoration opportunities. The trajectories of change analysis will focus on the patterns and mechanisms of succession from prior to Euro American settlement to present on sites that were not completely transformed by development or agriculture. Working with stakeholders to create and refine the land management scenarios that support the alternative futures analysis is the focus of this study. The results of the analysis of ecological change will be used to model and evaluate the potential effects of the land management scenarios at the site scale (between eleven and eighty hectares) and, coupled with the GIS analysis, at the landscape level (Willamette Valley ecoregion). Figure 1 depicts the how this analysis of land management options would serve as a decision tool.

To assess how alternative futures analysis might be adapted to meet the needs of this project, it is important to understand the ecological and historical trajectory Oregon white oak savanna in the Willamette Valley.

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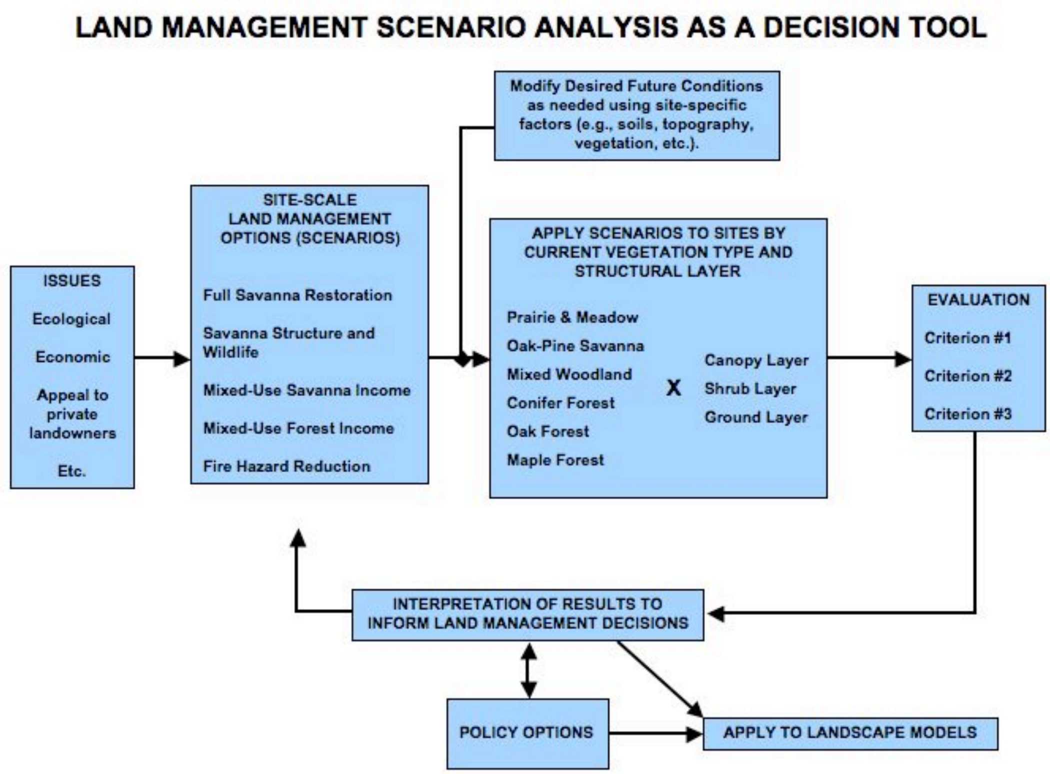
FIGURE 1


LAND MANAGEMENT SCENARIO ANALYSIS AS A DECISION TOOL
Modify Desired Future Conditions as needed using site-specific factors (e.g., soils, topography, vegetation, etc.).
ISSUES
Ecological
Economic
Appeal to private landowners
Etc.
SITE-SCALE LAND MANAGEMENT OPTIONS (SCENARIOS)
Full Savanna Restoration
Savanna Structure and Wildlife
Mixed-Use Savanna Income
Mixed-Use Forest Income
Fire Hazard Reduction
APPLY SCENARIOS TO SITES BY CURRENT VEGETATION TYPE AND STRUCTURAL LAYER
Prairie & Meadow
Oak-Pine Savanna
Mixed Woodland
Conifer Forest
Oak Forest
Maple Forest
X
Canopy Layer
Shrub Layer
Ground Layer
EVALUATION
Criterion #1
Criterion #2
Criterion #3
INTERPRETATION OF RESULTS TO INFORM LAND MANAGEMENT DECISIONS
POLICY OPTIONS
APPLY TO LANDSCAPE MODELS

Oregon White Oak Savanna

Certain aspects of the ecology and history of Oregon white oak savanna in Oregon's Willamette Valley are particularly salient to an understanding of the potential value of alternative futures analysis for informing land management decisions. Such issues include the need for disturbance and active management to sustain oak savanna, its life history and community dynamics, its habitat value for certain animal species, and the factors leading to its decline over time. This section provides an overview of these issues.

Oak Ecology

Oregon white oaks can occupy a wide range of environmental conditions. They can tolerate periods of flooding and drought, and can grow on a variety of soil types (Stein 1990). However, despite deep taproots that provide protection against drought, seedlings at xeric sites can be vulnerable to water stress (Fuchs 2001). In addition, Oregon oaks generally grow on gentle topography; only one fourth of the oaks studied in the Willamette Valley in 1968 were found on slopes greater than thirty percent (Thilenius 1968).

Although Oregon white oak seedlings are tolerant of shade for the first two years, saplings and mature trees are highly shade intolerant (Fuchs 2001). Shade will not only kill a white oak tree, but will also prevent understory species associated with Oregon oak savanna from establishing and persisting (Harrington and Devine 2006).

Oregon white oak communities rely on fire for establishment, maintenance and reproduction (Franklin and Dyrness 1988). Deep taproots, corky bark structure and sprouting abilities make the species more successful at surviving fire than many other tree species, such as Douglas-fir (*Pseudotsuga menziesii*), although seedling mortality does occur (Stein 1990). Fire not only prevents the establishment of many conifers, such as Douglas-fir, in oak savanna, it also stimulates stand regeneration by facilitating sprouting, which can be more effective than acorn-to-seedling establishment (Riegel, Smith, and Franklin 1992).

On more mesic sites and without disturbance such as fire, faster growing trees like conifers often out-compete Oregon oaks for resources (Agee 1993; Franklin and Dyrness 1988; Stein 1990; Thilenius 1968). Oregon white oak tends to be most competitive at xeric sites that experience drought during the summer and are poorly drained in the wet season (Chiller, Veseley, and Dean 2000; Stein 1990).

Oregon oak communities provide key nesting, feeding and roosting resources to numerous mammals, birds, reptiles and amphibians (Fuchs 2001; Wilken and Burgher 2000). Many vertebrate species use oak cavities, standing dead wood and downed wood (Fuchs 2001). Large oaks provide nesting habitat for a number of bird species. In addition to general use by resident bird species, migratory songbirds use oaks on rocky outcrops for refuge from inclement weather. In Oregon and British Columbia, Oregon white oak woodlands demonstrated a higher diversity of bird species than conifer forests, indicating white oak communities may be key to bird diversity on a regional scale (Fuchs 2001).

Oregon white oak ecosystems provide rich food sources for vertebrates and invertebrates (Chiller, Veseley, and Dean 2000). Gray squirrels, deer, black bear, livestock and other larger vertebrates feed on the acorns and the protein-rich leaves of young shoots and sprouts (Wilken and Burgher 2000). Bark on live trees, standing dead trees, downed wood, herbs and shrubs supply habitat for invertebrates, which in turn are a food supply for insect-eating vertebrates (Fuchs 2001).

The Decline of Oak Savanna in the Willamette Valley

The native range of the Oregon white oak extends from southwestern British Columbia, through western Washington and Oregon, and down to southern California (figure 2) (Harrington and Devine 2006; Thilenius 1968; Vesely and Tucker 2004). Since the Pleistocene era, changes in climate have caused both expansion and contraction of the range of Oregon oak savanna and woodland (Fuchs 2001; Whitlock 2002).

Paleoecological research indicates that oaks were not found in this region until around 9,000 years ago, when drier, warmer summer conditions allowed species more adapted to drought and fire to spread (Thilenius 1964; Whitlock and Knox 2002). At this point, oaks began to increase in abundance until about 5,000 years ago when they reached their maximum extent, associated with the climax of the warm, dry period following glaciation (Thilenius 1964). As the climate became increasingly cool and moist, oaks began to decline in numbers, while species better adapted to this climate such as Douglas-fir began to flourish (Thilenius 1968).

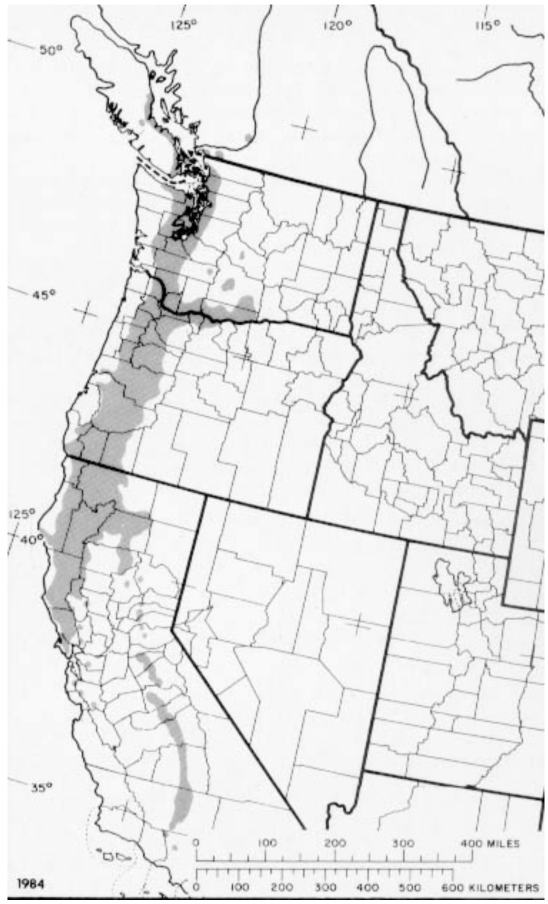


FIGURE 2

NATIVE RANGE OF OREGON WHITE OAK (Burns and Honkala 1990)

After the shift from the warm, dry climate that favored oaks to the cooler, wetter climate more suitable for Douglas-fir, it is thought that the indigenous peoples of this region used fire to maintain oak savanna. It appears that fire was used primarily to stimulate food plant production and increase hunting success (Boyd 1999; Habeck 1961; Wilson 2002). Regular fires set by Native Americans, thought to have occurred at least from 1647 to 1848 kept shrubs and less fire-tolerant tree species, such as Douglas-fir, from establishing (Franklin and Dyrness 1988; Hulse, Gregory, and Baker 2002; Sinclair 2005; Thilenius 1968). This fire regime changed with the settlement of Euro-Americans in the early 1830s, who displaced native peoples and eventually ended the anthropogenic fires (Boyd 1999; Sinclair 2005; Wallin et al. 1996). Active suppression of fire began around 1910 (Wallin et al. 1996).

