

Local Perceptions of Social-Ecological Change on the McKenzie:
Implications for Resilience

by

Timothy B. Inman

MPP Essay

Submitted to

Oregon State University

In partial fulfillment of
the requirements for the
degree of

Master of Public Policy

Presented May 31, 2011
Commencement June 2011

ABSTRACT

Local Perceptions of Social-Ecological Change on the McKenzie: Implications for Resilience

This study sought to catalog local knowledge of long-term residents of the McKenzie River Valley as it pertains to landscape and community change and provide a general assessment of factors affecting the local social-ecological system's resilience. Residents interviewed indicated that dramatic changes driven by market competition, timber industry changes, increased regulation, and rural restructuring have occurred in both the landscape and community. The changes that have transpired as a result have redefined the relationship between the community and the landscape, moving away from local dependence on timber harvests to a relationship oriented around tourism and other ecosystem services. In doing so the community has transitioned from one with a logging community identity to one that has begrudgingly transitioned to a retirement and vacation community.

Resilience thinking, a framework for assessing a social-ecological system's ability to adapt and confront forces of change, indicates that the social-ecological system in the MRV is still in the midst of redefining the systems thresholds and key feedbacks. As a result of low institutional capacity the system is vulnerable to continued drivers of change from outside the local system. Using a modified version of Ostrom's (2009) framework for the analysis of social-ecological systems, this study recommends policymakers and policy entrepreneurs take three key steps to facilitate enhanced system resilience: 1) ensure transboundary management strategies are put in place that transcend landownership classifications; 2) tighten system feedbacks to include more local influence; 3) develop local multilayered institutions organized vertically and horizontally.

Keywords: local ecological knowledge, resilience, adaptive cycle, rural restructuring

ACKNOWLEDGEMENTS

The last two years at Oregon State University has been an exciting time. In large part my advisor and committee chair, Denise Lach, have influenced my experience. I am grateful for her guidance, mentoring, and patience as I wrestled with research questions and developed first hand research skills. Hannah Gosnell provided invaluable guidance on this research project. I appreciate her insightful suggestions that helped to shape the outcomes of this process. Mark Edwards is one of the most attentive and responsive professors I have ever had. Mark helped make the MPP program a welcoming place and always had helpful suggestions to sharpen my thinking. Also, thank you to Brent Steel for all he has done crafting the MPP program and providing me with the opportunity to be a part of its growing success.

I would also like to thank the community members in the McKenzie River Valley I had the pleasure to interview and interact with during this study. The McKenzie is one of the most beautiful places I have been and the people are some of the most hospitable and welcoming I have encountered. I wish the best for this community as it continues to face the modern pressures affecting so many rural western communities.

The two people most affected by these last two years were my wife Kachina and daughter Callie. Just eleven days before this masters program began Callie was born. Kachina and Callie spent countless evenings alone as I read theory and wrote papers. Both did so with patience, kindness and understanding (at least most of the time). Thank you both. I look forward to spending more time having fun together. Finally, I would like to thank my parents, in-laws, and sister-in-law Noora, for the time they gave to help Kachina, Callie, and I as we adjusted to life as parents and I

was busy with school. We could not have made it without the support of such an amazing group of family and friends.

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
Transformation of the Rural Landscape	1
Overview: Maps and Locals Explained	3
Study Area Overview	5
Study Objectives	10
LITERATURE REVIEW	12
Resilience Thinking	12
The Adaptive Cycle	16
Resilience and Social-Ecological Systems	18
Measuring Resilience	21
Social-Ecological Systems	21
Community Resilience	26
Resilience in Forest Dependent Communities	28
Summary of Resilience Indicators	32
The Social-Ecological Relationship in the American West	33
Exploitation: Cut and Run	34
Conservation: Growth and Stability	35
Unraveling of the Stability Paradigm	37
Release	39
Reorganization: Ecosystem Management and Resilience	39
Rural Restructuring	40
FRAMEWORK OF ANALYSIS	43
Analysis of Social-Ecological Systems	43
Adapted Framework of Analysis	44
APPROACH AND METHODS	46

Local Ecological Knowledge	46
Defining the Sample Population	47
Recruiting Participants	47
Interview Format	49
Interview Questions	51
Recording Methods	52
Transcription Methods	53
Analyzing and Coding the Transcript	53
RESULTS	55
Knowledge of the Ecological System	55
Density	56
Diversity	60
Old Growth	60
Species	61
Wildlife	62
Riparian Conditions	63
Development	65
Infrastructure	65
Settlement	66
Threats	67
Knowledge of the Community Change	68
Demographic Change	69
Families	69
Retirees	71
Californication	72
Poverty	73
Changing Community Values	74
Locals	74
Newcomers	76
Changing Community Social Institutions	77

Declining Enrollment	77
We'll Drink at Home	80
Governance Structure	82
Land Management Structures	82
Personal Land Management	83
Timber Industry Structure	84
United States Forest Service	87
Government Regulation	89
Market Forces	89
Market Dynamics	90
Industry Changes	91
Industry Realignment	91
Technology	93
Change and Capacity in the McKenzie River Valley	94
No Going Back	94
Individual Capacity	95
Knowledge Transmission	96
Institutional Capacity	96
System Interactions	98
Knowledge of Management Practices	98
Fire	99
Logging	100
Replanting and Increased Management	104
Speculation	105
Management Beliefs	106
Past and Current Management Practices	106
Prescriptions for Future Management	108
Start Cutting	111
Stop Cutting the Young Stuff	112
Land Management Conflict	112
French Pete	113

Logging Public Land	113
Logging Private Land	114
Accountability	114
Evolution of Conflict in the McKenzie River Valley	116
Beliefs Regarding Conflict Management	117
Changes in Employment	117
DISCUSSION	123
Resilience in the McKenzie River Valley	123
Value of Local Ecological Knowledge	129
Policy Implications and Recommendations for the McKenzie River Valley	132
CONCLUSION	138
Limitations and Recommended Future Research	139
BIBLIOGRAPHY	142
APPENDICES	151

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Figure 1: The McKenzie River Valley	6
Figure 2: Land Ownership in the McKenzie River Valley	7
Figure 3: Ball in a Basin	15
Figure 4: The Adaptive Cycle	16
Figure 5: Core Subsystems in a Framework for Analyzing Social-Ecological Systems	43
Figure 6: Adapted Model for the Analysis of Social-Ecological Systems	44
Figure 7: Cougar Reservoir	66
Figure 8: Student Population in the McKenzie River Valley	79

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 1: Indicators of Resilience in Social-Ecological Systems	23
Table 2: Factors Influencing the Resilience of Social-Ecological Systems	33
Table 3: Primary Level Codes	54

LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
Appendix A: Informed Consent	151
Appendix B: Phase One Maps	155
Appendix C: Study Codebook	157

Local Perceptions of Social-Ecological Change on the McKenzie: Implications for Resilience

INTRODUCTION

Transformation of the Rural Landscape

The rural landscape throughout the American west is experiencing tremendous change. Over the course of the 20th century many forest ecosystems once filled with diverse stands of timber became fragmented and were replaced with relatively homogenous even aged harvest units. Communities once supported by sawmill operations and filled with young families have transitioned, or are in the process of transitioning, into retirement and recreation based communities. Driven by social, regulatory, political, economic, and technological changes, this rural transition often referred to as “rural restructuring” (Nelson 2001; Gosnell and Abrams 2009) is spurring questions regarding the short and long-term sustainability and identity of rural America. As Stauber (2001, p. 33) contends “for some parts of rural America, the slow slide to no longer being viable—economically, socially, or politically—is within sight.” For other parts of America though the community has found ways to innovate and adapt with changing structures in order to remain viable (Sturtevant and Donoghue 2008; Kelly and Bliss 2009).

In large part, the process underway represents a shift in the definition of the relationship between humans and the landscape; a process that has occurred several times in the relatively short history of western habitation of the American landscape. Past relationships included a boom and bust period of rapid exploitation and settlement during the 19th century; stability and

conservation efforts that stretched from the beginning of the 20th century well into the 1960's and 70's and; efforts at preservation and resilience that began in the later quarter of the 20th century (Nelson 1995; Kelly and Bliss 2009). Most recently the relationship between humans and the landscape can be seen as marked by uncertainty as policies struggle to implement a complex systems approach that fully recognizes both the ecological and human elements of the landscape.

Much of the current approach to define the relationship between human and ecological systems is based on the notion of resilience and adaptive management. The resilience framework recognizes the mutual dependence between social and ecological systems and the unique manner in which change is addressed as a result. From a resilience perspective, social-ecological systems are complex adaptive systems that are to be managed in ways that promote adaptability and the ability to absorb disturbances. Ecologically this has translated into an ecosystem management regime that aims for overall ecosystem health as the end goal of management policies. The byproduct of this approach has been to limit resource extraction opportunities impacting any dependent human communities. Socially the perspective has been difficult to translate into action as communities experiment with new ways to remain economically viable in a resource constrained environment.

This paper uses a resilience perspective to analyze local residents of the McKenzie River Valley (MRV) perceptions of landscape and community change. What the study reveals is the potential value gained by incorporating local knowledge of social-ecological systems into models for community and ecological management. Additionally, it highlights the need for further integration in both theory and management structures to more fully link policies that affect coupled social-ecological systems.

Overview: Maps and Locals (MALs) Explained

This research was undertaken within the confines of the Maps and Locals (MALs) project and in pursuit of Goal III established by the HJ Andrews Experimental Forest (AND). MALs is a comparative cross-site research endeavor, initiated by the Long Term Ecological Research (LTER) network and funded by the National Science Foundation. The project was initiated under the context of the NSF's 2007 Decadal Plan for the LTER Network's new initiative called Integrative Science for Society and the Environment (ISSE). The initiative calls for "a new kind of transdisciplinary science—one that ranges from local to global in scope, and that blends ecological and social science theories, methods, and interpretations in order to better understand and forecast ecological change in an era when no ecosystem on Earth is free from human influence." The AND is one of nine LTER sites participating in the MALs project.

Since the inception of the LTER network in 1980, sites from around the world have provided a venue for scientists to study long-term ecological change within a well-confined environment. The HJ Andrews Experimental forest, established in 1948, was one of the original LTER sites and has provided Oregon State University researchers a venue to study topics including climate, hydrology, stream ecology, vegetation, and other forms of integrated research. The HJ Andrews sits in the 15,800 acre drainage basin of Lookout Creek, a tributary of the Blue River and the McKenzie River. Management responsibilities for the HJ Andrews forest is shared by the USDA Forest Service's Pacific Northwest Research Station, Willamette National Forest, and Oregon State University.

The MALs project, begun in 2009, encouraged LTER sites to research questions that moved beyond ones focused solely on the natural environment to include research that seeks to

understand the dynamic interaction between the natural and human environments. Participating LTER sites were asked to identify the processes driving long-term change at their site and to specify the appropriate temporal and geographic scale at which the process should be studied. In addition, sites were to utilize two common methods in conducting their assessment: a GIS based assessment of land cover/land use change over time and a collection of local knowledge relating to landscape/land use change. While the LTER network helped to spur MALS research, develop general research questions, and provide a venue for comparative discussion between LTER sites, specific study questions and study methodology were left to researchers at individual sites to construct and implement.

In 2009/2010, as part of Phase One of the MALs project, researchers identified data for the AND and surrounding area to construct maps of land use/vegetative cover at three different points in time: 1938, 1992, and 2001. Researchers were unable to locate maps for three time periods that were derived from the same data set so data was utilized from two different data sets: USFS historical land cover (1938) and National Land Cover Database (1992 and 2001). Given the distinctions in data sets researchers at the AND resampled, reprojected, and clipped rasters from the NLCD files to create a new series of maps that utilized the same landscape classification scheme. Graduate students at Clark University used the maps to compare stationarity of change by comparing the rate of change in time period one (1938-1992) to time period 2 (1992-2001). Results produced showed that misleading results could be produced because landscape changes shown on the map could be the result of actual landscape change or could be a product of the different data sets used in constructing the maps.

This study represents Phase Two of the MALs project and complements mapping efforts by interviewing residents of the McKenzie River Basin to develop a catalog of local knowledge regarding perceived land cover/land use changes that have occurred in the basin.

