BIOREGIONALLY-BASED ECOLOGICAL EDUCATION:

A WAY TO BRING FIRE BACK INTO OREGON LANDSCAPES

by

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Education is necessary for the reintroduction of fire into Oregon ecoregions. Fire history, ecology, and management are explored, along with the major benefits and barriers to using fire in management and ecosystem restoration. Environmental and ecological education are explored as background for initiatives in fire ecology education—focusing on the benefits of community, bioregional, and adult education. I argue that ecologically- and bioregionally-based education about fire ecology is essential to the reintroduction of fire into fire-dependent ecosystems. I include case studies of several organizations that incorporate ecological education and fire in their education programs. Recommendations for these and like organizations are made so that they can best aim for increased public ecological understanding and local action in ecologically-sound management.

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CHAPTER I

INTRODUCTION

We are bombarded daily with the popular environmental slogan, "Think Globally, Act Locally," though what this actually means is often overlooked. This slogan implies that the Earth and its problems in all areas are connected, but that in order to have an effect on global environmental problems, one must focus one's action in the local community, where these actions will make a difference. It sounds simple. But what is really necessary for appropriate action to take place in a locality is for the people acting to know that place—ecologically, historically, economically, culturally, and spiritually. A deep understanding of the many intertwining factors involved in a city or ecoregion or state must be reached before a person can make an ecologically and socially informed decision for that place; a decision that may carry into action.

Americans, as a people, are sincerely lacking in this knowledge of place, however. Our ancestors lived more directly off the land than we do, and often stayed in one region for generations. Our mobility in modern times often means that a person moves around the country or world several times in his or her lifetime—encountering new ecosystems, cultures, and histories in each place and often not taking the time to learn them. We are therefore more detached from the places and ecosystems in which we live than ever before, just when our environment needs everyone to take action to protect

biodiversity, ecosystem health and functionality. Though we are aware of the environmental crisis and have taken many steps towards reversing and healing this crisis through education, protective laws, and living in a more sustainable way, the fundamental ways that we live and relate to the places in which we live have not changed enough. Children, laborers, intellectuals, and lawmakers alike need to know and care about the ecoregion they live within so that they can make sustainable, ecologically sound choices in their own lives and as a member of a community, both now and in the future.

I propose that the best way to achieve the joint goals of ecosystem health and human understanding of place is through community-based education programs; programs that are rooted within the bioregion where they are located, and that address the learning needs of all the people in their communities. In this introduction, I intend to address the biological background to the biodiversity and general environmental crisis, fire's relevance to this argument, and the need for community education programs that can help address these issues. Chapter II explores the ecology, history, and management of fire. Chapter III discusses ecological education as an idea and a way of addressing the environmental crisis. Chapter IV addresses the various ways education about fire can be achieved, and why community education programs can be very effective in attaining the goals of ecological education and in improving how people understand their bioregion. This chapter also profiles specific programs in the Willamette Valley and in the Klamath-Siskiyou ecoregions. And finally, in Chapter V, I offer conclusions for this research and recommendations for community education programs based on ecological education principles.

Conservation of Biodiversity

The environmental movement, as subjective and loosely organized as it is (Gottlieb 1993), has been very successful in raising awareness of many environmental issues to the general human population. Since the late 1960s, the attention of the public has been drawn to air and water pollution, nuclear waste, toxic chemicals, endangered species, wilderness preservation, and overpopulation. Scientific and social disciplines have grown to encompass increased concern about environmental issues, and new disciplines have also been created to address them. Among these new fields is conservation biology. This field, first defined as such by Michael Soulé and Bruce Wilcox in the 1980s, is different from other natural sciences because it has a defined mission to preserve biodiversity, it is interdisciplinary, and it is largely an applied science. Noss and Cooperrider (1994) list basic differences between traditional resource management and conservation biology. (See Table 1.)

TABLE 1. Differences Between Traditional Resource Management and Conservation Biology (Adapted from Noss and Cooperrider 1994).

	Traditional Resource Management	Conservation Biology
Time Scale	Short	Long
Research Orientation	Resource use	Ecology
Attitude	Confidence in human knowledge & technology	Uncertainty about human knowledge and effects on ecosystems
Role of humans	Domination and control	Living within an ecosystem
Species emphasized	Improved or introduced	Native
Program coordination	Disciplinary	Interdisciplinary

They also define the four major objectives of conservation biology:

- To represent all native ecosystem types;
- To maintain viable populations of native species;
- To maintain ecological and evolutionary processes; and
- To manage landscapes adaptively. (Noss and Cooperrider 1994)

This field has helped champion research on biodiversity loss, habitat restoration projects, and nature reserve design. It has also drawn more attention to problems such as habitat loss, degradation, and fragmentation; biodiversity hotspots; extinction rates; and using different scales to analyze species and ecosystem loss and conservation.

Much of the conservation biology work done to date has involved the Pacific Northwest, the area I am addressing in this paper. Pacific Northwest (PNW) forests are among the richest in habitat and organism diversity and productivity in the world. Yet, over the past century and a half, much of this region's forests and prairies have disappeared due to over-cutting, conversion to agriculture, and poor management strategies. These lands were seen mostly in economic terms for many years, and the U.S. government supported managing natural resources for the purpose of exploiting them for economic gain. Biological makeup and ecosystem health were not concerns for government management until relatively recently. There has been a major shift in philosophy and practice in forest management over the past two decades, however. "Over the period 1972-1993, the issue evolved from a question of dealing with a single species…to dealing with several such species simultaneously within the same ecosystem,

to considering the effects of broad scale management plans on *all* species associated with old-growth or late-successional forests" (FEMAT 1993, p. II-1).

Importance of Biodiversity and Disturbance

Two of the major issues now being addressed in forest management are preserving biodiversity and maintaining natural disturbance regimes, both components of a healthy ecosystem. Biodiversity is important to all ecosystems for several fundamental reasons. The diversity of organisms—including plants, fungi, and animals—is essential to maintaining proper function of ecosystem processes. Different organisms, interacting together, contribute to maintaining energy transfer chains, nutrient and water cycles, genetic diversity, and succession. All living things, great or small, must be included in evaluations of biodiversity. Many overlooked species may be keystone species or groups, organisms that play a pivotal role in ecosystem processes and which cause negative cascade effects in the ecosystem when lost (Perry and Amaranthus 1997, p. 42). Also, if ecosystems are to function properly, there must be species to fill every functional niche. Functional redundancy is important so that if one species is removed from an ecosystem, its functional niche is still filled and the ecosystem can function properly.

Although defined differently, biodiversity and disturbance processes are intimately related. Biodiversity includes such processes, and in turn, disturbance processes can maintain and create biodiversity. For example, the 1993 government report by the Forest Ecosystem Management Assessment Team (FEMAT) defines biodiversity as "the variety of life forms and processes, including a complexity of species,

communities, gene pools, and ecological functions" (p. IX-3). This broad definition by the U.S. government is an important one, in that it includes 'processes' and 'ecological functions,' two things that are very important to long-term conservation of ecosystems.

Perry and Amaranthus, PNW ecologists, define disturbances as "events that cause a significant change in the existing pattern in a system" (1997, p. 31). Noss and Cooperrider (1994), prominent conservation biologists, also recognize disturbance as an important component in ecosystems—one that creates and maintains structural diversity and maintains biodiversity. In other words, disturbances are important components of most ecosystems that help them function properly and create diversity.

This fact was not accepted for many years, however. Succession from one vegetation type to another in a logical progression was seen as the most natural way for ecosystems to change, and disturbances were seen as negative elements in this process. Ecologists, conservationists, and forest managers have realized in the past several decades, however, that sustaining ecosystems "and maintaining [their] biodiversity means assuring the long-term survival of the naturally occurring species in viable populations, as well as maintaining important processes which affect the sustainability of the ecosystem" (Angelstam 1998, p. 593).

Success at sustaining species, habitat, and landscape diversity will not come until land management takes a longer-term view of ecology. For example, focusing on immediate effects of disturbance on biodiversity may reveal nothing but destruction, but focusing on long-term effects and benefits reveals something completely different. Long-

term, large-scale examination of disturbances shows an overall increase in diversity and contributions to the health of ecosystems (Noss and Cooperrider 1994).

Fire

The natural disturbance perhaps most important to the PNW is fire. Fire has the potential both to destroy and renew, and has been an active participant in shaping PNW biodiversity. Ancient fire regimes are reconstructed by looking at fire scars on tree rings and by examining charcoal deposits in lakes, which can trace fire history back for thousands of years. 'Natural' sources of fire, like lightning, ignited some regions in Oregon, and Native Americans in various regions also set fires as a tool for gathering food and hunting. (See Chapter II for a more in-depth discussion of these topics.)

Because of the intimate relationship between disturbance, succession, habitat, and species makeup, biodiversity is tied tightly to fire. Recently, researchers have determined how forests recover from fire and how different organisms respond to the disturbance and subsequent shift in vegetation and structural composition. These studies further support the assertion that the long-term view of biodiversity maintenance is important; the high diversity of an area can not come about immediately after disturbance, but disturbance contributes to diversity over a long period of time (Halpern and Spies 1995).

Many arguments and much public misunderstanding take place over how much damage fire does to wildlife habitat and life patterns. While it is true that soil microfauna like mycorrhizal fungi and bacteria (very important parts of the forest ecosystem) are

damaged by fire, they usually recover quickly with spores and residuals (Agee 1993). More generally, Agee (1993) lists the effects of fire on wildlife as follows:

- Fire is not detrimental to many species of wildlife; conversely, it is not always beneficial to wildlife or of equal effect on all species;
- Death of large animals directly due to fire is rare;
- Many species ignore the presence of fire, while others are attracted to it because of the availability of prey;
- The major effect of fire is on animal habitat: food, cover, and water; and
- Fire may have different effects over time on an individual species, with immediate beneficial or detrimental effects and later offsetting effects.

Many species have even adapted to the fire regime of the region where they live, and are dependent on fire to keep the ecosystem in the state to which species are adapted.

Fire, as a natural disturbance in forests and grasslands, helps maintain ecosystem composition, structure, and function. It develops and maintains biodiversity at several levels over long time periods, especially where species and communities have evolved within a specific fire regime. Unfortunately, Euro-American management practices have excluded fire; and in so doing they have disrupted vegetation communities, habitat structure, and ecosystem processes. The effects of fire suppression are complex and far-reaching. Fire historian Stephen Pyne describes the past century of American fire control: "The tragedy… was not that wildfires were suppressed but that controlled fires were no longer set. ... The fire mosaic that had once shaped America had become a mosaic of fire-problem landscapes for which there was no single solution and no simple social or

ecological fix" (1997, p. 28). But aside from the important social implications of fire management, ecological biodiversity is also threatened. Species that depend on fire in their ecosystems are now in danger on multiple fronts. Many endangered plants and animals are those that depend on fire, which is not occurring as frequently or on as large a scale as these species and habitats need to survive (Noss, Strittholt et al. 1999).

Both scientists and land managers now realize the importance of fire in many different ecosystems. They claim that knowledge of fire effects can inform land management decisions and practice, and many have begun to work on ways to integrate this natural process into landscapes (Agee 1993; Angelstam 1998). Despite this recent recognition and acceptance in some circles, several major barriers to reintroducing natural fire regimes in Oregon exist. These include government policies and management, negative public perceptions, land use change, ecological change, and a lack of understanding of fire ecology: Though these barriers are difficult to overcome, a new management philosophy of the past two decades—ecosystem management—is a movement towards including biodiversity and fire in land management goals and design (Halpern and Spies 1995).

Ecosystem Management

Ecosystem management has been described as "management that acknowledges the importance of human needs while at the same time confronting the reality that the capacity of our world to meet those needs in perpetuity has limits and depends on the functioning of ecosystems" (Christensen, Bartuska et al. 1996, p. 666). Noss defines it as

"the conservation and stewardship of large areas of land or water containing multiple species, habitats, resources, and (often) ownerships" (1999). Agee describes ecosystem management as "regulating internal ecosystem structure and function, plus inputs and outputs, to achieve socially desirable conditions. It is a *process* of understanding ecosystem components (including people) and interactions" (1993, p. 390). This form of management is often noted for considering ecosystem function and complexity in management as opposed to focusing on single species or other ecosystem components.

Among the advantages to this holistic management method is that it considers social issues and that "it directly addresses the primary cause of many species declines (habitat destruction), …and it provides a cost-effective means for simultaneous conservation and recovery of groups of species" (Noss, LaRoe et al. 1995, p. 6). Some major components that should be present in an ecosystem management plan include:

- Long-term sustainability as a fundamental value;
- Clear, operational goals;
- Sound ecological models and understanding;
- Understanding complexity and interconnectedness;
- Recognition of the dynamic character of ecosystems;
- Attention to context and scale;
- Humans as ecosystem components; and
- Adaptability and accountability (Noss 1999).

Even though preserving ecosystems and habitats has been a stated goal in many management plans since the idea was put forth in the U.S. Endangered Species Act of

1973, most plans and actions ignore the needs of more than one species at a time (Noss 1999). More recently, however, as the crisis became plainer, most scientists and managers began to see ecosystem management as necessary and began working seriously towards this goal. While people working in this field make advances and accomplishments each day, they must also be cautious due to uncertainties about how and why ecosystems function. As Noss (1999) discusses:

> Management is not necessarily bad or good; it can be either or it can be neutral, depending on how well it mimics natural processes. If management introduces to the biological community a whole new set of disturbances and stresses that many species in the community have never experienced during their evolutionary histories, then the effects are most likely to be negative. ...A management regime that sustains or effectively mimics a natural disturbance regime may be expected to have neutral effects on native biodiversity. Finally, a management regime that effectively restores natural patterns and processes that were disrupted by former human activities would have a net positive effect.

The trouble lies in getting the management right without causing even more harm while figuring it out.

Ecoregions

One way that ecologists and other scientists have gone about incorporating a broader-scale, longer-term view of management and diversity is by developing the ecoregion concept. Brewer, in his 1999 thesis, describes the development of this concept as a reflection of the fact that environmental issues rarely conform to political boundaries. Rather than political boundaries, ecoregions[1] refer to an area of relative homogeneity in

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[1] Ecoregions are also known as ecological regions or bioregions. I use 'bioregion' and 'ecoregion' interchangeably throughout this paper.

ecosystems and the various components (biotic and abiotic) therein that is different from nearby regions (Gallant, Whittier et al. 1989; Noss and Cooperrider 1994; Brewer 1999). Although the general idea of ecoregions has been part of the discipline of ecology as biomes or natural regions for some time (Brewer 1999), it wasn't until the 1970s that 'ecoregions' were defined as such and these definitions were used for management or conservation purposes. Different ecoregion classifications have been developed for different purposes and by different organizations, but as long as the classification and purposes are made clear, ecoregions can be very useful in water quality, forestry, climate change, management, land use, endangered species studies, historical landscape reconstruction and more (Brewer 1999). Ecoregions are usually of a convenient working size, and since they are defined as being ecologically unique from other regions, they are convenient for use in biodiversity conservation efforts (as done by groups like the World Wildlife Fund, The Nature Conservancy, and the Sierra Club). They can also be useful to analyze fire histories and reintroduction potential.

One potential problem with ecoregions is that they are always subject to change through both 'natural' and anthropogenic dynamics. Boundaries and strategies for management or conservation must be continually reevaluated to account for climate change, species change, habitat degradation, and the discovery of new information regarding ecological function and composition (Christensen, Bartuska et al. 1996; Brewer 1999). This 'problem,' however, is also a very good illustration of the fact that ecosystems are dynamic and must be managed holistically and over the long-term.

Numerous ecoregions with different vegetation types, terrain, and fire histories exist within the state of Oregon (Omernik 1987). Some regions, like the forests of the Coast Range, have experienced fire only rarely due to the usually high year-round moisture. These forests have a very high fire return interval, and when fires do occur, they are usually large and of high intensity (Agee 1993). Other areas, like the high desert plateau on the East Side of the Cascade Range, are very dry, have a low-density understory, and have fewer trees per acre (Agee 1993). Regions like this probably burned much more frequently and with low intensity. In this study, I have chosen to focus mainly on two specific ecoregions—the Willamette Valley and the Klamath-Siskiyou Mountains. (See Figure 1.) These regions have very different geographies, histories, vegetation types, and historical fire regimes, but both regions need fire to maintain their native biodiversity and habitat types.

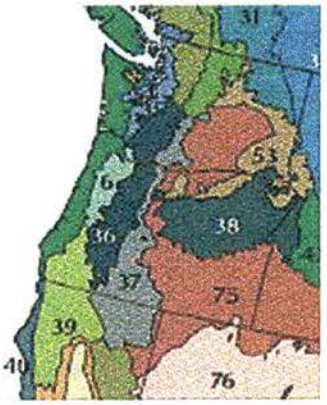

FIGURE 1. Willamette Valley (#6) and Klamath-Siskiyou (#39) Ecoregions
(From Ricketts et al. 1999)

To illustrate the vast differences in ecologies and natural histories between Oregon ecoregions, one must look no further than the two regions I am focusing on. The

Willamette Valley (WV) ecoregion stretches most of the length of Oregon between the Cascade and Coast Ranges and is relatively flat with hilly edges. The valley once supported vast prairies and oak savanna communities, with riparian forests along rivers and coniferous forests in the bordering hills (Habeck 1961; Johannessen, Davenport et al. 1971). Fire has historically played a large part in maintaining the ecoregion, and its exclusion over the past century has contributed significantly to ecosystem change. Open oak savannas and prairies in particular were adapted to frequent, low severity fires—ignited primarily by Native Americans in the valley until the mid-1800s (Boyd 1999c). Without fire, fire-sensitive coniferous trees have invaded open areas and will eventually shade-out the scattered oaks that once grew in savannas. In addition, many native prairie plants that are dependent on fire for survival are threatened by the exclusion of fire and invasive species. Noss, LaRoe, et al. estimate a "99.5% loss of native grasslands and oak savannas" (1995, p. 47).

The Klamath-Siskiyou ecoregion (K-S or 'Siskiyous'), on the other hand, has a very different geography and natural history. It is also a very important ecoregion biologically because it stretches along the Oregon-California border from east to west. This region has many endemic, rare species and communities, with varied and complex forest structures. Fire has historically played a large role in building and maintaining this diversity, and the region exhibits complex and varied fire regimes and histories as well. Many of the unique plants and communities in this ecoregion are adapted to fire. Logging, increased human population, and fire suppression policies beginning in the early part of the 1900s have changed the landscape and ecosystems significantly. Fire has

been largely eliminated from the forests, resulting in species composition changes and fuel accumulation—increasing the risk of catastrophic wildfires. The unique species assemblages of this region, found nowhere else in the world, are now in jeopardy due to these changes in the fire regimes they evolved with.

Bioregionalism

Though the development of ecoregions to address environmental problems and management has begun to take a more holistic and ecological approach to environmental issues, it does not address the cultural and philosophical issues of ecoregional identity. Gary Snyder defines one of these central cultural issues here: "There are tens of millions of people in North America who were physically born here but who are not actually living here intellectually, imaginatively, or morally" (Snyder 1990, p. 18). The concept and practice that has developed to combat this sort of problem within regions is *bioregionalism*. This concept is far from new, however. Many indigenous peoples all over the world believe we are connected physically, emotionally, and spiritually to a place (Caduto 1998); modern bioregionalists are simply using this concept to address environmental problems and to seek out solutions to the ecological and cultural crisis they see around them. Kirkpatrick Sale is one of the better-known writers on the topic of bioregionalism. He believes understanding the ecology, culture, geology, and resources of a place leads to developing the potential of the land within sustainable limits. If people understand the connection they have with the land and the ecosystems in a particular area, Sale believes they will not want to exploit or pollute that area (Sale 1985). Other

authors define bioregionalism in a similar vein. For example, Andruss, Plant, et al. say: "Bioregionalism calls for human society to be more closely related to nature (hence, bio), and to be more conscious of its locale, or region, or life-place (therefore, region)" (1990, p. 2).

Many bioregionalists mention the concept of *inhabitation.* This term, to them, implies more than simply living in a place; it means relying on the place and recognizing its connectedness to a person's needs. Because modern people have largely lost this concept of intimately inhabiting a place, bioregionalists talk about the need for *reinhabitation.* Peter Berg and Raymond Dasmann (1990) define reinhabitation:

> It involves becoming native to a place through becoming aware of the particular ecological relationships that operate with and around it. It means understanding activities and evolving social behavior that will enrich the life of that place, restore its life-supporting systems, and establish an ecologically and socially sustainable pattern of existence with it. (qtd. in Smith 1999, p. 214)

Becoming closer to a place and its ecological components would necessarily mean accepting and working with the natural processes, like fire, that are native to a place. Such a concept, and the change in philosophy and culture necessary to make it successful, cannot be spread without one key element: education.

Education

One does not have to look very hard to find a way to link conservation, fire, and management with a single theme—the need for education. Numerous sources in these and related fields suggest that education is necessary for a new, more holistic, sustainable, and ecologically sound paradigm to be accepted and applied in management,

conservation, and restoration. For example, Noss, Strittholt, et al., conservation biologists, feel that "a thorough grounding in biological sciences is absolutely necessary—even if not sufficient—for ecosystem management. Intimate biological knowledge of a place or species is a rare and precious commodity, and should be treasured as such" (1999). Norton and Ulanowicz, also in this field, proclaim: "A priority goal of conservation biologists must be educating the public toward a better understanding of ecological management, and in helping citizens to articulate their values and to express those values in management decisions" (1992, p. 221-222). In the field of forest management, Swanson, Jones, et al. claim, "social changes are critical—such as increased public understanding of the role of disturbances in ecosystems" (1997, p. 237). On the topic of fire ecology, Whelen asserts that "an understanding of the ecological effects of fire, both wildfire and management burning, is fundamental to conservation of plant and animal populations and representative communities in many areas" (1995, p. 2). Implications for successful ecoregional planning also include education and public awareness:

> Ecoregions could aid educators who teach regional and physical geography. Course work could be stratified by ecoregions. This stratification would allow teachers to incorporate information about soils, climate, vegetation, landforms, and land use activities in the course curriculum. These additions would help promote integrative thinking and holistic environmental management. (Brewer 1999, p. 158-159)

Fire, an essential element of many ecosystems that has been largely eliminated from the landscape, is a victim of the cultural crisis that is destroying the environment. It is one of many ecological elements that must be learned about in a more holistic, bioregionally-based way if native ecosystems are to be preserved or restored.