Since the early 1900s, fire suppression has been a major factor leading to the decline of this species locally and across its range (Agee 1993). Removal of this disturbance has substantially altered the composition, structure and function of Oregon white oak ecosystems, primarily by allowing the succession of open oak savannas to closed-canopy woodlands and conifer forests (Riegel, Smith, and Franklin 1992). According to Agee (1993), up to 50% of all Oregon white oak woodlands susceptible to conifer invasion might disappear within 20 years. As the faster growing conifers grow up under the shade of the oaks and rise above their canopies, the capacity of the oaks to photosynthesize is reduced, leading to their eventual mortality. While the invasion of Douglas-fir forms the primary successional threat, oak savanna is also succeeding to big leaf maple and oak forest.

Changes in the fire regime have had other deleterious effects on oak communities. Fire cessation has led to changes in the understory of oak savannas, allowing shrubs to crowd out oak-associated grass and forb species (Chiller, Veseley, and Dean 2000; Thilenius 1968). In addition, regeneration of oaks is declining and studies have identified a link between oak regeneration and fire (Agee 1993; Peterson and Reich 2001).

As described previously, urban and agricultural development over the last 150 years have significantly affected Oregon white oak communities (Baker et al. 2004; Fuchs 2001; Vesely and Tucker 2004). Approximately 44% of the oak savanna found historically in the Willamette Valley has been converted to agriculture, another 44% has succeeded to forest and other types of vegetation, and about 8% is now urban development (Hulse, Gregory, and Baker 2002). Almost 70% of Oregon's population resides in the Willamette Valley, the fastest growing region in Oregon, and population is expected to almost double by 2050 (Hulse et al. 2000; Program. 2003; Sinclair 2005).

The introduction of invasive exotic species from agriculture, development, roads and recreational use poses a significant threat to into Oregon white oak communities (Chiller, Veseley, and Dean 2000; Vesely and Tucker 2004). Nonnative grasses are present in most Oregon white oak ecosystems, often dominating the ground layer. These plants not only out compete native grasses by capturing water and nutrients and blocking light, they also can alter ecosystem processes by increasing nitrogen, changing the groundlayer microclimate and modifying fire regimes (Fuchs 2001). As a result, exotic species can alter the species composition and vegetation structure of the groundlayer, reducing the abundance of native plants and changing the conditions that birds and other species rely upon. Compounding this problem is the expense and difficulty involved in removing exotic species and establishing natives in the groundlayer.

The ecology of Oregon white oak savanna, and the resulting need to actively manage it, combined with the other challenges discussed earlier in this chapter, highlight the need for novel approaches to its conservation and restoration. The need for active management in the form of fire, tree removal or other disturbance requires a high level of technical knowledge and commitment of time and resources. The need to act quickly before legacy oaks are overtopped and killed by other trees creates a sense of urgency to oak savanna restoration efforts. However, this sense of urgency must be balanced with the need to address the concerns of private landowners, and the controversy regarding fire and tree removal. This study explores how one approach, alternative futures analysis, may be adapted to help navigate these challenges.

The next chapter, methods, describes the methodology used to answer the questions posed in this study.

CHAPTER II

METHODS

This chapter describes the sampling methods, the stakeholder process used to gather data, how the data were analyzed, and the measures taken to ensure the validity of the data.

Sampling

To maximize its utility and relevance to oak savanna research, this study was designed to incorporate the values of, and key constraints upon, primary stakeholders (e.g., technical experts, land owners and land managers involved in oak savanna restoration or fire hazard reduction). To that end, a core stakeholder group was invited to participate in a series of four focus group sessions spanning two months in the fall of 2005. The purpose of these meetings was to design and prioritize a set of land management scenarios to achieve oak savanna restoration and fire hazard reduction goals. A focus group format was chosen, rather than individual interviews, to facilitate a dynamic dialogue and to maximize the generation and synergy of ideas (Berg 2001). To refine the results of the focus group sessions, researchers held three follow-up meetings with a subset of stakeholders.

Prospective stakeholders were invited to participate based on purposeful or criterion-based selection, a type of nonprobability sampling typical to qualitative research. This type of "expert sampling" involves deliberate selection of participants to provide the best information relevant to the subject of the study (Berg 2001; Maxwell 2005; Miles and Huberman 1994; Weiss 1994). For this study, a panel of experts and owners and managers of oak savanna was convened based on their expertise and experience with oak savanna restoration or fire hazard management in Oregon's Willamette Valley, making them uniquely qualified to inform the research. The following interests were deemed important to represent:

- Land owners and land managers
    - Public (federal, state and local)
    - Private (citizen, industrial, and nongovernmental)
    - Native American tribes (Willamette Valley)
- Technical Experts
    - Ecologists/biologists
    - Foresters
    - Site managers
    - Nongovernmental organizations (e.g., land trusts, watershed councils)
    - Fire managers (e.g., public agency fire specialists)
    - Community fire protection planners (e.g., participants in community fire planning processes)

Of the forty-five stakeholders who were invited to take part in the focus group sessions, thirty-five expressed interest in participating in some capacity. Stakeholder attendance at meetings ranged from eleven to twenty, with an average of sixteen participants per meeting. Although this sample size may appear small, it was appropriate for the purposes of this study; participants were specifically selected for their expertise and experience, and it was important to keep the number of stakeholders small to facilitate group discussions. To better understand the knowledge and skills possessed by the participants, stakeholders were asked to describe on a data sheet their areas of expertise and/or experience related to oak savanna restoration and fire hazard reduction.

To ensure that input and comments were accurately captured, and to inform participants about the outcomes of meetings they were not able to attend, detailed meeting notes were taken by multiple members of the research team. Following each meeting, these notes were compiled, synthesized and distributed to all participants, including those who were unable to attend the meeting. The notes focused on summarizing the key ideas generated and their applicability to project goals. At each meeting, the notes from the prior meeting were reviewed to allow stakeholders to make revisions to improve accuracy or to add any omitted comments. This process provided the continuity needed for a progression of ideas from broad issues to specific techniques.

Stakeholder Process and Data Collection

The focus group sessions were organized to begin by establishing a common foundation of key issues and to progress toward specific expressions of these issues in land management scenarios. The primary objectives were to:

- Identify the crucial issues relevant to oak savanna restoration and fuels reduction;
- Develop a set of three to ten land management scenarios that could be applied to a variety of site conditions and ownership types in the southern Willamette Valley; and
- Prioritize the scenarios based on perceptions of their usefulness and effectiveness for oak savanna restoration and fuels reduction.

Summary of Meetings

The stakeholder meetings started with a discussion of general concepts and moved toward greater specificity with each meeting. The meetings were designed to be both systematic in terms of structuring the meetings to achieve desired outcomes, and adaptive in terms of adjusting the plans based on lessons learned from previous meetings. The strategy was to first develop dialogue among stakeholders about broad issues critical to oak savanna restoration and fire hazard reduction, use these issues to guide the development of a set of specific land management scenarios, and then identify the desired future conditions and best management practices for those scenarios. A typical meeting included one or more brainstorming or problem-solving exercises, often conducted in small groups that were followed by reporting from each group and a synthesis of ideas and results.

The focus group meetings began with an introduction to the larger research project and a description of alternative futures analysis as a tool for land-use decision-making (both described in chapter I, introduction). Stakeholders were then asked to brainstorm the key issues driving oak savanna restoration and fire hazard reduction in the southern Willamette Valley. Focusing on these key issues, stakeholders were asked to identify land management scenarios that would apply to a variety of site conditions and ownership types in the southern Willamette Valley. Desired qualities for the scenarios were that they be practical, feasible, and representative of contrasting values, approaches or priorities to allow useful comparisons.

An initial vote was held to narrow down the list of scenarios generated. For the highest ranked scenarios, stakeholders developed narrative scripts and desired future conditions. Desired future conditions were defined as the specific vegetation conditions that would result if restoration goals and objectives were fully achieved. These scenarios are described in chapter III, results. Next, stakeholders identified the range of best management practices they would consider for the canopy, shrub and ground layers to achieve the desired future conditions. Best management practices were defined as the standard, recommended, effective and practical land management techniques that are widely used and should be a central part of a palette of techniques available to those working in oak savanna restoration and fire hazard reduction.

To allow a more detailed discussion of the desired future conditions and best management practices for the scenarios, a subgroup of stakeholders with expertise in restoration and land management was formed. This group met three additional times in the winter of 2006 to refine and complete the work started by the group as a whole, focusing on finalizing the desired future conditions and best management practices for the scenarios.

Survey Data Collection

After a set of land management scenarios was identified and described, stakeholders were given a scenario ranking survey (appendix A), asking them to rank the scenarios from one to five (with one as the highest priority) and explain the rationale for their ranking. Stakeholders were asked to base their ranking on what they considered to be the most relevant and important scenarios for conserving and restoring oak habitats in the Willamette Valley.

Data Analysis

Analysis of the stakeholder scenario ranking survey involved two steps: quantitative analysis of the rankings and content analysis of the comments. To analyze how stakeholders ranked the scenarios, the number of votes for each ranking was calculated for each scenario. If a participant gave the same rank to more than one scenario, the ranking was modified to distribute an equal number of points to the scenarios sharing a rank. The average ranking of each scenario was then calculated.

The commentaries from the survey in which stakeholders explained their rationale for their rankings were examined using content analysis (Berg 2001; Miles and Huberman 1994; Richards 2005). The data from the survey were sorted by scenario and by ranking to allow initial development of a set of categories representing advantages and drawbacks. Relevant comments (i.e., words, phrases or paraphrases) were extracted and inserted into these categories, sorted and grouped by themes within these categories, and examined for meaningful patterns within and across scenarios.

Validity of Data

Validity with respect to qualitative research refers to the “the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account" (Maxwell 2005, 124). One specific threat to the validity of data is researcher bias, in which a researcher chooses data that either fit the researcher's original theory or ideas, or that appear conspicuous to the researcher (Maxwell 2005; Miles and Huberman 1994).

Project researchers, including the author, entered into the stakeholder process with certain preconceived notions about the efficacy of various approaches to oak savanna restoration and fuels reduction. For instance, to achieve the objectives of the project, it was assumed and explicitly stated that the Full Savanna Restoration scenario would be part of the land management scenarios ultimately selected. These ideas could have influenced stakeholder input or how researchers interpreted input throughout the process.

One way to address the issue of validity is to regularly seek feedback about the data and conclusions drawn from study participants, called "respondent validation" (Maxwell 2005, 36). The comments and data captured at each group interview that were used to develop the scenarios were summarized and presented back to the participants for their feedback. This not only allowed stakeholders the opportunity to correct any inaccuracies or misrepresentations, but also enabled researchers to more easily identify any biases or misinterpretations of stakeholder comments.

Reactivity, the ways in which researchers and participants respond to each other during the qualitative research process, can also affect the validity of data. In such research it is important to understand and acknowledge this influence, rather than attempt to remove it completely (Maxwell 2005). In this project, although researchers deliberately limited their own contributions to the discussions, the interaction between researchers and participants in the focus group interviews was dynamic. It is possible that participants' mindfulness of the goals of the researchers or the researchers' behavior during the interviews affected their willingness to share comments or to contradict statements made by the researchers. However, researchers solicited feedback from participants about how to improve the meetings by distributing an evaluation form midway through the process, and no comments were received indicating a perception of undue researcher influence.