STUDY AREA OVERVIEW

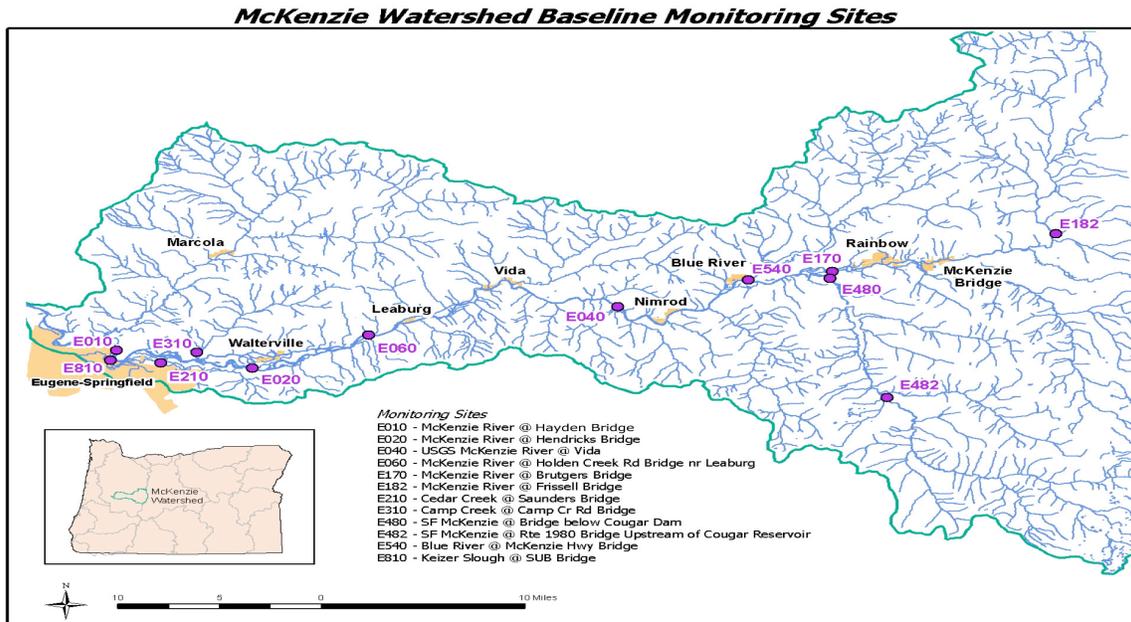
This section provides an overview of the social, political, and economic system of the McKenzie River Valley. Below is a description of the MRV followed by a historical discussion of the evolution of forest dependent communities like the MRV.

The McKenzie River Valley

The McKenzie River Valley runs from west to east, stretching from the southern end of the Willamette Valley east to nearly the crest of the Cascade mountain range, which runs north to south, dividing Oregon. The nearest metropolitan area at the western end of the McKenzie River Valley is the Eugene/Springfield metropolitan area with a population of 252,962 residents (U.S. Census Bureau, 2010 Census). Highway 126 and the McKenzie River stretch from the metropolitan area up through the 68 mile valley. The lower portion of the valley is composed of a fertile flood plain that is home to farms with philbert orchards and Christmas tree farms that are banked in by the forested edges of the valley to south and north. Lower valley communities of Deerhorn, Cedar Flats, and Walterville are only noticeable by a small sign on the road and small clump of houses or small stores. As you travel up the valley, the open farmlands and philbert orchards are left behind and the forested edges of the valley converge. Next you begin to reach the small communities of the mid and upper valley; Leaburg, Vida, Nimrod, Finn Rock, Blue River, Rainbow, finally McKenzie Bridge. Each of these towns, much like those in the lower

portion of the valley, may consist of nothing more than a small restaurant or may have a small collection of homes and a few businesses.

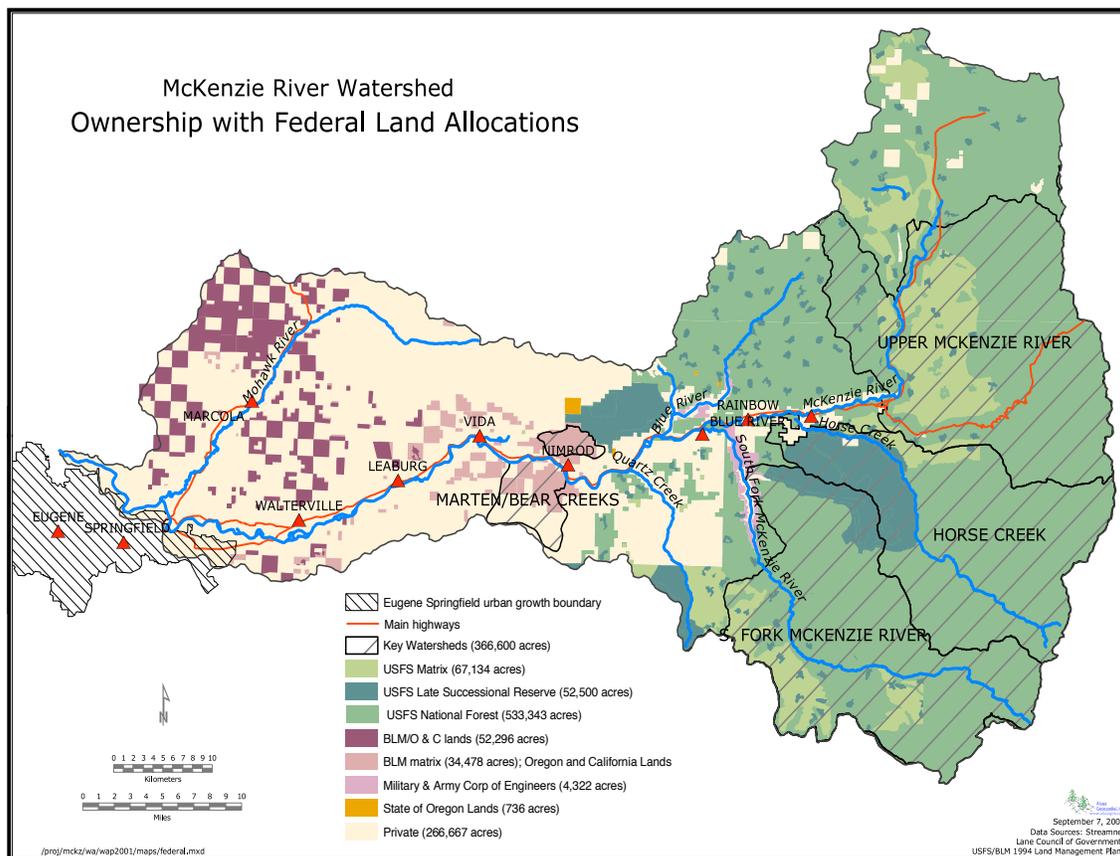
Figure 1: McKenzie River Valley



Source: <http://or.water.usgs.gov/proj/EWEB/description.html>

Overall land ownership in the valley is dominated by the federal government, which manages 69% of the watershed (McKenzie Watershed Council, 2002). In the upper portions of the valley, above the town of Blue River, land ownership is largely controlled by USDA Forest Service (USFS). Below Blue River, in the lower and middle portions of the valley, ownership patterns are checked as ownership is mixed between federal lands managed by the Bureau of Land Management and private land (owned primarily by large timber companies). The lower, flood plain portion of the basin is almost all private land. The structure of landownership and management in the basin has proven to affect landscape management strategies across the basin (McKenzie Watershed Council, 2002).

Figure2: Land Ownership in the McKenzie River Valley



Source: McKenzie River Watershed Council

Residents of the upper portion of the valley are comprised of people employed in resource extraction or resource management and recreation-based economies, are retired, or commute to the nearby metropolitan area for employment (Shindler et al. 1996). Past surveys of the area indicate residents have a fair amount of interest in forest management issues and appreciate being involved in collaborative decision-making processes (Shindler et al. 1996; Wright 2000; Williams 2001; Shindler and Mallon 2006). A 2005 survey of the attentive public in the McKenzie River watershed sought to assess residents' knowledge of ecological systems and management processes, relationships with the management agencies, and views regarding disturbance based management (Shindler and Mallon 2006). Researchers found respondents had

varying levels of ecological knowledge; knowledge of terms was generally high but knowledge of ecological process was low. Respondents also lacked confidence in management agencies, though local branches of the agencies were viewed more favorably than their regional or national parent organizations. And, the majority of respondents gave preference to environmental objectives over economic ones in landscape management.

All of the communities of the MRV reside in unincorporated portions of Lane County and lack any local general-purpose governments. Residents have access to county and state support services located outside of the MRV. Within the MRV, the key government institutions that affect community members are the McKenzie River Fire Department, the McKenzie School District, the McKenzie River Watershed Council, and the USFS. Outside of government institutions, residents rely on an array of local support networks including the local Chamber of Commerce, and EASE, a locally supported provider of ambulance and emergency medical services (Preister et al. 2002).

The often-used term community has multiple definitions that represent the various dimensions of human relationships encompassed by the term. As Magis (2007) notes in her review of both community development and natural resource literature communities include both a place based element and a relationship based element. Included in geographic element of community are the local institutions present in the area. The relationship element focuses on interactions and common beliefs held amongst local residents. Lee and Field (2005) expand the dimensions of community to include communities that share common feelings and beliefs but are not necessarily present in the same geographic location. As Donoghue and Sutton (2006) emphasize

this is important for many rural areas that are unincorporated but nonetheless share a sense of community. Magis (2007, p.7) defines community in the rural timber dependent context as:

A social grouping of people residing in a specific geographic territory. The community has a particular history, specific demographic patterns and contains and houses industries and organizations . . . rural communities can extend beyond the city limits or may be unincorporated . . . Forest communities are those that are adjacent to forests or are dependent on forest based industries.

For the purposes of this study this latter definition of community is used to describe the small towns within the MRV, an area that is unincorporated but shares a school, a common history, and relationships with government and social institutions.

The landscape has long provided a range of ecosystem services that support local communities. For much of the 20th century residents were able to rely on logging and the building of dams on local rivers to provide living wage jobs. Recreation and tourism have also become key components of the local economy. Residents and visitors alike enjoy the landscape for fishing, hunting, hiking, and rafting. In addition, the McKenzie River watershed provides water for the communities of Eugene/Springfield, as well as many other communities along the Willamette River.

Ecologically, large Douglas fir forests, interspersed with patches of cedar, hemlock, spruce and other native species, dominate the MRV. The valley is laced with streams and rivers that feed off the snowmelt from the Cascade mountain range and approximately 90 inches of rain that fall each year in lower elevations (Swanson and Jones 2002). These streams and rivers feed into the

McKenzie River that stretches from Clear Lake near the top of the McKenzie Pass down to the Eugene/Springfield area where it meets with the Willamette river and continues on its way north toward Portland and the Columbia River. Seven dams exist on the McKenzie River or one of its tributaries (Risley et al. 2010).

Numerous studies have been conducted on the hydrologic, ecological, and biological health of the McKenzie River Watershed (Risley et al. 2010). Studies cite a range of concerns. Several local species have been listed as endangered or threatened species under the federal Endangered Species Act, including the spring Chinook salmon, bull trout, Oregon chub, and northern spotted owl. Other species such as the western pond turtle are in decline. Some streams that feed into the McKenzie River have water quality issues. Lower portions of the valley face continuing development pressure for the Eugene/Springfield metropolitan area (McKenzie Watershed Council 2002). Despite these concerns many local residents and researchers have emphasized the general health of the MRV (Shindler Mallon 2006; McKenzie River Watershed Council 2002; Doppelt et al. 2009).

STUDY OBJECTIVES

The purpose of this paper is to provide a review of long-term ecological knowledge of changes in the social-ecological relationship in the McKenzie River Valley (MRV) and to identify the implied policy impacts on the resilience of the associated social-ecological system (SES). As mentioned, this project is conceptualized within the Resilience approach, a framework for analysis that takes a systems approach to analysis. Doing so recognizes the coupled nature of the natural and human environments and their linked dependency, and looks at variables that affect the ability of a system to adapt to change. Several questions guided this research:

- 1) What does long-term ecological knowledge reveal about resilience of the social-ecological system in the MRV?

- 2) What is the continuing role of long-term ecological knowledge in terms of the management of coupled social-ecological systems? What is this role in relation to spatial analysis previously conducted of the MRV?

- 3) What are the policy implications for systems management in the MRV?

To answer these questions, the literature on resilience, how resilience is assessed, and the social-ecological relationship in the American west is reviewed and a framework for analysis is provided. Second, this study's methodology will be outlined. Next, traditional ecological knowledge in the MRV is cataloged. Finally, the findings are discussed in the context of the resilience framework and policy recommendations are provided.

LITERATURE REVIEW

Resilience itself is a concept that spans multiple disciplines (Folke 2006). Literature in public health (Keim 2008), disaster preparedness (Norris et al. 2008), and urban poverty (Anthony 2008) employ the concept to help explain forces that aid in facing change and adversity. As an emerging field, methods are still developing for measuring resilience particularly in linked social-ecological systems. This review will explore the literature as it pertains to resilience in order to gain a better understanding of indicators of resilience as they relate to rural, traditionally resource dependent communities. First the initial concept of resilience and the adaptive cycle will be explored within ecological and then social-ecological systems. To compliment and inform the literature on social-ecological systems, resilience will briefly be examined in other disciplines. Finally resilience will be examined in the specific context of traditionally forest dependent communities. It is from this evolving concept of the social-ecological relationship that the notion of resilience will be examined using an emergent framework of analysis in the context of the MRV.

Resilience Thinking

Resilience as a framework for analysis was born out of the field of ecology and has been defined in two different ways. The construct we are most concerned with, ecological resilience, was first introduced by C.S. Holling and was defined as a “measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” (Holling 1973, p. 14). The concept emerged in the 1960’s and 70’s from ecology studies examining the interactions and responses of populations functioning in a predator prey relationship (Holling 1973).

At the time ecological resilience was posited, the dominant perspective of the natural systems in ecology was based on engineering resilience, or ecological equilibrium, in which the resilience of a system was measured by the system's ability to return to a previous state of equilibrium following a disturbance; the faster the system returned to equilibrium and the less it fluctuated the more stable the system (Holling 1973).

Underlying this position was a belief that systems had a single point of equilibrium. Identifying and understanding the key variables in a system, much like a simple equation, allowed for variables to be manipulated to optimize desired outcomes (Walker and Salt 2006). Such a perspective supported commodity based conceptions of the natural environment (Berkes 2003) to maximize production and efficiency. This took shape as natural resource managers and policymakers instilled command and control policies in which ecosystems were managed like simple equations in order to increase agriculture or timber harvests, manage fisheries, and maintain aquatic and terrestrial animal populations for conservation purposes (Holling and Meffe 1996).