Several different types of programs and methods exist to enhance public understanding of fire's role in ecosystems. These include federal and state agency outreach programs, media, Research Natural Areas, school curricula, field schools, and community-based education programs. Some of these methods offer generalized fire ecology or management information without focusing this information on the specific region that it is trying to reach. Others, like field schools that offer hands-on experience in the outdoors, are not accessible to everyone and often do not focus on fire or a specific region.

Education about the environment, or environmental education, has been taking place in schools and non-formally since the mid-1900s. Such education can help raise awareness about environmental and resource management issues in students, but it does have its drawbacks. Environmental education in schools has been sharply criticized by a new movement in ecologically-based education, which stresses biocentric thinking, a holistic philosophy, and bioregional awareness. This form of education may be the best way to reach people about natural disturbances like fire so that they understand fire ecology and management.

I believe community-based education programs offer the best means for reaching local people about their own bioregion's fire regime, ecology, and natural ecosystems. Some examples of such programs are the Friends of Buford Park, Mount Pisgah Arboretum, and the Camas Educational Network in the Willamette Valley (near Eugene) and the Siskiyou Field Institute in the Klamath-Siskiyous (in Cave Junction). These programs offer courses, guided walks, and workshops that specifically address the natural

history, ecology, and culture of their own bioregions. They are available to people of all ages and most ability levels, and are based firmly in a community that values the organization's presence.

Learning about fire's role in local ecosystems, and other locally relevant ecology and environmental issues through community-based, accessible, holistic education programs can address many of the fire management and education communities' concerns for the future. With education, people that live in fire-adapted ecosystems will be more likely to accept using fire as a restoration and management tool for the sake of the ecosystem. Feeling knowledgeable about the local environment can also empower people to get more involved in environmental issues. This type of grassroots involvement has been, and will continue to be, important for solving environmental problems and combating management practices that degrade ecosystem health and stability. What it boils down to is this: people are liable to be more active and make more of a difference in their communities when they can take action about issues that affect them directly every day. It is education at the bioregional and community levels that will lead most successfully to the necessary change in attitudes and actions that will save native ecosystems and species because it is at this local level where people are most willing to work for environmental and social change.

CHAPTER II

FIRE ECOLOGY AND MANAGEMENT

Fire Ecology Basics

Fire History and Ecology

Disturbance Regimes

Fire has been a part of the Earth's and, in particular the Pacific Northwest's, history for as long as there has been anything to burn (Agee 1993; Pyne 1997). Fire's major relevance to modern PNW plant communities began about 5,000-10,000 years ago, in a warmer, drier climate and when modern species assemblages began to appear (Agee 1993). Landscapes and bioregions have been shaped by fire and other disturbances in various ways, both destroying and creating plant communities and ecosystems.

> Disturbances occur at many intensities and scales, from the death of a single old dominant tree to a catastrophic forest fire to volcanic eruptions and impacts by comets, all of which are embedded within climatic cycles that may span decades to millions of years. The disturbance regime of a particular forest [or other community] usually consists of a complex mixture of infrequent, large-scale events (e.g., a large fire or windstorm) and more frequent, small-scale event (e.g., small fires, the fall of a single tree). (Perry and Amaranthus 1997, p. 117-118)

Disturbances like fire contribute to vegetation succession, nutrient cycling, soil structure, wildlife habitat, and the diversity of life in general (Kauffman 1990).

In today's carefully-planned and ever-expanding world of technology and progress, fire still plays a role in natural ecosystems and is necessary for the preservation of biodiversity and healthy ecosystems. As humans try to control and manage natural landscapes, fire is a disturbance that often eludes such control or planning, and managers must pay close attention to its natural force. Some definitions may help clarify how managers and scientists talk about fire:

- *Natural fire*: started from a natural event like lightning, spontaneous combustion, volcano;
- *Human-caused fire*: caused directly or indirectly by human activity;
- *Wildfire*: does not meet management goals and is usually suppressed;
- *Prescribed fire*: confined and controlled fire to manage fuels or attain other management objectives; and
- *Prescribed natural fire*: caused by natural ignition and allowed to burn as long as it meets prescribed conditions and previously stated objectives. (Adapted from DeBano, Neary et al. 1998)

Another important term is *fire regime*. Historic and modern fire regimes alike are characterized and defined by several elements. In general, the term *fire regime* summarizes "the characteristics of the fires that typically occur at a site" (Whelan 1995, p. 47). The site and its regime are a complex combination of topography, elevation, aspect, wind, and moisture, among other things (Teensma 1987). Regimes are often classified by frequency (or return interval), severity, seasonality, vegetation effects, and dominant vegetation (Agee 1993). Each of these factors, in turn, effect each other as well

(Teensma 1987; Binkley, Becker-Heidmann et al. 1993). For example, in grasslands, the season and frequency of burning act together to determine the ecological effect of fire (Kucera 1978)—one or the other cannot make such a determination.

Scientific tools of determining historic fire regimes (including intensity, frequency, and spatial elements) help ecologists tell when and how forest stands originated and how disturbances reshape local landscapes. Dendrochronology makes use of fire scars on both living and dead trees, and compares known dates of fires to reconstruct when and how fires burned in an area (Clark and Robinson 1993; Whitlock and Knox 2000). This information is used in statistical models to predict fire frequency in a study area (Cissel, Swanson et al. 1999). This method also has its limits, however. Because it relies on living or preserved trees, it can really only be useful for dating the last 600 years. Also, fires are only recorded on tree trunks when they are of fairly high intensity, and some trees record fires better than others or at different stages of life (Pyne 1984). Thus, low to medium intensity fire events are likely underestimated using this method. Another, farther-reaching method of obtaining historic fire information is through analysis of pollen and charcoal that was deposited in bogs and lakes (Agee 1990; Clark and Robinson 1993; Whitlock and Knox 2000). This method allows for analysis of longer time periods, but also has limits to its accuracy.

Scientists and land managers use information gleaned from fire studies to determine when certain forest stands may have originated, the historic time between fires in these stands, when there are increases and decreases in this usual interval, and what the climate may have been like to cause these changes (Teensma 1987; Halpern and Spies

1995). Fire ecologists, like Agee, then use this information to describe the role of fire in an ecosystem at a local level. To do this, one must consider all of the fire regime and ecosystem characteristics. Consideration of disturbance on a local level is important for managing for fire disturbance because each local ecosystem has a different fire history and responds differently to fire.

Scientists must be careful in interpreting and drawing conclusions from fire histories. Long and short-term climate change plays a role in when and how fires burn, as do human burning practices (Clark and Robinson 1993). These are relationships that are still not well understood, but must be considered when discussing 'natural' fire regimes and historical occurrence. To complicate the factors involved in 'natural' fire regimes still further, there are also human-caused fires that have played a role in shaping fire regimes. In the PNW, as well as across the continent, there is evidence that Native Americans burned land to maintain desired plant communities and to make hunting and gathering easier (Kayll 1974; Vogl 1974; Whitlock and Knox 2000). While most traditional Native American burning practices no longer occur, humans still use, and abuse, fire. Today, it is mostly the effects of our exclusion and suppression of fire from the landscape, however, that shapes modern fire regimes. In many cases we have allowed plant communities to change drastically from their historic conditions, thus changing how fire behaves in and affects these communities.

Adaptations and Biodiversity

As different as specific ecosystems and fire regimes are, it is natural that fire has different effects on different types of vegetation, and that different plants are adapted to deal with fire in different ways. Fire, as a dynamic process, leads to dynamism in ecosystems. But, specific fire regimes also can maintain plant communities through their effects on the system. Agee offers an introduction to this topic: "Fire changes ecosystem, community, and population structure, either by selectively favoring certain species or creating conditions for new species to invade. ...Fire also changes resource availability" (1993, p. 11). For example, fire can affect conditions for plant reproduction like light, space, soil composition, competition, and nutrient availability (Maret 1997). These changes can benefit species native to an area that are adapted to the fire regime, or can favor species that invade from outside burned areas, thus altering the habitat composition.

Plant species have adapted to the fire regimes within their home range in a variety of ways. Some plants have adaptations that help individuals survive fire events. For example, some trees have very thick bark to protect against scorching; some plants have underground sprouting centers that are unaffected by fire; and some have fire-resistant foliage (Agee 1993; Christensen 1993; Whelan 1995). Other species have evolved ways for its populations to survive fire, while sacrificing the individual. For example, some trees have cones that only open after a fire; others have seeds that will only germinate after a fire; and some have mobile seeds that move into a burned area from an area untouched by fire (Agee 1993; Christensen 1993; Whelan 1995). In this way, the plants can germinate and grow quickly in an open area that is not likely to burn again soon, thus

maximizing their chances of survival. Some ecologists group plants by their fire response and survival technique. Agee (1993), for example, names 1) invaders—good dispersers that move into a disturbed site and get a good start; 2) evaders—have a long-lived next generation that can wait until good growing conditions arise; 3) avoiders—have few adaptations to fire, invade late, grow slow; 4) resisters—survive low intensity fires fairly well; and 5) endurers—resprout from roots or shoots.

Modern ecology has thus shown that some species, and certainly some plant communities and habitats, have evolved with a certain fire regime and have found ways to thrive within it. Mutch goes so far as to hypothesize that adaptations of plants might even encourage a specific fire regime, thus benefiting that plant:

> If species have developed reproductive mechanisms (underground rhizomes, root sprouting, serotinous cones) and anatomical mechanisms (thick bark, epicormic sprouting) to survive periodic fires, then fire-dependent plants might also possess characteristics obtained through natural selection that actually enhance the flammability of these communities. ...Fire-dependent plant communities burn more readily than non-fire-dependent communities because natural selection has favored development of characteristics that make them more flammable. (1970, p. 1047)

Such adaptations are often specific to certain species and to specific fire regimes. A number of scientists have noted that species adapted to survive in a specific fire regime can be put in jeopardy when that regime is altered for a significant amount of time (Kauffman 1990; Norris 1990; Noss and Cooperrider 1994). In fact, "adaptations to fire survival are, in reality, adaptations to a particular ecosystem and its specific fire regime. If the regime is altered, then the capacity for that species to survive in an environment may be eliminated" (Kauffman 1990, p. 48). In this case it is clear that a disturbance

regime is as much a part of a particular ecosystem as soil types, dominant vegetation, weather, or terrain. The living components of the ecosystem, thus, have evolved and adapted to the disturbance regime of their ecosystem and region.

On the flip side of how fire can maintain or create biodiversity and ecosystem health are the effects of fire suppression on many ecosystems. The Nature Conservancy, a land conservation organization, lists fire exclusion as a threat to biodiversity in 45% of its land (Wilkinson 2001). In general, fire suppression has caused two major changes in fire-adapted ecosystems, neither good for biodiversity and long-term ecosystem health: it has increased fuel loads and thus moved the fire regime towards higher severity, and it has changed species composition and habitat types. Agee illustrates the first change—unnatural fuel build-ups:

> This effect is most pronounced in fire regimes of low to moderate severity, where increased fire area is now burned primarily by high severity fires. The more successful we are at fire control, the worse the problem becomes: a seemingly insolvable problem if we do not look beyond the short-term objectives. (1993, p. 389)

This issue has become the focus of much recent media attention and policy-making because of the large fires that have occurred in recent years. Issues of forest thinning, fuel-breaks, fire-fighting, and prescribed burning to control fuel levels are all highly charged ones relating to the issue of fuel buildup.

The change in species composition is perhaps more serious for biodiversity than fuel build-up is. In general, plant composition change due to fire suppression results in grasslands converting to woodlands, and woodlands to forests. Even in the 1970s, scientists were noting this change. "Without fires to maintain healthy grasslands and

check woody encroachment, many savannas have reverted to forests; and forest, brush, and scrub species have replaced grassland plants" (Vogl 1974, p. 173). On the Fort Lewis prairie in Washington state, "fire exclusion has allowed 6,560 ha of the original 16,800 [hectare] fescue [a native grass] prairie to be converted to forest since 1870" (Tveten and Fonda 1999, p. 146). In a forest setting in the late 1970s, Dickman (1978) measured a marked invasion of small Douglas-fir trees that are easily killed by fire into a previously open area dominated by large, scattered Ponderosa pine—most likely due to fire suppression in the area. Such changes lead to a loss of biodiversity and habitats that once inhabited fire-dependent areas.

Management and Restoration of Fire Regimes

The rise of conservation biology has led to increased concern for preserving biodiversity and natural processes. This trend has informed fire management; and many scientists and managers are working to restore natural fire regimes and ecosystems through prescribed burning and thinning. Noss and Cooperrider (1994) and Tveten and Fonda (1999) are just two such groups of scientists who agree that prescribed burning can help maintain biodiversity and restore native fire-dependent communities. For example, in making recommendations for conservation reserves, Noss and Cooperrider suggest they should be large enough to accommodate natural disturbances like fire and should implement prescribed burning where natural fires can not be allowed to burn.

Perhaps the most difficult task for managers today, however, is considering all of the factors that place-specific fire regimes, plant adaptations, and human changes impose

on an area. Whitlock and Knox sum up this challenge here, but I will address other challenges later in this chapter: "If humans altered ecosystems through their use of fire, then a return to presettlement landscapes (i.e. those that existed prior to European Contact) is not possible without instigating burning and fuel reduction through forest thinning. … The argument is that some forests are so altered by fire exclusion that fire alone may not restore them" (2000, p. 27).

Despite management challenges, there seems little choice but to try to restore fire to many habitats if we don't want to lose them forever, however. With the many barriers to natural fire regimes firmly established, Oregon's fire-dependent landscapes are quickly vanishing, and it is up to people to try to maintain what is left: "The collapse of our fire-dependent ecosystems is a one-time event in which the bulk of the biota is being eliminated from site after site…—except where managers maintain it" (Packard 1993, p. 14).

Barriers to Fire in the Modern Landscape

Even though fire ecology has become much better understood in the past few decades and is now accepted by scientists as a vital part of many ecosystems and bioregions, there are still many barriers to reintroducing natural fire regimes in Oregon. These include:

- Governmental policies and management that exclude fire from the landscape;
- The negative perceptions and fear of fire that have been bred into the American mind for the past century;

- The complexity of management goals, objectives, and philosophy;
- Changes in land use since European settlement that conflict with natural fire regimes, including an increase in population centers in many fire-dependent regions;
- Significant vegetation and ecosystem structure changes since the beginning of fire suppression; and
- A general lack of understanding of historical fire regimes and ecology, by both the public and the scientific community.

Government Policy and Management of Fire

The westward expansion of European settlers was dominated by ideas of human domination and control of nature. These settlers moved west with utilitarian intentions and the science of a logical order and hierarchy ingrained in their ideals (Jackson 1979). The early Forest Service principles and management efforts reflected this view, especially surrounding fire.

> America's aversion to wildfire—apparent in our past and current forest management policies—has deep cultural roots. In the late 19th century, forester Bernhard Fernow proclaimed fire the 'bane of American forests' brought on by 'bad habits and loose morals.' Gifford Pinchot, the first chief of the Forest Service, equated acceptance of fire in the forest with acceptance of slavery in the South. Even John Muir lamented that fires did ten times the damage of loggers. (Williams 1995 p. 37)

A bias against any Native American practices also contributed to most settlers' anti-fire mentality (Boyd 1999b). As the government began to regulate and manage public lands, this bias became more pronounced. Prescribed fire "was seen as a

continuation of Native American burning practices," something that "was perceived as a threat to forest management" and thus a challenge to modern, scientific fire management (Dahl, Pyne et al. 1978; Agee 1993, p. 64). Although some early settlers used fire to convert forests to agricultural land and to maintain healthy rangelands, turn of the century dogma changed these practices as fire suppression became the dominant, and government sanctioned, management policy.

In addition to bringing a different philosophy towards the natural world, European settlers also brought with them knowledge of ecosystems that were very different from the PNW. Early foresters did not understand the fire cycles, ecology, or mechanics of PNW forests and plains. Because of this lack of knowledge and familiarity, there was a misplaced sense of management (Langston 1995 p. 31). The evidence that fire could actually be healthy for the regeneration of forests and help maintain conditions appropriate for growing healthy trees was not apparent to early foresters in the West. "They saw the reproduction [of timber] dying in the frequent fires, and they saw the effects of intense slash fires on soil and water, so they thought that suppressing fires was the only way to save forests" (Langston 1995 p. 29).

With the advent of the United States Forest Service (USFS) in the first decade of the twentieth century, forest management became a priority for the newly settled West. Wildfire in this largely dry, mountainous, vegetation-covered land was a major concern. In fact, "fire in the forest was characterized as the antithesis of forest management" (Agee 1991, p. 196), and the Forest Service shaped many of its policies around the threat of wildfire.

Bad fire years in the first two decades of the 1900s set the stage for a strict fire suppression policy. The prominence of the idea of fire suppression was made explicit by the Forest Service's 1935 "Out-by-10 A.M." policy, which stated that all wildfires should be suppressed by 10 A.M. on the day after it started. The policy was adopted "to prevent catastrophic fires" and in reaction "against poor industrial logging practices that had resulted in conflagrations. The Forest Service saw burning as part of irresponsible laissez-faire logging practices—practices utterly opposed to scientific sustained-yield forestry" (Langston 1995, p. 249). Big fires and fire-fighting heroes drove early suppression management and attitudes until at least the 1940s and after World War II. Images and themes presented by the Forest Service in the time of World War II "closely tied fire prevention efforts to winning the war" (Haverkamp and Schamel 1994, p. 165), as well as offering explicit war analogies; for example, fire was likened to the fire bombings of the war, and presented as the 'enemy'. Disney produced 'Bambi' during this time, and infused fear and misunderstanding of fire into the public sphere (Pyne 1997).

The Wilderness Act of 1964 is deemed by many to be the turning point of policies about fire (Smith 1986, p. 43). Not only does the Act itself reflect changing attitudes about the environment, but also by advocating 'natural' conditions, this Act prompted much scientific research of forests to help determine what these conditions were. Partially due to this Act, changes in fire policy began to occur. Kilgore describes policies in place at the time:

> Natural fires are generally allowed to burn only in fairly large wilderness parks where there is sufficient land area to permit such a policy without danger to human life or property. Prescribed burns to simulate the role of natural fire may be used in carefully selected locations.... They are carried out under predetermined conditions of temperature, humidity, wind, and fuel moisture. Suppression continues as the primary action in most developed areas, in zones with high cultural resource value, and in many smaller National Park System areas. (Kilgore 1976, p. 483)

In 1978, "the 10 A.M. Policy was reviewed and finally replaced…by a whole new policy that, according to the fire historian Stephen J. Pyne (1982), 'encouraged a pluralistic approach to fire, a policy of fire by prescription'" (Brown 1999, p. 6). Dahl, Pyne, et al., writing in the year the new policy was implemented, heralded it as taking into consideration resource management objectives like wildlife habitat when considering fire suppression and were hopeful that prescription fire could be used "to protect, maintain, and enhance the natural resource values and esthetics" within approved areas (1978, p. 558). Whether or not the 1978 policy and its 'pluralistic approach to fire' was followed at this time, or even is today, is a topic of debate. Technically, the new policy required more intense monitoring of fire (not just suppression), fire-management plans for any fire that starts, and allowing fires to burn "unless it becomes a threat to public safety or adjacent lands" (Smith 1986, p. 43).

This pluralistic management view of fire, which included letting some fires burn, came under attack when several bad fire seasons led to the burning of much of Yellowstone National Park in 1988. Even with an increased 'wilderness ethic,' the American public did not seem to have the biological knowledge necessary to appreciate the role of fire in the Western landscape. After so much of Yellowstone Park burned in

1988, the public and Congress' reaction sent a message of outrage at the perceived 'destruction' of forests, hampering forest policy review (Williams 1995).

The USFS fire policy was reviewed once again in 1995, and the Federal Wildland Fire Management Policy and Program Review was implemented. This policy is a guide for federal wildland fire management agencies, and was chartered "to ensure that federal policies are uniform and programs are cooperative and cohesive" and to address the potential for large fires due to altered landscapes from "development, land-use practices, and aggressive fire suppression" (USFS 2000a). This new policy clearly states its priorities: "Protection of human life is the first priority in wildland fire management. …Property and resource values are the second priority…" The policy also encourages interagency cooperation and leadership, as well as the maintenance of ecosystem health (USFS 2000a).

The evolution of fire policy towards increased acceptance and use of fire, though welcome, needs to be taken with a grain of salt. The point is that the *policy* may advocate use of natural fire and no suppression, but the *practice* of fire management is often quite different. Forest management is largely about politics and economics, and not just about ecology. A 1998 article in the Forest Service publication, *Fire Management Notes*, exemplifies this view:

> In the USDA Forest Service, fire management is predicated on safety and cost effectiveness. …We've learned that avoiding risk and excluding fire from fire-dependent systems inadvertently piles up long-term consequences. It's time to put into place a total, balanced fire management program. It's time to bring concepts into practice and find ways to work with—not against—the very process that drives fire-dependent ecosystems. …A total, balanced fire management program means that prescribed fire use and suppression are complementary components of a larger program used in pursuit of…overwhelming goals. (Comanor 1998, p. 14-15)

So, although the Forest Service is heading towards a more ecological form of fire management, due to social and political issues suppression is still a viable option in these 'enlightened' days of fire management.

Negative Perceptions and Fear of Fire

After examining the history of fire policy and management in this country, it is fairly easy to see why the American public has a negative perception of fire—it has only been exposed to destructive images and conceptions of fire. The Smokey Bear campaign, started in 1944, was and is a highly effective one for preventing fires in wild areas (Haverkamp and Schamel 1994). The personal message, "Remember, only YOU can prevent forest fires," is a powerful one and the accompanying images on posters often portrayed forest animals running in fear from huge flames. These powerful images influenced the public to believe that fire is merely destructive and bad. Even though Smokey's message was intended "to discourage careless fire use by wildland visitors" (Brown 1999, p. 7), it has been widely adopted as an all-encompassing anti-fire attitude and policy and has contributed to the idea that all fire is bad. Unfortunately, as more

information about fire's role in ecosystems became available, the negative images were not replaced by any campaign like Smokey's.

> Nowhere does there exist an equivalent counter-image of fire as restorer, fire as purifier, fire as an ecological presence as fundamental as rain and sun. The sole exception, the renewal of fire in nature preserves, has only reinforced the sense of fire as a wild phenomenon, perhaps worth saving like wolves and grizzlies but only when confined to appropriate landscapes. (Pyne 1997, p. 34)

Indeed, fire in wilderness has gained some support, but still, "55 percent of all U.S. citizens say we should try to extinguish not only major forest fires, but all forest fires" (Williams 1995). Even today, many hold an "unconscious prejudice toward fire that usually starts in early childhood and…sometimes still is present among scientists" (Vogl 1974, p. 169). This barrier may be the most difficult to overcome, especially because it deals with attitudes and feelings, notoriously difficult elements to change in most people.