CHAPTER III

RESULTS

This chapter describes the results of the stakeholder process, in which participants identified the key issues driving oak savanna restoration and fire hazard reduction activities in the southern Willamette Valley, drew upon these issues to create a set of land management scenarios, and ranked these scenarios. The chapter begins with a profile of the stakeholders.

Profile of Stakeholders

A total of twenty-five stakeholders completed the participant profile form. Stakeholders were allowed to indicate as many areas of expertise or experience as they deemed appropriate. More than half of the stakeholders identified themselves as having expertise in biology and ecology, including some of the most experienced and knowledgeable experts in Oregon white oak savanna restoration (table 1). Public land managers had more representation than private landowners, and private landowners attended fewer meetings than public land managers. However, four participants indicated experience working as liaisons to private landowners and three noted their experience administering Oregon's Forest Practice Act as it applies to private landowners. Fewer fire managers were involved than was intended, although three additional people indicated a background in prescribed fire and fire ecology. Industrial landowners, such as those engaged in forestry, were not represented in the group. The cultural resource expert only attended one meeting.

TABLE 1

SUMMARY OF STAKEHOLDER EXPERIENCE AND EXPERTISE[1]

Area of Expertise or Experience	*Number of Stakeholders*
Public Land Manager (local)	3
Public Land Manager (state)	1
Public Land Manager (federal)	6
NGO Land Manager	2
Private landowner	7
Biologist/Ecologist	16
Forester/Silviculturalist	6
Fire Manager	2
Community Fire Planner	1
Cultural Resource Expert	1
Landowner Liaison	4
Other:	
o Restoration grants to private landowners	1
o Public parks outreach	1
o Horticulturalist	1
o Restoration Practitioner	1
o Steward Conservation Easements	1

[1]Sample size (n) = 25

Background Discussion of Key Issues for Oak Savanna Restoration and Fire Hazard Reduction

Stakeholders were first asked to identify the key issues that drive decisions regarding oak savanna management and reduction of fire risks in the southern Willamette Valley. The ideas from this exercise were summarized and categorized into two broad themes: (1) ideas that could be directly incorporated into land management scenarios; and

(2) ideas that were beyond the scope of the study and are more suited to a broader examination of oak savanna restoration and fire hazard issues. The former included the following categories: economic considerations; feasibility; savanna restoration priorities; and trade-offs. The latter included policy and economic issues; education and public support; lack of proven techniques; and potential conflicts with adjacent lands. These issues are summarized below.

Key Issues To Incorporate Into Land Management Scenarios

Economic Considerations

Economic considerations emerged as the key issue in these discussions, particularly with respect to private land, where most of the remaining oak savanna in the Willamette Valley is located. One break-out group of stakeholders noted that "there is often not a financial incentive for a [private] landowner to make savanna a winning proposition." The main economic issue cited was the need for sustainable income to fund the required long-term, active maintenance of oak savanna. Others noted the high costs associated with restoring the shrub and ground layers of a savanna community, particularly with respect to controlling invasive exotic species and establishing native species.

Feasibility

The feasibility of restoration strategies also emerged as a key consideration in these discussions. Site constraints such as parcel size, road access, slope, and adjacent land uses can restrict the types or success of restoration or fire management activities. For instance, lack of adequate road access and steep slopes may limit the types of tree removal equipment. Although prescribed fire may be a preferred management tool, close proximity to forested lands may inhibit its use due to the threat of escaped fire. The potential for invasion by exotic species from adjacent lands may dissuade managers from attempting to restore high quality savanna. Similarly, the abundance of nonnative species on a potential restoration site emerged as an important issue, as it may determine the feasibility of enhancing existing vegetation versus the need to remove all vegetation and start over, as well as the types of equipment that may be used. For example, the existence of a high quality ground layer may preclude the use of certain mechanical tree harvesting equipment, necessitating the use of more time-consuming and labor-intensive manual removal methods.

Whether a site has any development restrictions or habitat protections in place also proved to be important. Land trusts, for example, may be less willing to assist landowners interested in restoration on sites with no permanent conservation mechanisms. This is due to the possibility that the site may be developed in the future, negating the benefits of restoration.

Another central stakeholder question was the feasibility of combining the goals of savanna restoration with fire hazard reduction. It was noted that restoring savanna would only result in changing the type of fire regime from low frequency, high intensity fires to high frequency, low intensity fires. While this may reduce fire hazard on a site, the increased likelihood of ignition and rapid spread in the understory of a savanna could pose fire risks to adjacent lands, especially those with higher fuel loads.

Savanna Restoration Priorities

Some stakeholders contended that restoration efforts should be focused on the areas at highest risk of being lost or degraded, such as sites most threatened with conifer or exotic species, or proposed development. Another common comment was the importance of protecting oak-associated wildlife, especially federal- or state- listed species. Ensuring the long-term survival and regeneration of oak trees emerged as another priority. Many stakeholders also emphasized the need to increase the abundance of native plant species and to control or reduce the proliferation of invasive exotic species, particularly in the understory of oak savanna communities.

Trade-offs

Stakeholders also identified a number of trade-offs that characterize efforts to simultaneously restore oak savanna and reduce fire risks. One such trade-off, mentioned earlier, concerns the higher frequency of fire that could occur in oak savanna. While transforming a site from dense, mixed conifer forest to savanna may reduce the risk of catastrophic fire, it would likely increase fire frequency. Stakeholders also pointed out the trade-off between the size and quality of savanna restoration projects. In other words, given limited resources, managers must often decide whether to restore a large area to a relatively low quality savanna (i.e., little attention paid to the understory), or to restore a smaller area to a high quality savanna.

Important Issues That Extend Beyond the Scope of the Land Management Scenarios

Policy and Economic Issues

Financial considerations resulting from policy or regulatory structures figured prominently for private landowners and people working with landowners. The loss of current and potential future land use options and consequential reduction in market value of property that could result from savanna restoration was cited as a major consideration for private landowners. Specifically, the risk that restored habitat might eventually be protected under Goal 5 (Oregon state law), the federal Endangered Species Act, or other regulations might dissuade landowners from engaging in restoration because such protected habitat might be rendered undevelopable. Since market value of property is based on its most profitable land use, which is generally residential or commercial development, a site containing restored habitat with development restrictions would have a reduced market value. This potential outcome may cause landowners to refrain from restoring oak savanna on their properties out of fear of reducing potential profits from selling or developing the land, or limiting options for descendants.

Similarly, stakeholders observed that the lack of incentives and existence of disincentives to restore and maintain oak savanna on private land poses a barrier.

Restoration can be expensive, especially if it involves removing invasive species and establishing native species in the ground and shrub layers. Harvesting merchantable conifers for sale as lumber can be a way to recoup costs associated with oak savanna restoration in some cases. However, it is not always feasible, and can have negative consequences such as soil disturbance and increases in nonnative species. The underdeveloped market for oak wood or other sustainable products associated with managing oak communities also serves as a financial constraint. As such, landowners generally rely on assistance and incentive programs that provide technical and financial support for restoration, such as Oregon Department of Fish and Wildlife's Wildlife Habitat Conservation and Management Program. However, few landowners take advantage of such programs, and those that do cite numerous barriers to their effectiveness, such as difficulty accessing such programs, onerous bureaucracy, minimal interagency coordination, and lack of funding for long-term maintenance--a key issue for oak savanna habitat (Fischer 2005).

Regulatory barriers also block oak restoration efforts, according to stakeholders. In particular, Oregon's Forest Practices Act requires landowners to replant trees that are removed, which is counterproductive for oak savanna restoration efforts. Although a landowner may request an exemption from this requirement by preparing a plan for an alternate practice, the process of securing such an exemption can be time-consuming and onerous (Oregon Forest Practices Act 1971). Other regulations and required permits (e.g., for prescribed fire) can burden landowners and dissuade them from engaging in restoration projects.

Education and Public Support

Another important theme that emerged in discussions of key issues driving oak savanna restoration centered on the need for public education and support for such efforts. Since savanna restoration often involves the removal of trees, and given the heightened public attention to logging issues in Oregon, cultivating public understanding and support for restoring oak savanna is essential. The aesthetic impacts of girdling or topping trees may also cause alarm, especially on publicly owned land. Similarly, the use of prescribed fire for restoration efforts is often controversial, for instance due to concerns about health hazards from the smoke generated, or the risk of escapement. Stakeholders pointed out the need for partnerships at multiple levels (e.g., landowners, agencies, regional governments, etc.) to enhance the success of restoration efforts by mobilizing public will, creating policy consistency between jurisdictions, and attracting funding and expertise.

Lack of Proven Techniques

Another major concern voiced was the lack of assurance that restoration and management techniques would be successful, given the paucity of data and experience about the viability of specific techniques. Private landowners, in particular, are understandably hesitant to invest money and time into restoration strategies that may fail. Stakeholders also were quick to point out that no standard prescription exists for oak savanna, as all sites are different and require individualized restoration planning and implementation. Stakeholders also noted the low availability of native plant stock for restoration and a concern that some of what is available may not be genetically appropriate if derived from non-local sources.

Potential Conflicts with Adjacent Lands

Risks from conflicting uses on adjacent lands and the need to coordinate with nearby landowners and managers constituted another challenge. For instance, as mentioned earlier, the use of prescribed fire to treat or maintain savanna could be viewed skeptically by neighbors, or could be too risky given adjacent land uses. An owner or manager of a site surrounded by land covered in invasive shrubs and grasses may need to work with his or her neighbors to reduce the likelihood of encroachment of such species onto a restoration site.

Description of Scenarios

The discussion of key issues for oak savanna restoration and fire hazard reduction summarized above prepared the stakeholder group for constructing a set of land management scenarios. After identifying an initial set of scenarios, stakeholders narrowed the group of scenarios to a set of five, and developed narrative scripts and desired future conditions (DFCs) for each one. Quantitative targets were set for the three primary structural vegetation layers: the canopy layer, shrub layer and ground layer. The primary parameters were plant cover and/or plant density, species composition, particularly the relative amounts of native and exotic species, and spatial distribution of plants. It should be noted that although the DFCs consist of specific vegetation targets, they also represent generic standards that in practice could be modified based on site-specific conditions, such as current and historic vegetation, soils and topography, habitat patch and/or site size, landscape context, parcel ownership and management resources. Targets for tree density and species composition might be modified based on site surveys, knowledge of nearby or similar conditions, or historical archives including vegetation maps. The greatest amount of detail is provided for the Full Savanna Restoration scenario, which provided a useful comparator for the other scenarios.

A summary of these scenario descriptions is provided below. A more complete description of the DFCs for these scenarios is provided in appendix B.

Full Savanna Restoration Scenario

This scenario aims to create a high quality, ecologically functional oak savanna with a central focus on restoring native vegetation in all layers – canopy, shrub and ground layers. Quality was defined in terms of vegetation structure and habitat for native plants and wildlife, with specific targets based on what would be expected to be achieved through best management practices (BMPs).