For example, to ensure stability and efficiency crops are sprayed with pesticides to reduce bug infestation and increase harvests, diverse stands of forest are replaced with monoculture stands to maximize growth, and fire and pest outbreaks are suppressed in forests to protect timber supply (Holling and Meffe 1996). These outcomes are the product of what Holling and Meffe (1996) have termed the 'pathology of natural resource management' in which humans believe they can select and control natural variables in a dynamic natural system and maintain essentially the same form of that system (Holling 1986; Holling and Meffe 1996).

As has been shown, the result of command and control policy has been to reduce the natural

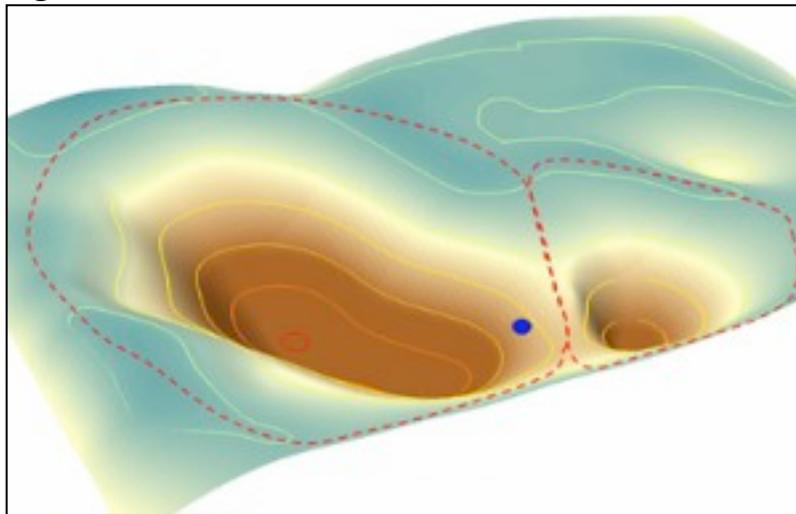
variation in ecological systems and in turn diminish the system's resilience (Holling and Meffe 1996; Gunderson 2000; Berkes 2003). In the examples highlighted above the loss of resilience translates into greater susceptibility to droughts, floods, insect or pathogen outbreaks, and large forest altering fires. What has been revealed as the flaw of such management practices is its reliance on a belief in the static nature of complex ecological systems. As Holling (1973) initially articulated, and subsequent resilience researchers have supported (e.g. Folke 2006; Walker and Salt 2006; Walker et al. 2009), the complexity of ecological systems cannot be described by a linear process with easily managed outcomes.

The ecological resilience perspective offered an alternative to these traditional theoretical and management practices (Gunderson and Holling 2002). From a theoretical standpoint the concept is based on the understanding that stability can exist at multiple stability domains, or what has been termed basins of attraction (Holling 1973; Gunderson 2000). This conception of stability within ecological systems translates into an alternative measure of resilience that focuses on the magnitude of disturbance that can be absorbed before the system crosses a threshold and shifts into a new ecological state (Holling 1986; Gunderson 2000; Folke 2006). Walker and Salt (2006) define thresholds as the levels in underlying control variables in which feedbacks to the system change. Positive feedbacks reinforce or improve the resilience of the system while negative feedbacks weaken the system's resilience. The important variables to monitor are the controlling variables (i.e. key variable such as nutrient levels that determine levels of other variables in the system) (Walker and Salt 2006). These variables are either slow or fast. Slow variables, are often ignored or more difficult to detect, but are what control the more apparent fast moving variables that tend to be the focus of natural resource management and policy. Instead of the focus being on key variables that define a state of stability, ecological resilience focuses on feedbacks and the

relationships among the system components (Nelson et al. 2007).

Another way to conceive of the concepts of ecological resilience is to use the metaphor of a ball in a basin (Gunderson and Holling 2002; Walker and Salt 2006). The ball is the state of the system, whereas the basin is all the possible states in which the system can exist while still retaining the same feedbacks and essential function. The shape of the basin is always changing and moving the position of the ball in the basin. The edges of the basin are the thresholds. The farther the ball is from the edges the more resilient the system. The closer the ball moves toward the edge of the basin (threshold) the less resilient, or vulnerable the system. If the ball crosses the edge of the basin and rolls into a new basin it then exists in a new system, with different dynamics and a new function. The system's resilience has led to a shift in regimes.

Figure 3: Ball in a Basin



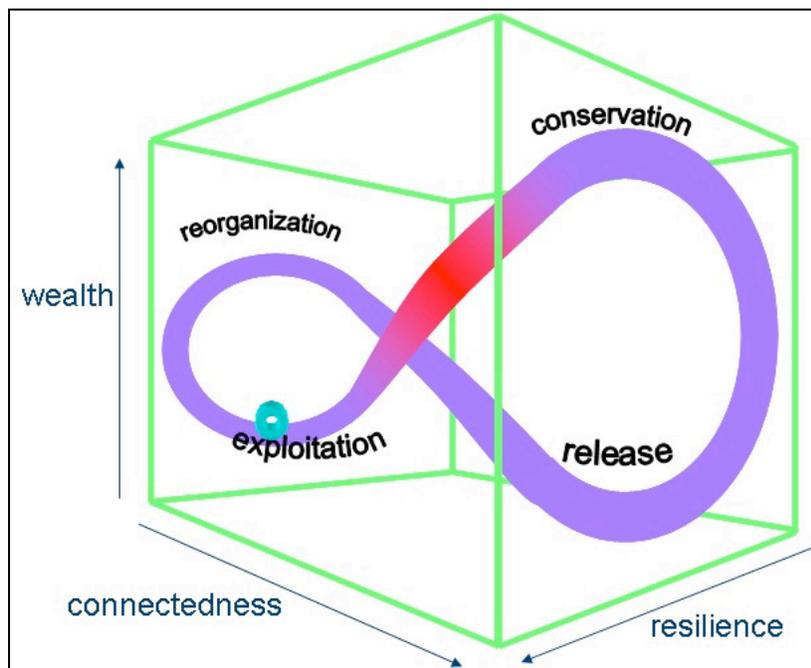
Source: http://www.spurse.org/fishfutures/?page_id=6

In the diagram above, the blue represents the current state of the system, contour lines represent all the possible states in which the system can exist, and the dotted line represents the system's threshold. Once that threshold is crossed the ball moves into a new system with different characteristics and functions.

The Adaptive Cycle

The final building block to understanding resilience thinking is identifying the process by which change occurs, both within a basin of attraction and as a system shifts from one regime to another. In resilience thinking change is determined by the system's adaptive capacity, which is managed by the adaptive cycle, a four phased process that at varying points maintains different levels of potential for change, connectedness to others within the system, and resilience to shocks and disturbances. (Holling 1986; Gunderson 2000; Gunderson and Holling 2002; Walker and Salt 2006).

Figure 4: The Adaptive Cycle



The initial, *exploitation* phase of the adaptive cycle is characterized by rapid exploitation as species or humans fill ecological and social niches to utilize available resources. The inhabitants of the exploitation phase can be viewed as

Source: Gunderson and Holling (2002).

opportunists or entrepreneurs who are aggressive and adaptable to variability and uncertainty, but who are also short lived. During this phase resilience is initially high but diminishes as the system consolidates and loses flexibility.

The exploitation phase gradually gives way to a longer phase of *conservation*. During the conservation phase the opportunists of the exploitation phase are replaced by specialists that build connections amongst the system, increase potential, and reduce the impacts of external variability. This translates into more efficient use of resources and tighter regulation of system functions that stores energy and capital. Gradually the systems growth rate slows and the system becomes less resilient and more vulnerable to external disturbances from the lost variation achieved through earlier increased efficiencies.

This increased vulnerability makes the system susceptible to a quick transition to a *release* phase where the tightly bound structure of the system is torn down and stored energy and capital are released. While release is destructive and chaotic, Walker and Salt (2006) contend the phase can also have a creative element. This creative capacity helps spawn the final phase of *renewal* or *reorganization* when new or old players emerge and begin to sort out the direction and identity of the new order. From a complex adaptive systems perspective what sustains the adaptive cycle is the ability of the system to self-organize (Gunderson and Holling 2002). This capability allows the system to continually select for variables, and variable interactions that allows for perpetual novelty that supports adaptation and change (Folke 2006).

At the heart of resilience thinking is an acknowledgement that change and evolution occur as part of complex processes that can transcend multiple temporal and spatial layers and is layered amongst both larger and smaller systems that provide external inputs. If the focus is narrow enough a system can be defined as a single lake in a much larger river valley. Within that lake can be defined a system with its own set of variables and adaptive cycles. Step back though and that lake suddenly becomes a part of a larger watershed that has a system of variables and

adaptive cycles that is composed of and overlays the smaller system contained within the lake. Either the lake system or the watershed system can be examined for changes that occur within an annual cycle or understood for much longer periods of time that account for larger shifts in external variables. Gunderson and Holling (2002) developed the concept of panarchy to express the interactive nature of nested adaptive cycles that occur at multiple spatial and temporal scales. The concept will be pertinent in understanding the multiple layers that challenge residents of the McKenzie River Valley.

Resilience and Social Ecological Systems

After Hollings initial articulation of resilience thinking researchers began to explore the concept in a range of ecological settings in a way that emphasized the connection ecological settings had with both social and economic settings. This larger systems approach was a recognition that the health and well being of ecological systems was innately linked to the external forces influencing and attempting to manage their function (Berkes and Folke 1998). Folke (2006) provides a thorough catalog of the various studies including examination of spruce budworm infestations in boreal forests (Holling 1978; Ludwig et al., 1978), rangeland management (Walker et al., 1981; Westoby et al., 1989), freshwater systems (Fiering, 1982), and fisheries (Walters 1986). The complex systems nature of the theory led to a gradual application of the concept to fields outside of ecology. Again, Folke (2006) provides an account of the many disciplines that began to integrate resilience concepts into their work including anthropology (Vayda and McCay 1975), ecological economics and biodiversity (Perrings et al., 1992), non-linear dynamics (Common and Perrings 1992), systems of humans and nature (Costanza et al. 1993), environmental psychology (Lamson 1986), cultural theory (Thompson et al. 1990), human geography (Zimmerer 1994),

management (King 1995), and property rights and common property (Hanna et al 1996).

What has emerged from resilience research is a framework for analysis that recognizes the connection of human and natural systems; a relationship resilience researchers have termed a social-ecological system (Carpenter et al 2001; Gunderson and Holling 2002; Walker and Salt 2006). Anderies et al. (2004, p. 18) define a social-ecological system as “an ecological system intricately linked with and affected by one or more social systems”. Folke (2006, p. 259) highlights how a lot of the research done on resilience has focused more on the original ecology based definition’s emphasis on persistence and the ability to withstand shocks and disturbances. As the concept evolved and incorporated the link with social systems and the adaptive cycle, the definition of resilience too has needed to evolve to include the “opportunities that disturbance opens up in terms of recombination of evolved structures and processes, renewal of the system and emergence of new trajectories. As a consequence of this expanded definition resilience has become intimately linked to managing a system for adaptive capacity that allows for continuous development, like a dynamic adaptive interplay between sustaining and developing with change”.

Nelson et al. (2007) articulate how, based on the expanded definition of resilience that incorporates adaptive capacity, a system has several scenarios it could experience when confronted by a disturbance or threat. The system could have low resilience and be vulnerable to a disturbance that would shift the system across a threshold into a new system as occurred in the ancient southern Jordan from overly intensive agriculture practices. The system could have high resilience and stay within its current basin of attraction as occurred in the Okanagan Basin, British Columbia when water shortages threatened the health of the system and institutions were

able to react in a manner that retained the system's health. Or finally, the system could have high resilience but deliberately transform the system into a new basin of attraction. This happened in northern Arizona where local policy shifted its focus from supporting agriculture toward tourism, a more competitive industry in the long-term. What each of these scenarios represents is the possibility for two types of system transformation, one intended and one unintended. Managing for resilience, as was done in the second two scenarios can allow for both incremental (changes within the existing basin of attraction) and transformative (threshold crossing) responses. As Nelson et al. (2007) argue, managing for resilience is more likely to produce outcomes that provide for social well-being.

As the examples above illustrate resilience is a normative concept and can be both good and bad. In Arizona, the existing agriculture based economy was deemed resilient but planners felt the long-term health of the community was better served by a transition into a new system with a new function and identity. Thus as Walker and Salt (2006), among others (e.g. Carpenter et al. 2001) point out, managing for resilience requires an understanding of what resilience you wish to create or maintain and from what type of disturbance the system should be resilient from.

To summarize, resilience thinking is a way to explain a complex system's ability to confront change. Resilience has four key properties: 1) systems exist in multiple basins of attraction and are nested in numerous temporal and spatial scales; 2) resilience is measured by the amount of disturbance a system can absorb without crossing a threshold into a new basin of attraction in which it exists with a different function and structure; 3) the process of change follows the adaptive cycle in which potential, connectedness, and resilience ebb and flow as the system cycles through four phases, exploitation, conservation, release, and finally reorganization, which

are all controlled by the system's ability to self-organize, and; 4) the ability of the system to build and increase capacity for learning and adaptation is achieved through adaptive management (Gunderson and Holling 2002; Walker and Salt 2006). Folke (2006, p. 260) summarizes the essence of the concept well, "the resilience approach is concerned with how to persist through continuous development in the face of change and how to innovate and transform into new more desirable configurations." The resilience approach, by acknowledging that multiple states of stability exist and by shifting the goal of landscape management away from consistency to the persistence of populations, has laid the foundation for new management practices and policies. This orientation offered to shift the management of linked social-ecological systems toward policies that manage for change and account for the health of ecosystem and the social communities dependent on these systems.