Complexity and Conflicts in Management Goals and Land Use

Conflicting views on how to manage ecosystems with prescribed or natural fire present considerable problems for reintroduction. One of the reasons for disputes over fire management is the complexity of the issue and of fire ecology in different areas. "Since the ecosystems man wishes to manage or manipulate are exceedingly complex, it follows that prescriptions for wise and intelligent use of fire will also be complex, utilizing a host of interacting factors which are not well understood singly, let alone collectively" (Kayll 1974, p. 484).

There are also cultural values involved in fire management. Society's perception of fire, the value it places on healthy ecosystems, and economies that rely on areas that

once burned all influence how land and fire is managed. These values, like fire regimes, vary by different regions. This variation between regions is also a major barrier to appropriate fire management. Reeves describes how infeasible a federal fire management policy might be in light of regional differences:

> The causes and seasons of wildfire vary on a regional basis, and the use of fire as a management tool is far more important in some areas, such as the South and Pacific Northwest. So any national fire management policy must be very flexible. A consolidated communication effort to explain fire and its use to the public would appear possible particularly on a regional basis where there is some agreement on the application. (1975, p. 12)

In addition to complex cultural and ecological issues that must be factored into fire management, there is also disagreement amongst scientists and land managers on what they should be managing for. As we have already seen, humans have been using fire as a land management tool for a long time. Modern humans have their own ideas about what fire should be used for. In the resource management world, fire can be used to improve grazing, remove unwanted species, create fire-breaks, reduce fuel loads, enhance species diversity, and improve recreational wildlife habitat (Kayll 1974; Whelan 1995; DeBano, Neary et al. 1998). Even when managers seem to want to manage for ecosystem health and integrity there are debates over what the 'natural' state of the ecosystem was, whether fire effects should be managed for, or whether the historic fire process is the desired management objective. "Kilgore (1973) argued that, in management, we should be attempting to produce the range of fire *effects* found historically, rather than attempting to discover and mimic fire season, intensity, frequency and size of burns" (Whelan 1995, p. 304), whereas Agee (1993) describes the controversy "over whether fire should be reintroduced as a *process* or to achieve objectives defined in terms of

structure for park and wilderness ecosystems." The question seems to be this: "Are we mainly interested in recreating the natural fire regime, or do we want the vegetation and other structural ecosystem components that a natural fire regime should have produced" (Agee 1993, p. 393)?

Even once a fire management objective is agreed upon, there is still the complex question of how to achieve it. This practical step can also be a major barrier to fire's use in many ecosystems. Because of fire suppression and social concerns, natural or wild fire may not be an acceptable way to achieve ecosystem needs, and mimicking historic fire regimes through prescribed fire is far from easy. Consideration of soil effects, nutrient release, fuel consumption, smoke management, vegetation impact, exotic species reaction, fire line intensity, damage to cultural artifacts, fire-fighting economics, proper scale, public support, and more all must be considered when planning a prescribed burn (Chambers 1992-93). It is difficult to consider all of these factors appropriately and in a way that satisfies all the planners and scientists involved.

This leads us into another major challenge to fire reintroduction: the complex ownership and management uses of regions that were historically maintained by fire (Kruckeberg and Lang 1997). Humans, their modern way of life and modern political system, have altered the ways that ecosystems look, connect, function, and are used. We are a part of the landscape and must be considered when planning for fire management. We have a more-or-less ingrained aversion to fire and are not likely to accept its presence near where we live. Therefore, population centers, land use, ownership, and management

goals must be particularly considered in fire management. Unfortunately, we have created a lot of physical and practical barriers to natural fire regimes.

Specific land use, population, and management barriers in the Willamette Valley and Klamath-Siskiyou ecoregions are delineated below.

Environmental Change from Fire Exclusion

The major changes in vegetation and ecosystem composition and structure in many areas since European settlement are very challenging for fire reintroduction and ecosystem restoration efforts. Although native plants and ecosystems may have evolved with a specific fire regime, the plants and structures that exist today are often quite different from those that existed even 100 years ago. They cannot, thus, be expected to respond to the historical fire regime in the same way historical ecosystems did (Agee 1996). Agee notes: "Reintroducing fire is a complex task. Fire may have undesirable effects if it is reintroduced outside of its 'historical range of variability,' or where the ecosystem has undergone major shifts in species composition or structure due to fire exclusion" (1996, p. 72). For example, invasion of non-native species into grasslands can have numerous effects on native vegetation. Aggressive species can out-compete native species, and shrubby species (like Scot's Broom) can shade out native species. These exotic species are sometimes destroyed by prescribed burns meant to restore native ecosystems, but such fires in areas lacking in native species can also increase the presence of exotic and weedy species after the burn (Maret 1997). Agee agrees: "A critical constraint to using fire in oak woodlands and prairies is the presence of alien

species. …Fire can be used to reduce the spread of these invaders, but must be used very carefully" (1996, p. 72).

In addition to exotic species invasion, fire-sensitive species that could not live in an area with a high frequency fire regime have moved in to many areas since the fire regime has been altered. Fast-growing conifers that are not adapted to surviving fires have moved in to open areas and are currently over-topping and shading-out fire-adapted trees like oaks. A high-intensity fire might kill such conifers, but such a fire is also outside of the historic fire regime and would likely kill the oaks. Associated changes in the area, such as a shrubby understory, would also respond differently to fire than would the grasses that once formed the understory in the oak savanna.

The structural and compositional changes in Oregon ecosystems from fire suppression make the situation of prescribed burning very complex. Smoke management, alien species, season of burning, additional disturbances natural to the area, and philosophical issues all must be considered in any modern management plan (Wilson, Alverson et al. 1995; Boyd 1999c; Davison and Kindscher 1999). Because of the drastic changes in vegetation and land use in the Oregon ecoregions since the mid-1800s, restoring the regions to their historic vegetation types and structures with a historical fire regime may be impossible.

Another major environmental change that has taken place since fire suppression began is a great increase in the amount of available fuel. When fires burned frequently in areas of the Willamette Valley, for example, fuels did not accumulate much between fire events and few young trees grew in open areas—keeping fire intensity low. Without

regular fires, however, grass thatch builds up on the ground and large numbers of young trees grew up—contributing to fuel loads that are much higher than they ever were historically (Vogl 1974; Kilgore 1976). Fires that do occur in such increased fuel conditions are usually much more severe than historic fires were. Effects on the ecosystem can be very damaging—killing mature trees that could have survived low or medium intensity fires, destroying whole forest stands and leaving no cover for wildlife, and other unknown effects. "The great increase in fire hazard is the most ominous change since earlier days. The very success of foresters in suppressing fires has radically changed conditions described by…early observers" (Weaver 1974, p. 300).

Lack of General Understanding about Fire Ecology and Place

Government policy has done much to contribute to fear and misunderstanding of fire in natural systems. Williams (1995) derides the Smokey campaign for contributing to a strict anti-fire dialogue that ignored any ecological context, benefits, or need for fire in ecosystems. Reeves also observes that: "Fire prevention messages imply that all fire in the forest is bad" (1975, p. 13). It remains difficult for the American public to ignore the message that government policy on fire has been sending for decades. But even outside of the government's role in shaping society's view of fire, people, in general, simply do not know enough about fire, fire ecology, and natural history to be able to make judgments about fire management and fire's role in local ecosystems. This problem of a lack of understanding has only very recently made significant gains. Knowledge and

understanding of fire is still too low, and can be attributed to several things—lack of place knowledge, lack of scientific knowledge, and lack of ecological knowledge.

Lack of Place Knowledge

Knowledge of the place where one lives comes with a commitment to that place and the amount of time spent there. In the past, many families stayed in one area for generations, living on the land and learning from its cycles and components. Today, however, people in the United States are much more mobile and disconnected from the land their ancestors settled. Many people move several times in their lives, often to completely different ecological regions of the nation or world. For example, the Adaptive Management Area in the Applegate watershed in Southwestern Oregon is an effort to involve residents, businesses, scientists, and other resource managers in ecosystem management. The project is facing many problems, however, largely due to the fact that, "newcomers are less integrated in and less knowledgeable about the ecosystem and community" (Atzet 1995, p. 164). Part of the problem with lack of place-specific *fire* knowledge in particular is described here: "The 'fire problem' of the United States had become very largely confined to [public] lands, places over which people guarded or to which they visited but in which they did not in any meaningful way reside or live off" (Pyne 1997, p. 10). In other words, people don't always feel a connection to lands that burn today. With fuel accumulation problems and the expansion of the urban/wildland interface, however, fire will begin to affect more and more people in the places that they live and they will be forced to learn something about it if they want to live in fire-prone

areas. Movements such as ecological education and bioregionalism advocate an increase in place-based knowledge. I will spend some time addressing this issue further in Chapters III and V.

Lack of Scientific Knowledge

Scientific knowledge and understanding is often the first step in public understanding of biological and environmental issues. Despite the prevalence of fire in many ecosystems, its effects are still not very well understood. Early

> …fire suppression policies were based on claims that fire of any kind: (1) damages mature trees and kills seedlings; (2) destroys the best forage plants and perpetuates undesirable grasses; (3) robs the soil of nature's fertilizer and promotes floods, droughts, and erosion; and (4) destroys the natural breeding places and shelter for birds and animals and often burns up nests, eggs, and young, (Kilgore 1976, p. 477-478)

but these claims were based on little real evidence. Many scientists in the early 1900s catered such assumptions to the management goals at the time: logging, hunting and fishing, and recreation. Some ecologists in the early part of the century did see ecological value in light burns, but their work was largely overshadowed by the "support for total suppression [that] was so strong in the late 1920's and early 1930's..." (Kilgore 1976, p. 478). An increase in studies and symposia on the subject of fire in the 1960s and '70s played a significant role in revealing fire's place in natural ecosystems and its variability among ecosystems (Kilgore 1976). Two scientists of that time, Mutch (1970) and Parsons (Parsons 1978), both advocated the need to know more about historic fire regimes and fire effects on plants and communities. This sentiment continues to this day, and much work is now being done in the field of fire ecology and management. There is still a long

way to go, however, before even scientists fully understand natural fire or its more popular counterpart, prescribed fire.

Lack of Ecological Knowledge

A general lack of ecological knowledge, and in particular fire ecology knowledge, among U.S. citizens is also an issue relating to how well the public understands fire. The most common misunderstandings about fire ecology stem from the difficulty in understanding the large time-scale that natural processes like fire work within, and the natural role of fire in forest ecosystems (Daniel 1988). Both of these issues can likely be resolved through a brief fire ecology or general ecology class. People need to know about the ecological benefits of fire—like fuel reduction, wildlife and plant habitat quality, historic roles, and regenerative effects—instead of the negative effects of fire that most think of now. The movement towards such environmental and fire education is described in Chapters III and IV.

Fire Ecology and Management Issues of Specific Ecoregions

Illustrations of the differences between fire regimes in different areas of the PNW are not hard to come by. In the central western Cascade Range of Oregon the fire regime is a mixed one of low-, moderate-, and occasionally stand-replacing intensities (Stewart 1989). This contrasts with other areas in the PNW where infrequent, catastrophic disturbances are proposed. Wright also found differences within the Cascade ecoregion, stating: "Fire severity is highest in the north Cascades and more mixed and moderate in

the central Oregon Cascades and southern Oregon" (1999, p. 12). I have chosen to focus specifically on two ecoregions in the PNW, the Willamette Valley and the Klamath-Siskiyou Mountains, and their regional characteristics and fire ecologies will be the focus of this section.

Willamette Valley Fire Ecology

The Willamette Valley ecoregion, as defined by Omernik (Omernik 1987) and further described and analyzed by Ricketts, Dinerstein, et al. (1999), stretches much of the North to South length of Oregon between the Cascade and Coast Ranges. (See Figure 1.) The region has changed significantly since pre-European settlement times. The fertile valley once supported vast prairies and oak savanna communities, with riparian forests along rivers and coniferous forests in the bordering hills (Towle 1982). Wilson, Alverson, et al. describe the land as follows:

> Prairies, remarkable for their biodiversity, once covered large areas in the Willamette Valley in western Oregon. Wetland prairies occurred on poorly drained areas of the valley floor, while upland prairies and oak savannas occurred on better-drained soils along valley margins. Frequent burning by indigenous people reduced the abundance of shrubs and trees, favored grasses such as tufted hairgrass on wetter sites and red fescue on upland sites, and promoted a rich variety of native forbs. (1995, p. 26)

However, conversion of much of the valley to agriculture, logging of the forests, and a large population influx has destroyed or degraded most of the prairie and savanna vegetation, and river channelization has eliminated many wetlands and riparian forests. The 1999 World Wildlife Fund study (Ricketts, Dinerstein et al. 1999) classifies this region as in critical need of protection due to the severity of habitat fragmentation and

destruction. The native prairie habitat, for example, is more than 99% gone and in need of conservation efforts (Wilson, Alverson et al. 1995).

Fire and humans have both played a large historical part in maintaining the WV ecoregion. Open oak savannas and prairies in particular were adapted to frequent, low severity fires—ignited by Native Americans in the valley until the 1800s. These people were largely responsible for maintaining different habitats and vegetation types in the Valley (Towle 1982). Fire exclusion over the past century has also contributed significantly to ecosystem change. Without fire, fire-sensitive coniferous trees have invaded open areas and will eventually shade-out the scattered oaks that once grew in savannas. In addition, many native prairie plants are dependent on fire for survival. Without fire, these populations and communities are in serious jeopardy.

Historical Fire Ecology of Region

The ecology of the Willamette Valley has been very dependent on disturbance. A climate change around 7800 years ago shifted to a cooler and wetter situation than previous conditions (Whitlock and Knox 2000). The prairies that likely dominated the entire region during the hot, dry period began to shrink, and oak savannas were established. Paleoecological studies have determined that the oak savanna of the WV was established between 4000-7000 years ago, after the climate change Whitlock notes (Boyd 1999c). Charcoal records from limited sites suggest that dominant plants in the WV did not change until agriculture began in the 1850s (Knox 2000), even though the modern climate can support forests in the Valley (Brady 1996). Most researchers conclude that

the WV was maintained in prairie and oak savanna form by various disturbances; flooding and river channel movement maintained wet prairies and riparian woodlands, and fire and grazing helped maintain prairies and open savannas (Knox 2000).

The first European explorers and settlers in Oregon described the WV oak savannas and prairies, as well as fire in the region (Boyd 1999c). Several sources of generalized fire ecology describe prairies and oak savannas as ecosystems that depend on frequent, low-intensity fires (Noss and Cooperrider 1994). This fire regime was likely in the WV (Franklin and Dyrness 1988; Agee 1993; Boyd 1999c). Frequent, low-intensity fires would have maintained the scattered, isolated trees of an oak savanna while destroying seedlings, and preventing development of a closed woodland or coniferous forest (Towle 1982). Agee describes the importance of this fire regime for the ecosystem:

> Low-severity fire regimes are associated with frequent fires of low intensity. Most of the dominant trees are adapted to resist fires of low intensity because of thick bark developed at an early age. Natural fire frequencies are usually less than 25 years, and limited overstory mortality occurs; most of the structural effects of these fires are on very small trees in the understory. Fires in the low-severity regime are associated with ecosystem stability, as the system is more stable in the presence of fire than in its absence. (Agee 1990, p. 33)

Even with this open environment, *Quercus garryana* (Oregon white oak) woodlands and savannas included several different types of understory vegetation, each with their own fire histories and reactions, providing varied microhabitats for wildlife and herbaceous plants (Franklin and Dyrness 1988; Agee 1993).

Native American Burning

Most WV researchers have concluded that Native Americans of the region were largely responsible for the fire regime that maintained the open prairies and oak savannas (Johannessen, Davenport et al. 1971; Towle 1982; Agee 1996; Boyd 1999c). Since lightning became uncommon in the Willamette Valley with the shift to a cooler, wetter climate, frequent human-set fires were necessary to maintain the open habitats characteristic of the WV (Towle 1982; Agee 1993; Boyd 1999c).

The Natives of the WV, members of the Kalapuya language group, were largely hunters and gatherers, moving their camps with the seasons and food supply (Boyd 1999c). Fire was used for immediate benefits like deer hunting, tarweed gathering, and grasshopper collecting, as well as longer-term purposes like acorn harvest, deer habitat, tobacco cultivation, hazel growth for baskets, root growth, and berry cultivation (Boyd 1999c). Evidence also exists that "native plants such as camas (*Camassia quamash*), which Native Americans harvested as bulbs for their flour, seem to flourish after burning" (Agee 1996, p. 72).

Most of the information that has been gathered and written about the Kalapuya is based on accounts of early explorers and settlers in the region. For example, accounts by Wilkes and Douglas, two famous PNW explorers, mention Kalapuya burning practices and uses of fire (Johannessen, Davenport et al. 1971; Towle 1982; Boyd 1999c). Boyd establishes the importance of Kalapuya fire activity:

> Clearly, fire was an important component in both the cultural and ecological systems of the prehistoric Willamette Valley. The Kalapuya Indians used fire in a wide range of subsistence activities, and fire was essential for maintaining a fire climax biotype. The link between the two systems was the natives' use of fire as a tool—a tool that simultaneously improved the subsistence quest while maintaining ecological diversity. With control over and knowledge of the ecosystemic effects of fire, the Indians established an important symbiotic relationship with their environment. (Boyd 1999c, p. 128)

While the impact of the Kalapuya on the WV vegetation and other ecosystem components are not ignored, other studies put forth alternative theories on the use of fire in this region. Many journal accounts from the early 1800s did not mention fire or a burned landscape, so there may not have been as much fire as some researchers believe (Knox 2000). The rapidly declining populations of Native Americans in the Valley in the mid-1800s may have been using fire as a tool for driving away settlers and explorers, rather than simply continuing an age-old tradition of burning. Knox believes that the fires described by explorers like Douglas may have been accidentally set by settlers, as definitive proof of ignition sources do not exist for most fires. These alternatives should be considered along with accounts of fire and different theories, but fire's role in the WV landscape should not be discounted to any degree. The evidence, both biological and anthropological seems to be overwhelmingly in favor of frequent, human-caused, fires for many centuries before European settlement.

Post-Settlement Change

Willamette Valley vegetation and ecosystems have changed considerably since the beginning of the nineteenth century. In general, native ecosystems have been

destroyed through agricultural and urban conversion, exotic species have been introduced, there has been an increase in shrub and tree density, and the structure and function of native ecosystems has changed dramatically (Cole 1977; Towle 1982; Brady 1996). Fire has been largely excluded from areas that were adapted to the fire regime for this region, leading to successional and ecosystem changes (Towle 1982; Franklin and Dyrness 1988; Whitlock and Knox 2000). Without the Kalapuya and their way of life, the WV bioregion can never be the same. As Brady describes this change:

> Within the space of about 50 years, from the 1840's to the 1890's, the ecology of the Willamette Valley underwent incredible and rapid change. By 1890, the Kalapuyah had completely disappeared. With their passing, the major landscape type of the valley, the oak prairie, went into decline. Wildlife that had evolved with the Kalapuyah and the oak also experienced dramatic shifts in composition and abundance. (1996, p. 48)

Based on the original land survey done in the 1850s, Habeck (1961) determined that the native vegetation that dominated the WV at that time had changed significantly by the mid-1900s. The land survey noted a lot of area as "oak opening," but Habeck notes that most of this area is now characterized as oak forest; in other words, the oak opening habitat is now very rare, and has been replaced by another vegetation type. Habeck also describes the abundant prairie habitats that existed in the 1850s. These have almost all been converted to agricultural use today. Franklin and Dyrness second these observations: "Very little of the original vegetation remains at this time. Control of Indian-set fires has permitted the development of oak forests from the former oak openings, and nearly all of the prairie is now being used for agricultural or grazing purposes" (1988, p. 76). Other researchers, such as Agee (1993), Franklin (1988), and Towle (1982) also describe the disappearance of oak and riparian woodlands that have

been eliminated since the 1800s. Many native species of the region, especially prairie species, are now endangered and in need of protection because of this conversion and ecosystem change (Maret 1997).

Another major ecoregional change since pre-settlement times is the increase in conifer trees and other woody vegetation into formerly open areas. Most of this invasion is due to fire suppression over the past century. After Native Americans burning practices were eliminated from the landscape, fires were not set as frequently or as extensively. Some grazing lands and agricultural fields were and are still burned, but the effects on the ecosystem are not the same, as many exotic species and monocultures took over these fields. Fires have also been suppressed in hilly, riparian, and settled areas and fire-sensitive species have moved in. *Quercus garryana* woodlands and savannas, in particular, are at risk from fire suppression. Douglas-fir (*Pseudotsuga menziesii)* is a faster-growing species (especially in sunny areas where oaks are widely spread) and are able to reach maturity in large numbers without fire to kill young trees. Many scientists agree that this successional change will lead to the eventual elimination of oaks from formerly open areas (Towle 1982; Agee 1993; Brady 1996; Boyd 1999c). Douglas-fir trees will overtop the oaks and shade out both young and old trees. The oak savanna and woodland habitat will be lost forever unless regular fires are reinstated to control Douglas-fir growth and to promote acorn germination.

Specific Barriers to Fire Restoration

Land use and population in the Willamette Valley are the biggest challenges to fire reintroduction. The majority of the Valley is in agricultural production (See Figure 2.), and three of the largest cities in Oregon are located within it . Since so much of the WV is in a degraded and non-historical state, even extensive fire reintroduction would do little good. In areas where native savannas and grasslands persist, care in fire reintroduction must be taken because these areas are often surrounded by urban areas or rural neighborhoods and the presence of exotic species can have undesired consequences.