Targets for the canopy layer were defined in terms of canopy cover, tree density and species composition. Canopy cover limits of 5-25% were set to distinguish savanna from woodland (>26-60% canopy cover) and prairie (0-5%). Stakeholders defined the target tree density for the canopy layer, as twelve to twenty-five large trees per hectare (five to ten trees per acre), a slightly higher density than usual for savanna to take into account potential tree mortality and to plan for replacement age cohorts. Oak trees would include variety of ages and size classes, from large savanna-form trees to maturing trees to replacement saplings. The canopy would be dominated by open-grown Oregon white oak (*Quercus Garryana*) or California black oak (*Quercus kellogii*), comprising 70-90% of all trees. As indicated from historical records and surveys, small numbers of other tree species frequently associated with oak savanna could be included in certain sites. These would be principally ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Psueudotsuga menziesii*), but could occasionally include incense cedar (*Calocedrus decurrens*) and madrone (*Arbutus menziesii*). A minimum of one to two snags per acre, up to a maximum of fifteen, and similar numbers of downed logs, all in a range of decay classes, would be desired to provide wildlife habitat.

Targets for the shrub layer and ground layer were set based on factors such as total percent cover, species composition and spatial distribution. The target for percent cover of the shrub layer was set at 2-10%, but not to exceed the tree canopy cover. Species composition would be expected to vary substantially by site. Targets for exotic species were set at 1% cover for extremely invasive exotics that are amenable to control if treated before they have become established but otherwise become almost impossible to control, and 5% for invasive exotics that do not spread as rapidly but are also difficult to eradicate entirely. Desired spatial distribution was described as a combination of dispersed individual shrubs and widely scattered clumps.

The desired ground layer would be mostly continuous grasses and forbs, with 50-100% plant cover depending site productivity. The target for percent native species relative to exotics would be 50% for a site in which existing vegetation was being enhanced, and 70% for a site in which existing vegetation is being completely removed. Targets were also established for the maximum cover of individual invasive exotic species ranging from 1% for extremely invasive species amenable to early control to an as-yet-unspecified upper limit for less aggressive invaders. Stakeholders also set a goal to minimize the encroachment of invasive native species in the ground layer to allow greater species diversity.

Savanna Structure and Wildlife Scenario

This scenario focused on creating the vegetation structure of an oak savanna with the potential for adding habitat elements to support specific wildlife and/or threatened and endangered plant and animal species. It would have the same general desired future conditions for the canopy as the Full Savanna Restoration scenario except that more snags may be tolerated if this would reduce costs for canopy layer treatments and long-term management. This primary difference with the Full Savanna Restoration scenario is that there would be substantially lower standards for the quality of the shrub and ground layers in terms of functional group composition, species richness, and, in particular, the percent cover of native species relative to exotics. The higher tolerance for nonnative species in the shrub and ground layers would lead to substantial cost savings relative to the full savanna restoration scenario.

Mixed-Use Savanna Income Scenario

This was one of two scenarios designed primarily for privately owned land. This scenario would include income-generating uses that are consistent with, and could be incorporated into, restoration of moderate-quality oak savanna. Specific uses suggested by stakeholders included grazing of goats or other livestock, haying, and planting and selective harvest of conifers, particularly ponderosa pine.

Grazing with sheep, cows or goats could serve to generate income, maintain savanna vegetation structure by controlling shrub and tree invasion, and remove biomass, thus lowering the probability of fire and reducing fire intensity and spread rates should ignition occur. Haying would involve growing pasture composed of both native and exotic species and would have similar structural and fire effects as grazing.

The growth and harvest of pines would involve two potential strategies. One would be planting open stands of pine as a nurse crop for oaks, with the eventual goal of a more open stand of oak and pine. The second would be to plant pines at low densities purely as a harvestable crop. In both cases, pines would be selectively harvested on a long-term rotation. Other potential income-generating uses mentioned included stables for equestrian use, production of oak for firewood or other products, Christmas tree farming, filbert nut production, and vineyards, although the benefits and drawbacks of these uses were not discussed.

Canopy conditions would be similar to those for the Full Savanna Restoration scenario, with the exception of a higher limit of 25% canopy cover to allow a greater density of pines for harvest. This increase in pines would also shift the species composition target to allow a higher percentage of conifers. If haying were incorporated as an income-generating use, the number of downed logs might need to be reduced or eliminated to avoid hazards.

Desired future conditions for the shrub layer would also mimic those for Full Savanna Restoration, except that the maximum percent cover of invasive exotic species would be the same as in the Savanna Structure and Wildlife scenario and that greater restrictions on shrub cover might be needed to maximize grazing or haying profits.

Ground layer cover targets would be reduced compared to those for Full Savanna Restoration but higher than Savanna Structure, and depend on the types of income-generating activities used (i.e., grazing versus haying), and the specific management techniques employed. For instance, certain approaches to grazing, such as holistic range management, could support a higher percentage of native grass species compared to traditional grazing techniques.

Mixed-Use Forest Income Scenario

Similar to the Mixed-Use Savanna Income scenario described above, the Mixed-Use Forest Income scenario was intended to allow private landowners to engage in profitable land uses that could subsidize restoration activities. This scenario differs from the other mixed-use scenario in that it includes income-generating uses that do not themselves maintain oak savanna. These uses would take place in a separate location than areas managed as oak savanna, resulting in a mosaic of land uses on a site. Timber production was cited as the most likely income-generating use under this scenario. For the areas managed as savanna, the specific targets for the canopy, shrub and ground layers would be similar to those for the Full Savanna Restoration scenario. The rationale behind setting these high standards was that the higher income generated from timber sales could be used to restore a higher quality savanna on a smaller portion of the site.

Fire Hazard Reduction Scenario

This scenario was designed to prioritize the management of fire hazards on a site to protect people, structures and the landscape from catastrophic wildfire. However, elements that would support savanna restoration could also be incorporated if they would not substantially compromise fire hazard reduction goals.

The DFCs for this scenario focused primarily on maintaining adequate spacing of trees and shrubs to reduce the likelihood of fire spread, and reducing the build-up of woody fuels on a site. Stakeholders saw some compatibility between this scenario's goal of reducing fuels and that of maintaining the structure of an oak savanna. For the canopy layer, the main DFC would be a minimum of ten feet (three meters) of space between tree crowns, and thirty to one hundred feet (ten to thirty meters) clearings around structures. The percent canopy cover and density of trees would thus depend on the size and spatial distribution of trees and structures on a site. However, these criteria would allow a substantially higher canopy cover and tree density than the other scenarios, likely changing the system into a woodland rather than a savanna. The number of snags and downed logs would need to be reduced from the targets established for the Full Savanna Restoration scenario if they posed a fire hazard. Lower tree limbs might need to be removed to minimize ladder fuels and the likelihood of a crown fire. For the shrub and ground layers, the general DFC would be to limit the overall fuels, isolate dense shrubs, and eliminate ladder fuels. Exotic species would be a concern only if they increased fire risk due to height or flammability.

Other Scenarios

A number of other scenarios were suggested that were ultimately not chosen as the top five priorities, or were incorporated into one of the five scenarios. These included (1) Maximize biodiversity via diverse habitat mosaic, (2) Wildland/Urban Interface - focus on fire hazard management, and (3) Landowner Goal Driven - restoration as secondary goal. Several other scenarios were suggested that were either more appropriate for a landscape-level analysis, allowing a comparison of outcomes across and between sites, or were outside the project scope and capabilities. Landscape-level scenarios included creating a habitat mosaic across sites, and creating a reserve system by targeting high priority areas across the landscape. Another scenario suggested that was outside the scope of the project focused on preparing for global climate change by perpetuating species and systems capable of adapting to such change. Stakeholders also suggested changing land use development policies by creating an “oak savanna stewardship and dwelling agreement” option, which would allow landowners to build a home on a parcel if they actively managed the site to maintain oak savanna. Yet another scenario focused on a mixed-use alternative that would include social and recreational amenities, in addition to habitat benefits.

Overall Results of Scenario Ranking by Stakeholders

This section describes the results of the stakeholders' ranking of the five land management scenarios described above. Each scenario was given a rank, between one and five, with one representing the highest priority, and five as the lowest. The average ranking for each scenario is provided, as well as the distribution of votes for each scenario. A total of twenty-three ranking surveys were completed.

The Savanna Structure and Wildlife scenario had the highest average ranking (2.5), followed by Mixed-Use Savanna Income (2.7), Mixed-Use Forest Income (2.9), Full Savanna Restoration (3.0) and Fire Hazard Reduction (3.9). It is important to note that these were the top selected scenarios of all those considered. Therefore, even the lowest ranked scenario was still thought of as a high priority.

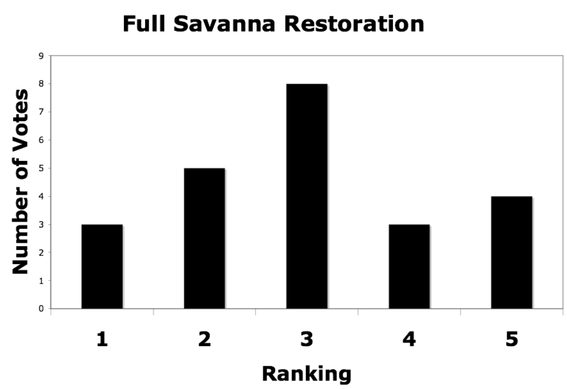
More informative than the average rankings is the distribution of rankings for each scenario (figure 3 a-e). This distribution shows that stakeholders held divergent views of the relative importance of the scenarios. Although the Savanna Structure and Wildlife scenario received the most votes for priority one, it also received substantial votes for priority four. The Mixed-Use Savanna Income scenario received nearly the same number of votes for ranks one and two as savanna structure, but also had more votes for rank five than any scenario except fire hazard reduction. The Mixed-Use Forest Income scenario received the most votes for priority two, however, it received almost as many votes for priority four. Most stakeholders thought that the Full Savanna Restoration scenario should fall in the middle of the ranking. However, almost as many ranked this scenario as fourth or fifth priority as those that ranked it first or second. No one ranked the Fire Hazard Reduction scenario as first priority, and most stakeholders viewed it as a lower priority than the other scenarios.

Rationale for Scenario Ranking

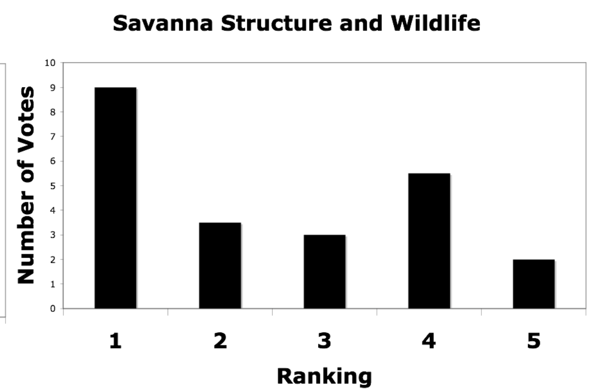
The comments that stakeholders provided to explain their rankings reveal much more about the values, priorities and constraints perceived by stakeholders than the rankings alone. The open-ended nature of the survey instrument was intended to capture the overall impressions of stakeholders. While the frequency of similar comments made in reference to a particular scenario or rank were tallied, these numbers serve only as a general indication of stakeholder preference rather than a complete account of the advantages and disadvantages of each scenario as perceived by stakeholders.