Measuring Resilience

Social-Ecological Systems

What has proven challenging is measuring resilience. Social-ecological systems contain both designed and self-organized components and are not easily captured by indexes often used to capture defined and static objects or processes (Anderies et al. 2004). Many of the studies that apply resilience thinking to their research have used it as a metaphor and less as theory with a testable set of hypothesis (e.g. Carpenter et al. 2001; Norris et al. 2008; Walker et al. 2009). Despite this, initial steps were made to identify key indicators of resilience. Gunderson (2000) highlights several strategies that can be employed to manage social-ecological systems for resilience, which consequently provide indicators of resilience. In regards to ecological resilience managers can work to increase the buffering capacity of the system, manage for processes across

multiple scales, and nurture sources of renewal. Gunderson highlighted the importance institutions play in managing social-ecological systems for resilience, defining institutions as both the rules and structures that allow people to organize for collective action (Gunderson 2000). For institutions to be successful they must incorporate capacities to learn, engage, and trust, using local knowledge and common property systems to link people and the environment.

The early focus on institutions and slow moving variables is complimented by work done in the field of sustainability. Sustainability as a concept is quite similar to the notion of resilience, with both terms often being mixed in their respective literatures. Both are focused on the persistence of systems into the future while recognizing the need to access resources in the present. In research on the sustainability of forest dependent communities in Canada, Beckley et al. (2002) argue for moving toward measures of community stability that incorporate broader concepts of community well-being. Doing so requires a focus on process indicators that examine social processes, relationships between groups, and behavior based on perceptions within a community. Focusing on process indicators reveals underlying variables that influence the dynamics of change and ability to adapt (Beckley et al. 2002). Process indicators include leadership, volunteerism, entrepreneurism, social networks, and sense of place (Beckley et al. 2002).

Recently though, researchers have worked to establish a more specific set of criteria for assessing resilience. Carpenter et al. (2001) helped initiate the effort to move resilience thinking from a useful metaphor to a more measurable theory by analyzing the resilience of two well studied social-ecological systems, the agricultural lake districts of North America and the rangelands of Western New South, Australia. Their analysis applied the concept of resilience and the adaptive cycle to explain transformations that have occurred in both social-ecological

systems. Given the wealth of data that already exists for both locations they were able to identify a set of resilience indicators for various elements contained within the system (see Table 1).

Table 1: Indicators of Resilience in Social-Ecological Systems

Social-Ecological System	Ecological Indicator	Social Indicator	Economic Indicators
Lake districts	-Soil phosphorous concentrations -Animal stocking densities -Land under construction	-Institutional flexibility -Institutional economic capacity -Institutional knowledge -Public Support -Existence of networks -Power and capacity of interest groups	- Ability to capture externalities
Rangelands	-Shrub: wood ratio	- flexibility in property rights	-flexible market conditions for shift in commodity production
General	-Slow moving variables - diversity	-Flexibility of agents to negotiate local solutions - existence of networks to build flexibility and maintain a balance of power amongst interest groups - existence and persistence of local ecological knowledge - capacity to learn	

Source: Carpenter et al. (2001).

Additionally the authors developed general guidelines for assessing the resilience and adaptive capacity of the social-ecological system. The focus, they emphasize, is on variables that underlie the system's capacity to continue to provide ecosystem services. In terms of ecological indicators of resilience, Carpenter et al. (2001) stress slow changing variables that determine the boundaries of the system's threshold and enhance diversity.

Social indicators are also influenced by slow moving variables, such as systems of land tenure and culture but are measured in the degree of flexibility they provide agents and institutions to problem solve and adapt, the existence of networks that create flexibility and balance power amongst interest groups, and the capacity to learn. The capacity to learn is aided by institutions that are flexible enough they can experiment, monitor, and adapt policies. Crucial system wide variables identify the system's ability to self-organize, or self-manage. For example, in fire management practices that rely on vigorous suppression systems develop uniform vegetation and high fuel loads. In contrast a system with the ability to self-organize would be managed in a way that allows for a mosaic of land cover to develop that protects human property but allows for natural variation and diversity of the ecosystem (Carpenter et al. 2001).

Walker and Salt (2006) suggest nine general indicators of resilience that measures could be developed for. First, is the existence of diversity. Diversity includes biological, social, landscape use, and economic. Second is the allowance of variability within social-ecological systems. This would include allowing forest fires to burn, and limiting flood control. Third, is the existence of modularity, which limits a system's connectedness in order to provide flexibility and ability to absorb shocks and disturbance. Fourth is the acknowledgement of slow variables such as climate change. Fifth is the existence of tight feedbacks, which allow a system to feel shocks in order to detect thresholds before they are crossed. Globalization has delayed feedbacks making it more difficult for communities to feel coming disturbances. Sixth is social capital. By creating and promoting trust, strong social networks, and leadership communities develop the capacity to confront and adapt to change. Seventh is the existence of innovation within communities. Innovation allows for active learning, experimentation, and locally developed rules that embrace change and disturbance. Eighth is an overlap in governance structures that incorporates

redundancy and vertical and horizontal organization. This includes a mix of common and private property rights that can allow local access. Last is the existence of all ecosystem services in development proposals, assessments, and other planning tools. The emphasis here is on the structure, function, and desired outcome of the institutions that communities are organized around.

In their analysis of social-ecological systems, Anderies et al. (2004) identify several institutional measures that can be used for gauging the robustness of social-ecological systems. Anderies and colleagues substitute the term robust for resilience because they feel it more accurately captures what occurs in social-ecological systems that are designed and not self-organized as is implied in resilience thinking. Despite this substitution of terms they do not abandon the concept of resilience (Andreis 2004) and explore the factors that allow a system to persist and adapt in the face of change. Their work provides valuable insight on the structure of institutions and the role they play in managing for social-ecological resilience. Andreis et al. (2004) emphasize the need for analysis of institutions to focus on the operational and collective-choice components of a social-ecological system. Operational elements consist of the resource users, traditionally those harvesting the resource. Collective-choice refers to the public aggregation of resource user preferences and the construction of policies. Their analyses developed a set of principles that were generally present in robust social-ecological systems. Key components included clearly defined boundaries, equity in the allocation of costs and benefits, collective choice agreements, monitoring processes, presence of graduated sanctions, conflict resolution mechanisms, minimal recognition of the right to organize local system and solutions, and multilayered nested institutions (Andereis et al. 2004).

Nelson et al. (2007) discuss the concept of resilient institutions and their role in adaptive governance. Their discussion is born out of work highlighting the value a resilience approach has in supplementing the literature on adaptation to environmental change, specifically, climate change. Nelson and colleagues build on Berkes' (2002) earlier findings that management should be structured across scales, both horizontally and vertically. The resulting institutional structure is organized around principles of adaptive co-management (Nelson et al. 2007). Adaptive co-management emphasizes an iterative learning process that incorporates governance institutions at multiple levels. In doing so, adaptive co-management includes local knowledge in its structure to enhance and complement other knowledge used within the system (Nelson et al. 2007).

Langridge et al. (2006) chronicle how recent research on social-ecological systems has identified several components as supporting resilience. These include: prevalence in flexibility and diversity in management regimes; existence of ecological knowledge; multi-layered, and accountable institutions with the capacity to learn; and the existence of coalitions, networks, and leadership. In their study of access to water as a resource the authors build on these concepts by suggesting that social resilience is enhanced by access to resources. The mechanisms that facilitate that access are technology, capital (financial or social), authority, markets, identity, knowledge, and networks (Langridge et al. 2006).

Community Resiliency

The resilience envisioned within the study of social-ecological systems is complimented by the literature found in several other fields that look more specifically at social or community resiliency, and community sustainability. Community or social resilience is a concept that emerged from ecology and Holling's (1973) seminal paper highlighting the existence of multiple

stable states within systems and the resulting need to manage complex systems for change. While the concept of social resilience is embedded in this conceptualization, less explicit attention has been paid to the concept of social resilience in social-ecological resilience literature (Langridge et al. 2006; Obrist et al. 2010).

In his study of resource dependent communities in coastal Vietnam, Adger (2000) explores the concept of social resilience and its links to ecological resilience through social resource dependence. Adger finds that social and ecological resilience cannot be measured through a single measure but is represented through the amalgamation of a range of indicators. Adger contends that resource dependency can be an indicator of social resilience and can be measured by dependence on narrow range of resources for income, resource distribution, technology, training, and labor mobility. He further suggests cultural and demographic information can provide general measures of resilience. Examples include the equitable distribution of assets, formal sector employment, crime rates, and migration and mobility. High or low migration and mobility can be indicators of both resilience or a lack of resilience and their interpretation must be done within the context of other events occurring within the community (Adger 2000).

Norris et al. (2008) extend the concept of resilience to communities confronted with acute stressors, such as a natural disaster or the attacks of September 11th. Their discussion provides a comprehensive listing of the ways resilience has been defined in the literature by the various disciplines and at various levels of analysis. Their conclusion posits that two themes are consistent throughout the existing literature: first, resilience is better conceptualized as a process than as an outcome; and second, resilience is better conceptualized as adaptability than stability. With this summation in mind Norris et al. (2008, p. 130) choose to define resiliency as "a

process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance." The definition is designed to encompass cross levels of analysis, yet the authors acknowledge portions of the definition would be operationalized differently depending on the analysis being conducted.

Norris et al. (2008) conclude that resiliency comes from a set of networked adaptive capacities. These capacities consist of actual resources and the dynamic traits of those resources: robustness, redundancy, and rapidity. They note this definition matches closely with Gunderson's (2000) definition of adaptive capacity. Four sets of resources are claimed to be key to networked adaptive capacity: economic development, social capital, information and communication, and community competence.

Resilience in Forest Dependent Communities

Literature discussing the well-being of forest dependent communities uses two common measures: community capacity and community resilience. As defined in the community development and natural resource literature, community capacity represents the "community's collective ability or capacity to address a variety of circumstances through use of various community assets or endowments, and to engage in collective action" (Magis 2007, p. 9). The distinction between community capacity and community resilience is the dynamic nature of resilience that incorporates a constant state of change. Community capacity on the other hand addresses both static and dynamic states. Donoghue and Sturtevant (2007) dismiss the distinction in practical application, contending that the distinction is an argument over definitions that should be moved beyond. The studies discussed below use resilience, capacity, and well being to describe a community's ability to adapt and confront change.

Since just prior to the adoption of the Northwest Forest Plan in 1994 several studies have been conducted to examine the well-being of forest dependent communities affected by the shift in federal forest policy. Three different teams conducted three initial studies, which included community assessments, the Forest Ecosystem Management Assessment Team (FEMAT), the Sierra Nevada Ecosystem Project (SNEP), and the Interior Columbia Basin Ecosystem Management Project (ICBEMP). Two of the projects, FEMAT (1993) and SNEP (1996), chose to look at their study population using the community capacity framework. ICBEMP chose to review their study population using a community resilience framework. Resiliency was defined as “the community’s ability to respond and adapt to change in the most positive constructive ways possible for mitigating the impacts of change on the community (Harris et al. 2000, p. 7). Researchers developed a resiliency index to measure community member’s perceptions of their community’s resilience. Resilience was measured based on rankings in four categories: 1) civic leadership; 2) social organization; 3) economic structure, and; 4) physical amenities and attractiveness. Study results found that civic leadership and social organization to be the most influential factors affecting resilience.

Donoghue and Sturtevant (2007) compared the three studies conducted above to conclude that the distinction between community capacity and community resiliency is a debate over definitions and see little distinction in practice. The more important focus, they argue, is on clearly defining distinctions between the indicators used in community assessments. Specifically they classify the factors contributing to resiliency as assets, or types of capital, that should distinguish between foundational and mobilizing capital. Foundational capital consists of the assets that exist in the community like infrastructure, natural resources, and economic capital. Mobilizing capital consists of the human, social, and political capital that organize the social

processes that lead to collective action (Donoghue and Sturtevant 2007). It can be revealed in workforce skills, social cohesion, collective decision making, and leadership that organize the community's foundational resources for use.

In 2002, partially based on the work done by Harris et al. (2000), the USDA Forest Service conducted an assessment of the viability and adaptability of Oregon's forest dependent communities (Donoghue and Haynes 2002). The assessment was in response to criteria established by the Montreal Process that stressed the maintenance of forest dependent communities as an essential part of forest management. The assessment attempts to move beyond traditional measures of community stability to incorporate notions of community well being that encompass the capacity of communities to adapt to change. Three measures were used to identify adaptability to socioeconomic change: connectivity to service centers, socioeconomic well-being, and proximity to public lands. Connectivity sought to capture mobility and migratory capability to connect with other markets and communities. Socioeconomic well-being was calculated based on census data regarding levels of poverty, educational attainment, and occupational diversity.