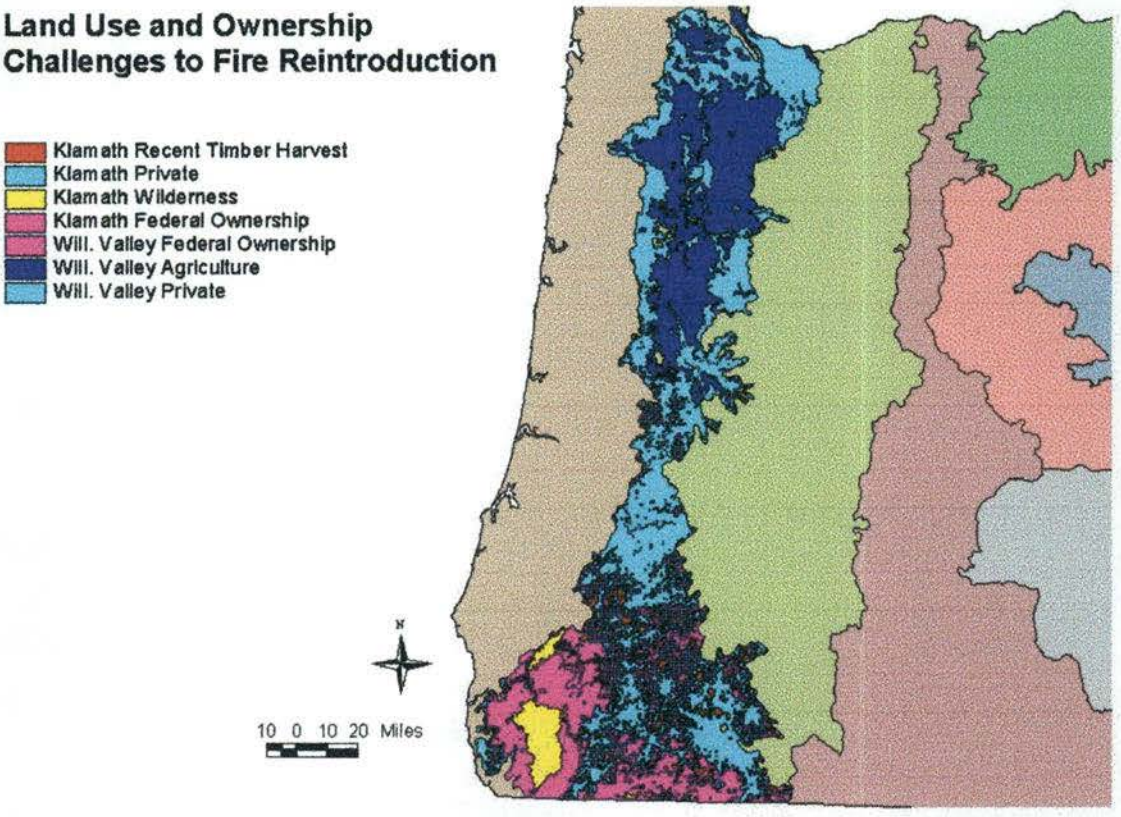

FIGURE 2. Land Use and Ownership Challenges to Fire Reintroduction in Two Oregon Ecoregions

Very little of the Willamette Valley is federally owned or otherwise protected from harmful management. (See Figure 2.) Most land is privately owned and, as noted above, already converted beyond much hope of restoration. The only real hope for fire reintroduction in this ecoregion is in the few parks and reserves with intact prairie and savanna habitats. The Finley National Wildlife Reserve near Corvallis, Oregon and the Howard Buford Recreation Area near Eugene are two such areas that contain these habitats and either already benefit or can benefit from further prescribed fire programs. Issues of smoke management, high population density, recreation uses, and exotic species must be addressed in these areas, however, complicating the ability for these programs to be successful.

Klamath-Siskiyou Fire Ecology

The Klamath-Siskiyou ecoregion, as delineated by Omernik (1995) and further described in Ricketts, Dinerstein, et al. (1999) (See Figure 1.) is often heralded as one of the most biologically important ecoregions in North America. The Klamath-Siskiyou ecoregion contains several mountain ranges (including those that give the region its name) and other varied terrains. The Oregon portion stretches along the Oregon-California border from East to West, and has a unique geography, geology, and natural history (Franklin and Dyrness 1988). This region has many endemic and rare species (281 vascular plants alone!) and communities, with varied and complex forest structures (Kruckeberg and Lang 1997; Marsden and Jules 2001). The region was designated an Area of Global Botanical Significance by the International Union for the Conservation of

Nature in 1997, and "one of the ten richest temperate conifer forest ecoregions in the world" by the World Wildlife Fund in 1999 (Marsden and Jules 2001, p. 17). Dellasala, Olson, et al. describe the region's diversity:

> Species richness and beta diversity are particularly high in this region because of extensive turnover in community composition along environmental gradients and overlapping ranges of numerous species from nearby geographic regions, including the Cascades, Sierra Nevadas, Great Basin and Central Valley of California, and coastal California redwoods. ...[I]t has been a refuge for ancient (relict) species that otherwise might have perished during geological upheavals. (1997, p. 16)

Rare and endemic species contribute to the area's species richness, but the region also hosts a variety of unique habitat and vegetation types that are part of its biodiversity. For example, a unique soil type—serpentine—supports rare communities adapted to this harsh environment (Kruckeberg and Lang 1997). In surrounding areas, hardwood trees mix with conifers in unique assemblages and with very particular adaptations.

Diverse fire regimes have shaped the diversity of the forest structures and habitats of the region (Taylor and Skinner 1998). Indeed, fire has historically played a large role in building and maintaining the diversity of the region, and it exhibits complex and varied fire regimes and histories as well (Agee 1991). Many of the unique plants and communities in this ecoregion are adapted to fire, and in particular to a mixed fire regime.

Logging, increased human population, and fire suppression policies beginning in the early part of the 1900s have changed the landscape and ecosystems significantly. Fire has been largely eliminated from the forests, resulting in species composition changes and fuel accumulation—increasing the risk of catastrophic wildfires. The unique species

assemblages of this region, found nowhere else in the world, are now in jeopardy due to these changes in the fire regimes they evolved with. Logging, mineral extraction, road building, grazing, the spread of non-native species, forest fragmentation, and habitat degradation also contribute to their endangerment (Dellasala, Olson et al. 1997; Ricketts, Dinerstein et al. 1999). The Klamath-Siskiyou region is ranked among the top distinct regions in the world for its biodiversity, but is also considered globally endangered, as only about 10% of the area is strictly protected, and only 25% of its native habitat is relatively intact (Dellasala, Olson et al. 1997; Ricketts, Dinerstein et al. 1999). The region was recently the subject of a conservation plan design, which recommends that many existing roadless areas be more strictly protected, and in total that 53% of the entire region be placed under the plan's highest conservation priority designation in order to maintain and protect its natural biodiversity (Noss, Strittholt et al. 1999).

Historical Fire Ecology of Region

Fire history in the Siskiyou region has been reconstructed in numerous studies through tree core analyses, stump fire scar analysis, historical photographs, and basic stand reconstruction techniques (Agee 1991; Taylor and Skinner 1998). Despite the difficulties in accurately determining fire events that occurred more than a few hundred years ago (Agee 1991), these studies determined fire return intervals and other regime characteristics for different sites with different characteristics. For example, Agee (1991) found a conservatively determined fire return interval of 76 years in the years 1400-1989 for the area surrounding the Oregon Caves, and a much shorter interval near Kinney

Creek, a lower elevation and drier site. Taylor and Skinner found that "fires burned frequently on Thompson Ridge between 1626 and 1992. Median FRIs of 12-19 years indicate that fire was an important process affecting late-successional stand development in Klamath Mountain forests" (1998, p. 295-296). Overall, fire seems to have played a very important role in shaping the diversity and structure of southwestern Oregon landscapes.

Because fire danger is often high in the hot, dry southwestern Oregon summers (Franklin and Dyrness 1988), and lightning is a fairly common occurrence in this region and acts as a prolific ignition source (Agee 1991; Martin 1997), there has been no shortage of fire in this ecoregion. Fire and its effects in the K-S are, in fact, as diverse as the flora, fauna, and landscape of the region. The variability evident in fire regimes in the Siskiyous is one way fire has shaped this region. "Overlapping fires of mixed severity created complex stand structures at both the plot and landscape scale," and this "variation in fire severity is recognized as a potentially important source of landscape diversity that has been little studied in Pacific Northwest forests" (Taylor and Skinner 1998, p. 297). Regimes vary in frequency and severity due to topography and climate, among other factors. Fire also varies in correlation with the vegetation present in the area in which it burned. "Fire history in vegetation common to the Siskiyou area runs from very frequent fires in the oak and pine to long intervals between fires in the cooler, moister high elevations..." (Martin 1997, p. 87).

Variety in fire regimes effects and is affected by the vegetation complexes in an area. Complex stand structures, with low trees and shrubs as well as taller trees,

contribute to how fires behave, but fire severity and interval also influence what trees and shrubs grow in an area. Atzet and Wheeler (1982) describe vegetation series, or associations of plants that are dominated by specific species, in the Siskiyous, as well as their different fire regimes: "The fire regime differs significantly between series. Because of the differing environments; the number of times fire occurs in a series and the intensity at which it occurs, i.e. the fire regime, depends on the fuel characteristics and weather conditions within the series" (1982, p. 5). Each vegetation series also responds differently to the type of fire that it encounters.

Plant adaptations to fire in the K-S are also extremely varied. For example, one might find a few plant species with each type of fire adaptation described earlier in this chapter on a single site. The Siskiyou plants' varied strategies to survive in or after a fire are likely indicative of the variety in the fire regime. As Martin puts it: "One might compare…fire adaptations with characteristics of plants in the Siskiyous to judge the plant's relationship to different fire regimes" (1997, p. 87).

Perhaps the most important aspect of the fire ecology of the Siskiyou ecoregion is its proven non-transferability. The variety in climate, topography, plant associations, geology, and land use history make each site in the Klamath-Siskiyou unique and makes it impossible to transfer research results from one sub-region to another (Atzet and Wheeler 1982; Agee 1993).

Native American Burning

Although lightning starts most fires in the Siskiyous, there is some evidence that Native American burning also contributed to the landscape (Agee 1993). Some researchers list ways in which Native Americans probably used fire in this region:

- "Human-set fire would have helped to maintain the more fire-resistant oak/pine woodland in the fact of encroachment by the returning fir forest" (LaLande and Pullen 1999, p. 266).
- "Before European settlement, native Americans set fires that may have burned through the study area. Local Klamath tribes used fire extensively to promote acorn, berry, root, and fiber production and to hunt game" (Taylor and Skinner 1998, p. 288).
- "The use of fire, for a variety of purposes, was important to the native people of southwestern Oregon, as it was for hunting/gathering groups living to the north and south of the area" (LaLande and Pullen 1999, p. 257).

Unfortunately, other references to Native burning are rare due to their small (and rapidly declining) population when settlers arrived in the area (Martin 1997).

Post-Settlement Change

Just as most other regions in the United States, fire suppression that began in the 20th Century is taking its toll on the fire-adapted ecosystems of the Siskiyous. This region has not gone without the natural fire regime for as long as many other regions have, due to its relative inaccessibility and large tracts of forests in difficult terrain. Because of this,

the vegetation has not changed as much as it could have, had fire suppression started sooner. Nevertheless, on some sites forests are experiencing the longest fire-free interval they have known in more than 300 years (Agee 1991). And overall, the landscape has changed dramatically with fire suppression, including a shift to denser underbrush and dominant tree changes (Atzet and Wheeler 1982; Atzet 1995; LaLande and Pullen 1999). Since fire has helped maintain vegetation complexes over many years, without fire more fire sensitive tree species like hemlock, tanoak and white fir are replacing the species that once dominated the region such as ponderosa pine and Douglas-fir (Atzet and Wheeler 1982). The diversity of fire regimes has also been suppressed. "The prehistoric fire regime in most areas was quite diverse, but fire suppression has reduced the fire regime diversity. …The reduced diversity in fire regimes will result in reduced biodiversity" (Martin 1997, p. 86 and 88).

Restoring K-S forests to a more natural state will need to involve both allowing natural fires to burn and using prescribed fire. Prescribed fire "will likely be an integral component of management plans that successfully maintain natural processes and structures in newly established late-successional reserves in the Klamath Mountains" (Taylor and Skinner 1998, p. 285).

Specific Barriers to Fire Restoration

There are also significant cultural challenges to allowing fires, both natural and prescribed, to burn in the K-S region. So far, the most success in fire reintroduction has happened on federal lands. Nearly two-thirds of the Siskiyou ecoregion is federally

owned, and the rest is either state or privately owned (Noss, Strittholt et al. 1999). (See Figure 2.) Legislation and popular opinion does not have an effect on private property unless the owner chooses to let it. In other words, a private land manager does not have to use prescribed burning or any other beneficial ecosystem management unless he/she wants to. Thus, an informed and concerned landowner that knows about fire's role in the environment and knows how to implement appropriate management is necessary for the reintroduction of fire in this region.

Another challenge to fire reintroduction in the Siskiyous is land use. While a significant portion of the ecoregion is protected as wilderness or another form of semi-protected land, much of it is also in active timber production. (See Figure 2.) Since areas that have been logged and are being regrown as timber plantations are highly disturbed and not at all like the historical/natural vegetation with mixed ages and species, fire reintroduction would not help to maintain a natural/historical fire regime in these areas.

Population in the Siskiyou ecoregion is also an issue in fire reintroduction. There are several growing urban centers in the region, including Ashland, Medford, and Grants Pass. Fires in forest-urban interfaces are generally dangerous and not well accepted. Prescribed fire or allowable natural fires may not be tolerated in these areas of high population density.

Overcoming the Barriers

Policy and Management Shifts

Policy

The Wilderness Act of 1964 and the rise of the environmental movement in the late 1960s are deemed by many to be the turning point of attitudes about fire (Smith 1986, p. 43). It was at this time that ecology and history started being looked at to inform policy, especially in wilderness areas and National Parks. As Stocks explains, "By the 1970s there was a growing realization in North America that total fire exclusion was neither an economically feasible nor an ecologically desirable goal" (Stocks and Trollope 1993, p. 317). The popularity of fire suppression began to wane as ecological thinking began to rise. A change in national fire policy was one move that illustrated the seriousness of this shift.

The 1995 fire policy took some important steps in changing how fire is managed, but perhaps most importantly, the Forest Service's explanation of this new policy includes recognition that fire (and thus nature) cannot necessarily be controlled or suppressed and that a fundamental change in this expectation needs to take place (USFS 2000a). The policy describes this shift and the philosophy that for many years stressed control of nature and suppression of fire. This admission marks a further shift to a more holistic view of natural processes, as seen in ecosystem management practices, and towards a closer approximation of the principles guiding the environmental laws explored above. The revised 1995 plan also asserts that the integration of fire into the landscape

"must be reconciled with other societal goals, e.g., maintaining species habitat, producing commodities, and protecting air quality, water quality, and human health" (USFS 2000a). This type of reconciliation can best come about by increased public knowledge of fire and management issues.

Numerous policy changes regarding fire have already occurred since the turn of the century—usually in the direction of increased acceptance of its role in nature. Policy changes have not affected changes in practice as much as one would expect, but policy makers and managers keep claiming that they are moving in a new, more enlightened direction. For example, in the fall of 1999, Secretary of Agriculture Dan Glickman eloquently addressed the need for changes in forest management practices: "Today," he said, "we are announcing more than just a change in policy. This is a fundamental change in philosophy" (USFS 1999). Glickman's proposal advocates increased public involvement in land management decisions and implementation, sustainability in the environment, society, and economy, and dynamic planning processes. In addition, Rasmussen notes that:

> So much has changed in a decade. The Forest Service now cuts a quarter of the trees it did in the dark days of the '80s. Agency employees—including the one at the top—are much more apt to utter words like *restoration* instead of *production*. And the American public is slowly awakening to the importance of national forests. (1999, p. 2).

Slow change is change after all.

Management

Modern management plans are definitely moving in the direction of ecosystem health, sustainability, and biodiversity protection. In fact, "consideration of biological diversity has…guided the design, implementation, and critique of existing policy on natural resource management" (Halpern and Spies 1995, p. 913) in many ways. One example of this shift towards ecosystem-guided principles is the advent of a new type of forestry. At the heart of the concept of 'ecological forestry' is the notion that:

> Manipulation of a forest ecosystem should work within the limits established by natural disturbance patterns prior to extensive human alterations of the landscape. The key assumption here is that native species evolved under these circumstances, and thus that maintaining a full range of similar conditions under management offers the best assurance against losses of biodiversity. (Hunter 1999, p. 29)

The term that has been recently introduced to describe the type of management that accounts for biological processes, structure, and function is ecosystem management, "a strategy or plan to manage ecosystems to provide for all associated organisms, as opposed to a strategy or plan for managing individual species" (FEMAT 1993, p. IX-11). Many encouraging recent management recommendations involve the use of fire and disturbance. The FEMAT issued a large document (eventually leading to the implementation of the Northwest Forest Plan, or Option 9) in 1993 with many such recommendations and in-depth studies on how forest management effects the forest ecosystem. It states that "natural disturbance is an important process within late-successional forest ecosystems but humans have altered disturbance regimes. Management may be required to reintroduce natural disturbance such as fire or to

minimize socially unacceptable impacts" (FEMAT 1993, p. IV-35). Ecologists also see the need to consider fire in management plans: "Our approach to fire management in North America must accommodate fire; we cannot be so bold as to think we can eliminate fire from the landscape. It has been with us so long precisely because it is an inevitable part of our environment" (Agee 1993, p. 6). This admission, especially by government agencies, would not have been considered two decades ago, but is today a common statement, and one that forest managers and policy makers are now working to remedy.

Both biodiversity and fire regimes are becoming a standard part of federal forest management today. The FEMAT report, for example, sets forth many management recommendations that can be used for conserving whole ecosystems. It states:

> The objective of an ecosystem management plan for late-successional forests should be to maintain the full range of biological diversity, process and function that is typical of these forests. We acknowledge that our concept of ecosystem management is only partially developed, and that we have much to learn about managing ecosystems. (1993, p. IV-190)

In Oregon, a 1995 Department of Forestry report includes ecosystem health and sustainability objectives that include rumblings of ecosystem management and conservation biology principles like diversity, long-term processes and effects, historic patterns, and sustainability, although it also emphasizes timber and production (McLennan and Brown 1995).

Another example of a project that seeks to integrate the goals of fire restoration and timber extraction is the Augusta Creek Project (Means, Cissel et al. 1996; Cissel, Swanson et al. 1999). Researchers there use analyses of past fire regimes to design timber

harvest to be more like historic mosaics created by fire. "Our main goal in the Augusta Creek Project was to develop a landscape management approach that used past landscape conditions and disturbance regimes to provide key reference points and design elements for future landscape objectives while meeting the objectives of the Northwest Forest Plan" (Means, Cissel et al. 1996, p. 62). While this project is controversial in its assumption that fire is not needed to create appropriate fire effects, at least it is an effort to create sustainability and natural systems within the resource industry. It is a step in the right direction.

As we have already seen, many land managers and scientists are advocating for the use of fire in ecosystems that have been too long deprived of this natural process. Scientists in the 1960s, in fact:

> Presented arguments for the use of fire in management of all fire-type communities, including grasslands, that are part of national parks, refuges, and preserves. They reason that if fire was a natural part of such communities as grasslands prior to man's interventions, then natural area management will be incomplete and the grassland environments deficient until controlled burns or wildfires are allowed to again take their place among the natural order of things. (Vogl 1974, p. 181)

Today, prominent scientists like Agee claim that fire's effects "can be integrated into land management planning through an understanding of how fire affects the site and the landscape" (1993, p. 3). Restoring the "right kind of fire," i.e. fire that ecosystems in an area evolved with, should now be the goal (Williams 1998, p. 15).

Better Citizen Education

Knowledge of fire ecology within the scientific community has increased greatly since the first few decades of the twentieth century. This knowledge no doubt will improve how managers think about and use fire in many landscapes, as it already has to some degree. For example, the combination of a philosophical and policy shift and a greater understanding of natural systems has led to more prescribed fire in fire-dependent landscapes and management that considers ecosystem functions (Cissel, Swanson et al. 1999). Yet, again, with more knowledge of how fires interact in ecosystems and how much it needs to be restored to them, will come more challenges for how to integrate this knowledge with societal needs, cultural change, and other environmental issues (Dahl, Pyne et al. 1978). One important way to meet this challenge head-on is for scientists to share their knowledge of fire ecology with the general public.

Another important thing that needs to happen to increase the public's understanding of fire ecology is to counteract the message that Smokey Bear and decades of fire suppression has set forth: all fire is bad. Because 'fire suppression at all costs' has been the fire policy on public, and most private, lands for so long, the Forest Service has convinced the public of the need for such practice. Smokey left the public with a strong belief that all fire in forests is destructive and bad. Such a successful, and long-lasting, campaign is difficult to reverse or add more truthful information to, like the role of fire in healthy forest ecosystems and the positive ecological effects of fire. The Forest Service itself admits this in a recent Wildland Fire Policy review document: "For many people, fire remains a fearsome, destructive force that can and should be controlled at all costs.

Smokey Bear's simple, time-honored 'only you' fire prevention message has been so successful that any complex talk about the healthy, natural role of fire and the scientific concepts that support it are often lost" (USFS 2000a) by various audiences. "A comprehensive message is needed that clearly conveys the desired balance of avoiding fires with adverse effects while simultaneously increasing ecologically beneficial fire" (USFS 2000b). Although Smokey started his campaign in the name of education, his influence cannot really be counted as the education the American public needs to understand fire's role in nature.

Clear information about fire's natural role in ecosystems is needed so that people better understand why prescribed fire is now being used more often as a management tool, and why more and more 'let-burn' policies are being implemented in wilderness areas. Public support is the key to successful management of this kind. Norris links public support to the level of knowledge a person has about the benefits of fire in a region. He also found that "public support is more favorable if prescribed burning is seen to reduce the risk of wildfire, to improve recreational opportunities, or to manage ecological conditions to reflect a more natural state" (Norris 1990, p. 16). Getting positive messages like this across to people who will likely be affected by fires should be top priority for agencies and managers.

In addition to the ecological effects of fire, people need to know the practical implications of managed fire. For example, they should know about how prescriptions are made, why fires are set at certain times of year, how they can best protect their homes

from uncontrolled fires, and what management objectives are being met by prescribed fires in their area (Kilgore 1976; Daniel 1988).

Active, Politically Involved Communities

One goal for moving ahead with much needed long-term fire management initiatives is "greater public understanding of and involvement in developing and approving our management practices" (Kilgore 1976, p. 484). This goal follows the logical trend from public education to public involvement. Many other authors also mention the need for public involvement in fire policy and management implementation. For example, Chambers states: "Public involvement, along with an understanding of the social and political dimension, is a logical and important part of modern-day fire management that we can't do without" (1992-3, p. 9). And Norris states: "Public perceptions and attitudes are without question the dominant force in the development and implementation of prescribed burning policies and action programs as well as the formalized array of regulations to control them" (1990, p.15). Government agencies are also stating the need for citizen involvement. The Oregon Department of Forestry report, "Forestry Program for Oregon," includes a public education and involvement objective. It states: "The ability to effectively manage Oregon's public and private forests for the future is as much dependent on an informed and involved public as it is on solid science and good policy" (McLennan and Brown 1995, p. 34). The report also implies that without public involvement in policy making, people won't understand, accept, or support manager decisions—making policy implementation very difficult.