FIGURE 3, A-E: DISTRIBUTION OF RANKINGS FOR EACH SCENARIO

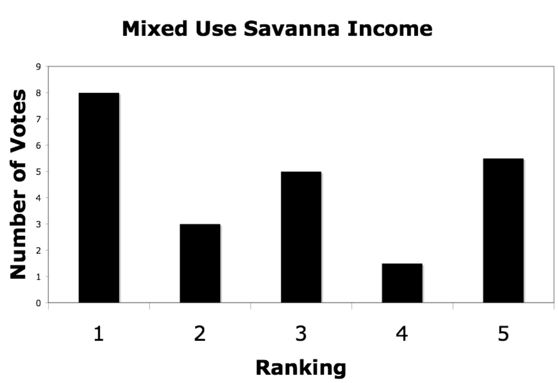
A



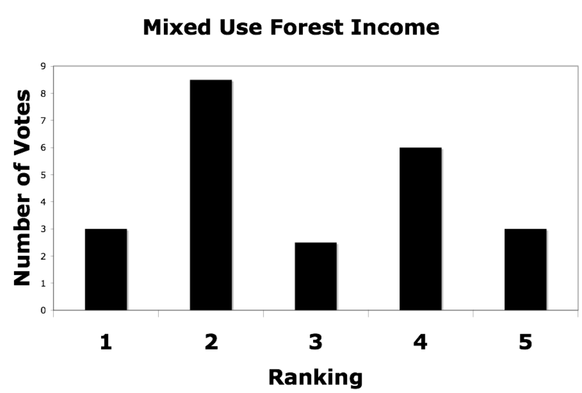
B



C



D



E

Legend

Distribution of votes for each scenario. The x-axis shows the rank (1-5), with 1 as the highest priority. The y-axis shows the number of votes for each rank.

Full Savanna Restoration Scenario

TABLE 2

FULL SAVANNA RESTORATION SCENARIO,
SUMMARY OF COMMENTS

Comment	No. of Times Comment Appeared
Advantages	
Important to prioritize restoring sites to higher quality habitat	11
Could inform restoration efforts/serve as reference ecosystem	3
Protect rare species/ greatest gains in biodiversity	3
Important for public lands	3
Assumes fire so achieves fire hazard reduction objective	1
Total	*21*
Drawbacks	
Costly	10
Only feasible in limited areas	7
Restricted to public lands	5
Difficult	3
Total	*25*

The Full Savanna Restoration scenario received slightly more negative than positive comments (table 2). By far the most commonly cited advantage was higher quality habitat. Several comments noted the scenario's ability to protect rare species and biodiversity and to serve as a reference ecosystem for other savanna restoration efforts. However, almost as many comments noted the high cost and difficulty of implementing this scenario, and therefore its limited application. A common theme in the comments was that this scenario would be "desirable but only practical on selected sites due to cost, management and maintenance effort needed." Several stakeholders stated that this alternative would apply to public lands, indicating both its importance for such lands and its limited applicability (i.e., excluding private land).

Savanna Structure and Wildlife Scenario

TABLE 3

SAVANNA STRUCTURE AND WILDLIFE SCENARIO, SUMMARY OF COMMENTS

Comment	No. of Times Comment Appeared
Advantages	
Protects habitat/function/processes and species	16
Ability to draw funding/financially feasible	8
Restore largest area	6
Practical, especially when full restoration infeasible	4
Get the most bang for the buck	3
Most technologically feasible	1
Emphasizes high quality sites	1
Provides measurable goals and monitoring targets	1
Complements full savanna restoration	1
Intermediate strategy	1
Total	*42*
Drawbacks	
Redundant with other scenarios	4
Fewer benefits than full savanna	2
Limited to private land	2
Limited to public land	1
Costly and difficult	1
Total	*10*

The Savanna Structure and Wildlife scenario received over four times as many positive comments as negative ones (table 3). The top three reasons stakeholders supported this scenario were its ability to support basic oak habitat species and functions, to draw funding or otherwise be financially feasible, and to restore the largest area of land. These were followed by related comments about its broad applicability, cost-effectiveness and technical feasibility. These ideas were characterized by comments such as "(would) take less money to accomplish so more acres can be restored" and "capture most species and function at best price." The most common negative comment was that this scenario was unnecessary because its' major elements were covered by other scenarios.

Mixed-Use Savanna Income Scenario

TABLE 4

MIXED-USE SAVANNA INCOME SCENARIO,
SUMMARY OF COMMENTS

Comment	*No. of Times Comment Appeared*
Advantages	Total
Appeals to private landowners	11
Generates income	6
Protects savanna habitat and species	4
Applicable to agricultural land (i.e., haying, grazing)	3
Applicable to larger area of land	2
Applicable to nonfarm and nonforest land	1
Addresses social, environmental & economic goals	1
Could stop conifer invasion and reduce fire hazard	1
Applicable to mid-Valley (poor soils, less conifer invasion)	1
Total	*30*
Drawbacks	
Creates lower quality savanna	5
Creates conflict of interest between income and savanna	2
Generates less income than mixed use forest scenario	1
Total	*8*

The Mixed-Use Savanna Income scenario received nearly four times as many positive comments as negative ones (table 4). By far, the main advantage cited was its appeal for private landowners, due to its ability to generate income to support restoration. In supporting this scenario, stakeholders noted both the need for incentives and the need to make money, stating that "any cornerstone landscape-level strategy must include incentives to landowners" and "ongoing management needs to be tied to income generating uses." However, one stakeholder noted that it would generate less income than the other mixed-use scenario. While some stakeholders stated that this scenario would maintain savanna habitat and species, others said that it would create a lower quality savanna than other scenarios. Two stakeholders noted that the dual goals of savanna restoration and income generation could create a conflict of interest for landowners and managers, and that ultimately income generation would likely prevail, to the detriment of savanna. Several other comments refer to the wide applicability of this scenario.

Mixed-Use Forest Income Scenario

TABLE 5

MIXED-USE FOREST INCOME SCENARIO,
SUMMARY OF COMMENTS

Comment	No. of Times Comment Appeared
Advantages	
Appeals to private landowners/ most oak habitat privately owned	11
Generates income	6
Protect higher quality oak habitat & species on some portion of land (devoted to savanna)	3
Mimic natural mosaic/trajectory of oak and fir	2

Comment	No. of Times Comment Appeared
Advantages	
Restore largest area	1
Most bang for the buck	1
Sustainable (like mixed-use savanna)	1
Applicable to nonfarm and nonforest land	1
Interim approach	1
Total	*27*
Drawbacks	
Reduced extent of savanna restored/too much compromise	3
Timber production on savanna land is marginal/no link between forestry and savanna	2
Redundant with other scenarios	1
Could make fire and other management options due to adjacent land uses	1
Total	*7*

The Mixed-Use Forest Income scenario also received nearly four times as many positive comments as negative ones (table 5). Like the Mixed-Use Savanna Income scenario, the most common comment was that it would appeal to private landowners due to its ability to generate income. Related to this comment, several participants noted this scenario's ability to generate income to fund restoration. While some stakeholders said this scenario would protect higher quality oak habitat and species on some portion of land, just as many stated that it would result in a reduced extent of restored savanna. Some comments related to the ability of this alternative to either mimic the naturally occurring mosaic of oak and fir, or be consistent with the natural trajectory to conifer forest. Others disagreed with making a link between forestry and savanna, pointing out that timber production on savanna land is marginal and there is no clear conservation link between forestry practices and savanna restoration. However, one stakeholder preferred this scenario to the other mixed use scenario because "savanna restoration will be most effective if it is the primary focus of that designated portion of the property, not compromised by other uses as in top [Mixed-Use Forest Income] scenario."

Fire Hazard Reduction Scenario

TABLE 6

FIRE HAZARD REDUCTION SCENARIO,
SUMMARY OF COMMENTS

Comments	No. of Times Comment Made
Advantages	
Funding available for fire hazard reduction	7
Fire hazard reduction is important issue/social need	5
Fire hazard reduction compatible with oak restoration	5
Public support for fire hazard reduction	4
Important for certain geographic areas	4
Would appeal to private landowners who otherwise would not be interested in savanna restoration	3
Important on public land	1
Total	*28*
Drawbacks	
Fewer benefits to oak savanna	3
Redundant with other scenarios	2
Would increase some types of fire (short-term high intensity)	1
Funding for fire reduction may not be available on west side	1
Fire hazard reduction only one goal	1
Fire hazard threat overblown	1
Total	*9*

Despite its low ranking, over three times as many comments pertained to the positive aspects of this scenario as compared to the negative (table 6). Most of the comments about its advantages related to its ability to garner support and funding that could be channeled to oak savanna restoration, with several comments focused on this scenario's ability to "attract private landowners without specific interest in oaks and oak habitat" and to "use fire funds to do restoration or at least leverage with other restoration funds." Several stakeholders acknowledged public support for fire hazard reduction or cited it as an important social need, although a few downplayed it. While some stakeholders noted the compatibility between fire hazard reduction and oak savanna restoration, others thought that this scenario would result in fewer benefits to savanna or indicated that fire hazard reduction was not as important as restoring savanna in the Willamette Valley. Still others noted that this scenario would not actually reduce the likelihood of fire, but rather change the fire regime from low frequency, high intensity fires to high frequency, low intensity fires.

Comparison of Rationale Across Scenarios

A synthesis of the comments across scenarios reveals further patterns of stakeholder preferences and concerns. The comments used to describe the advantages and disadvantages of the scenarios were grouped into several broad categories of key issues: ecological issues, economic issues, appeal to private landowners, practicality, geographic applicability, fire issues, and redundancy with other scenarios. Ecological issues refer to the quality and extent of savanna habitat, function, or biodiversity. "Economic issues" relate to the general financial feasibility of a scenario, including cost, its ability to draw funding or generate income, or its cost effectiveness. Geographic applicability includes the spatial extent or types of land (e.g., public, agricultural, etc.) to which a scenario could apply. Comments related to fire had to do with both the importance of fire for oak savanna, and the value of reducing fire hazards. Practicality referred to the both the technical feasibility of a scenario and its ability to address multiple goals (e.g., ecological, economic and social). The following table summarizes these comments, grouping similar remarks. More detailed summaries of these comments are provided in appendix C.

TABLE 7

COMMENTS REGARDING ADVANTAGES AND DRAWBACKS ACROSS SCENARIOS

Comment	Scenario					
	Full Sav[a]	Sav Str[b]	Mxd Sav[c]	Mxd For[d]	Fire Haz[e]	Total
Advantages						
Ecological issues	17	17	4	5	--	43
Economic issues	--	11	6	8	7	32
Appeal to private landowners	--	--	11	11	3	25
Geographic applicability	3	8	5	1	5	25
Fire issues	1		1	--	14	16
Practicality	1	6	1	--	--	8
Drawbacks						
Geographic applicability	12	3	--	--	--	15
Ecological issues	--	2	5	3	3	13
Economic issues	10	1	1	--	1	13
Practicality	3	1	2	3	--	9
Redundancy with other scenarios	--	4	--	1	2	7
Fire Issues	--	--	--	--	3	3

[a] Full Sav=Full Savanna Restoration
[b] Sav Str=Savanna Structure and Wildlife
[c] Mxd Sav=Mixed-Use Savanna
[d] Mxd For=Mixed-Use Forest
[e] Fire Haz=Fire Hazard Reduction

Advantages

The most common positive comment concerned ecological issues, primarily made in support of the Full Savanna Restoration and the Savanna Structure and Wildlife scenarios for supporting high and basic ecological function, respectively. Economic advantages also figured prominently, cited in support of all scenarios except Full Savanna Restoration. Within this general category, stakeholders distinguished between scenarios that could attract funding in the form of grants or government assistance, and scenarios that could generate their own income to fund restoration. The Savanna Structure and Wildlife and Fire Hazard Reduction scenarios fell into the former group, while the two mixed-use scenarios fell into the latter. A scenario's appeal to private landowners was also a common criterion. Most of these comments were made in support of the mixed-use scenarios, with a few stakeholders noting that the Fire Hazard Reduction scenario could attract landowners who otherwise may not be interested in oak savanna restoration. Stakeholders also focused on the geographic applicability of a scenario, with a majority of these comments stating that the Savanna Structure and Wildlife scenario would allow the largest area of land to be restored.