In 2003 Haynes conducted a similar study looking at adaptability of forest dependent communities across the United States. In this study he modified his key variables slightly, focusing on population size (a proxy for civic infrastructure), economic diversity, and amenities lifestyle (proxy for social and cultural diversity). Haynes acknowledges challenges existed with this methodology, but his assessment represented a continued attempt to measure community well-being using a broad range of indicators.

More recent studies have continued these early attempts to assess the well-being of timber dependent counties. Charnley et al. (2008) utilized a mixed methodology to assess the flow of goods, services, and opportunities from federal lands and the socioeconomic well being of communities affected by the Northwest Forest Plan. A range of quantitative data was collected including census data on employment diversity, percent unemployment, percent of people living below the poverty level, household income inequality, percent of population 25 years or older having a BA degree or higher, and average travel time to work. Quantitative data was supplemented by data gathered through interviews that provided a picture of nature of community change. The paper often cites the changes in resilience and capacity to address change. These measures are often referenced in relation to availability of amenities, migration and mobility, and connection to other communities.

Most recently the U.S. Roundtable on Sustainable Forests commissioned a research project to develop theoretically and empirically based definitions and measures of community resilience. The project was spurred by the Montreal Process Criteria and Indicators (MPCI) inclusion of *resilience in forest dependent communities* as an indicator of social resilience (Magis 2010). The report defines community resilience as “the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise” (Magis 2010, p. 402).

Eight dimensions of community resilience were operationalized from the research: community resources, development of community resources, engagement of community resources, active agents, collective action, strategic action, equity, and impact. Similar to Donoghue and Sturtevant’s (2007) distinction between assets as foundational capital and mobilizing capital,

Magis distinguishes assets by their active and inactive or latent capacity. Resilience is distinguished by the community's ability to develop and engage resources in a collective manner to respond and adapt to change.

Summary of Indicators of Resilience

Measuring the resilience of social-ecological systems is an emerging field. Currently no commonly used structure exists. Instead, based on existing literature in the fields of social-ecological systems, combined disciplines studying community resilience, and assessments of the resilience of forest dependent communities, a set of variables common in resilient SES is beginning to emerge that utilizes lessons from several disciplines. The structure that is taking shape is focused on slow moving variables such as species diversity and land tenure arrangements, and other institutional arrangements that influence a social-ecological systems flexibility and ability to adapt in the face of change. Continued work is needed to refine the variables for measurement, particularly the coupled interaction of human and natural elements, their linkages and feedbacks (Gunderson and Holling 2002). Based on the literature examined a range of variables exist that can be considered traits indicative of a resilient system. Table 2 summarizes the pertinent variables.

Table 2: Factors Influencing the Resilience of Social-Ecological Systems

Institutional Structure and Process	
Learning Capacity that emphasizes an iterative process	Ability to self-organize
Inclusion of Local Knowledge	Modularity
Inclusion of common property systems	Allowance for variability
Flexibility to negotiate local solutions	Overlapping government structures, vertically and horizontally organized
Institutional Knowledge	Clearly defined boundaries
Support and trust of the public	Equity in cost benefit allocation
Existence of networks and interest groups with capacity	Process for local problem solving and sanctions that provide accountability
Ability to capture externalities	Access to resources
Flexibility in property rights structure	Collective decision-making
Flexible market conditions	
Community	
Economic Capacity	Social Capital
Economic Capital	Leadership
Access to markets	Entrepreneurism
Technology	Volunteerism
Formal sector employment	Social cohesion
Workforce skills	Education
Proximity to public land – amenities access	Identity
Economic diversity	Sense of place
Occupational diversity	Local culture
	Diversity
Ecological	
Focus on slow moving variables	Vegetation ratios
Density	Diversity
Land under construction	

The Social-Ecological Relationship in the American West

As was discussed in the section about the resilience framework, it is important to understand the social-ecological context a system rests within in order to understand the full range of drivers affecting behaviors within the system. The social-ecological system within the MRV is nested within the larger western relationship of resource management and dependent communities that stretches from early settlement of the American west. The connection between human

communities and the natural landscapes has long been part of the natural resource management dialogue. How that connection has been defined is largely shaped by the forest and community paradigm dominant at the time. Three paradigms have shaped the forest-community relationship and roughly follow the first three phases of the adaptive cycle: exploitation and boom and bust settlement; conservation and stability; and preservation and resilience. The legacy of these earlier relationships continues to influence local conditions in both the landscape and their dependent communities now engaged in the process of reorganization.

Exploitation: Cut and Run

Despite the myth believed by western settlers that the landscape they found was pristine and untouched, native populations had managed the landscape for centuries (Langston 1995; Robbins 1997). Tribes hunted, fished, raised horse herds, harvested roots and berries, and burned land to improve hunting and grazing grounds (Langston 1995).

The social-ecological relationship changed with western settlement. Notions of manifest destiny and productive use of the landscape shaped western settlers' relationship to the land. Production for these settlers was defined in economic terms as the value achieved through commodity production. Fertile grasslands were seen for their value grazing domesticated animals for markets and forests were viewed as sources of timber to be utilized in American markets (Wilkinson 1992). In this era of abundance, the relationship was based on society's expansion and technological advances, combined with little regulation. Expanding commodity markets encouraged large-scale cutting of forests and trapping of game (Robbins 1994).

Federal policies such as the Homestead Act of (1862) and the Timber Stone Act of (1878) encouraged relatively unbridled expansion and exploitation of the land that characterized much of this era (Kelly and Bliss 2009). The cut and run pattern of landscape management thrust dependent communities into a boom and bust cycle as an area was populated to harvest timber and left to its own once all the timber had been harvested (Robbins 1994; Sturtevant and Donoghue 2008). As early as 1920, A USFS Bulletin noted “Forest regions have been well developed, provided with excellent transportation facilities, and made prosperous for a few years, only to be striped of their timber, left desolate, poverty stricken, and depopulated”(Dana 1920, p. 30).

Conservation: Growth and Stability

Gradually concern began to develop about the rate and severity of timber harvests (Kelly and Bliss 2009). In response Congress passed the Forest Reserve Act (1891), granting the President the authority to set aside forests prohibited from sale to the public. The purposes of these federal reserves were defined by Congress in the Organic Act (1907), which clearly stated federal forest reserves were set aside for the purpose of protecting the nations timber supply and to, “provide a continuous supply of timber” (16 U.S.C. 471 et seq.).

What the Organic Act and subsequent forest policy implied was a social-ecological relationship based on *stability*. From a forest management perspective, stability found form in silviculture management practices. Silviculture was a management practice imported from Europe and adapted for American forests. A key component of the practice was the belief that the Old Growth forests that dominated western landscapes were beyond their prime age of production (Langston 1995). Production was equivalent to health and thus the prescription was to heavily

manage the forests to improve health. What this meant was the conversion of old growth forests into even aged stands that could be managed so timber was harvested on a sustained yield basis in which no more timber is taken from the forest each year than the forest could regenerate (Dana 1918). For example, if a stand was on a 60 year rotation and a 1,000 acres a year was to be harvested, what would be needed to manage the forest on a sustained yield basis is a 60,000 acre forest. In theory this strategy ensured the perpetual existence of healthy forests for consumption.

From a social perspective this meant timber supplies would be consistent and guaranteed to provide for the surrounding community. Through silviculture, professional foresters could manage a forest “indefinitely and a permanent forest community established for the utilization of the annual cut” (Dana 1918, 36). Thus a state of stability was established that would establish healthy forests and healthy communities through continuous supplies of timber.

The concept of stable communities was not explicitly enshrined in public policy until 1937 when Congress passed the Oregon and California Revested Lands Sustained Yield Management Act. The bill required the Bureau of Land Management to manage their western lands to “provide a permanent timber supply . . . and [for] contributing to the economic stability of local communities and industries” (43 U.S.C 1181a). This was followed in 1944 when Congress passed The Sustained Yield Act (Beckley et al. 2002). Congress expressed the purpose of the act was to “promote the stability of forest industries, of employment, [and] of communities . . . through continuous supplies of timber” (16 U.S.C. 583). Though the Sustained Yield Act of 1944 was never fully implemented, it did lay the policy foundation for the management of the relationship between forests and their dependent communities. A relationship that was again echoed in the National Forest Management Act of 1976, which again directed the Secretary of

Agriculture to consider community health in managing federal forests (Kelly and Bliss 2009).

The perceived contract between the government and local communities to provide for sustained harvest levels led to unprecedented levels of timber harvests in the second half of the 20th century (Sturtevant and Donoghue 2008).

Private land in Oregon had also been regulated along a similar regulatory path. In 1941, the State passed the Forest Conservation Act that required reforestation of harvested lands and allowed the State to assess fees to cover reforestation costs if private owners did not replant. Responding to pressure that built on federal lands, during the 1960's the State passed the Oregon Forest Practices Act (OFPA) in 1971. This comprehensive act set guidelines for forest management practices and gave the State the authority to shut down an operation in progress if it was violating the act's requirements. The OFPA has been amended several times since its original passage.

Unraveling of the Stability Paradigm

While timber harvests continued to increase after World War II and rural communities grew to meet harvest needs, as early as the 1950's the flawed assumptions of the stability paradigm began to become publicly apparent. In the 1950's, increased mechanization, over-harvests, and company consolidation began to cause a decrease in industry employment (Robbins 2004). In the area of Bend, Oregon, two companies, Shevlin-Hixon and Brooks-Scanlon, dominated the logging industry. Since 1916 the wealth of Ponderosa Pine in central Oregon had sustained both companies operations but in 1950 Shevlin-Hixon was sold to Brooks-Scanlon, eliminating 850 jobs from the community. Blaming an overactive timber market, the companies acknowledged that a depletion of Shevlin-Hixon's timber supply had precipitated the sale (Robbins 2004).

These early signs of problems with the stability paradigm were covered through increased harvests on federal land up until the 1980's (Robbins 2004) when policies could no longer manage the unanticipated consequences of mechanization, consolidation, globalization, ecosystem degradation, and shifting social values (Beckley et al. 2002; Kelly and Bliss 2009; Donoghue and Sturtevant 2008).

The notion of community stability was based on several flawed presumptions revolving around the believed static nature of forests and communities (Beckley 1995; Beckley et al. 2002; Kelly and Bliss 2009). First, was the conviction that professional foresters can manage forests to be static and predictable, guaranteeing flows of timber from the land to the mills. Second, that stable flows of timber would translate into stable levels of employment in the surrounding community (Beckley et al. 2002). And third, stable employment in the forest sector could provide for the well-being, and thus stability, of the community (Beckley et al. 2002; Donoghue and Sturtevant 2007).

When Congress passed the Multiple-Use Sustained-Yield Act (1960) they broadened the definition of sustained yield to include all renewable resources and not just timber harvests, broadening the class of stakeholders involved in federal forest management. In response the public began to utilize two federal policies, The National Environmental Policy Act of 1969 and the Endangered Species Act of 1974, to challenge government land management strategies (Kelly and Bliss 2007; Sturtevant and Donoghue 2008). By the 1980's most of the important decisions made by the USFS were being litigated (Sturtevant and Donoghue 2008). Kelly and Bliss (2007, p. 524) argue "the paradigm of a stable community dependent on a well-managed forest adhering to sustained yield principles was interrupted by unanticipated social and

ecological changes that called into question the resilience of both the timber-dependent communities and the forests themselves.”

Release

The timber industry in the Pacific Northwest witnessed gradual declines throughout the 1980's as industry migrated to the southeastern United States and increasing exports from Canada competed with Pacific Northwest timber (Machlis and Force 1988). Market forces, technology shifts, and increased regulation were creating a difficult situation for the timber industry. The situation came to a head in 1991 when a lawsuit was filed in Federal court to protect the old-growth habitat of the northern spotted owl (*Strix occidentalis caurina*). The legal battles set by the spotted owl case led to reduction in harvests from federal lands. Between 1987 and 2000 timber harvests in the USFS Region 6, encapsulating Oregon and Washington, were reduced from 6 billion board feet to .5 billion board feet (Sturtevant and Donoghue 2008). Forest related employment dropped from 135,000 to 105,000, a trend that had begun prior to the listing of the spotted owl due to industry restructuring and mechanization (Warren 1998).

Reorganization: Ecosystem Management and Resilience

The collapse of stability era management policies led to the creation of the Northwest Forest Plan (1994). The Northwest Forest Plan was intended to shift forest management away from commodity based production that had dominated much of the conservation era toward ecosystem management that meets the dual purposes of providing for “the need for forest habitat and the need for forest products” (Regional Ecosystem Office). In their 1997 plan review, Forest Service Regional Foresters acknowledged that ecosystem management may appear similar to natural

resource management of the past but in fact the concept was much more comprehensive, accounting for the dynamic interaction of watersheds, people, and communities (USDA Forest Service 1997). Embedded in this concept of ecosystem management is the notion of resilience and the need to manage systems for adaptability in the face of change.

From an ecological perspective, management's focus shifted away from individual species to managing for biological diversity and the complexity of systems on multiple spatial scales and across ownership boundaries (Sturtevant and Donoghue 2008). In part this is achieved through adaptive management practices that emphasize an iterative learning process and the inclusion of decentralized processes that engage local knowledge. Discussing ecosystem management, Sturtevant and Donoghue (2008, p. 14) comment, "Despite broad interest in these new approaches, agencies and interest groups are unclear about the implications for forest management, forest communities, and increasing consumer demand for timber."