With increased education and public involvement in decision-making, more ecologically sound management and restoration projects—that include fire—can proceed. Since, as Agee (1993) says, fire policy is largely a function of culture, it stands to reason that it is culture, through education and involvement, that must change the way fire is perceived and used in modern landscapes.

CHAPTER III

ENVIRONMENTAL AND ECOLOGICAL EDUCATION

Social and Educational Reform

One of the major ways that education, ecology, and the environment are related is through social and cultural values. Education can be defined in many ways but is commonly accepted as meaning a way for a community or culture to pass on attitudes and knowledge to the next generation that sustains that community or culture (Weintraub 1995). Such education can take place both in and out of schools. For the most part, schools focus on educating children ages 4 to 18 for becoming active, functional members of society. As such, schools have usually been seen as an agency of socialization (Cross and Price 1995) and a mechanism for imparting the next generation with the "cultural knowledge, practices, norms, values, attitudes, and skills" (Hutchison 1998, p. 124; Lacey 1987) needed to participate in society. This means that education, and especially schools, has had a "preservative" role because it passes on cultural values and skills to maintain a culture. Oakes writes:

> Schools, as social institutions, do far more than impart knowledge and skills to students. They do more than pass on the traditions and values, the folkways and mores of the culture, to the young. Schooling is both more and less than education in the purest sense. It includes as an important function the preparation of youth for future adult roles and for their maintenance of the social structure and organizational patterns of society. (1985, p. 75)

She continues this dialogue, saying: "Schools have a dual role. First, they are obliged to follow, reflect, and reproduce the nature of the society in which they exist. But, second, they are also responsible for changing society as it exists in favor of what 'ought' to be" (p. 200). The kind of social change necessary for building a more ecologically sustainable culture that 'ought to be', many argue, is not taking place in schools (Jarvis 1985; Cross and Price 1995).

Though educational reform efforts have been in progress, in different forms, since formal schooling was begun in this country, none of this reform has dealt with the fundamental shift in social values and action needed to bring about social and environmental change.

> Most contemporary school restructuring efforts…are essentially programs for retooling students to become more efficient workers, designed to make children more competitive in the national economy or, more recently, in the emerging global economy. Absent from the debates nationally and locally about our educational system has been critical discourse on the responsibility of schools to the communities that support them and to the planet's life-support systems that sustain us all. (Kiefer and Kemple 1999, p. 28)

Many educators and researchers do see the need for an environmental ethic built into schooling and education systems (OECD 1995; WSDOE 1992). As one author states: "Because education is the vehicle through which society prepares its citizens to carry our their responsibilities, education must be environmental" (Ramsey, Hungerford et al. 1992, p. 35). Educational reform that leads to environmental sustainability cannot follow in the footsteps of previous reform efforts, however. Most past reform efforts are rooted in ideas of anthropocentrism, individuality, progressive change, and technological reliance that promote unsustainable cultures and environmental degradation (Bowers

1996). Bowers has been one of the most vocal critics of the lack of ecological consideration in education reform. He says:

> If the thinking that guides education reform does not take account of how the cultural beliefs and practices passed on through schooling relate to the deepening ecological crisis, then these efforts may actually strengthen the cultural orientation that is undermining the sustaining capacities of natural systems upon which all life depends. (Bowers 1993, p. 1)

He calls this lack of recognition of the ecological crisis in education reform part of a "culture of denial," which involves denying that our lifestyles and our technologies can be damaging to the environment (Bowers 1997). Bowers also points out reasons that educational institutions are so often ignored as places that can change the cultural values associated with the ecological crisis. He fingers "the fragmented nature of the environmental movement, the marginal status of a deep cultural perspective in the education of the people who become environmental writers and activists, and the ideological orientation that many members of environmental groups share with the educational community" (Bowers 1997, p. 19).

Education for the environment and for fire ecology, like all education, will have to deal with social values and evolution (Schmieder 1977) if it is to move beyond the denial of the wrongdoings of modern society. Environmental issues and the need for a shift in educational values towards environmentalism are core reasons for a needed shift in educational philosophy (Buzzati-Traverso 1977, p. 13). Three philosophies used in modern education are technocratic, progressive, and holistic. Whereas the technocratic, which focuses on the need to teach a basic curriculum with high standards and assumes an atomistic and exploitive view of the natural world, and progressive, which takes an

inquiry and experimental based approach to learning and aims to produce effective citizens with its pragmatic curriculum, philosophies have dominated reform and discourse in this century, Hutchison feels that "the holistic philosophy affords the most promise for effectively dealing with the environmental crisis that currently confronts us" (1998, p. 56) as it focuses on personal growth and holds an interconnected worldview. In this vein, advocates of educational reform for the environment stress interdisciplinary studies, an increase in ecological and regional knowledge, and inclusion of traditional cultural values and knowledge in education (Sale and Lee 1972; Kiefer and Kemple 1999).

A shift in educational philosophy and practice in favor of the environment and ecological sustainability has been slow in coming. A movement that began in the late 1960s—environmental education (EE)—was the first step forward in educating for the environment. Though not without its faults, this movement has evolved and grown more and more popular through the present day.

Environmental Education

The term and field of environmental education has been used since the late 1960s. It came about largely out of the rise of the environmental movement in this decade, and has enjoyed attention since then because of U.S. policy and the continued rise in environmentalism and environmental commentary. The first National Environmental Education Act was signed in 1970, funded through 1975, and repealed in 1981. President Bush signed the second Act of the same name in 1990. The comprehensive policy states:

> It is the policy of the United States to establish and support a program of education on the environment, for students and personnel working with students, through activities in schools, institutions of higher education, and related educational activities, and to encourage post-secondary students to pursue careers related to the environment. (NEPA 1990)

In addition to policy, the Act established an Office of Environmental Education within the Environmental Protection Agency; included language ensuring that the diverse needs of various cultures and ethnic groups would be addressed; made available environmental education grants, internships, and awards; and created a task force on environmental education (Marcinkowski 1990-91). Since the 1970 Act, several conferences (both U.S. and international) have been held to evaluate environmental education, exchange ideas and success stories, and to continually redefine environmental education goals and objectives (Schmieder 1977; Hungerford and Volk 1990; Hale 1993; Tahir 1995; Filho 1996; Pace 1996). The trend in EE has been from a focus on nature study in the first half of the century towards resource conservation and wise use in the 1950s, and then toward a more ecological perspective in the 1960s and '70s (Faulconer 1992).

Several different definitions of environmental education have been put forth over the years, differing in their scope, focus, and applications. One early definition separates EE from past efforts of conservation education and emphasizes the practicality of EE (Swan 1969). In fact, practical results are stressed in many definitions of EE. One of the first is Stapp et al's 1969 definition: "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward their solution" (qtd. in Weintraub 1995, p. 354). Words like 'awareness' and

'understanding' of ecology and environmental issues come up in many definitions, but they are almost always accompanied by phrases like 'participation in planning,' 'action to improve the environment,' 'translating awareness into action,' 'resolving environmental issues,' and fostering 'motivation' and 'skills' for solving problems (Swan 1969; Pratt 1971; Hungerford and Volk 1990; Ramsey, Hungerford et al. 1992; Hale 1993; Wals 1994; Weintraub 1995; Hale 1997; Yudomustopo 1997). While most such definitions focus on the issues of the natural world, some illustrate the connection between social, cultural, and environmental issues in education:

> Environmental education must incorporate many aspects of the environment: natural and manmade, technological, social, economic, political, cultural, and aesthetic. Further, environmental education must emphasize and bridge from the personal, local and national to the global in linking the actions of today with the consequences of tomorrow. (Ramsey, Hungerford, et al. 1992, p. 36)

Thus, the goal of EE is "to help students become environmentally knowledgeable, skilled, and dedicated citizens who are willing to work, individually and collectively, toward achieving and maintaining a dynamic equilibrium between the quality of life and the quality of the environment" (Ramsey, Hungerford et al. 1992, p. 36).

Environmental education curricula and strategies for integration into the larger educational system are just as varied, if not more so, than its definitions and goals. Many agree that environmental education should be a lifelong process, with foci on different topics and skills at different stages (Golley 1993). I will discuss the idea of a lifelong EE later in this chapter. Approaches to incorporating environmental education into the formal school system, are just as important to discuss, however.

The major approaches to incorporating environmental education fall into two main categories, insertion and infusion, though these approaches are described differently by different authors (Pratt 1971; Eichler 1977; Hungerford and Volk 1990; Ramsey, Hungerford et al. 1992; Hutchison 1998). Insertion refers to incorporating environmental education as a separate subject in the curriculum, often utilizing standardized and nationally distributed curricula that are perceived to take less time to prepare for and require less specialized environmental education knowledge to teach. These programs are often globally or nationally focused and deal largely with scientific topics (Simmons 1989). Infusion means that environmental education topics are taught in existing subjects in an interdisciplinary manner. Infusion is "the integration of content and skills into existing courses in a manner as to focus on that content (and/or skills) without jeopardizing the integrity of the courses themselves" (Ramsey, Hungerford et al. 1992, p. 40). Other authors also give examples of how environmental education can be interdisciplinary and infused into other topics (Kiefer and Kemple 1999, for example). While infusion of EE topics would promote the holistic method of education, this strategy is not often used due to perceived time restraints and conflicts of interest in classrooms and state-mandated curricula.

In addition to how pervasive EE should be, many recommendations have been made regarding how EE should be taught in schools. These suggestions range from which traditional school topics should include environmental components, where EE should be focused (either inside or outside of the classroom), how science-based EE should be, how much problem-solving should be stressed, and at what grade levels EE should be taught

(Sale and Lee 1972; Withrington 1977; Berkowitz 1993; Hale 1997). For the most part, such issues are left unresolved in the education world. Environmental education remains loosely organized and largely voluntary.

The interdisciplinary nature of many definitions, goals, and curriculum proposals for environmental education all seem to be pointing EE in a direction that can solve environmental problems. This very nature, however, makes it difficult for implementation of EE programs in many schools. Barriers to implementation include, for example, the fact that environmental education is often marginalized by "the dominant industrial ethos of schools" (Hutchison 1998, p. 25). On a more practical level, Ham and Sewing (1987-88) have found that logistical (time, funding, and resources), conceptual (uncertainty of what environmental education is and what is can be used for), and educational (lack of ecological training among teachers) considerations present considerable barriers to environmental education implementation. They suggest, however, that stressing environmental education's interdisciplinary nature, creating networks among schools so that resources seem more available, and holding workshops to inform teachers about the aims, purposes, and approaches to environmental education can help overcome these barriers.

Even if teachers and schools decide they want to incorporate EE into their curricula, there are also public misconceptions about EE that must be overcome. For example, the public may see EE as a frivolous topic when there is such a concern about illiteracy in schools. The public might also believe EE is too expensive if they believe it must be field trip and outdoors based (Ham and Sewing 1987-88). A final barrier to the

widespread implementation of EE is teacher education. If teachers are not made aware of the need for environmental education and ecological sustainability, they will feel no obligation to implement EE into their classrooms. More specifically, if teachers are taught in a technocratic or progressive philosophy, rather than a holistic one, they may simply use EE to inadvertently perpetuate environmental destruction (Bowers 1999). This returns us to the idea of the need for fundamental educational reform towards a more ecologically sound philosophy.

Criticism of Traditional Environmental Education

Despite the ambitious and inclusive nature of most environmental education definitions and goals, there are many critics of how environmental education has progressed and manifested itself over the years. Some claim that EE is far too marginalized in mainstream education and needs to be included in more types of classes and in more topics (Ham and Sewing 1987-88; Bowers 1997). Others would like to see EE curricula be more interdisciplinary. While most EE focuses on natural sciences, there are aspects of all environmental issues that involve social science, philosophy, economics, history, arts, and religion. As environmental problems transcend traditional disciplinary lines, so should education about and for the environment (Schaefer 1973; Bakshi 1978; Simmons 1989). The current separation of environmental issues from these other topics lead students to believe these issues are not relevant to their outside lives and to anything but science (Orr 1992).

Another major criticism of current EE programs in schools is the influence corporations have over their content and language. Blatant sponsorship of EE programs by industry is rare, but many groups affiliated with industry do sponsor EE curricula and bias the perspectives found therein in the industry's favor (Borowski 2000). Many industry-backers even go so far as to sabotage EE efforts. Some such individuals and groups speak out against the need for EE, saying it is too reactionary, not based on hard science, and is opposed to economic growth (Adler 1992; Smith 2001). Such opinions do not address legitimate environmental concerns, but do get the support of many companies and anti-environmentalists.

Perhaps the worst criticism EE could receive is one that is becoming more and more clear: the global environmental crisis is not being solved by the current use of environmental education. For example, Gigliotti claims environmental education has failed to arm people with "the knowledge and conviction of their own role in the environmental problems" and thus we "have produced a citizenry that is emotionally charged but woefully lacking in basic ecological knowledge" (1990, p. 9). In addition, the problem-solving aspect of environmental education that is included in most definitions is lacking in most environmental education curricula. Instead, simple knowledge and awareness of surroundings is usually focused on (Ham and Sewing 1987-88). Evidence that EE is failing to correct environmental problems is especially prominent when examined at a global scale:

> It is the relatively well educated and well intentioned Canadians, Americans, and Europeans who contribute most to the ecological crisis while fighting most vocally to lessen the crisis. And it is certainly the well educated who make the decisions in the developing countries that lead to increased desertification, loss of species, deforestation, the shift to cash cropping and subsequent malnourishment of local children, and the enormous hydroelectric power projects that routinely make homeless thousands. (Booth 1998, p. 4-5)

The superficiality of most EE programs, the lack of action-oriented teaching, and the ill-prepared teachers themselves all contribute to this problem of worsening, rather than improving, the environment through education. Radical changes in the way education for the environment is approached must take place to address this problem. Educators since the 1980s have looked towards movements in ecofeminism, deep ecology, conservation biology, social criticism, and bioregionalism to inform new ways of educating for the environment (Faulconer 1992; Corcoran and Sievers 1994). A new movement in education, which I call *ecological education* has recently come about to incorporate some of these principles in an attempt to change the cultural and educational system that continues to destroy the environment.

A Different Approach: Ecological Education

According to some critics, traditional environmental education, as discussed above, is based in the scientific paradigm, focuses on school-aged children and the natural sciences, and usually offers generalized environmental lessons. A relatively new movement in *ecological* education adds the criticism that EE is anthropocentric, mechanistic, and ignorant of root cultural causes of the environmental crisis. Ecological

education focuses on addressing these cultural roots, and on educating about cultural, social *and* biological issues within a specific bioregion.

Many educators and authors have recognized this need to address deeper causes of environmental problems. Smith points out:

> Most classes in environmental education focus on scientific analysis and social policy—not cultural change. They approach issues related to the degradation of the environment as capable of being solved through the collection of better data, the framing of regulatory legislation, or the development of institutional procedures aimed at reducing waste. …These efforts are without question commendable in that they develop awareness for and an understanding of real-life environmental issues. Missing in most of these efforts, however, is a recognition of the deeper cultural transformation that must accompany the shift to more ecologically sustainable ways of life. (1999, p. 3)

One of the basic tenants of the ecological education movement is that most EE is based on assumptions that perpetuate environmental degradation. Bowers, in particular, criticizes schools' grounding in technological advancement and their marginalization of traditional ecological knowledge and ways of knowing (Bowers 1997). Others agree: "The knowledge conveyed in school is the knowledge of people who have accepted the tenets of the modern/industrial worldview. Knowledge that is more regional in nature, tied into nonindustrial economic practices, or premised on nonscientific approaches to natural phenomena is given little credence" (Smith 1992, p. 61). In order to battle such environmentally destructive practices and assumptions, ecological education looks towards an interdisciplinary, multi-cultural form of education, one that does not marginalize different cultures or traditional ways and that includes a strong environmental ethic.

A New Way of Educating

The new movement in ecological education incorporates a much more holistic philosophy of education than most EE used in schools today. It is based in multidisciplinary and multicultural diversity and thus "promotes ecological understanding and connectedness, environmental awareness and appreciation, as well as earth stewardship" (Caduto 1998, p. 12). It also seeks to address the shortcomings in our cultural values and behaviors that base education in individuality, linear progress, and a particular kind (rather than multiple kinds) of intelligence (Bowers 1995; Bowers 1997). Questioning modern cultural roots and developing a holistic form of education is challenging and politically threatening, but necessary (Orr 1992).

Orr, one of the proponents of a new type of environmental education believes that the fundamental problem in education is the way people think and the way institutions teach people to think. He claims that the current ecological crisis "is a crisis *of* education not one *in* education; tinkering won't do" (Orr 1996, p. 7). In other words, there needs to be a completely different way of educating in order to solve the environmental crisis through education. He offers a number of foundations for educating people in an ecologically sustainable way, including the necessity for interdisciplinary education about environmental issues, the importance of experiential and outdoor education, and the importance of learning about a specific place (Orr 1992).

To build and teach from these foundations, educators have proposed using several different methods and ideas that have been traditionally marginalized in EE. The first idea is that of biophilia. This principle, when integrated into education, would include

relationships to place and formation of community. It would also include experiential education—direct contact with the natural world (Cajete 1999). Building from this sort of principle are those that involve a biocentric, rather than anthropocentric view of the world. Bowers offers the following commentary of the exclusion of biocentric and bioregional thinking from education:

> Currently, presentations of history involve putting humans in the foreground—their thoughts, artistic achievements, wars, political struggles, technological developments, and so on. ...This narrative tradition seldom gives an adequate account of how different aspects of cultural development—political and religious ideas, arts, technologies and economic practices, etc.—were influenced by the unique features of the local ecosystems. (Bowers 1993, p. 170)

A refocusing of educational topics as rooted in the environment is an important way of changing both the cultural and educational systems. In particular, incorporating the principles and knowledge of ecologically sustainable cultures into our own ways of knowing will combat the destructiveness of anthropocentrism and biophobia that now dominates the education system in our country.

Though all traditional or indigenous cultures should in no way be glorified for being ecologically sustainable, many of them are and share certain characteristics that have been identified by ecological educators. Such aspects include a focus on an inter-generational time frame, connectedness to all aspects of the biotic community, and living sustainably on the land (Bowers 1994; Kawagley and Barnhardt 1999). Bowers defines such cultures as rooted in a cultural/bio-conservative orientation:

> The core beliefs and values shared by both primal cultures and contemporary thinkers include the following: (1) Cultural/bio-conservatism involves a way of understanding time that is more attuned to the cycles of the different elements in the biome. ...(2) Cultural/bio-conservatism is oriented toward a deep knowledge of place: that is, a knowledge of the life supporting characteristics of local natural systems. ...(3) Cultural-bio-conservatism is non-anthropocentric. ...(4) Cultural/bio-conservatism is dependent upon elders to carry forward the accumulated knowledge of local systems, as well as the human practices and ceremonies that have been renewed over generations. (Bowers 1995, p. 165-166)

Learning about such cultures, and adapting their ways, is an important part of what ecological educators feel are steps towards changing our current society into a more ecological responsible one.

Focus on Place

Another important difference between traditional EE and ecological education is the new movement's focus on bioregional education. National EE curricula that are most often used in school EE rarely include specific information about different regions of the nation. One educator notes that these curricula are intended for teachers everywhere in the U.S., and they thus could not include material about specific ecosystems and issues in his area. He says, "Although the activities were about nature, they could be done in such a way that students remained completely isolated from the natural world" (Krapfel 1999, p. 48), and especially isolated from the natural world in the children's own backyards. While it may be difficult for teachers to find any EE materials that are not national in scope, it would behoove educators to seek out opportunities in their communities and regions to get involved in that region's ecology.

This way of educating—rooting students' education in the region in which they live—is advocated throughout ecological education, and much environmental education, literature (Orr 1992, for example). One author states:

> It is vital that environmental education pay attention to [the] uniqueness [of specific places]. EE has traditionally been very effective at teaching about *generalized* ecological processes and environmental hazards. Out of the *particularized* experience and understanding of our own unique places, however, grow personally meaningful relationships with personally significant environments. EE that combines both is likely to be especially effective in promoting environmental understanding, values, and action. (Lutts 1985, p. 38)

Despite the prevalence of literature in favor of this kind of place-based education, actually practicing this form of EE in schools is still controversial. Krapfel sees this kind of education as something that could revolutionize the education system, evaluation techniques, and where education takes place:

> If 'teaching about place' means learning about what is right around students, then this concept creates reverberations throughout the educational infrastructure. For example, local knowledge, by definition, could never be incorporated into nationally distributed standardized examinations. Therefore, assessment of students and evaluation of a school's program could not rely simply on tests of standardized content. Evaluation would have to look more closely at the local and nonstandardized. (1999, p. 60)

'Training about place,' in Krapfel's eyes, would involve more outdoors work, more complex thinking and investigations of topics, and more experiential learning—all means of changing the education system that ecological education advocates.

Field trips and outdoor explorations in the students' ecoregion are important ways of incorporating bioregional education into school curricula (Traina 1990). These experiences can give students the interaction with the natural world that they are

otherwise deprived of in the classroom (Smith 1992). Involving children in community environmental issues, moreover, can also foster a sense of activism and real problem solving. Such involvement has multiple benefits for changing education and the cultural roots of the ecological crisis:

> Understanding life processes within the context of local ecosystems leads to reframing our guiding ethical, epistemological and ideological systems of representation. The inclusive sense of community also leads to fundamental changes in how community is represented to children both in the everyday world and in the classroom. (Bowers 1994, p. 69)

Not only is getting involved in local communities good for children, it is also a fundamental way of resolving the need for adult and whole community involvement in environmental issues. Ecological education for these larger groups is just as important as reforming schools and the education of children.

Expanding Ecological Education

Principles of ecological education like bioregionalism are important outside of the formal education system as well (Traina 1990). The interdisciplinary and complex nature of environmental issues makes it necessary to address education for solving these issues in a multitude of ways. Not only should schools be teaching children about the environment, nurturing awareness of the natural world, and teaching skills for developing solutions, but all members of society should also be aware of, concerned about, and working towards solutions to the ecological crisis. While schools can pass ecological knowledge on to parents and teachers in an indirect way, they are not primarily responsible for the kind of adult and nonformal education that must take place in order to

reach the majority of citizens that need to know about environmental issues. Adults in the wider community beyond schools are the present decision makers in our society, and a lack of ecological knowledge among these ranks is unacceptable. In addition to the reforms noted for formal education in the ecological education movement, I suggest that ecological education must also take place in a lifelong, nonformal, and community-oriented manner.