Drawbacks

The most common drawback noted concerned the limited geographic applicability of a scenario, with twelve of fifteen comments ascribed to Full Savanna Restoration. Seven stakeholders specifically stated that this scenario would only be feasible in limited areas and five said it would be limited to publicly owned land. Stakeholders also focused on the ecological limitations of a scenario, citing both the reduced quality and spatial extent of savanna created. Economic constraints were also commonly cited, focusing on the costs associated with the Full Savanna Restoration scenario. Redundancy with other scenarios was given as a drawback for several scenarios, most frequently the Savanna Structure and Wildlife scenario. Five stakeholders cited conflicting goals or management issues, all associated with the mixed-use scenarios. Four comments noted the difficulty of a scenario, three of which were directed at the Full Savanna Restoration scenario.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Oak savanna restoration efforts in the southern Willamette Valley have occurred mostly on a case-by-case basis without coordination or consideration of landscape-level applications. There has been little systematic inquiry about how to restore oak savanna to optimize benefits and costs at site or landscape scales. In addition, pressing threats to oak savanna necessitate immediate implementation of creative restoration and management strategies. Restoring oak savanna also provides an opportunity to reduce the build-up of hazardous fuels resulting from the succession of savanna to woodland and forest, potentially reducing fire hazards.

This study has proposed that alternative futures analysis provides a useful approach to systematic land management planning for oak savanna restoration and fire hazard reduction by facilitating an exploration of the potential effects of differing approaches. I have focused on one component of alternative futures analysis – the identification and description of the alternative future scenarios. To explore the use of alternative futures analysis for landscape-level oak savanna restoration and fire hazard reduction planning, this study aimed to develop and prioritize a set of land management scenarios that would (1) apply to a wide variety of site conditions and ownership types in the southern Willamette Valley, and (2) be practical, feasible, and representative of contrasting values, approaches or priorities to allow useful comparisons.

Answers to Research Questions

To evaluate the utility of this application of alternative futures analysis, I posed three research questions in chapter I. The following discussion addresses these questions.

Question #1. What are the key issues driving oak savanna restoration and fire hazard reduction in the southern Willamette Valley, according to the stakeholders most involved in such efforts?

In the beginning of the stakeholder process, stakeholders were asked to identify the key issues that they believe drive efforts to restore oak savanna and reduce fire hazards in the Willamette Valley. This brainstorming exercise was intended to serve as a springboard for constructing a set of land management scenarios. When stakeholders were asked to create the actual scenarios, they were forced to clarify the broad issues they initially identified and confront the trade-offs that must be made when attempting to incorporate these key issues into a coherent set of distinct and contrasting scenarios. The final step of ranking the scenarios required stakeholders to further clarify and refine these key issues. The value of this process lies in transforming implicit values and broad issue statements into explicit choices that demonstrate the decisions that must be made in actual on-the-ground projects.

The initial brainstorm exercise produced a list of key issues that were categorized as economic considerations, feasibility and savanna restoration priorities and trade-offs. These initial ideas were generally framed in terms of barriers to savanna restoration and fire hazard reduction. Because ecological restoration was a primary goal of the process, stakeholders did not discuss ecological goals explicitly in the exercise, and instead folded such comments into discussions of the other categories.

Economic considerations, especially for private landowners, emerged as the key issue in this initial discussion. Stakeholders focused on the need for income to fund restoration efforts, noting in particular the expense associated with restoring the shrub layer and ground layer of a savanna community.

Another set of constraints identified by stakeholders had to do with the feasibility of restoration strategies, such as site constraints (e.g., road access), limits on the use of prescribed fire, and the existence of invasive exotic species onsite or on adjacent sites. Some stakeholders also questioned the feasibility of combining the goals of savanna restoration with fire hazard reduction, noting that restoring savanna would result in a fire regime that might reduce fire hazards on the restoration site, but could increase fire risks on adjacent lands due to the greater likelihood of ignition and increased rate of spread.

Stakeholders also identified a number of restoration priorities and trade-offs. Given the limited resources available for restoration, stakeholders focused on the need to target habitat areas at the greatest risk of succeeding to woodland or forest. Other priorities included protecting oak-associated wildlife, ensuring recruitment of young oak trees, and managing the understory of savanna communities to increase the abundance of native species. Stakeholders noted that limited resources also force a choice between restoring a large area to a relatively low quality savanna (i.e., little attention paid to the understory), or to restore a smaller area to a high quality savanna.

Question #2. Can these issues be incorporated into a small set of alternative land management scenarios that both: 1) encompass the range of site conditions and management needs in the southern Willamette Valley; and 2) represent contrasting values, approaches or priorities to allow useful comparisons?

Addressing this question first requires an evaluation of how well the key issues initially identified by stakeholders were incorporated into the land management scenarios. Through the process of developing and refining the scenarios, the initial three types of broad concerns that stakeholders enunciated in the initial meeting were largely carried through to the scenarios and reframed more specifically as six key issues differentiating the scenarios: ecological issues, economic issues, appeal to private landowners, practicality, geographic applicability, and fire issues. For instance, concerns about economic issues and recognition of the trade-offs associated with restoration decisions remained as dominant themes in creating and ranking the scenarios. The initial emphasis on feasibility (i.e., physical constraints) was expressed both as an interest in creating practical scenarios and a broader desire to create set of scenarios that would apply to a variety of land types.

The initial stakeholder concern about economic issues was clearly incorporated into the scenarios as a primary driving force. Economic issues manifested in two distinct ways – attracting or generating income and reducing restoration costs. Stakeholders prioritized strategies that would be the most financially feasible, especially for private landowners. The top three ranked scenarios were designed to minimize costs, generate income, or draw funding to offset restoration costs. The Savanna Structure and Wildlife scenario was seen as suitable for attracting grants and other assistance, while the two mixed-use scenarios were designed to generate income for private landowners. Although ranked last, the Fire Hazard Reduction scenario was noted for its ability to draw funding that could be channeled to oak savanna restoration. The expected costs of restoration treatments substantially determined goals for habitat quality. When scenarios were specified to the level of desired future conditions, the key differences that emerged among the four restoration scenarios were in the targeted levels of native and exotic species in the understory – the most expensive long-term management issue.

The restoration priorities and trade-offs initially identified by stakeholders were incorporated into the land management scenarios to varying degrees. The ecological trade-off quantity versus quality of savanna restored emerged as a crucial issue in the scenarios. For instance, while stakeholders noted the ecological benefits of both the Savanna Structure and Wildlife and Full Savanna restoration scenarios, they ranked the Savanna Structure and Wildlife Scenario as priority one and Full Savanna Restoration as priority four. Stakeholder commentaries indicated a general preference for focusing restoration efforts on restoring the largest quantity of oak savanna possible, at least in the short-term. While stakeholders expressed a strong desire to restore some sites to high-quality savanna, the overall preference was to prioritize strategies that would achieve basic savanna structure and apply to a wide variety of sites, especially privately owned land. Stakeholders also saw this trade-off in comparing the two Mixed-Use scenarios. The Mixed-Use Savanna scenario was seen as likely to result in a lower quality savanna over a larger area, while the Mixed-Use Forest scenario would produce a smaller, higher-quality savanna. Overall, stakeholders ranked the Mixed-Use Savanna scenario higher. This preference likely stems from the urgency surrounding oak savanna restoration efforts, in particular the rarity of this plant community and the need to actively manage historical remnants before surviving legacy oaks die or decline beyond the point of recovery due to forest succession. A strategy of restoration "triage" would allow for a second round of restoration efforts to focus on quality (e.g., native plant species in the understory).

It appears the initial stakeholder focus on the need to protect oak-associated wildlife, especially threatened or endangered species, was ultimately balanced with concerns about economics and practicality. It became expressed as an optional component to the Savanna Structure and Wildlife scenario, and as a likely outcome of the fourth-ranked Full Savanna Restoration scenario. Similarly, the desire to emphasize management of the understory of savanna communities to increase the abundance of native species seemed to become less important as stakeholders developed and ranked the scenarios. In the end, creating a high quality ground and shrub layers was seen as an important objective for a limited number of sites, but not the top priority overall.

The initial focus on the feasibility of a scenario, focusing on physical site constraints, was transformed through this process into a broader concern about the practicality of general restoration and fire hazard management strategies, and a desire to design a set of scenarios to address a wide variety of situations. Despite the fact that ecologists were by far the predominant interest represented in the stakeholder group, stakeholders placed high importance on the practicality of a scenario, even if its' ecological benefits would be reduced. For instance, the middle ranking of Full Savanna Restoration scenario clearly reflected the tension between what stakeholders would like to see happen on the landscape, and what they realistically expect can happen. By and large, stakeholders viewed this scenario as an important component of a landscape-level approach to oak savanna restoration, but likely limited to publicly owned land due to the cost and effort of restoring a high quality, native plant-dominated understory. The high ranking of the Savanna Structure and Wildlife scenario and the pattern of comments reflect the overall stakeholder preference a practical approach to oak savanna restoration. By focusing on the canopy layer, the maximum amount of savanna could be restored with the limited amount of funds available. This scenario was also generally viewed as the most technological feasible.

Consistent with the focus on practicality noted above, most of the scenarios were specifically designed to appeal to private landowners. In addition to these financial benefits, the two mixed-use scenarios would likely appeal to landowners by allowing them to continue traditional uses of their lands. While both mixed-use scenarios were ranked highly for their importance to private landowners, stakeholders identified a number of trade-offs associated with these scenarios. While stakeholders generally viewed the Mixed-Use Savanna Income scenario as more applicable to a wide variety of land uses and types, its potential to produce income to fund restoration efforts was seen as lower than the Mixed-Use Forest Income scenario. Stakeholders also recognized the conflicts that can arise when land is managed to both generate income and restore habitat, and stakeholders felt it likely that income-generating uses would prevail. Stakeholders also posited that the Fire Hazard Reduction scenario would appeal to landowners who would otherwise not be interested in managing their lands solely to benefit oak savanna.

Another main criterion stakeholders used to judge the value of a scenario was whether it would apply to a variety of landowners, site conditions and land uses, as well as specific geographic areas. Overall, stakeholders seemed to value scenarios that would apply to the largest area of land. In particular, stakeholder comments reflect the need for strategies that would be relevant and adaptable to a diversity of land types and uses, such as agricultural or nonforested lands.