Rural Restructuring

Socially, the shift from a management regime that focused on natural resource extraction has altered economic opportunities provided by the landscape. The result has left many of these communities subject to "the triad of economic, demographic, and environmental forces combining to reshape the western landscape" in a process of rural restructuring (Nelson 2001, p. 395). Literature on rural restructuring was born out of early studies investigating transformation in boomtown communities experiencing a renaissance during energy related development (Freudenberg 1982). Much of the literature focuses on the transition experienced by resource based economies that have transferred to activities in a resource constrained or "post-productivist" environment (Holmes 2002, 2006; McCarthy 2005; Wilson 2001, 2006). It has

been expanded to understand forces that are both drivers and outcomes of rural restructuring such as amenity migration (Gosnell and Abrams 2009) and exurbanization (Nelson and Dueker 1990). Egan and Luloff (2000) examined the trend of exurbanization in relation to America's forests and found that the process can have a significant impact on local forest based economies, community social structure, and attitudes about forest management. Rural restructuring literature has demonstrated that communities experience the process of rural restructuring in a variety of ways (Nelson 2001).

In isolated instances, researchers, local governments or non-governmental organizations have initiated adaptive management processes that fully incorporate the dual goals of fostering ecological and social resilience. In the Northern Highlands Lake District (NHLD) in Wisconsin, for example the social-ecological system has witnessed tremendous population growth since 1990. The rapid transition led to increased deforestation, removal of key riparian habitat, reduction in fish and wildlife, an increase in invasive species, and pollution of the lakes.

Researchers from the University of Wisconsin engaged members of the NHLD community in a scenario mapping process to identify different futures that might be available to the community. Researchers engaged members of local and state natural resource agencies, members of area lake associations, local realtors, tribal representatives, and part and full-time residents. The process identified areas of low resilience in the NHLD system as well as areas where the system was resilient. In addition, the process engaged community members and built networks amongst the different groups that have enhanced the NHLD's adaptive capacity (Walker and Salt 2006).

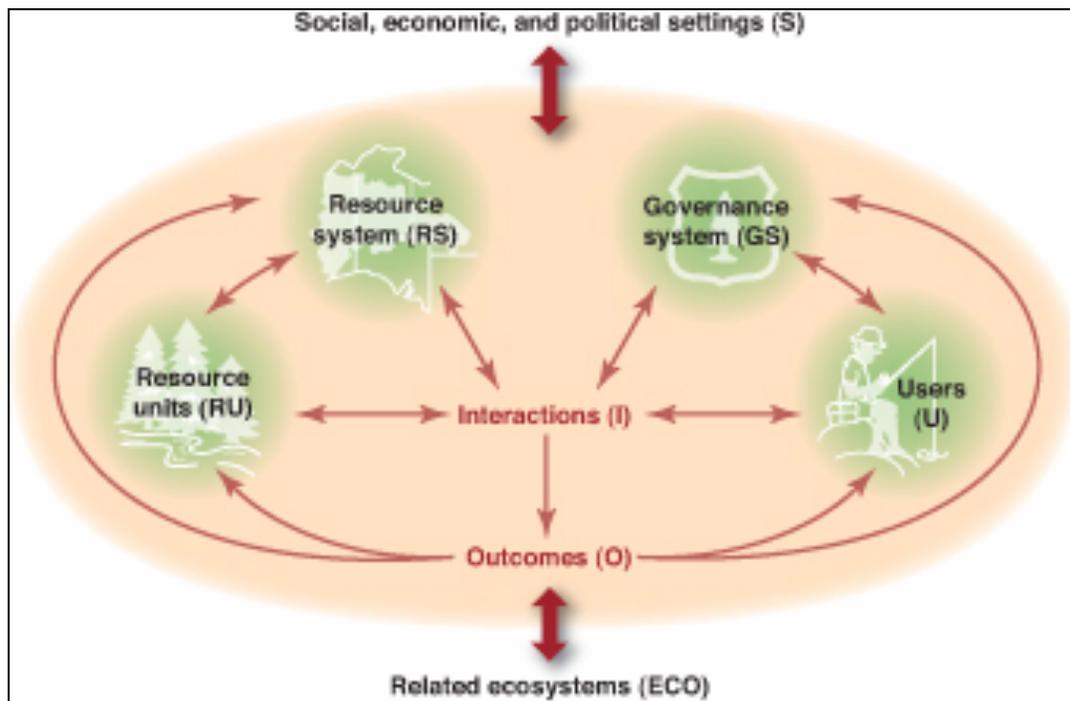
Another example of a community working to enhance their own resilience is in Wallowa County in northeast Oregon. When sales of timber on federal land (accounting for nearly 58 percent of

county lands) came to a halt in 1994, the local economy was impacted severely as all three local mills were closed, affecting more than 20% of the workforce (Christofferson 2005). Community members united to form Wallowa Resources, a nonprofit organization that focuses on developing collaborative efforts that promote natural resource management and local economic opportunity (Kelly and Bliss 2009). Sturtevant and Donoghue (2008, p. 4) explain, “Wallow Resources continues to work with county government, private landowners, public managers, and environmental groups to fill the gaps left by departing industry, diminished public agencies, and divided communities.”

FRAMEWORK OF ANALYSIS

In effort to move forward the analysis of social-ecological systems, Elinor Ostrom (2009) has proposed a multi-level nested framework for analyzing social-ecological systems. Ostrom's framework is composed of four subsystems: resource system, resource unit, governance system, and users (Figure 5). Each of these subsystems is nested within other social, economic, political, and ecological systems and is composed of a variety of variables found in the literature to affect resilience. The interactions that occur between the relevant subsystems produce outcomes that in turn shape the sustainability of the social-ecological system in question and reshape the subsystems and their subsequent interactions.

Figure 5: Core Subsystems in a Framework for Analyzing Social-Ecological Systems



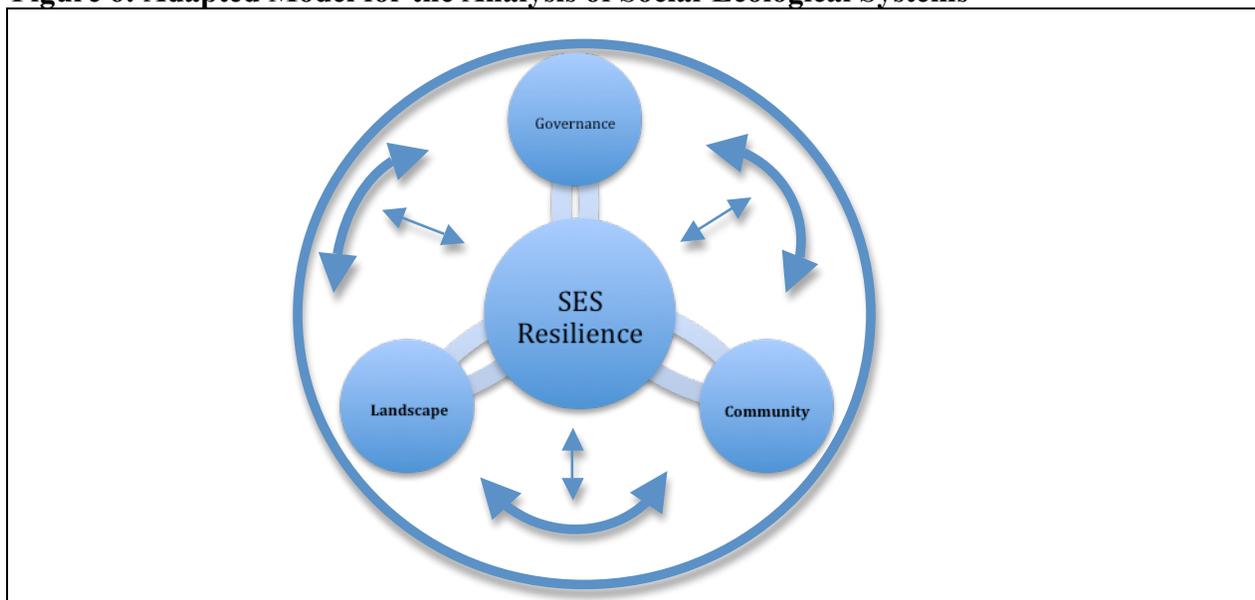
Source: Ostrom (2009).

As Ostrom (2009, p. 419) contends the subsystems of complex social-ecological systems “are relatively separable but interact to produce outcomes at the SES level, which in turn feed back to affect these subsystems.” By isolating each subsystem and their key variables researchers and policymakers are better able to assess and improve management by targeting efforts at key variables and interactions.

Adapted Framework of Analysis

Ostrom’s framework served as a general model for the analysis of the MRV social-ecological system but was adapted to more appropriately account for the way residents of the MRV discussed local change and how the process of change has occurred in the MRV. The model depicted in figure 6 illustrates the framework used to analyze the social-ecological system present in the MRV.

Figure 6: Adapted Model for the Analysis of Social-Ecological Systems



This model maintains Ostrom’s core subsystems but combines the elements of the two resource systems and elevates the role of the community present in the system. This more appropriately

allows for the discussion of community changes in contexts not directly tied to its role in resource management.

Governance systems are discussed in terms of the institutional structures that affect and manage both the resource system and the social system. This includes government institutions, non-governmental organizations, industry structure, and market influences. The ultimate outcome for this assessment becomes the relative resilience of the social-ecological system and the value of LEK in determining resilience. By utilizing variables found in the literature for each appropriate subsystem, the resilience of a particular social-ecological system was assessed.

It is important to note that due to the multi-directional interaction *system interactions* and *outcomes* have with the core subsystems, these forces are often difficult to distinguish from their subsystem. In cases in which the interaction or outcome is distinguishable it will be discussed separately, otherwise it will be noted in the discussion of its appropriate subsystem.

After a description of the methods used in this study, the social, political, and economic setting the MRV is nested within will be reviewed. Following that review this study's results will be provided by utilizing the framework and variables described above to examine the social, ecological, and governance structure as perceived by long-time residents of the MRV. Finally, the results will be discussed to assess the system's outcomes (i.e. its relative resilience).

APPROACH AND METHODS

This study utilized a flexible design approach that relied primarily on qualitative data gathered through interviews with long-time residents of the McKenzie River Valley. Data gathered through interviews was supplemented by a thorough review of the literature on key thematic topics, quantitative data received from the US Census Bureau and Oregon Department of Education, and key studies conducted by past researchers in the MRV. Below is a detailed discussion of the methodology used to gather and analyze pertinent qualitative data.

Local Ecological Knowledge

An increasingly valid tool in the management of resource systems is the use of Local Ecological Knowledge (LEK) (*Gadgil, et al. 2003*). It has been documented how local communities that live, work, and interact with a resource system maintain knowledge of resource system dynamics (*Berkes et al. 2000*). Gradually resource management policies have sought greater inclusion of local knowledge (Oregon Forest Resources Institute). Some concern has been expressed about the potential for overreliance on LEK to arrive at conclusions that are not based on a consistent methodology and may be too subjective in nature (*Davis and Ruddle 2010*).

Gilchrist et al. (2005) use four case studies of migratory birds to assess the value of local ecological knowledge. Their results indicate that LEK proved to be a useful source of information but should be used in concert with other sources of information when making management decisions. Others support the contention that LEK can be a valuable tool when assessing systems and can be seen as a form of knowledge that can both complement and challenge quantitative scientific approaches to research (*Gadgil, et al. 2000*; *Yli-Pelkonen and*

Kohl 2005). Olsson and Folke's (2000) study of a rural Swedish fishing community revealed that local users have substantial knowledge of resource and ecosystem dynamics. The cumulative effect of LEK can transcend traditional western resource management practices that have been structured from the top down and are not oriented toward local feedbacks. This paper catalogs LEK in the McKenzie River Valley. The terms local ecological knowledge and long-term ecological knowledge are used interchangeably.

Methods

Defining the Sample Population

The purpose of this study was to catalog traditional ecological knowledge of long-time residents in the McKenzie River Valley (MRV). In order to gather such information the study set out to interview individuals who had a significant history living or working in the MRV and who have knowledge of landscape conditions and how those conditions may have changed over time. It was envisioned that participants could include but not be limited to, timber industry employees, USFS employees, local landowners and land managers, and long-time residents of the community. Participants were not selected based on inclusion in any demographic, social, or economic group. The desire to acquire long-term ecological knowledge led to a focus on residents who had been of working age at the time the spotted owl was listed on the endangered species list in 1991, a seminal policy that transformed forest management practices in the MRV.

Recruiting Participants

Study participants were chosen using a non-probability purposive sampling technique known as snowball sampling. Non-probability sampling is an acceptable survey technique when there is no

need or intention to make generalizations outside the survey population (Robson 2002).

Purposive sampling is a technique that allows researchers to build a survey population that is suited for the purposes of their study. The aims and objectives of this study sought to assess knowledge of a specific population with the MRV and did not intend to generalize results beyond the community of interest. Thus, the use of a non-probability purposive technique was deemed acceptable and used to recruit study participants.

Snowball sampling is a particular form of non-probability sampling in which research participants are asked to aid researchers in identifying other potential study participants.

Snowball sampling is arguably the most widely used survey technique in qualitative social science research (Noy 2008). It is most commonly used to access so called hidden populations or those that are difficult to access through more general means (Faugier and Sargent 1997; Robson 2002; Browne 2005). To employ the technique researchers identify one or more key informants, or points of entry, from the population to interview or provide names of individuals in the population who meet study criteria. After these individuals are interviewed they are asked for names of others to interview and the process continues until saturation is reached (Robson 2002).