Adult and Nonformal Education

Adult and lifelong education in environmental education is by no means a new concept. The Belgrade Charter on EE drawn up in 1975, as well as later documents, drew attention to the need for EE for all ages, but little official development of EE for adults has occurred to date (Clover 1996). Aside from official documents, many educators and authors have also called for EE to play a more lifelong role in people's lives. For example, Golley feels, "we need an integrated ecological education starting with the primary grades and extending continuously into adult life" (1993, p. xi), and Ben-Peretz believes "environmental education as a continuous task of society has to become an integral part of all educational endeavours for all age levels from kindergarten to adult education. An intensive attempt should be made to include environmental aspects in all new curricula using all media available" (1978, p. 20).

Such goals are ambitious, but can be attained if organizers, educators, and adults have an active interest in the natural world and their communities. Because most adult education is voluntary, it is essential that topics of study are interesting and pertinent to

the learners in a community (Jarvis 1985; Thomas 1993). Most people interested in continuing education classes do so to pursue interests they already have, but a wide range of courses can include information about local ecology. Natural history classes through community colleges, seminars and courses organized by non-profit organizations, and volunteer projects with an environmental focus can all increase enjoyment of being outdoors, lead to grassroots involvement in ecological issues, and lead to more concern for global environmental issues and how they relate locally (Thomas 1993).

One successful program that has gotten many adults involved in environmental issues is Critical Environmental Adult Education (CEAE) in Canada. This program realizes the potential that ecologically educated adults have to make changes in society, and recognizes the different experiences that adults bring to learning situations by involving them in projects (Clover 1995). Programs like this also focus on making environmental issues relevant to the adult learners. They can address what the Washington State Department of Ecology defines as the fundamentals of a good EE program:

- Recognizing "that adults learn best when they feel they need to know something;"
- Providing "information that is relevant to those needs;"
- Helping "citizens feel that their participation will make a difference;" and
- "Pointing out the benefits of environmental protection" (WSDOE 1992, p. 27).

While formal education programs for adults, like college courses, have their benefits, this kind of education is often stressed too much. As one educator puts it:

> Many conservation education efforts have been aimed at the formal school system and often eclipse programs for adult and youth populations that are carried out informally by nongovernmental organizations, community groups, and resource agencies. These informal programs represent an area of neglect in natural resource education, yet one of enormous potential. (Jacobson 1995, p. xxv)

Indeed, nonformal education programs are growing both in popularity and variety. Such programs have an advantage over the formal education system due to this variety. For example, there are many techniques and options available to educators in the nonformal and adult fields that are not usually considered in a formal education setting (Emmelin 1977). Nonformal education can take place in homes, in communities, through peers or media, at parks and museums, or through workshops and seminars (Clover 1996). These methods of education can be very creative and flexible, responding to the needs of the learner and communities much faster than can formal curricula in schools (Young and McElhone 1986).

Nonformal education can reach a greater number of adults than formal education can as well. All skill levels and occupations can be exposed to ecological issues through the variety of education methods used in nonformal education, not just literate people or those who can afford tuition to a college (Taylor 1996). Through occupational seminars, community gatherings, and other kinds of informal dispersal of information, workers in many fields, can learn about environmental issues.

Involvement in Locality

Another way of expanding ecological education to all ages and spheres of education is to ground this education in communities and regions. Especially if principles

of ecological education are being fostered, education about and for the environment in a nonformal setting can offer much in the way of community empowerment, knowledge, and action that in turn can lead to social change in favor of ecological sustainability. Many successful environmental education programs have involved students working in the local community. Such experiences necessarily make students integrate economic, social, and environmental elements of a real-life project (OECD 1995). It also makes environmental issues relevant to the students and area residents. Many researchers acknowledge the necessity for making environmental education relevant to residents. Bowers (1999) feels that including place politics—how economic and political forces have influenced the place and harmed the natural systems—is essential; Booth (1998) advocates environmental service projects in communities; Weintraub (1995) stresses community involvement because it fosters connections between theory and practice; and Kiefer and Kemple state:

> It is crucial for schools to focus curriculum locally, even while using resources, teaching materials, and lesson plans that come from far away. We have discovered that by learning "the basics" in the context of their own community, students are more eager to take ownership of their learning process. At the same time, they learn to value and treasure the place where they live, which contemporary educational practices tend to undermine. (1999, p. 43)

All ages and types of education can become involved in community-oriented environmental projects. In a school setting, teachers need to begin using the community as a place for fieldtrips and experiential learning. There are many benefits to such involvement. It gets children outdoors to get first-hand experience with principles and

topics they learn about in the classroom, and it gets them involved in community problems that diverse people are involved in.

The best way to connect environmental issues and community issues is to involve classes in community environmental projects. Projects teach problem solving, involve different viewpoints, and deal with the interdisciplinarity of a specific topic (Taylor 1996). These types of community-based activities combat the problems many see with in-school EE:

> At present the process of integrated environmental education in schools is hampered by the nature of the educational setting. Environmental problems are treated in schools as belonging to a kind of 'no man's land', located between the studies of biology, geography and social sciences. Only a few hours are set aside for the treatment of topics related to studies of environment, mainly in biology courses. Thus, the students do not get a grasp of the complexity and scope of the subject, nor do they see the full extent of factors interacting in the environment--physical, biological and social. (Ben-Peretz 1978, p. 21)

Projects address these issues by being interdisciplinary, issue oriented, focusing on problem solving, and taking up a significant portion of the time during the educational experience.

At the community level, beyond schools, environmental projects are also beneficial to community involvement, environmental problem solving, and education about ecological issues. A restoration project, for example, can include knowledge from all members of a community who choose to get involved. As the project progresses, participants begin to teach each other and form a committed community group working for a common ecological goal (Smith 1999). In one example involving a particular environmental and social issue, a number of small grassroots groups, each focused on a

specific topic of the larger problem, formed in a community. These groups were able to join together and learn from each other, becoming stronger and more committed to solving the problem in an ecological way. Education about the issue was done at all levels of the community, involving schools, families, and surrounding areas (Taylor 1995). In this case, volunteer opportunities offered the best way to learn about local ecology and to get involved in the process of community problem solving. Such first-hand knowledge of a community's ecology, economics, and social structure, in addition to seeing how these elements relate, is one of the biggest benefits of this type of community education.

A form of education and community involvement that is becoming more popular all over the world is participatory research (PR). This type of research and, more specifically, project, typically involves community involvement in defining and implementing conservation plans or other environmental projects. The goal of such projects is

> …To empower people to build democratic organizations and movements to bring about needed changes in society. PR is a process where grassroots people and organizations can sharpen community knowledge through careful and strategic analysis of various kinds of information. Community members can gain critical thinking skills for improved problem solving and decision making at multiple levels. They can also build better and more solid relationships within and between community members and groups. Ultimately, participants in PR can develop in themselves the capacity to determine and address the root causes of problems and issues in their lives and communities. (Williams 1999, p. 5)

PR can thus be very useful for solving environmental problems that affect people's everyday lives, and it can incorporate elements of nonformal education, bioregional education, and other elements of ecological education.

Community participation in education efforts has been successful all over the world. For example, a Community Baboon Sanctuary (CBS) in Belize has increased public knowledge about local ecosystems and involved community members in a conservation project that does not jeopardize their livelihood or traditional ways of life. While conservation was the main objective, the CBS project has resulted in "the inculcation and nurturing of a conservation consciousness and ethic within the local populace" (Horwich and Lyon 1995, p. 246). The program involves landowner education, Belizean school education, adult education, and ecotourist education. The success of the program is largely due to its involvement of local peoples and their needs. As the primary researchers of the project conclude:

> To be truly effective, conservation and environmental education programs must be tailored to the realities of local people and communities. ...Localized community projects also can provide various avenues of direct economic and social benefit to the very people and communities pursuing the conservation effort. (Horwich and Lyon 1995, p. 252)

Fire Ecology Education

Fire's role in so many endangered ecosystems and in the ecoregions of so many people, and its continued misunderstanding and marginalization makes it an especially important topic of education. Not only is it an integral part of ecosystems that school children should learn about in ecology classes and environmental issues lessons, but it is also a political and environmental issue that adults and communities need to be aware of when making decisions about the land and ecoregion. Fire is an important topic in biodiversity conservation, in resource management, in economics, and in politics. Its

interdisciplinarity makes it a prime example of the interdisciplinarity of all environmental topics and knowledge. In order for fire to be accepted in areas where it was once natural, there must be an educated majority of stakeholders—land managers and communities—who understand the benefits of fire and can address public concerns about it (Norris 1990).

Fire's cultural roots in Native American use also make it a necessary component of ecological education. Considerations of the traditional ecological knowledge that underlies fire ecology and management can be an important part of a community-based ecological education. Understanding of Native American management practices and hunting and gathering traditions can make fire a meaningful ally in modern fire management and education (Boyd 1999a).

Current means of fire education, their drawbacks and potential, will be addressed in Chapter IV in relation to the principles of ecological education laid out above.

CHAPTER IV

BIOREGIONAL FIRE ECOLOGY EDUCATION

The Need for Fire Education

With the shift in management and conservation focus towards ecological sustainability, ecosystem health, and conservation of biodiversity comes a natural need for average citizens to know more about these issues. In the past, information about fire distributed by the government has largely focused on suppression and prevention. Government agencies now realize the need for all citizens, government employees, land managers, media staff, and interest groups to know more about the ecological role of fire in many ecosystems, not just negative aspects of fire (Fire Education Task Force 1995). While education about all ecological topics is important, knowledge about fire is specifically needed simply because it has been misunderstood for so long. An analogous predicament can be found in the area of bat conservation. Bats have long been misunderstood and feared by modern humans, and have thus been persecuted and, in some cases, driven to the brink of extinction. Like fire, bats can play a key role in ecosystems and their survival is essential to the health of these ecosystems. As one bat conservationist states: "Learning the truth about bats before stereotypes become established is key to breaking the cycle of misinformation in future generations" (Morton and Murphy 1995, p. 105). Education, in the case of both bats and fire, is essential to

conservation of species and ecosystems that depend on these ecosystem components as well as the components themselves.

Education in communities where prescribed fires are used in management, or simply those that are in areas where fire once played a natural role in the ecosystem, can help land managers and conservation organizations gain acceptance for the use of fire. Education campaigns and available information can help citizens learn about the ecological role of fire, the uses of managed fire, and the benefits of fire in an ecosystem, rather than allow negative perceptions of fire and ignorance of fire ecology influence their management decisions. Knowledge about fire ecology and management increases the likelihood that people will be accepting of fire's use as a management tool in their area or even of natural fires (Stankey 1976; Shelby and Speaker 1990; Fire Education Task Force 1995)—leading to the more widespread reintroduction of fire that must occur to conserve fire-dependent habitats. Management agencies modify their practices in part based on public opinion, so a shift in citizen awareness and acceptance of fire issues can play a large role in a shift towards allowing more fires to occur on public and private lands (Norris 1990; Shelby and Speaker 1990).

While long-term education about fire and ecology is the best way to for people to learn about and understand these topics, even short-term education about the ecological effects of fire can affect citizen response to fire and have important consequences. A 1984 phone survey by Cortner, Zwolinski, et al. (1984) revealed that even in the course of a half hour phone interview a person could change his or her mind about the need for prescribed fire after being given information about fire effects and management goals. A

study by Taylor and Daniel (1984) also supports the hypothesis that increased education about fire issues leads to a higher acceptance level of prescribed fires and more knowledge of their effects.

A comparison of wilderness visitors' attitudes about fire in 1971 and in 1984 illustrates how the long-term shift in policy, management, and science towards more understanding and acceptance of fire influences the level of knowledge and acceptance people have for fire (McCool and Stankey 1986). During this time period, fire ecology, fire's use in management, and its acceptance as a part of nature progressed markedly. Distribution of information about fire also increased during this time. The wilderness managers in the Selway-Bitterroot Wilderness (the location of McCool's study) made a point of providing much information over the decade in question. Because of these efforts, positive attitudes about fire increased significantly in that time. Such important surveys and findings indicate not only that public opinion can be changed by education, but also that the acceptance of prescribed fires can be very high in communities that receive information about management plans and effects in their area.

In addition to the increased public acceptance of fire gained with more information about its effects and use, fire ecology education can also make people feel more connected to their home and region. Armed with more knowledge about natural processes and beneficial effects of fire, citizens can feel more empowered to get involved with local management efforts and fire policies. Having ecological and managerial information readily available to community members can strengthen local knowledge and make learning and involvement easy for the average citizen. For example, citizens and

scientists who proposed an Ecology of Fire alternative (Alternative EF) for the Warner Fire Recovery Project in the Willamette National Forest employed this concept, as discussed below. Engaging communities in regular outings is a very effective way for managers to help community members see, not just read about, how the forest changes with and without fire. This is but one of a number of strategies that managers, government agencies, scientists, and community education centers can use to educate and reach out to the public regarding fire ecology and management issues, however. More traditional outreach, publications, and education can also be effectively employed.

For example, some community fire departments, which usually fight building fires rather than wildland fires, have investigated ways of educating the community about fire safety before a catastrophe happens. While most fire departments do not face the same issues as wildland fire managers, community outreach and education efforts by these groups are good examples of ways to rally the community through education and proactive efforts. Community fire departments in Florida utilize newsletters, chat groups, educational talks, school assemblies, free inspections, and post-fire education strategies and have made their communities safer and more prepared for catastrophe (Lobeto 1999). Government agencies working within the wildland/urban interface, in areas at risk for wildland fires, or areas targeted for prescribed burns would do well to use these same strategies and also involve fire departments in educating citizens about wildland fire risk near their homes.

Public education is most effective when addressing timely issues of local impact that community members have some experience with and an incentive to learn more

about. Targeting communities located in fire-prone areas, ecosystems with historical fire regimes that have been suppressed, and areas being managed with prescribed burns to restore the ecosystem's communities and biodiversity with fire ecology education and managerial information should thus improve agency and manager relationships with communities, increase public knowledge of their area's ecology, encourage citizens to get involved with local land management with fire, and increase public acceptance of prescribed fires and fire management. Such information should be focused on the issues that local people find relevant and interesting to be most effective. If, for example, a general survey on public concerns about wildland fires reveals that most people are very concerned about loss of wildlife and habitat, an education campaign focusing on these topics will reach more people and is more likely to change their opinions about fire than a campaign that only addresses vegetation effects (Cortner, Zwolinski et al. 1984).

Because fire ecology knowledge and effective education are so important to ecological fire management, I believe it is essential to know where the public receives its information about fire ecology. Below, I identify several sources of fire education, though this list is not exhaustive. In each case, I describe some methods and drawbacks to a particular means of education. While it is important and valuable that information about fire ecology is distributed by any means possible, some forms of education are better at reaching people and at involving people in the type of bioregional and ecological education that I feel is so important to the future of fire reintroduction, biodiversity, and the environment in general.

Types of Fire Education

Government Agency Programs

Federal and state government agencies are the primary practitioners of prescribed burning programs and owners of land that burns. As such, they have a stake in how their fire management plans are understood and perceived. Many reports have mentioned the need for education about fire management and fire ecology, and some offer practical suggestions for implementing such education campaigns or programs. For example, a 1979 collaborative report between the U.S. Department of Commerce, Fire Administration, and Public Education Offices identifies a five-step process for implementing a fire education plan:

1. Identification of local fire problems;
2. Selection of available community resources and achievable objectives;
3. Design of the education program;
4. Implementation of the education program; and
5. Evaluation of impact, redesign, and re-implementation (Stamps, White et al. 1979).

More recently, the need for public support of fire management has driven managers to address the issue of education more seriously. Successful education programs include an emphasis on managers having direct community involvement and distributing clear, locally based messages (Magill 1992-93). After so many years of Smokey Bear's form of fire education, this sort of straightforward, multifaceted education is a refreshing change in government programs. Rather than just teaching

communities how to prevent fires, agencies are realizing they need to be educating the public on the many roles of fire in ecosystems (Reeves 1975).

To achieve this education, several government agencies now have information on their web sites about fire effects on biodiversity and forests, including the U.S. Forest Service and U.S. Fish and Wildlife Service. Many web sites put out by private organizations also offer information on how certain plants and animals are affected by fire, including the very comprehensive Fire Effects Information System (http://www.wildfire.org/feis/).

The BLM, as well as various agency partnerships, has developed some fire education programs that address issues of ecology, management, property protection, resource use, suppression, and prescribed fire. An interactive CD-ROM called "Burning Issues" was released in 2000 as a joint project of the Bureau of Land Management and Florida State University (2000). The CD is an interactive education tool that features information about four different fire-dependent ecoregions around the country. Each location includes ecological information about plants, wildlife, the role of fire, and a lesson on a fire management issue. Fire suppression techniques, prescribed fire management, urban-wildland interface, and fire's relationship to conservation issues are all addressed on the CD. The CD encourages scientific exploration and thought, and addresses several aspects of fire ecology and management. It also offers some commentary on cultural and social fire issues. While somewhat resource oriented, and limited in distribution, this CD offers valuable fire ecology lessons and practical skills for managing fire.

Another interagency partnership, the Fire Education Task Force, produced the curriculum entitled, "Fire Ecology: Resource Management Education Unit." This program recognizes that students need to know about land management issues like fire ecology in order to become informed, decision-making citizens (1995). The curriculum packet includes background information for teachers and students and lessons or activities for teachers to use in science and social science classrooms. While the background information and lessons cover a number of topics—including management, prescribed fire, and fire behavior and technicalities—the material stresses the negativity of natural fires and promotes the viewpoint that the only fires that can be beneficial are properly controlled prescribed burns. In fact, these materials imply that prescribed burning is the only kind of fire that "fosters new plant growth and expands wildlife populations" (Fire Education Task Force 1995), even though natural and wildfires have been maintaining ecosystems for millennia.

The Fire Education Task Force materials are generally very broad and non-specific in describing fire and ecology. They do attempt to briefly describe a few ecoregions' fire ecologies, however, and also make brief mention of human uses of fire, historic fires, and suppression history—but not by region. Teachers are "encouraged to regionalize [the] materials to help students understand that fire is an issue in their own backyards" (1995), but the curriculum packet does not include suggestions for where to find such detailed information.

A much more bioregionally-based school curriculum developed by a collaboration between the Environmental Education Association of Oregon, the Pacific

Northwest Wildlife Coordinating Group, and numerous Oregon, Washington, and federal government agencies is "Fire in Pacific Northwest Ecosystems." This program is focused entirely on PNW ecosystems and the fire ecology and issues in these ecosystems. The lessons are designed to build upon each other, but they can also be taught independently (Ettlin, Ferschweiler et al. 1997). The lessons in this curriculum include sections focused on fire ecology (ecosystems, forest succession, fire effects, field trips, soil science, and fire behavior), human influences (use by American Indians, legends, early settlers and fire, and fire suppression), urban interfaces, and fire issues (use as a tool by foresters, and when to burn). There are also accompanying fact sheets and case studies that profile the fire ecology and effects of certain ecosystems or specific fire events and issues (Ettlin, Ferschweiler et al. 1997).

While some of these government-based education programs address regional and cultural fire issues and can potentially contribute greatly to student's understanding of the cultural, ecological, and scientific issues surrounding fire, they have some major flaws. Firstly, none of these programs are very widely distributed or used in U.S. classrooms. Second, they are by no means mandatory learning materials and so can easily be left out of a busy teacher's yearly lesson plans. And finally, all of these programs (other than the web sites) are designed for the education of children in a formal setting.

Media

News media has alternately been both a demon and a savior for fire education. As a popular and widespread form of communication in all its forms—newspaper,

magazines, radio, television, and the Internet—commercial media reaches most people in the United States to some extent. Media can thus be an important source of knowledge about fire and ecology, but it can also propagate myths, however inadvertently, about these important topics (Emmelin 1977). Managers have long advocated using the media for disseminating knowledge about fire and fire effects in different regions (Reeves 1975), and have, in fact, used it on many occasions to publicize both wild and prescribed fires.

One major problem with news media coverage of fire issues is its largely global focus. Television, especially, "has enormous potential to inform, fascinate, stimulate and challenge people's views on environmental issues but, even more so than radio, it lacks a local perspective" (Young and McElhone 1986, p. 65). Local news programs are the exception to this example, but these reports are usually very brief in nature.

While some idyllic reports describe local "minidocumentaries" that can involve community groups, planned ad campaigns, and positive local response (FEMA 1982); the realities of using media for fire education campaigns are less than ideal. Production and advertising costs would likely preclude any non-profit participation, and support for fire ecology coverage would have to be high in an area for the topic to even have a chance at being included in the news. This is not to say that local newspapers, national news, and magazines have not run stories about fire and its role in ecosystems, but the effect of many of these stories is not the desired one for greater acceptance and ecological understanding because they are often in reaction to disasters or human devastation.

Classic negative media coverage of fire is found in the reporting of the 1988

Yellowstone National Park fires. Media coverage of this event mostly focused on devastation and flawed policy, not rebirth or benefits of fire. Many news stories were wrought with errors and misperceptions (Smith 1995). One of the main problems was that reporters didn't understand how wildfires worked—how long it takes to control or extinguish them, strategies for fighting them, or how much 'damage' they cause to forests. The media led the American public to believe these fires burned Yellowstone down and that the forests were all destroyed due to Park Service fire policy (Smith 1995). Scientists and government agencies now have to undo the damage the media caused in reporting their own misconceptions and misunderstandings. In the decade and a half since the Yellowstone fires, coverage has improved greatly and is no longer so one-sidedly in favor of fire suppression: The general shift in management and philosophy to include fire in ecosystems has made its way into media reporting and more of the American public mind.

The major problem with relying on media to distribute environmental and fire news and issues is this medium's overall inattention to these topics. "Merely increasing the flow of environmental news, while a necessary step, does not attack the ideological base of the problem—the tendency to ignore the environment when making everyday life decisions" (Filho and Bandeira 1995, p. 56). Because the media reaches so many people, it must be prepared to change the fundamental way it educates the public about fire, ecology, and environmental issues. It cannot continue to ignore long-term effects and the connections between conservation, endangered species, climate change, land use, fire, and other socio-ecological issues.

Fire Research Natural Areas

Government-designated research forests and natural areas are another important way of learning about fire. Scientists can use these areas to study fire ecology and behavior in a natural setting, and the knowledge gained can then be distributed to the public. These areas also offer opportunities for citizen exploration and experiential learning. One such area, the proposed Warner Creek Fire Research Natural Area, illustrates research areas' potential for fire education.