Stakeholder ambivalence toward the feasibility of integrating savanna restoration with fire hazard reduction played out in the scenarios. On the whole, stakeholders seemed to view fire hazard reduction as worthy endeavor and generally compatible with oak savanna restoration. However, the emphasis on reducing fire risks was viewed as a means of attracting financial and public support that could be channeled to oak savanna restoration. The last place ranking of the Fire Hazard Reduction scenario could reflect most stakeholders' principal interest in restoration as compared to managing fire risk. However, these results could reflect how participation of fire managers compared to ecologists and other interests involved in these discussions.

In summary, the following general statements reflecting general stakeholder priorities for restoration may be inferred by the manner in which stakeholders framed, described and ranked the land management scenarios:

1. Near-term restoration efforts should focus on restoring the largest area of oak savanna structure possible in the short-term.

2. Restoration strategies that are the most financially feasible and practical for private landowners should be emphasized.

3. Restoration approaches that apply to a variety of land types and uses are important because of their adaptability.

4. Restoration to high-quality savanna is an important component of a landscape-level approach to oak savanna restoration and should be prioritized for some sites.

This research question also asks about the ability of the set of scenarios to address the range of site of site conditions and management needs in the Willamette Valley. The primary management needs appeared to be strategies that are both cost-effective and technically feasible for private landowners. As discussed earlier, the set of scenarios substantially addresses this need. However, it is not possible to anticipate all of the possible site conditions across the southern Willamette Valley, and it seems more useful to design a set of scenarios to be adaptable to a variety of land uses and types. As opposed to other uses of alternative futures analysis that assign a single land use for a specific location, this process identified a suite of possible conditions that could be selected from for any given site. The desired future conditions for each vegetation layer (i.e., canopy, shrub and ground layers) can be mixed and matched to create new scenarios. As a result, the set of resulting scenarios offers myriad site-scale land management options.

The final component of this question has to do with the ability of the scenarios to represent contrasting values, approaches or priorities to allow useful comparisons. The challenge was to construct a set of scenarios that balanced the need for versatility with the desire to address specific concerns. In doing so, it was important to avoid creating redundant scenarios (i.e., ones that are too similar or directed at the same issues). Several stakeholders felt there was some redundancy. Their comments were directed principally at the Savanna Structure and Wildlife Scenario, but also included the Fire Hazard Reduction and Mixed-Use Forest income scenarios. While it is true that the Savanna Structure and Wildlife scenario could look very similar to the Mixed-Use Savanna Income scenario on the ground, incorporating an optional wildlife component gives this scenario a unique purpose and focus. Also, management would be linked to the need to generate income and could be achieved through substantially different means. It is also true that fire hazards could be reduced as a side benefit of the other scenarios, potentially reducing the utility of the Fire Hazard Reduction scenario. However, there are other reasons to include this scenario, discussed below.

To allow a useful comparison of land management approaches, the set of scenarios need to be distinct from one another in terms of the priorities, constraints or values they encapsulate. In other words, they should each represent a plausible and coherent bundle of values, falling at different places on the spectrum of the key issues identified. As discussed above, each scenario embodies different emphases on issues related to ecological goals, economic constraints, fire hazards, practicality and geographic applicability. For instance, while Full Savanna Restoration aims to achieve higher ecological function, Savanna Structure and Wildlife was seen as having much stronger accompanying advantages related to economics, applicability and practicality, whereas these were all disadvantages for Full Savanna Restoration. In a similar vein, Full Savanna Restoration sets the standard for high-quality habitat but will be most difficult to achieve due to high costs and levels of current knowledge, thus limiting its applicability.

Question #3. How might this framework for alternative land management scenarios be transferable to other restoration planning projects?

The ultimate goal of alternative futures analysis is to inform decisions by forecasting the on-the-ground results of various approaches to an issue. The results of modeling the effects of the alternative land management scenarios on the landscape were not available at the time this study was completed. Therefore, the success of these scenarios in enhancing land management decision-making cannot yet be judged. However, the framework used to develop the scenarios may be valuable in and of itself. This section describes how the use of alternative futures analysis in this study differed from other uses, and how this adaptation may be applied to other types of conservation and restoration projects.

This study fell somewhere in the middle of the spectrum of stakeholder involvement found in the alternative futures analysis literature. Although it was not stakeholder-driven in that not all of the decisions were made by stakeholders, the framework developed for this study did allow the meaningful engagement of stakeholders. In addition to creating a foundation for an analysis and comparison of the effects of various land management strategies, the scenario development process itself can benefit those involved through shared information, improved understanding, and the opportunity to articulate and discuss a spectrum of values and concerns (Nassauer and Corry 2003; Wollenberg, Edmunds, and Buck 2000). This enhanced understanding can also translate into more effective strategies on the ground. Furthermore, since the stakeholder process can be time-consuming and costly, making the most efficient use of stakeholder involvement by drawing upon the most relevant experience and expertise available may be an effective strategy for other types of restoration projects for which resources are limited.

The focus of this study differed from other applications of alternative futures projects. Rather than develop alternative land use planning and development scenarios for a region undergoing major demographic changes, this study focused on a particular restoration goal and possible strategies to achieve it. Rather than use alternative futures analysis to develop consensus about a regional planning approach, this study started with general consensus about a desired goal and sought to explore ways to achieve the goal. Because of this, the process was designed not so much to develop common ground, but to draw upon the expertise and experience of stakeholders relative to the issues at hand to bracket a range of plausible scenarios. It did not attempt to engage a sample of people that would represent the general public and their attitudes toward oak savanna and fire hazards. Rather, it convened a panel of experts who were already supportive of the concept of oak savanna restoration.

This project also differed from the typical application of alternative futures analysis in that the scenarios were not designed as spatially explicit alternative future landscapes for a geographically defined region, but rather as a range of land management options that could be applied to any site. While this lack of a spatial component posed a special challenge for stakeholders by requiring them to design scenarios without a particular site in mind, it also was necessary to achieve a set of scenarios that would apply to a variety of site conditions. At specific points in the meetings, researchers provided stakeholders hypothetical sites to help them envision and compare land management scenarios. This device was used to help focus thinking, but then set aside so that scenarios were not tailored to that specific site, restricting their applicability to other sites.

As discussed earlier, by developing specific but generic desired future conditions (DFCs), this adaptation of alternative futures analysis also differs in the variety of scenario options possible. This process did not attempt to establish a single land use or land cover for specific locations, but rather identified a suite of possible conditions that could be selected from for any given site. The DFCs for each vegetation layer (i.e., canopy, shrub and ground layers) can be mixed and matched to create new scenarios at the landscape scale, or spatially by using different DFCs on different parts of a single site. As a result, the set of resulting five scenarios offers many more site-scale land management options, which could maximize the numbers and types of locations in the Willamette Valley ecoregion in which some level of oak savanna function may be reestablished. This could be a useful goal for other alternative futures projects.

The way alternative futures analysis has been adapted to this particular project may make it a valuable tool for other types of projects in which general consensus has developed around a particular restoration goal, but insufficient information exists about how to achieve the goal. If some basic ecological data are available for analysis, a land or resource management scenario process could be designed to harness the expertise of local experts to design a variety of strategies to achieve the goal and to test their utility.

Caveats and Limitations

It is important to note that while this process was intended to be inclusive of stakeholder ideas and concerns, certain project parameters were predetermined and therefore not influenced by stakeholder input, such as the type of ecological data gathered that could be incorporated into the alternative futures analysis. In addition, the project took a streamlined approach to conducting the stakeholder process, making it more a stakeholder-informed than a stakeholder-driven process. In this way, this process differed from many other applications of alternative futures analysis (e.g., Baker et al. 2004; Hulse, Branscomb, and Payne 2004).

It should also be noted that in conveying stakeholder values, concerns and priorities, some interpretation was involved. Researchers drew upon the specific comments made by stakeholders, but also relied upon the context in which the comments were made, observations of group dynamics, and general knowledge of oak savanna and fire hazards to interpret some of the comments.

The composition of the stakeholder group likely influenced the outcomes of the process. As expected, attending daytime meetings proved more difficult for private landowners. As a result, the perspectives of private landowners may have had less representation than their proportionate land ownership would require. However, four stakeholders identified themselves as landowner liaisons, which likely meant that they had an increased awareness of private landowner experiences and concerns, and that they were able to articulate the needs and concerns of a wide array of landowners. In addition, as discussed in the next section, private landowner concerns figured prominently in the discussion and rankings at the meetings.

People with expertise in managing fire risks were also underrepresented. While fire hazard reduction was specifically addressed as a key issue in these meetings, most of the discussions focused on issues related to restoring oak savanna. Having more representation by stakeholders with fire management expertise may have provided more balance to the discussions and more useful information about how to approach reducing fire risks in conjunction with oak habitat restoration.

Two other targeted stakeholder groups that were not sufficiently represented at the meetings were Native American tribes and private industrial landowners engaged in forestry or agriculture. These groups would likely have had different priorities and concerns than other stakeholders and both have significant land holdings in areas of former and current oak habitats.

The following strategies might have been successful in recruiting these under-represented interests so that the land management scenarios reflected the interests of all primary stakeholders. (1) Night-time or individual meetings with private landowners could have made it easier for them to participate. (2) More intensive recruiting efforts aimed at fire managers, Native American tribes, and industrial landowners, and focusing on how they might benefit from participation in this study, might have been successful. (3) Providing greater lead time for recruiting stakeholders might have allowed more time to get buy-in from their respective agencies for participating in this study.

Suggestions for Further Research

Since the actions of private landowners hold the key to oak savanna restoration in Oregon's Willamette Valley, future research should focus on a further examination of the values and needs of different types of private landowners. A study of privately owned oak woodlands in California revealed key demographic differences among oak woodland landowners, affecting their interest and utilization of outreach and assistance programs (Huntsinger and Fortmann 1990). While some studies have been conducted on landowner attitudes toward oak communities and resource conservation in general, these studies were not specific to oak savanna (Fischer 2005). A number of excellent outreach tools for the Willamette Valley have been created and disseminated, such as "A Landowners

Guide for Restoring and Managing Oregon White Oak Habitats," and it would be valuable to have information on how they were received by landowners (Vesely and Tucker 2004).

More research needs to be done on the potential for income-generating uses that are compatible with oak savanna. Landowner experiences with specific uses should be documented and shared with others. For instance, some participants also expressed skepticism about the viability of the market for ponderosa pine as part of the Mixed-Use Savanna Income scenario. Answers to questions like these would help alleviate some of the uncertainty around oak savanna restoration efforts.

Final Thoughts

Conservation and restoration resources are scarce, and threats to biodiversity continue to intensify. Conservation planning and land management decisions must be as deliberate and effective as possible. Unfortunately, the tools available to address conservation challenges are not on par with the challenges themselves. Innovative technologies exist in other fields that if applied to conservation and restoration would likely dramatically increase the success of such efforts. Similarly, strategies to create common ground among diverse interests and envision new ways of thinking are emerging as crucial tools in the quest for more ecologically sustainable ways to manage land and for ways to integrate human desires with the needs of the natural world. The old model of focusing efforts on public land is becoming insufficient as we realize the importance of the matrix of privately-owned land in contributing to biodiversity, and the crucial connections between public and private land. Techniques to help bridge the gap between scientific knowledge and political decision making are also needed. More often than not, decisions are motivated by political expediency, while scientific research continues with little connection to real world issues. These two worlds rarely intersect, and when they do, integrating them is difficult. Tools like alternative futures analysis shine a light down a new path of conservation planning that makes us more aware of our relationship with nature and empower us to act responsibly.