In this study three points of entry were used to gain access to potential study participants. Points of entry included a life long resident of the valley known by the researcher, USFS staff, and staff at the AND. Each individual provided a list of names of potential interviewees who were then contacted to discuss possible inclusion in the study. Individuals who agreed to participate were then scheduled for interviews, interviewed, and asked to provide a list of other individuals who may be of value or interested participating in the survey. In one instance the snowball technique led the researcher to the McKenzie Forest Service station. When the individual to be interviewed

had to leave early other staff volunteered to take the individual's place and be interviewed. In essence, this created a fourth point of entry given the random selection of individuals at the ranger station.

Despite the multiple points of entry it was quite common for potential interviewees to be recommended by multiple individuals as possible study participants. Interviewees included teachers, fire department personnel, current and former loggers and timber industry employees, current and former log truck drivers, river guides, private forest owners, community activists and observers, retired community members, and current and former USFS employees.

Generally in flexible design research it is difficult to predetermine the number of interviews necessary to meet the demands of the research. Robson (2002, p. 199) states that the "basic notion is that you keep going until you reach saturation. This is when further data collection appears to add little or nothing to what you have already learned." Morse (2000) recommends that determining the number of interviews needed to reach saturation is dependent on several factors including the scope of the study, nature of the topic, quality of the data, study design, and the research method. Based on the study characteristics described herein initial estimates aimed to interview 15-25 individuals. Saturation was reached early on in this process but interviews continued due to the rich detail provided by each study participant. In sum 21 individuals participated in interviews.

Interview Format

Interviews are a common format for gathering data in social research. They provide an opportunity to gain data that is distinguishable in its depth and richness (Robson 2002). The lack

of standardization in relation to more quantitative methods can raise concerns regarding reliability and bias. These are issues that can be addressed through the professionalism of the researcher (Robson 2002). This study utilized a semi-structured interview format. Semi-structured interviews have a list of pre-determined questions to be asked but allow for additional questions to be added or dropped if appropriate for the particular interviewee.

King (1994) recommends the use of qualitative research interviews in several situations: when the research is concerned with individual perceptions of a given phenomenon; where individual historical accounts are required to determine how a phenomenon developed; and where qualitative assessment has been carried out and quantitative data is needed to validate particular measures or clarify meanings. All three of these circumstances existed in this research context and supported the need to conduct qualitative interviews.

All interviews were conducted at interviewee's homes or place of business. The interview would begin with the researcher reviewing the informed consent form with the participant and securing signatures from the participant indicating their willingness to participate in the study and their willingness to have the interview recorded using an audio recorder (see Appendix A). After signatures were attained the researcher would begin asking the interviewee the pre-determined questions described below.

Questions would begin with the researcher displaying a series of three maps completed in phase one of the MALS project representing land cover in the MRV prior to 1938, in 1992, and in 2001 (see Appendix B). Interviewees were asked to comment on the relative accuracy of the maps as they began to provide a response to the first question asked below. When further probing was needed to attain an answer to one of the core questions asked, the researcher would ask

additional questions or describe in more detail the question being asked. Questions were generally asked in the same order, though as is noted below it was not uncommon for the order of questions to be rearranged to account for the manner in which the interviewee responded. Once formal questions were finished interviewees were asked if they had anything further to say. If not the interview concluded. Interviews ranged from forty-five minutes to three and a half hours.

Interview Questions

Interviews were initially structured around five main questions that sought to assess change in the MRV. A sixth question was added after the first interview based on the degree to which landscape change was described as occurring in conjunction with community change in the MRV.

The first main question asked interviewees, “How long have you lived in the Basin?” This question was intended to gather information on the individuals length of time living in the community and thus to assess their ability to speak to change over a significant period of time. Often, but not always, individuals began by taking their description back to the first family member to live in the community. They would then continue by discussing their parents’ background and employment, often noting their parents had been employed in the same industry in which they are or were employed.

The second question asked was, “In what ways have you been involved in the natural landscape (i.e. do you manage natural resources or work in the logging industry)?” This question too was an effort to establish credibility and understanding of where an individual’s knowledge of the

landscape came from and what their relationship to the landscape is based on. It both provided insight into an individual's employment and landscape values.

The third question began to assess what an individual perceived to be changes in the local landscape. Interviewees were asked, "What type of landscape changes have you witnessed while living in the basin?" As will be described later, responses here were laced with discussions of changes that have occurred in the community and timber industry, as well as the landscape.

The fourth question sought to assess what happens to local knowledge that is acquired in the basin by asking, "How do you document and share your knowledge of land cover change?" Responses were often very short.

Fifth, interviewees were asked, "How does that knowledge shape how land is worked or used?" Here the goal was to understand the implications local knowledge had on landscape management. Again, responses were often short and not overly involved.

A sixth question was added after the first interview that sought to explicitly ask interviewees about the changes witnessed in the community. Interviewees were asked, "What kind of changes have you witnessed in the community as the landscape has changed?" The question was added in response to the amount of community change discussed by the first interviewee, who highlighted the degree landscape and community change are coupled in the MRV.

Recording Methods

Interviews were documented using two methods. The primary method for documenting interviews was with an Olympus DS 40 digital voice recorder. Interviewees were asked

permission and to sign a waiver allowing the use of the voice recorder. The recorder generally sat in between the interviewer and interviewee for best audio reception. The second method for documentation was through a journal kept by the researcher to record information provided before or after the recording equipment was set up and to note any general details that helped provide context for the interview.

Transcription Methods

Immediately following the interview recordings were uploaded onto a laptop computer. Once all interviews were completed, the researcher transcribed each interview using Olympus DS 40 software, which allowed audio recordings to be slowed down during playback to allow for more accurate recording. Each interviewee was given a unique identifier to protect their identity during the course of transcription and subsequent use. Over 21 hours of audio recording was transcribed for analysis.

Analyzing and Coding the Transcript

Once transcripts were completed the task was to code transcripts into discrete chunks of data that represented the different themes and concepts discussed by interviewees. Interviews resulted in nearly 160 pages of single-spaced transcripts. To begin the analysis interviews were broken down into data units based on unique identifiers prescribed to each interview and transcripts were numbered by line. Based on the framework for analysis of social-ecological systems identified in the this papers literature review five primary level codes were developed to identify thematic comments about the landscape, social community, governance system, adaptive elements, and system interactions (see Table 3). General descriptions of each code were

developed to begin the creation of a codebook to aid in the coding process (attached as Appendix C). With initial codes developed and a codebook initiated, transcripts were coded at the primary level.

Once responses had been assigned one of four primary levels of code, the transcript was analyzed three more times to create secondary, tertiary, and in some instances quartile codes to characterize themes in the data. The resulting analysis resulted in 18 secondary level codes, 31 tertiary codes, and five quartile codes.

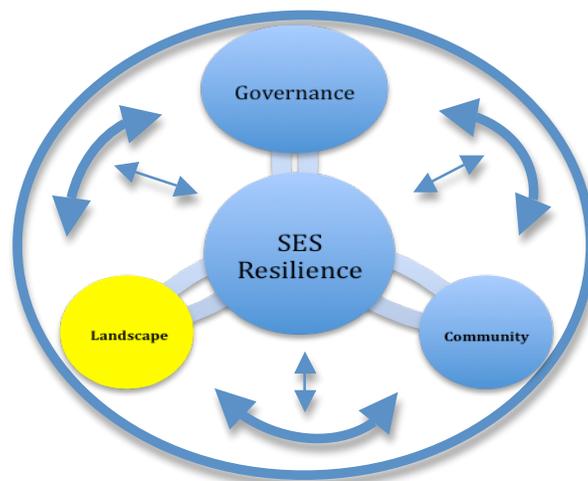
Table 3: Primary Level Codes

Primary	Description
Landscape	Comments dealing with changes in landscape conditions, including forest density, vegetative land cover, riparian conditions, wildlife, threats and human development.
Community	Comments that deal with changes in community demographics, changes in community values, changes community social institutions.
Governance	Comments addressing system management institutions including governance structures, market forces, and governance capacity.
Interactions	Comments that deal with interactions between the landscape and local community including land management practices and beliefs, user conflict, and employment.

RESULTS

This section will describe the analysis of interviews with long-time residents of the MRV. The unit of analysis is the individual comment made by interview participants. Results will be discussed based on primary level codes structured around the theoretical model described in above and pictured below. Primary sections include: knowledge of the ecological system, knowledge of the human community, governance structure affecting the system, and system interactions. Each primary code is broken down into its subsequent secondary codes, and in some instances tertiary and quartile codes. Each interviewee is given a label to protect their identity. No label is used for more than one individual.

Knowledge of the Ecological System



Knowledge of the ecological system in the MRV consisted of comments regarding landscape conditions. In general, the MRV is described as a working landscape, one that has undergone a series of transformations throughout the course of most interviewees lives, and which continues to be shaped by the human growth and landscape management decisions (i.e. system interactions). When asked about changes witnessed in the landscape, interviewees discussed six categories of change that have been observed in the McKenzie River Valley: timber density, age

and species diversity of the timber, fluctuations in wildlife populations, riparian conditions, timber and resource related infrastructure development, residential development, and threats to the landscape. Specific categories were noted with varying frequency and levels of depth but emerged as common observation by interviewees.

Before discussing interviewees' perceptions of landscape conditions, it is important to reemphasize the diversity in land ownership in the McKenzie River Valley. Much of the upper portion of the valley is Federal forest; as you move into the middle and lower portion of the valley, State, BLM, and federal ownership begins to merge more heavily with private land. While there are small family parcels of land, much of the private land is owned by large timber companies, primarily Weyerhaeuser, Rosboro, Giustina Brothers, and Senecca. Local residents were very conscious of who owned what land, and were often quite clear in delineating landscape conditions based on the ownership characteristics of that land.

Density

Comments about timber density refer both to the overall quantity of timber in the MRV and how tightly or loosely the timber is distributed across the landscape. For most individuals, changes in timber density are the most dramatic and persistent change that is observed. Discussions often began with a historical account of the landscape that highlighted the bountiful nature of the area in the early settlement period. The important distinction several individuals made regarding this early landscape was the general belief that the valley held less timber than it currently does, particularly in areas prone to fire disturbances caused by natural forces or Native American induced burns.

Individuals focused on the evolution of the valley over the course of the second half of the twentieth century to the present. They describe how prior to major declines in timber harvests in the late 1980's and early 90's, the landscape that had been dominated by large old growth forests, early successional growth, and open meadows for the first half of the twentieth century was seen as a speckled mosaic. Land throughout the valley, both public and private, had been heavily logged beginning after World War II leaving clear-cuts of varying sizes interspersed with forests. Individuals could drive up to local points like Wolfe Rock or Castle Rock and be able to see out across the landscape due to the large number of clear cuts that were common on both public and private land.

As timber harvests began to decline in the late 1980's and were essentially halted on federal land in 1991 when court order placed an injunction on harvests on federal land to protect the northern spotted owl, the landscape began to change. As was required by law, forested areas that had been clear-cut were replanted for future harvesting. When logging was halted on federal lands all the timber that had been replanted for future harvest was left to grow, resulting in a landscape beginning to fill back in with forest. One long-time resident of the MRV and local timber cruiser described the current situation, "You just don't see clear-cuts on federal land. You used to drive up on a mountaintop and you could see. Now you drive up and it's hard to see anymore. So that's one of the bigger changes."

Almost every individual emphasized this same point that there is more timber growing now than they have ever seen before and that much of it is very tightly packed.

A lot of those old clear cuts are 40 years old and are in pretty bad shape, heavy density, and need thinning badly (Environmental activist)

Believe it or not right now we have more trees as we've ever had (Gippo logger).

When I fly over in an airplane it's greener than it was in 92 on any of the federal land because all of the old clear cuts are filled in and greened up, virtually no new clear cuts (Logger).

One side effect of increased timber on federal land is a loss of open prairies or meadows. As described by this resident, "there's a huge difference on that prairie land from when I was a kid. Those big open meadows are declining like crazy. The trees come in from outside, the seedlings start populating and pretty soon the whole prairie is gone" (Ex-logger).

Perceived changes on federal land are in many ways contrasted with changes that occurred on private land. Private land in the MRV had long been logged, but much of the private timber companies' focus prior to 1991 had been on purchasing timber sales on public land. When logging on Federal land stopped in 1991, the "impact was switched over to the state and private lands" (Former old growth timber faller).

From 1992 to 2001 there wasn't much logging on the upper part. Down here in this part it's all private and BLM so that would explain why this [federal land] would fill out more because when they stopped logging forest service land, you know the

demand for trees didn't stop so they just started logging the private land, which is down here lower (Ex-logger).

Interviewees continued to emphasize the contrast between the federal lands where forests have become thick and often crowded and private lands that continue to be harvested, often clear cut, and replanted, or as some described it, "managed." One interviewee carefully described the different parcels of land surrounding his home, who owned the land, and when it had been logged. To the south and east the land was divided among different private timber companies and in some cases transferred ownership during the period the interviewee had lived at the home. In contrast, the property behind this individual was Forest Service land that had not been logged since spotted owls had been found in the vicinity.

The glaring thing is Roseboro, across the highway, their massive clear cut there, and half of that, that's not the first time it's been cut in forty years. Extremely short rotation. Had a lot of change when they logged to the west of us, was Cone Lumber Company when we bought and they did some butchering in there, then I don't remember who had it in between that really stripped it down, oh it was Willamette Industry that stripped it down . . . Behind this [on forest service land] we haven't got a lot of change (environmental activist).