The area of the Willamette National Forest now known as Warner Creek has a contentious recent history. It was designated as a Northern Spotted Owl Habitat Conservation Area (HCA O-10) (Willamette National Forest 1993, p. 2), and was thus protected from logging by various legislations for forest and endangered species protection. Arsonists started a fire in the Warner Creek area in October of 1991, and with the help of suppression efforts, the total burned area was nearly 9,000 acres (Willamette National Forest 1993). The ecological significance of this large burned area in a designated roadless area and the high-profile campaign to save the area from salvage logging prompted citizens and scientists to find a valid way to save the ecologically rich and sensitive area. A group of such concerned people proposed a Fire Research Natural Area alternative for the Environmental Impact Statement, and efforts are ongoing to have the area designated as such. The RNA proposed by activists would include the entire 9,000 acres of the fire as well as parts of the surrounding forest to use as a study comparison. Designation as an RNA would protect the area from any salvage (or other) timber sales, and so is a popular choice with both scientists and environmentalists.

Timothy Ingalsbee, with the Western Fire Ecology Center in Eugene, Oregon, has been a major contributor to the push for this designation. In order to successfully integrate a long-term view of fire disturbance and its effects on forest biodiversity, he claims that areas must be set aside to help scientists and managers learn about fire's effects in a controlled environment (Ingalsbee 1999). This is important because if an improper disturbance regime is reintroduced to an area in hope of maintaining biodiversity or local ecological health, more damage than good may be done. The proposed Fire Ecology Research Natural Area on the Warner Creek fire site could potentially offer the much-needed knowledge about how forests respond to fire and what disturbance regimes are appropriate for PNW forests. Ingalsbee (1998) claims, "The intent of the Fire Ecology RNA is to protect in perpetuity a landbase of sufficient size and logical boundaries necessary to do longitudinal research on fire ecology processes. …A large area provides for numerous comparative studies of burned and unburned sites, and several replications of a single field study." Any understanding that can come from natural forest fires will likely come from large Research Natural Areas like the one proposed at Warner Creek. Such areas will necessarily address issues of social perception, species diversity, recovery rates, and ecosystem structure—all key components in working towards a long-term solution for sound forest management.

A fire RNA in the Warner Creek area can offer many educational opportunities to scientists and the general public. Proponents of the RNA have led hundreds of people through the burned forest, teaching them about fire processes and ecology, and inspiring many of these citizens to write letters of support for a Research

Natural Area and against salvage logging (Ingalsbee 1999). Without the chance to go out into the forest and learn about fire ecology, these people may never have gotten involved with the fate of a local fire area. This type of hands-on experience with the area in question—its processes, recovery, wildlife, and management plans—can also lead to increased public support and acceptance of prescribed burning.

Environmental and experiential education efforts continue in the Warner Burn area, and regularly lead to the amazement of visitors. Ingalsbee has seen "numerous first-time visitors undergo a dramatic 'Gestalt switch' whereby they suddenly perceive forest fires as agents of rebirth and renewal rather than death and destruction" (Ingalsbee 1999). Ingalsbee has also independently set up long-term monitoring sites with Northwest Youth Corp workers to illustrate some aspects of fire ecology to young people and also to contribute to the larger body of scientific knowledge. Similar activities could become much more prevalent if the area is designated as a fire process RNA and becomes more formally recognized as a valuable research and education area.

In-school Environmental Education Programs

In-school environmental education programs are largely of the variety critiqued in Chapter III. Popular EE programs, designed and distributed by private organizations, have been widely adopted to meet environmental education curricula requirements, but focus primarily on natural sciences, management, and global (or national) environmental issues. Even with numerous recommendations for integrating environmental education throughout school curricula, in reality EE is still a special topic that is only addressed

during part of the school year or in certain grade levels.

Project WILD is one very popular EE curriculum that is used in many schools. Project WILD defines itself as "an interdisciplinary, supplementary conservation and environmental education program emphasizing wildlife" (Project WILD 1992, p. vi). Its main audience is K-12 school classes, and the program's goal is to raise learners' awareness and knowledge about the environment and to teach skills they can use to make environmentally responsible decisions and actions (Project WILD 1992). Project WILD is one of the most commonly used EE programs in the United States: since 1983 more than 38 million children have been taught using this curriculum (Project WILD 1992).

Though many different topics are covered in Project WILD's activity book, fire is not a prominent topic. Project WILD contains one lesson about fire ecology for each age group it addresses. These lessons are designed to take up one class period, with an option of expansion for the older age group. Both levels have a focus on science exploration, but the younger level includes more creative and artistic activities. The background information provided in these lessons includes the differences between prescribed and wild fires, objectives of prescribed fire, using fire for fuel management, Smokey's message and its place in fire management, negative effects of fire on wildlife, and the benefits of fire for the environment, habitat and wildlife. Neither the background information nor the activities themselves focus on specific regional fire ecologies. The curriculum does stress identifying differences between forest and grassland ecosystems, but does not encourage the teacher to incorporate more specific differences. The lesson for older children includes the option of taking a field trip to a burned area and

researching fire effects, however. The basic Project WILD lessons focus mainly on the biology and science of fire management, but they do offer suggested extensions for including the study of economic, social, cultural, and resource management consequences of fires (Project WILD 1992).

Though even one lesson about fire ecology is a breakthrough in education since a few decades ago, there are still major limitations to programs like Project WILD and their lessons about fire. First, the very nature of the programs allow them to be marginalized in the overall school curriculum. This is one of the major critiques of EE discussed in Chapter III. Simply because a fire ecology lesson (or any other topic) is included in a popular curriculum like Project WILD does not mean a teacher has to incorporate it into her lessons. Another drawback to many EE programs like Project WILD is their affiliation with resource management organizations, government agencies, or industries. While Project WILD claims balance and political objectivity in its lessons (Project WILD 1992), one of its sponsors (the Council for Environmental Education) also sponsors Project Learning Tree (PLT). PLT has been highly criticized by environmentalists and ecological educators for also being sponsored by the American Forest Foundation, an industry-backed resource management organization (Borowski 2000).

Field Schools

The popularity of outdoor education and organized field trips for various groups has led to the formation of many field-based schools and institutes. None of these programs focus specifically on fire ecology and management, which is understandable

when they are located in parts of the country that are not fire-adapted, but some could potentially include education about fire in the general and regional ecology lessons offered. Information about several such field schools is available on the Internet. Most are somewhat place-focused, offer lessons about natural history and ecology, and hope to foster environmental caring and understanding about the region within which the school is based. Examples of such schools are the Wild Rockies Field Institute affiliated with the University of Montana (2001); the Canyonlands Field Institute, a non-profit organization based in the Colorado Plateau (2001); and the Institute for Field Education (Gould 1995), affiliated with the University of Minnesota but based in the Arctic.

While such programs have the ability to reach a few hundred people every year and immerse the participants in regional ecology and issues, there are still several drawbacks. The college-affiliated programs are aimed primarily at college students and can be fairly expensive. They thus do not reach a broad public nor get a large number of community members involved in their dispersal of knowledge and understanding.

The Canyonlands Field Institute is aimed more towards a public audience and invites people of all ages and backgrounds to participate in learning about the region's ecology and social issues. This kind of holistic, non-profit, community-based education effort is precisely what I believe is necessary for communicating knowledge about fire ecology in Oregon ecoregions.

Community-based Education Programs

The regional variation in fire regimes and ecology makes it absolutely necessary to base fire education regionally if not even more locally. Not only will people in a region relate more readily to information about the region within which they live, the information will also be much more accurate when based on bioregional fire ecology and not generalized. Numerous authors have stressed, "to be most effective, public education should be directed to local…conditions as well as to local knowledge and acceptance of fire management" (Cortner, Zwolinski et al. 1984, p. 359).

For example, lessons learned by the public involvement coordinator for the Forest Service from working in the community of Buffalo Creek after a large fire in the nearby forest indicate the importance of working with community members and existing structures to bring about successful education and involvement projects (Duncan 1997). Duncan found that involving the community in early tours of the fire area, exhibiting information on fire at community events, listening to community members' concerns about fire, sharing scientific and management information related to the agencies plans and discoveries in the fire area, and getting elementary teachers and students involved helped the citizens accept the fire and learn about its positives and negatives. Duncan says, "I realized I had the perfect opportunity to introduce the students and teachers to their own backyards in the form of the Buffalo Creek fire area" (1997, p. 13).

Not only is basing fire education in local communities and regions important, but reaching all ages and education levels of a region is essential to effective fire ecology education. Nonformal and adult education, as well as the involvement of schools, is an

excellent way to ensure life-long learning and long-term understanding and acceptance of fire's role in a region. Though traditional environmental education is focused primarily on children, adults are the primary supporters of cultural values and education programs. We thus need to "consider ways that nonformal educational experiences directed toward adults might contribute to the shift in thinking required to engender the new values and understandings needed to live more in harmony with the earth" (Smith 1999, p. 207). Community-based education programs can contribute to this necessary shift through its nonformal methods.

Community education programs are ideal ways to involve people of all ages and backgrounds in regional ecology education. The programs I describe below are each rooted in the ecology and issues of a certain bioregion, are available to different age groups, include cultural aspects of environmental issues and ecology, and facilitate the inclusion and building of local ecological knowledge. Each of these programs includes fire ecology and management in their curricula in some way, and I discuss ways that this element can be expanded and improved in each case. Overall, I feel education programs like those found in these profiled groups offer excellent opportunities for bioregionally-based fire ecology education, and best address the concerns of ecological educators.

Friends of Buford Park & Mount Pisgah

Friends of Buford Park & Mount Pisgah (FBP), a non-profit organization in Eugene, Oregon, was founded in 1989. It is the primary advocate group for the preservation, restoration, and management of the 2,363-acre Howard Buford Recreation

Area (also known simply as Mt. Pisgah). This park is very significant ecologically: it hosts one of the largest oak habitat areas left in the Willamette Valley (Blazar and Orsinger 2000). A Nature Conservancy ecologist recently stated "'Buford Park has more occurrences of our [TNC] plant species conservation targets [22] than any other site in the Willamette Valley, which helps to emphasize the importance of restoration and management efforts in the park'" (Blazar and Orsinger 2000, p. 4).

Friends of Buford Park has grown over the years to have the continuing membership support of more than 500 people. FBP's stated mission is "To protect and enhance native ecosystems and compatible recreation in the Mt. Pisgah area" (2001). The organization carries out its mission by performing stewardship and restoration activities to enhance native plant communities and wildlife, providing education and volunteer activities, encouraging community involvement in park planning and maintenance, and fundraising to benefit the management of the park (2001).

Current Programs

Though FBP does not have an official education program, it does offer opportunities for learning about the ecology of the area. These opportunities are largely manifested through the efforts of the Stewardship and Technical Advisory Committee's actions and the volunteer coordination efforts of the organization.

Stewardship efforts, under the direction of FBP and Jason Blazar, the group's stewardship coordinator, involve restoring native plants and habitat structures to Mt. Pisgah's acres. Species inventories, such as the one completed in the spring of 2001 in

the first annual 'Biothon,' help determine what species should be in the area and how much work needs to be done to remove unwanted species. Removal of invasive exotic plants, such as Scot's Broom and Himalayan Blackberry, is the primary way that restoration of native species and habitats is accomplished (2001). Many volunteers from the community help with these activities throughout the year.

Aside from manual removal and mowing, another way that FBP has begun to reach its goals of restoration and protection of the Mt. Pisgah ecosystem is through fire. The first prescribed burn for ecosystem restoration was performed in the fall of 1999. This fire was done to benefit a population of the federally listed endangered plant species, Bradshaw's Lomatium (*Lomatium bradshawii*). This plant was being shaded out of its natural habitat by shrubs in the absence of regular fire and other disturbance. Since the fire, the lomatium population has stabilized, and a repeat fire is planned for the fall of 2001 to further improve and maintain the habitat (Blazar 2001). FBP has proposed more prescribed burns for habitat maintenance and restoration in other areas of the park, though none have been carried out yet.

Volunteer work parties are another major way that FBP gets ecological messages out to the public. Volunteers for the organization are a diverse group. Many work parties are composed of retirees, college students, families, FBP members, and other random community members. Other volunteer parties are coordinated with school groups, the Northwest Youth Corps (a work program for at-risk youth), Looking Glass (another at-risk youth organization), and the University of Oregon. Regardless of the group make-up, work party leaders try to include a wide range of educational activities in the volunteers'

day. Members of the FBP staff often lead volunteer parties, but local ecologists and botanists also lead these groups.

Blazar describes how he tries to get children in particular to think about the ecosystem they are helping to restore. When someone finds a rare flowering plant under the invasive species she has just cleared away, he tells her about it and encourages her to think about its chances of survival in that place both before and after the brush removal. He also encourages her to let others in the group know about the plant and to pass along her thoughts (Blazar 2001). This type of education encourages creativity and ecological thinking, and also is firmly rooted in the place the group is working to protect. This is one very important aspect of using restoration events as education events: the education that takes place is necessarily based on regional ecology. This form of hands-on education serves to connect people with the ecosystems that surround them in vital ways (Smith 1999).

The volunteer program at FBP has expanded greatly in the past few years. The number of active volunteers nearly doubled between 1999 and 2000, with another significant increase (up to almost 200 people) in 2001 (Kelly 2001). With more volunteers, FBP can do more outreach into the community, providing information about the park at festivals and to groups in the community. It can also do more active management at Mt. Pisgah with the help of community members. The increase in volunteer hours from 1,670 in 1999 to nearly 2,500 in 2000 has enabled the park's stewardship staff to control large patches of exotic species, collect native seeds for propagation, restore trails to prevent erosion, and plan new restoration tasks (Blazar and

Orsinger 2000).

Potential For More Fire Education

Friends of Buford Park works in an ideal area for educating the public about fire. Opportunities for using prescribed fire to restore and maintain native habitats abound in the park, and a 1999 wildfire on Mt. Pisgah offers numerous lessons in fire ecology, management, and philosophy. FBP hopes to take advantage of Mt. Pisgah's fire history and needs to benefit the area, as well as to educate the public. The group is in the beginning stages of creating a prescribed burn program "focused on maintaining globally endangered prairie and oak savanna habitats" (Blazar 2000, p. 5). Objectives for a prescribed burn program include reducing chances of a severe wildfire, prevention of ecological succession that would further eliminate oak savanna and prairie, maintenance of fire-dependent habitats, control of invasive species, and education about fire and the environment (Blazar 2000).

Blazar and Kelly of FBP both identified funding as a major limitation to how much education and outreach FBP can do about park management, fire, and conservation (Blazar 2001; Kelly 2001). Blazar believes that with more funding the group could do more proactive education such as leading more tours and hosting more talks about the ecology of the region, rather than depending on volunteer opportunities to present teaching moments. Regardless of such challenges, FBP has been steadily improving their programming and outreach about fire ecology. School groups, volunteer parties, and participants in guided walks all learn about how native ecosystems and wildlife rely on

fire and other natural processes for their continued survival. One such walk in July 2001, co-sponsored by the Mount Pisgah Arboretum, drew only three local participants, but these people all learned new things and saw the complex connections between fire and other park components. One participant of this walk worked for the local newspaper and brought her new understanding of fire's ecological role to a prominent section. Increased public awareness of these issues, no matter how small, is one goal FBP is accomplishing more and more each year.

Mount Pisgah Arboretum

Mount Pisgah Arboretum (MPA) occupies a 208-acre space within the land that Friends of Buford Park manages and protects, but is managed by an autonomous non-profit organization. The Arboretum was established in the early 1970s and the organization has grown to include around 600 members. MPA contains more than seven miles of trails, a Visitor Center with educational displays, gifts, and books, and several picnic areas (2001). While many arboreta tend to focus on displaying plants from all over the world and from many different ecosystems, MPA has made a point of focusing on native plants and ecosystems within its borders. This effort is vital to the threatened and sensitive habitats it encompasses—oak savanna and woodland, riparian areas, wetlands, upland prairie, and coniferous forests. The Arboretum's mission—"To promote conservation, research and awareness of ecology; to encourage and assist education on all levels in the natural sciences and arts; and to provide facilities for the public enjoyment

and use of its gardens" (2001)—is carried out through a well-established education program, management strategies, and public outreach.

Current Programs

To accomplish the goal of education, MPA implemented an outdoor education program in 1981, making it the longest-running program of its kind in Lane County (2001). The education program at MPA consists of several different components, most more formal than FBP education opportunities described above. First, the Arboretum serves as a place of learning for several college-level courses at the University of Oregon and Lane Community College, though MPA is not directly involved with guiding these experiences. A second, and the most extensive, part of MPA's education program is its partnership with local school districts.

Fran Rosenthal, MPA's education manager, has been coordinating the education program since 1991. She has seen the school program grow to include about 2,000 children in the spring program and 1,500 in the fall. Fran defines the goals of the education program: 1) To supplement and complement natural science curricula in local schools; and 2) To inspire children with the outdoors, reconnecting them with the natural world. The program attempts to accomplish these goals by encouraging area classes to visit the Arboretum during the school day (Rosenthal 2001).

Each school group's experience consists of a two-hour tour at the Arboretum, led by volunteer nature guides who are trained extensively in the weeks prior to the program. These volunteers comprise a wide cross section of the local population. They "include

botanists, mycologists, science professors and teachers, foresters, master gardeners, and ecologists, as well as college students (who receive credit for their work), outdoor educators and enthusiasts, parents and retirees" (2001). Each of these types of people bring special skills and experience to the children they guide and teach about the natural world.

The curriculum for the on-site tours has always been focused on ecological principles, but in 2000, Rosenthal changed the curriculum to fit in with the Eugene area school system's use of the National Science Research Center's "Science Kits." The tours now teach first and second graders about habitats and life cycles, third graders learn about trees, fourth graders about water ecology, and fifth graders learn about ecosystems.

Mount Pisgah Arboretum's school program, though based on nationally-distributed curriculum standards, does focus its lessons on the ecology of Mt. Pisgah and the Willamette Valley. Rosenthal believes this focus works well, not only because those habitats are the ones available for the tours, but also because the kids should learn about their home region (Rosenthal 2001). Though the Science Kits in schools are a good introduction to life sciences, being outdoors at the Arboretum brings the topics and concepts home to the children, relating them to a place they are familiar with and can visit again and again.

The third major component of MPA's education program is its walks and workshop events offered for all ages. The workshop program has been in place for more than twenty years, but it wasn't until the past five years or so that these events have become more prevalent and a greater variety of topics have been added. Most workshops

are focused on natural history topics—such as birding, plant identification, ecology, native cultures, and specific groups of animals. Many nature craft workshops are also held as part of this series. Some such workshops include making bird feeders, wreaths, and baskets out of native materials. Some more recent workshops also include the arts. Botanical and wildlife illustration and nature photography are offered, and a nature writing class is being offered for the first time in the summer of 2001. Workshops are mostly led by community members who have a skill or expertise to share, or by University of Oregon and Lane Community College instructors.

Guided walks are another major part of MPA's events. Walks are often themed for the season to increase public interest in these events. For example, spring features birding and wildflower walks, summer offers general ecology, tree, and insect walks, and fall includes mushrooming walks. Other themes with a natural history focus, like Kalapuya culture, mosses, lichens, and wetlands are also offered. Volunteers from the community lead these walks. Most either have experience and expertise on a topic, or are trained nature guides who volunteer in the school program as well.

The walks and workshops program has included some events addressing fire ecology and cultural history of the landscape. For example, two fire ecology walks were held in the year after the fall 1999 wildfire at Mt. Pisgah. Another, longer one, took place in the summer of 2001. This walk involved the 1999 fire site, the FBP prescribed burn site of 1999, and proposed prescribed fire sites in oak savanna habitat. Several walks and workshops have been held in the past on the topic of the Kalapuya Indians that once lived in the area. These events necessarily addressed issues of Native American use of fire in

Willamette Valley habitats, as well as cultural and ecological histories of these two connected themes—people and the land.

Potential For More Fire Education

Currently, very little of MPA's education program is focused on the issue of fire. The school programs deal primarily with school curricula needs. These needs do include general ecology and knowledge of different habitats, which may include some information on fire, but does not focus on it specifically or go very in-depth on the subject. Rosenthal does believe that fire is an important issue for school participants to learn about, and has encouraged guides to learn about and mention fire ecology in their tours. She feels disappointed that she was not able to incorporate the 1999 wildfire into more outdoor lessons, but is limited by the requirements of the schools the programs cater to and by the knowledge of the volunteers (Rosenthal 2001).

While walks and workshops have generally done a good job at including fire history and ecology from time to time, opportunities for learning about these issues are not always capitalized on. The 1999 fire, for example, offered an excellent example of fire behavior in savanna and forest habitats, plant and wildlife response to the fire, and benefits of fire in the landscape. While some college-level classes used the fire area as an illustration of such concepts, no formal programs or interpretive signs were installed to facilitate use of the unique area. Two articles about the fire and its results appeared in *Tree Time*, MPA's newsletter (Crow 1999; LoCascio and Palmer 1999), and several articles in the local newspaper reported on the fire and its effects (Perkins 1999, for

example).

Increased collaboration with FBP, the University of Oregon, and local experts can increase the walks and workshops programs offered about fire. These programs would have the benefit of a wide-ranging audience of community members, experiences and age levels, reflecting the diverse learners in the Willamette Valley ecoregion.

Camas Educational Network

Mission and Goals

The Camas Educational Network (CEN), based in the Eugene area, was conceived in late 1998 and gained non-profit status in August of 2001. A board of volunteers including retired educators, students, conservationists, and other interested community members administers the group. Jason Blazar, the current president of the CEN, defines the organization's mission to "enhance opportunities and encourage field-based approaches to learning for K-12 students" (Blazar 2001). CEN establishes partnerships with school districts in the Willamette Valley region, designs restoration and stewardship projects for classes, and works with teachers and districts to implement a project based on class needs and teacher interests.

This approach is unique in the Eugene area, and though this program focuses on school children, it incorporates many elements that I feel are important for a bioregionally-based ecology and fire education program. The Camas Educational Network's approach to conservation and restoration education takes students out of the classroom and beyond theory to a hands-on experience without many of the constraints of

other experiential education programs. For example, CEN's partnership with the Creswell School District involves restoring and maintaining a wetland prairie habitat on the school grounds (Blazar 2001). Involvement in this project teaches children to get involved in the matters of their own backyards, and gives them tools for transferring knowledge learned in the classroom to a real-life situation. The Network plans on involving students of all ages in various phases and activities of the restoration project, and to create a conservation network among many groups by getting other nearby schools and community organizations involved in the project as well.