APPENDIX A

LAND MANAGEMENT SCENARIOS RANKING

Please rank the following land management scenarios from 1 to 5, with 1 as the highest priority and 5 as the lowest priority. Base your ranking on what you consider to be the most relevant and important scenarios for conserving and restoring oak habitats in the Willamette Valley. (Please do NOT consider our project needs in your ranking.) Then briefly describe why you ranked each as you did. Be as specific as possible.

Ranking	**Scenario**	**Reasoning**
	Mixed-use savanna income: Mix of restoration of oak savanna structure and other income-generating uses that are consistent with maintaining oak savanna (e.g., grazing, selective thinning of pines, haying).	
	Fire hazard Reduction: Focus on managing fire hazards to protect structures and the landscape.	
	Savanna Structure & Wildlife: Create savanna structure with key habitat elements to support specific wildlife and/or threatened and endangered plant and animal species.	
	Mixed-use forest income: Mix of restoration of oak savanna structure and other income-generating uses that are not consistent with maintaining savanna (e.g., timber production).	
	Full savanna restoration: Restore ecologically and culturally functional oak savanna	

Use this space for any additional comments.

APPENDIX B

DESIRED FUTURE CONDITIONS FOR LAND MANAGEMENT SCENARIOS

The DFCs represent generic standards for each land management scenario that in practice could be modified based on site-specific conditions. These factors include current and historic vegetation, soils and topography, habitat patch and/or site size, landscape context, parcel ownership and management resources.

	Full Savanna Restoration	**Savanna Structure**
Canopy layer[1]		
percent canopy cover[2]	5%-25%	same as full rest.
relative percent native	100%	same as full rest.
spatial distribution	*use project data for clumping or dispersal of presettlement trees*	
large trees/ac (convert to trees/ha)[3]	5–10 large trees/ac (12-25 trees/ha) Savanna may be 2-15 trees/ac but plan min. 5 for mortality and max. 10 so room for replacement age cohorts.	same as full rest.
younger tree cohorts[4]	Need replacement trees - *~5 sapling & 5mid-age?*	*same as full rest.*
functional group composition	use site-specific data/estimate OR default =70%-90% QUGA or QUKE (large, open-grown); 10%-30% variety other sp.: PIPO, PSME, CADE madrone, etc. (>% -> > diversity, esp. not 30% PSME)[2]	*same as full rest.*
Snags	1-2 snags/ac (max of 15 trees/ac), 12”–18” dbh or larger for wildlife. Want range of decay classes	*tolerate more if needed to save money*
downed logs	5/acre? Calculate based on literature. Use decay time calculations to help det. #s of snags and logs	*same as full rest.*
Shrub layer		
total percent cover	2-10% and not to exceed tree canopy cover	*same as full rest.*
max. percent cover invasive exotic[5]	Tier 1: <1% = target, ≥1%intervention trigger; Tier 2: target ≤5%, intervention trigger is >10%	50% tolerance for Tier 2 spp. and 0-tolerance

	Full Savanna Restoration	Savanna Structure
		for Tier 1 spp.
spatial distribution/structure	combination dispersed shrubs and widely scattered clumps	*same as full rest.*
functional group composition	depends on site characteristics	*same as full rest.*
vascular percent cover (assume ocular cover w/max 100%)	mostly continuous groundlayer: 50-100% (% varies by site condition and canopy cover)	*same as full rest.*
spatial distribution	*mostly continuous*	*same as full rest.*
Ground layer		
functional group composition	50-70% cover graminoids; 30-50% cover forbs (nearly the same as saying 50-70% relative cover graminoids)	*no constraints?*
species richness (#/m^2)	review data & literature: ~15 sp/m^2 (native) and 50-75 total species at site scale	no constraints
relative percent native[5, 6]	50-70%: 50% for enhancement of remnant, 70% for full restoration from converted area. 0-tolerance for Tier 1 invasive exotics, max. tolerance for Tier 2 sp. to upper limit for a single sp. Also minimize native invasives.	*no constraints? Or control only Tier 1 sp.*

	Mixed Use Savanna Income	Mixed Use Forest Income	Fire Hazard Reduction
Canopy layer[1]	**Ground Layer**		
percent canopy cover[2]	allow >25% for pines to harvest	same as full rest.	allow >25%? Goal is 10' spacing betw. crowns
relative percent native	same as full rest.	same as full rest.	same as full rest.
spatial distribution			
large trees/ac (convert to trees/ha)[3]	same # savanna trees + max. 10-15 pine/ac under long-term pine harvest option[3]	same as full rest.	allow >density than full rest? Need >overstory to keep ground fuels moist?
younger tree cohorts[4]	*same as full rest.*	*same as full rest.*	*same as full rest.*

	Mixed Use Savanna Income	Mixed Use Forest Income	Fire Hazard Reduction
functional group composition	*same as full rest + harvest trees*	*same as full rest.*	depends on costs
Snags	*same as full rest.*	*Same as full rest.*	*limit if fire hazard*
downed logs	*less than full rest.to allow haying?*	*Same as full rest.*	*limit if fire hazard*
Shrub layer			
total percent cover	*same as full rest.*	*Same as full rest.*	constraints only for fuels
max. percent cover invasive exotic[5]	same as savanna structure (unless need to restrict more due to economic impacts?)	Same as full rest.	constraints only for fuels (e.g., height, volatile compounds)
spatial distribution/structure	*same as full rest.*	*Same as full rest.*	need fuel breaks and no ladder fuels
functional group composition	*same as full rest.*	*Same as full rest.*	*same as full rest.*
Ground layer			
vascular percent cover (assume ocular cover w/max 100%)	*same as full rest. but not lower than site potential due to overgrazing*	*Same as full rest.*	constraints only for fuels
spatial distribution	*same as full rest.*	*Same as full rest.*	constraints only for fuels
functional group composition	*no restriction?*	*Same as full rest.*	constraints only for fuels
species richness (#/m^2)	1/2 full restoration?	Same as full rest?	no constraints
relative percent native[5, 6]	*what's reasonable for grazed land if using rotations & timing to foster/minimize impacts on natives*	*Same as full rest? 1/2 as much?*	matters only if affects flammability (cont. fuels)

Footnotes:

1. Need to consider min. and max. tree density and canopy cover that optimize savanna species, while still supporting prairie sp. and not converting to woodland species

2. Upper limit of canopy cover based on NVCS and does not reflect known value for WV oak savanna

3. Density based on best W.V. knowledge and general savanna literature. May be revised when ONHRC complete GLO survey data analysis

4. Trees should include variety of ages (oaks) from large savanna-form trees to maturing trees to replacement saplings and not just one size/age class.

5. Tier 1 = "0 tolerance" invasive species: highly invasive due to life history characteristics and are relatively amenable to control if applied early in the invasion, otherwise can become virtually unmanageable

Tier 2: "low tolerance" invasive species. Slower to get out of control and difficult to eradicate completely.

6. These standards are intended to represent a goal for a future time when techniques and the application have been well-established.

APPENDIX C: COMMENTS ACROSS SCENARIOS

Advantages

Comment	***Number of Comments for Each Scenario***					
	Scenario					
	Sav Str	Mxd Sav	Mxd For	Full Sav	Fire Haz	Total
Advantages						
Ecological Issues	**17**	**4**	**5**	**17**		**43**
o Protects habitat/ function/processes and species	16	4				20
o Protects higher quality oak habitat and species on some portion of land (devoted to savanna)			3			3
o Emphasizes high quality sites	1			11		12
o Protects rare species/ greatest gains in biodiversity				3		3
o Could inform restoration efforts/serve as reference ecosystem				3		3
o Mimic natural mosaic/trajectory of oak and fir			2			2
Economic Issues	**11**	**6**	**8**		**7**	**32**
o Ability to draw funding/ financially feasible	8					8
o Generates income		6	6			12
o Get the most bang for the buck	3		1			4
o Funding available for fire hazard reduction					7	7
o Sustainable			1			1
Appeal to private landowners		**11**	**11**		**3**	**25**
o Appeals to private landowners/ most oak habitat privately owned		11	11			22
o Appeals to private landowners who otherwise would not be interested in savanna restoration					3	3
Geographic Applicability	**8**	**7**	**2**	**3**	**5**	**25**
o Restores largest area of land	8	2	1			11
o Important for public lands				3	1	4
o Applicable to agricultural land (i.e., haying, grazing)		3				3
o Applicable to nonfarm and nonforest land		1	1			2
o Applicable to mid-Valley (poor soils, less conifer invasion)		1				1

Comment	Number of Comments for Each Scenario					
	Scenario					
	Sav Str	Mxd Sav	Mxd For	Full Sav	Fire Haz	Total
o Important for certain geographic areas					4	4
Fire Issues		**1**		**1**	**14**	**16**
o Fire hazard reduction compatible with oak restoration					5	5
o Fire hazard reduction is important issue/social need					5	5
o Public support for fire hazard reduction					4	4
o Could stop conifer invasion and reduce fire hazard		1				1
o Assumes fire so achieves fire hazard reduction objective				1		1
Practicality	**6**	**1**	**1**	**0**		**8**
o Practical, especially when full restoration infeasible	4					4
o Intermediate/interim strategy	1		1			2
o Addresses social, environmental & economic goals		1				1
o Most technologically feasible	1					1
o Provides measurable goals and monitoring targets	1					1

Drawbacks

Comment	Number of Comments for Each Scenario					
	Scenario					
	Sav Str	Mxd Sav	Mxd For	Full Sav	Fire Haz	Total
Drawbacks						
Geographic Applicability	**3**			**12**		**15**
o Only feasible in limited areas				7		7
o Limited to public land	1			5		6
o Limited to private land	2					2
Ecological Issues	**2**	**5**	**3**		**3**	**13**
o Creates lower quality savanna		5				5
o Reduced extent of savanna restored/too much compromise			3			3
o Fewer benefits to oak savanna					3	3
o Fewer benefits than full savanna	2					2
Economic Issues	**1**	**1**		**10**	**1**	**13**
o Costly	1			10		11
o Generates less income than mixed use forest scenario		1				1
o Fire funding may not be available on west side					1	1
Practicality	**1**	**2**	**3**	**3**		**9**
o Practicality	1			3		4

Comment	*Number of Comments for Each Scenario*					
	Scenario					
	Sav Str	Mxd Sav	Mxd For	Full Sav	Fire Haz	Total
○ Creates conflict of interest between income and savanna		2				2
○ Timber production on savanna land is marginal/no link between forestry and savanna			2			2
○ Could make fire and other management options infeasible due to adjacent land uses			1			1
Redundancy with other scenarios	**4**		**1**		**2**	**7**
Fire Issues					**3**	**3**
○ Would increase some types of fire (short-term high intensity)					1	1
○ Fire hazard reduction only one goal					1	1
○ Fire hazard threat overblown					1	1

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