Some school partnerships with CEN will not be involved in the Creswell site, but will participate in restoration and management projects at Mt. Pisgah. Though not on school grounds, the habitats at the park are important native ecosystems that connect students with their region. Service learning projects at the park also give students meaningful skills. Blazar hopes learning projects both on school sites and in Buford Park will stimulate both students' and teachers' sense of place, an interest in learning, and engagement of all school topics (Blazar 2001).

Potential for Fire Education

Since CEN will be dealing with fire-dependent ecosystems for most of their projects, fire is a natural component to include in their stewardship and restoration projects. The Network has not yet included fire in their programming, but plans on implementing some prescribed burns within the next three to five years at the Creswell School site. Most prescribed burns will be small scale and part of an experimental design

that tests fire's role as a stewardship tool (Blazar 2001). The use of fire in projects will depend on the selected site and the local fire code, but once some successful fire management projects are implemented, Blazar hopes this success will encourage more school districts and teachers to get involved in using fire as a learning tool in their CEN projects.

Though still several years down the road, fire management and restoration projects within CEN seem a feasible, and highly practical goal. Learning about fire ecology and effects first-hand, as students and teachers will in CEN projects, is one of the most valuable ways to gain knowledge about fire. Such projects will improve general understanding of fire, as well as native habitats, in the school and community.

Siskiyou Field Institute

Perhaps the most exemplary program in this study—due to its community and regional focus; emphasis on including scientists, citizens, and everyone in between; and its attention to the region's natural and cultural history—is the Siskiyou Field Institute (SFI). SFI is based in the community of Cave Junction, within the Illinois River Valley in southwestern Oregon. SFI's parent group is The Siskiyou Project, a:

> Nonprofit grassroots group with a nationwide network, which has been working for protection of the K-S bioregion since 1983. The SP combines science, education and advocacy to preserve the ecological integrity of this biologically unique region. The SP envisions and works toward a human community that lives in this place in a way that encourages local endemic diversity and sustainability, and which interacts with the land, forest and rivers in a knowledgeable and respectful way. (Marsden and Jules 2001, p. 21)

The Siskiyou Regional Education Project was formed and held its first conference

in 1997 to address the lack of understanding of the region's ecological uniqueness in the local population and to improve communication between the scientific community and regional citizens (Marsden and Jules 2001). The SFI was then initiated in 1998 to carry on this dialogue and to offer field-based courses on regional ecology. The Institute's target audiences are as varied as the Klamath-Siskiyou habitats:

> Courses are designed for a range of participants, both in age and skill level, including youths, nonscientist adults, advanced naturalists, professional scientists, and students. These programs bring together scientists and community members, as well as people from throughout the region and beyond, all of whom are interested in studying the K-S. (Marsden and Jules 2001, p. 18)

To ensure that everyone who wants to participate can, there are also scholarships and college credit available.

The SFI hopes to encourage cooperation among community groups, management agencies, and educational institutions (Marsden and Jules 2001), so that study and conservation of the ecoregion is highly participatory and cognizant of all stakeholders.

Current Programs

Table 2 lists the course topics at SFI since its inception in 1998. While some classes are geared towards adults, others are family-oriented or designed for children. All classes are based in the outdoors and nearby Cave Junction (or, in 2001, near Ashland). All the classes offered at SFI deal with the Klamath-Siskiyou region. They include education about the plants, habitats, wildlife, cultures, and art of this diverse region, increasing local people's knowledge of their backyards and spreading the word to outsiders that this region is incredibly unique and worthy of conservation.

TABLE 2. Courses Offered at The Siskiyou Field Institute 1998-2001

	2001	2000	1999	1998
Multi-Day Courses	Butterflies and the Western Siskiyous (W)	Identification of Western Siskiyou Trees	Bryophytes Of The Klamath Mountains	Lichens Of The Klamath Mountains
	Conservation Biology in the Field (W)	Conservation Biology in the Field	Geobotany Of The Siskiyous	Geobotany Of The Siskiyous
	Liverworts of the Klamath Mountains (W)	Fire Ecology	Nature Photography	Nature Writing In The Siskiyous
	Birds and Birding in the Klamath Region (W)	Forest Ecology of the Klamath Mountains	Ecology Of The Klamath Mountains	Amphibians & Reptiles Of The Siskiyous
	Making Plant Medicine: Ecologically Balanced Medicine Making (W & E)	Glorious Graminoids: Sedges, Rushes and Grasses of the Siskiyous	Salmon Biology & Stream Geomorphology	Birding The Western Siskiyous
	Klamath-Siskiyou Geo-Ecology (W)	Geo-ecology of the Klamath-Siskiyou Ecoregion (Parts I and II)	Mushrooms & Truffles Of The Siskiyou Mountains	Nature Sketching
	Natural History of Bats of Southwestern Oregon (W)	Shrubs of the Siskiyous	Nature Sketching	Salmon Biology & Stream Geomorphology
	Crash Course in Keying and Recognizing Plant Families (W)	Crash Course in Recognizing and Keying Plant Families	Amphibians & Reptiles Of The Siskiyous	Beginning Plant Indentification
	Siskiyou Trails: A Natural History (W)	Nature Writing in the Siskiyous	Siskiyou Landslides: Physical Processes & Ecological Roles	Wilderness First Aid
	Ethnobotany of the Cascade-Siskiyou National Monument (E)	Carnivorous Mammals of the Klamath Bioregion:	Introduction To Siskiyou Ecology	Introduction To Geology Of The Siskiyous
	Insects of Southern Oregon (E)	Wilderness First Responder	Conservation Planning Using Computer Mapping Technologies	Fire Ecology Of Sw Oregon
	The Clash of Ecoregions: Butterflies on the Edge of Eden (E)	Vocational Birdwatching	Stream Macroinvertebrate Monitoring	Conifers Of The Siskiyous
		Introduction to Siskiyou Geology	Birding The High Siskiyous	Natural Dyeing With Lichens
		Gauging Stream Health Using Aquatic Insects and Water Temperature	Field Entomology	Siskiyou Sedges
			Conifers Of The Siskiyou Mountains	

TABLE 2. CONTINUED

			Water: Energy & Life Jurassic Lark - the Geologic Setting Of The Josephine Ophiolite Ethnobotany Of The Siskiyous Wilderness First Aid	
One Day Courses	Siskiyou Wildflowers (W)	Native Seed Collection and Propagation	Getting To Know Siskiyou Butterflies	Ethnobotany: Native Plants & Folklore
	Wilderness Wisdom (W)	Improving Forest Health Through Natural Selection Harvesting	Botanizing The Bolan Lake/Peak Loop	Introduction To Serpentine Ecology
	Serpentine Plant Ecology (W)	Speleology of Caves	Geoecology Of The Oregon Caves	Native Grasses And Their Habitats In The Siskiyou Mountains
	Gold Placer Mining in the Waldo Vicinity 1850-1940 (W)	Geo-ecology of Oregon Caves National Monument	Native Seed Collection & Propagation	Retaining Ecosystem Integrity Through Natural Selection
	Botanizing Fiddler Mounain (W)	Glacial Ecology	Natural Selection Management Of Forestlands	Botanizing The Crest Trail
	Salmon Snorkeling (W)	Wild Medicine: Ecologically Balanced Medicine Making	Botanizing The Crest Trail	Native Seed Collection & Propogation
	Botanizing Days Gulch and Babyfoot Lake Botanical Area (W)	Serpentine Plant Ecology	Native Grasses And Their Habitats In The Siskiyou Mountains	Botanizing The Bolan Lake/Peak Loop
	Improving the Health of the Forest through Natural Selection Harvesting (W)	Salmon Snorkeling		Oregon Caves Inside And Out
	Botanizing Briggs Valley (W)	Native Grasses and Their Habitats in the Siskiyou Mountains		
	Botany and Birding (W)	Botanizing the Bolan Peak/Lake Loop		
	Birds & Birding in the Klamath Region (W)	Botanizing the Crest Trail - Cook and Green Pass towards Lily Pad Lake		

TABLE 2. CONTINUED

	Siskiyou Trails: A Natural History (W)	An Evening With Owls		
	Wetland Plants in the Eastern Siskiyou Mountains (E)	Siskiyou Trails: A Natural History		
	Introduction to Landbird Monitoring Techniques (E)			
	Ecological Overview of the Eastern Siskiyous (E)			
	Birds of the Cascade-Siskiyou National Monument (E)			
	Cascade-Siskiyou National Monument Vascular Flora (E)			
Youth Programs	Into The Woods ... (W)	Ethnobotany of the Siskiyous	Exploring The Forest	The Wonders Of Wetlands
	Wildflower Wonders (W & E)	Reptiles and Amphibians of SW Oregon	Ecology & Conservation Of Butterflies	Creative Writing
	The Klamath Region: A Place to Call Home (W)	Insect Exploration Adventure	You'll Be Likin' Lichens	Within The Forest
	Trees of Oregon (E)	Nature Art and Writing	The Wonders Of Wetlands	
	Feathered Friends (E)	Animal Tracking: Following Animal Footprints	Siskiyou Adventure!	
		Exploring Habitats		

Since it's beginning, the SFI has had roughly 300 participants at each summer's program. Local support has grown for the institute over the years, as it has become a fixture of the community and gotten more local people involved (Marsden 2001). SFI organizers feel that increased outreach to local people and regional scientists, as well as their non-political agenda of increasing awareness of local ecology, will only improve the institute's image and stature in the community (Marsden 2001).

Classes at the SFI are taught by a variety of people. Some are college professors, others are agency experts, and some are local schoolteachers or simply local nature lovers who have developed an expertise in an area. The range of participants is even larger. SFI was founded to increase both scientific research in the area and community knowledge about the bioregion, and judging by the diversity in Institute attendees, it is accomplishing these goals. Scientists, members of natural history groups, college students, agency employees, professors, local and regional residents, and residents of other regions all come to SFI to learn about the region's unique biodiversity (Marsden 2001).

Potential for More Fire Education

Two SFI courses have been offered to exclusively address fire ecology in the K-S region, one in 1998 and one in 2000. Tom Atzet and Darren Borgias, two prominent ecologists of the region, taught the 1998 course. This three-day course "examined the principles of fire ecology and successional development of forests and woodlands in response to environmental variables and fire" (Marsden and Jules 2001, p. 19). Evan

Frost, who taught the 2000 course, plans on teaching another class on this topic in the future (Frost 2001).

Shaded boxes in Table 2 indicate SFI courses that are likely to contain some fire ecology content. Because fire has played such an important role in shaping and maintaining the Siskiyous' physical, botanical, and zoological richness, it is only natural for teachers to include the topic of fire in many of these classes. Without a lot of fire ecology knowledge themselves, however, teachers are unlikely to go into great depth on the subject in these courses.

As the SFI becomes better known and fire becomes better understood and more accepted in the landscape, fire ecology classes at SFI may become more popular. The Forest Service and Bureau of Land Management are both beginning to use prescribed fire as a management tool more frequently in the K-S region, contributing to a higher profile for prescribed burns and more opportunities to use these fires for educational purposes. Both shortened one-day classes and the usual multi-day class on fire ecology could be offered each year if there is demand for the courses. Examples of both wildfires and prescribed burns exist near Cave Junction, making the outdoor fire ecology classroom varied and very relevant to all fire ecology and management issues.

New opportunities for fire education have been created with the expansion of SFI to the eastern part of the ecoregion, based in Ashland. This spring, the Siskiyou Project sponsored a community open house for the discussion of fire in Ashland. Including fire issues in the monthly local programs SFI sponsors is another option for further education (Frost 2001).

The continuation and refinement of organizations like Friends of Buford Park, Mount Pisgah Arboretum, The Camas Educational Network, and The Siskiyou Field Institute can make a large difference in the quality and quantity of fire ecology education that goes on in Oregon and in the entire country. If such groups consider using principles of community-based and ecological education, they can only benefit the understanding of fire among modern people.

CHAPTER V

CONCLUSIONS AND HOPE

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.
"Little Gidding" - T.S. Eliot

Recommendations for Ecological and Fire Education

The major principles of ecological education that I promote as necessary for a change in education for a healthy environment are also necessary for education that can lead to the restoration of fire's natural role in many ecosystems, including the Willamette Valley and the Klamath-Siskiyous. These principles—cultural and philosophical change, bioregionalism, lifelong education, and nonformal education—should form the foundation of any education program, particularly those teaching ecology and environmental issues. Education for cultural change must address the root causes of the environmental crisis and encourage people to examine the philosophies and assumptions present in their treatment of the natural world. Biocentric education should stress the interconnectedness of all ecosystem components, the necessity of these components for life and for healthy ecosystems. Bioregionalism in education must focus on teaching people about the natural systems that surround them, building a sense of place and

appreciation for the uniqueness of the landscape that learners inhabit. Lifelong education for the environment can be carried out in many ways, including school curricula, community learning centers, college curricula, occupational seminars relating to the environment, or other nonformal forms of education—all leading to the continued awareness and understanding of the environment for all ages. Nonformal education, outside of schools, is essential for ecological education because it can address a great diversity of people and the different learning styles and cultures within an area when implemented properly.

These foundational principles of ecological education have lessons not only for environmental education in general, but also for fire ecology education. In this study, I have stressed the role of education in conserving ecosystems through the use of fire and the importance of basing such education in a particular bioregion so that local citizens feel connected to the ecology and ecosystem needs of the place in which they live. The education programs profiled in Chapter IV are good examples of how bioregionally-based ecological education can be achieved, and of how regional fire ecology can be included in the curricula of these programs. They can only be strengthened by further incorporating the principles of ecological education I base recommendations for community education programs like these on the necessity of these principles.

Cultural and Philosophical Change

The philosophical change underlying recent management and policy shifts towards ecosystem management and biocentrism are evidence that American society, in

general, is becoming more environmentally aware and is valuing all elements of natural systems (not just 'resources') more than ever. Continued change in this direction can be facilitated by educational organizations in two major ways. The first is for a program to be aware of the complex economic, political, social, and ecological issues within the area it serves. The complexities of American society, including economic and demographic changes within regions and populations, must be addressed by educators if they are to encourage understanding of environmental problems and regional ecology (Johnson 1995). For example, the 1993 FEMAT report on PNW forest management issues included an analysis of the many various issues affecting this area and the outcome of government analysis. Documents like this could serve as a springboard for educational organizations to address these issues and to make connections between them. Fire, in particular, is an issue that involves such complex issues and relationships. Fire's role in society, in the economic base, and in the ecology of a region must be addressed in any education program that deals with this issue. In particular, programs that have an understanding of a region's population—their beliefs and attitudes about the environment, fire, and other issues—will have success in reaching their clientele (Negra and Manning 1997). For example, the SFI can avoid problems that the Applegate Adaptive Management Area is having with local people be being responsive to changing demographics and catering courses to meet the needs of the area and its people.

The other major way educational institutions can address the principles of cultural and philosophical change, is by educating the public about the cultural/bio-conservative and traditional cultures that once lived in a region. For example, teaching current

Willamette Valley residents about the Kalapuyas and their way of life can prompt an analysis of how these native people's sustainable ways can be incorporated in modern life. Regional citizens could learn how to use native plants in their gardens or farms to promote native ecosystems, wildlife, and processes like fire. Although we have lost many cultural resources in the cultural/bio-conservative tradition, we can at least learn from the reports of their practices and the landscapes they left behind (Hutchison 1998; Boyd 1999a).

Bioregional Understanding and Activism

A common theme in literature and studies about both fire and ecological education is the importance of knowledge rooted in a specific ecological place. By knowing and caring about a place, people are more willing and able to get involved in solving its problems—whether they are economic, political, social, or ecological. The special connection to places that humans can develop is evident in several movements related to education and the environment. The first is the bioregionalism movement, which urges the reinhabitation of ecoregions. The second are the numerous grassroots environmental movements that address local problems and are led by local citizens. Both hold lessons and promise for fire ecology education efforts.

Bioregionalism

The lessons of bioregionalism can apply importantly to fire education programs. While bioregionalists like Sale proclaim the importance of seeing the interconnectedness

of ecosystem components, people, and a place, the main challenge is making people *see*. Making people *see* must be the endeavor of bioregionally-based education programs. It is programs like these that must make residents of a place understand their connection with a place by involving them in restoration projects and educational experiences that foster learning about the ecosystems all around them.

Once this understanding is accomplished, education programs have the further opportunity to take advantage of this understanding and to get people involved in their region, thus turning bioregional theory into a practical thing. Bowers believes, "The bioregionalists are really concerned with the problem of empowerment...The bioregionalist views empowerment in terms of living in harmony with the rhythms of the environment" (Bowers 1987, p. 164). 'Living in harmony with the environment' necessitates some action on the part of people, which leads us to the second major way education programs can promote bioregional principles.

Grassroots Environmentalism

Learning about the ecology of the area in which one lives through bioregionally-based education enables a person to see herself embedded in the ecology of that region, and thus care about it (Lutts 1985). Caring and appreciating our local ecosystems is not enough though: "We should also integrate active participation and advocacy to preserve and protect our home with the more traditional approaches to interpretation that rely on passive empathetic participation and appreciation" (Lutts 1985, p. 41). When action and

advocacy for regional issues is incorporated into education or community events, grassroots action takes place.

Grassroots organizing has traditionally risen out of marginalized communities in search of representation and social or political power (Pilisuk, McAllister, et al. 1996). In the past few decades, however, more and more grassroots organizing has taken place surrounding environmental issues. People have realized that the government does not "initiate environmental actions on their own, but rather respond to expressed public concerns" (OECD 1995, p. 80). Grassroots activist organizations are the moving force behind such actions, "so environmentalism and environmental education are fundamentally grassroots social movements or derived from grassroots activity" (OECD 1995, p. 80).

Gottlieb describes the emergence of environmental grassroots groups as a response to mainstream groups that did not focus on issues of empowerment, urban issues, or fundamental cultural change. The field of environmental justice and groups like Greenpeace and Earth First! came out of this response (Gottlieb 1993).

Lessons from such movements can be used easily in ecological education efforts. Rallying community support behind an ecological issue, such as habitat destruction in a favorite park for example, is both a grassroots and, necessarily, an education project. Existing grassroots groups and issues in a region can also be used effectively as educational opportunities. The disappearance of oak savanna habitat in the Willamette Valley, for example, can be a rallying point for communities and those involved in groups like Friends of Buford Park.

Lifelong and Nonformal Strategies

The two programs at Mount Pisgah—Friends of Buford Park and Mount Pisgah Arboretum—have the advantage of being associated with a common nonformal education system: they are situated in a public park. Parks have long contributed to the process of nonformal education. Parks are places:

> Where people may develop increased concern for nature through contact with natural environments; provide opportunities for learning about natural systems, which may increase awareness of how nature is threatened by human actions; are some of the few remaining relatively undisturbed natural places that enable people to experience an alternative to degraded environments; and [they] provide unique opportunities for environmental learning as locations where people spend their leisure time and seek out new experiences. (Negra and Manning 1997, p. 10)

The main problems with park education are that it is of short duration and it lacks follow-up. In order for such education to be effective, issues of the length of the educational experience, follow-up, and quality must be addressed (Hungerford and Volk 1990; Gillett, Thomas et al. 1991). Programs offered by groups like FBP and MPA must learn to capitalize on the short-term visits of their clientele, and encourage repeat visits for increased learning opportunities.

The benefits of nonformal, outdoor, lifelong educational opportunities in parks to both the educational programs and the public do outweigh any drawbacks however. Studies of education programs and community involvement in parks show mutual benefits for both learners and the parks. For example, one study found that school children visiting parks learned a lot about the park's environment and then encouraged their families to get involved in the park's activities and to learn more. The park, in turn,

gained stronger community support and participation in its conservation activities (Jacobson and Padua 1995).

While Mount Pisgah Arboretum already has an established education program, educational displays, and is working on an interpretive sign for one of its ecosystems, Friends of Buford Park could increase awareness and involvement by improving such nonformal learning opportunities at its trailheads. Both of these groups reach a great variety of people that visit their grounds or participate in their volunteer opportunities. The Camas Educational Network, when more established, can also take advantage of its projects for nonformal education. Descriptive signs can mark the areas the schools are restoring, and brochures to parents and neighbors can raise awareness of the importance of the projects.

While educating all age and demographic groups in a region may be desirable for the sake of the environment overall, each education program does define its own target groups and should try to focus on these groups in order to gain maximum understanding. The Siskiyou Field Institute, for example, targets both scientists and community members for its education program. Catering to both groups may be difficult, but is necessary for raising awareness in the region.

Hope for the Future of Fire-dependent Ecosystems

An increased commitment by many government agencies, schools, and community groups for education about regional ecosystems—including their specific processes like fire—is a good sign that environmental, if not ecological, education is here

to stay. Environmental education has several things going for it that should ensure that it continues to grow and facilitate change in society, education, and the environment.

- "There is genuine public concern about the environment;"
- "There is already a dedicated core of activists, including many educators, in many parts of the world who are committed to action, even if they are loosely organized;" and
- "The nature of the environmental threat is such that precipitating public events are likely to occur frequently, thus stimulating public action" (OECD 1995, p. 93).

As so many scholars and educators have stated: "Only through ecological knowledge and understanding...can people develop a sense of concern for what is happening on a local and global scale and be encouraged to take appropriate action" (Hale 1993, p. xv). This ecological knowledge can be taught through continuing environmental education, supported by educational and social reforms, and maintained through students who have learned that the environment includes getting involved in their own backyards, streets, and schools. As the incorporation of cultural examination, a regional focus, lifelong, and nonformal elements into education programs continues, increased ecological knowledge and acceptance of natural processes is inevitable.

The fact that there *are* programs like those profiled in this study is a ray of hope in the environmental and educational worlds. If all ecoregions were serviced by an organization like The Siskiyou Field Institute, for example,—a regionally-based, ecology-focused, inclusive, and holistic education project—local citizens would have little choice but to be aware of their surroundings and active in managing the landscape.

If programs like these become more pervasive and accepted in our society, ecological education and its important principles will have a good chance of changing the ecologically-destructive ways of our culture. Programs like SFI, MPA, FBP, and the CEN that are situated in fire-dependent ecoregions are even more important to the survival of threatened ecosystems than community-based ecology education programs in general. When communities learn about their own backyards and the importance of fire for maintaining the wildlife and habitats they love so well from organizations like these, they are likely to care enough to act in favor of using fire as a management and restoration tool. Fire-influenced and fire-dependent lands depend on this for their survival.

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