Others pointed to specific areas of the valley where forests continue to be harvested:

A lot of this ownership is Weyerhaeuser . . . They have went in and logged a lot of that (Timber land owner).

Quite a bit of that property we went in and thinned for Roseboro and it has been completely clear-cut . . . Drive by my driveway where I used to live and they cut the whole hillside (Gippo logger).

I have a son that owns a plane and we've flown over this area around here. There's lots of trees out there, lots of them. You can see green all over except down here where Rosboro is. That's been lots of clear cuts. That's a big area, they own a lot. They've cut a lot down within the last five years . . . you can look at the sides of the hills here (community member).

Diversity

Comments about diversity referred to both the age of the forest (old growth vs. second growth) and the different species of timber present in the MRV. Most interviewees discussed the transition in diversity present within the MRV. Comments generally indicate that the area had been home to a more diverse landscape than present, both in terms of age of the forest and the diversity of species present.

Old Growth

Most accounts paint a picture of a landscape stretching back as far as the 1940's and 1950's and as recently as the 1980's that contained mixed age forests with large amounts of old growth with smaller diameter trees that had either been vulnerable to forest fire or had previously been harvested. Gradually as logging in the valley persisted the amount of old growth timber began to diminish.

We logged Foley Ridge, We logged up Blue River, We logged over at Oakridge. Had some big timber, big old growth timber but most of that stuff is now gone, or they tried to tie it up (landowner).

They pretty much cut off all the old growth (Truck driver).

While there was a rough consensus that most of the old growth is gone, not all individuals were in agreement. One former logger was very assertive that there is still plenty of old growth left:

If you go up and look there is a heck of a lot of old growth up there. It's all over. You get above the private land here; I mean look across there, that's Weyerhaeuser there, BLM land, a lot of that hasn't been cut. There's an awful lot of trees to cut out there. I didn't get near all of them (Ex-logger).

Part of the discrepancy could be a result in disagreement over what is "old growth." Several respondents discussed the lack of clarity regarding what is an old growth tree. As one interviewee expressed, "old growth" could be considered anything from an 80-year-old tree to the more iconic trees that are hundreds of years old.

Species

Local residents have also witnessed a change in the diversity of species present in the MRV.

While the valley is primarily home to large Douglas fir forests, the landscape is also interspersed with Western Hemlock, Western Red Cedar, and small amounts of Noble Fir, Alder, Spruce, and Maple. As the landscape began to be more heavily managed for commodity production, the composition of the forests began to change. As one former old growth timber faller recalled, the

area “Was converted from an old growth, primarily Douglas Fir overstory with some Western Hemlock, and Western Red Cedar as the sub species of the understory. Some dogwood, Maple, Alder, those sort of species on the understory. Now it’s primarily in Douglas Fir.” The subspecies mentioned above are still present but are often not perceived as prevalent as they once may have been.

As will be discussed on management practices, Douglas fir has been the most valuable commodity species present in the valley. When forested areas containing naturally diverse stands were logged, the area would be replanted with Douglas fir seedlings. The effect was to reduce the amount of natural species diversity with more homogenous managed Douglas fir forests.

Wildlife

As individuals living in the basin discussed the effects of changes in the landscape, a common issue mentioned was the change in animal populations, particularly Roosevelt Elk populations. Several long-time residents could recall how in the 1940’s and 1950’s there were not any elk down in the valley. To find elk people had to venture to the high Cascades.

When I was a kid I used to elk hunt and you had to go clear up in the wilderness to find elk. They planted elk here in the 50’s, up in the wilderness area. The elk were all on the other side [east] of South Fork and came into those units like crazy. They all of a sudden thrived. From there they moved in and hit Weyerhaeuser land (Ex-logger).

As logging increased on lands outside the wilderness and, increasingly in lower portions of the valley on private land, elk herds migrated down to access feed provided in large clear cuts. One long-time resident echoed the common theme that the best hunting was now on private ground

where there were clear cuts for the animals to feed. “In fact, your best hunting now is on private Rosboro land where they still have the nice big clear cuts” (Retired USFS employee).

Riparian Conditions

As mentioned, the MRV is laced with creeks and streams that feed into the McKenzie River, a waterway that stretches through the valley and supplies the Eugene-Springfield area, as well as other portions of the Willamette Valley, with drinking water. One long-time resident mentioned when he first moved to the area and crossed Blue River, the waterway lived up to its name and was one of the bluest rivers he had seen. While several residents mentioned different floods that have altered the river’s banks since the early 1940s, most comments related one of two things: 1) short periodic changes in water quality, and 2) changes in fishing.

Changes in water quality were often noted as side effects of logging operations and affect both the amount of material in the water and water temperatures. When a site was logged, a couple of things could happen that would impact nearby streams. First, more sediment could be washed off the logging site and into the stream. As one river guide claims:

One of the things I’ve been aware of is whenever the river gets high, is to see what creeks get muddy. This year the muddiest creek on the river is Quartz creek, and that’s where Rosboro logs. They’ve been active up there (River guide).

Second, as timber is cut close to streams, the water is more exposed to heat from the sun. In the early 1990’s, in anticipation of regulations limiting how close to a stream could be logged, some timber companies and landowners rushed to beat the regulation and logged right down to the edge of the stream. One former logger described how Rosboro went out and cut every streambed

on their property. One private timber company that owned land above this same individual's home also cut out all the timber along the stream that ends up winding down through his property. When asked if he saw the effects of that cutting on the stream he replied that:

It's not a fish-bearing stream. There's not that much effect 'cause it's very small. On the larger streams like Quartz creek definitely. Much warmer temperatures because it was shaded the entire length. Now the entire length was cut so that shading just disappeared (Ex-logger)

The second manner in which changes to the riparian system were noted was in regards to changes in fishing. Most individuals, when discussing changes in fishing, agreed that the number of fish have declined over the years. Several reasons were given for the decline. A couple of individuals attributed the change to changes in stream conditions caused by logging operations. One resident truck driver recalls how he used to be able to walk down Gate Creek and catch his limit of fish in just a mile of fishing. Now he says "You're lucky to catch a fish in Gate Creek. I think a lot of that, as far as the timber and logging of the creek beds, really hurt it" (truck driver). A river guide suggested that the increased sediment in the waterway from logging operations and when they release the plug on the dams might have hurt the bug hatches, which the fish feed on. One local landowner cited the impact DDT spraying to combat a spruce bug infestation during World War II had on the fish population:

They sprayed the whole country with DDT. It killed off most of the spruce budworms but it also killed off most of our fish and the Herons and the Osprey and anything else that lives on the fish. Then after the war the fishing was pretty

tough so they started stocking the river and building it back. It's back in pretty good shape, not as good as it was twenty years ago (Local landowner).

Others cited declines in fish numbers as caused by too many fishing seasons and an increase in sea lions that prey on salmon coming back to spawn.

Development

In additions to shifts in timber density, species composition, and wildlife and riparian conditions, interviewees talked about landscape transformation in terms of the human development of the landscape. Development came in two forms: 1) logging or landscape management infrastructure, and 2) human settlement.

Infrastructure

Several of those interviewed have lived in the MRV since the 1930's and 1940's and discussed witnessing incredible transformation. One landowner and former logger recalls how when he arrived in 1940 the area had yet to be logged heavily. As a result there were few roads in the area "Except for a jeep trail up the South Fork and Clear Lake road." For some who arrived not long after, the paved roads where they now live were only gravel roads.

As logging increased, the Forest Service (USFS) became much more active in building roads across the landscape to access logging sites. A private landowner and guide noted how "The biggest changes have come through areas being logged and roaded. They kinda go together."

One retired Forest Service employee recalls how during the 30 years he was there from the mid 1960's to the early 90's, they built probably two-thirds of the road system through forest service

land. In the McKenzie District he estimates they had almost 2,000 miles of road by the time he retired.

Residents describe that this system of roads has undergone a relatively recent transition. As logging declined and there's been a general increase in the perceived need to limit access to protect lands from fire danger and destruction, much of the road system has begun to decline. There's "more inaccessible areas . . . It was more accessible ten, fifteen, twenty years ago to the public. There were more road systems. Those have started to decline and are being locked up, especially on national forest lands" (Former old growth timber faller).

Figure 7: Cougar Reservoir



The MRV was also transformed by the installation of two major dams in the area; Cougar dam on the South Fork of the McKenzie River and Blue River dam. The dams, both installed in the 1960's, altered the surrounding landscape. As a retired log truck driver described:

That drainage where Cougar reservoir is was huge timber in there. That valley had logs eight feet in diameter. The road wound right through the bottom of the canyon right alongside (Retired log truck driver).

Settlement

The second type of development mentioned when discussing landscape changes was development caused by the human settlement of the MRV. Development came in two phases.

The first came to accommodate families that had moved to the area to either log or work on the dams that were built, with “a lot of homes being built from the 1950’s to the 1970’s” (former old growth timber faller). In recent years residents have seen an increase in development, as the community has become a popular retirement and vacation destination and competed with urban expansion in the lower portions of the basin.

You don’t see the stars as much anymore out here. We can see the Springfield glow of lights out here now. You couldn’t see that 25-30 years ago. As the city limits have encroached to the east it is changing our landscape (Timber land owner).

Threats

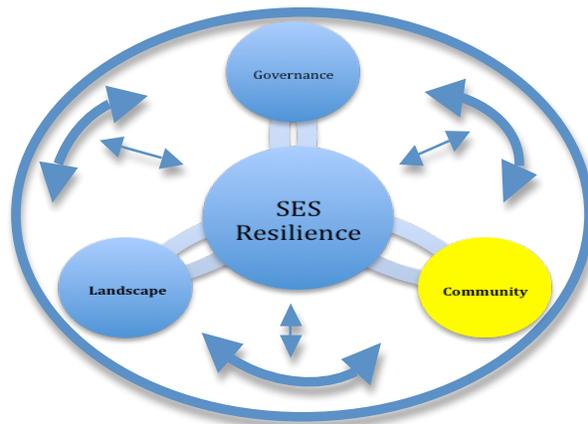
When talking of landscape conditions many interviewees highlighted developing conditions in the landscape that are becoming threats to the long-term health of forests in the MRV: 1) fire, and 2) disease and bug infestation.

Most individuals interviewed discussed the developing threat posed by fire as forests on federally managed land continue to increase in density. “Those lands are overstocked and going to need some attention both from a disease and fire protection” (Former old growth timber faller). That same concern is not necessarily shared for lands lower in the basin that is subject to continued timber harvests and where the weather tends to be moister and cooler. “Up at the pass that’s known, there’s lots of dead trees, a high fire risk” but there’s a “huge difference in the land moving from federal to private land [in terms of fire conditions]” (Biologist).

Fewer comments were made regarding the risk posed by disease and bug infestation but several individuals did note issues with beetle kill and root rot on land in the MRV. “You drive up and

down the valley and there's pockets of bug kills. Red needled trees. Next year there won't even be needles on that and it won't stick out as much" (Logger).

Knowledge of Community Change



Knowledge of community change is represented by comments about changes in the local community that are interwoven with changes in the natural landscape of the MRV. Ostrom's model conceives of the community element of the SES as consisting of a set of characteristics directly linked to the resource system. The adapted model used for this analysis incorporates community elements that are linked to the resource system but may be evolving in a manner that makes the link more indirect than it once was.

Interviewees' comments about the community can be grouped into three thematic categories: demographic change, descriptions emerging differences in landscape values, and changes in community social institutions. Everyone interviewed echoed a similar story of community change in the MRV that emphasized a loss of young families and an increase in retirees as the timber and dam building industries decline and are slowly replaced by a piecemeal working environment. Another facet of community change, employment, will be discussed in section four on system interactions.

Literature on community resilience emphasizes the value of identity and social cohesion as components of social capital, a key factor in resilience. The descriptions below highlight a loss of venues that help promote community identity and social cohesion.

Demographic Change

Demographic change in the MRV is discussed as a transition from a working class community filled with young families to a retirement and recreation community that has increased in size due to people coming from outside the area, often from California. Several people also discussed poverty in the community.

Families

As every interviewee described, the MRV used to be filled with working class families. Initially the area was populated with logging families and families of the USFS. When Cougar and Blue River Dams were being built in the 1960's the logging community saw a significant influx of families that moved to the area to work on dam construction. As one retired USFS employee stated every family had a "Husband and a wife with 2.4 kids and a husband in the woods" (Retired USFS employee).

The community identity was consistently described as working class or as being a timber community. Respondents also reported a belief that everyone knew everyone else. One individual that lived in the MRV since the 1940's commented on how it "used to be I knew everybody from McKenzie Bridge to Vida. Now I'm lucky if I know three people. The local family type things that were here for ages and ages have dwindled" (Truck driver).

All respondents agreed that the family situation in the MRV has changed significantly. As first dam building and then logging and working for the USFS declined, the families that populated the area began to leave.

There's not a lot of local people that live on the river and log anymore. I really don't know many. Back in the 80's it was like everyone was logging (Life-long resident).

It transitioned from the old logging, the old families and people who settled the land . . . then you got this big influx of workers for the dams and the Forest Service. Big, big community during the 70's. As that all finished they gradually left and left the old logging people plus a lot of tourists (Community activist).

It was made clear by most interviewed it is very difficult to find work in the MRV and very expensive to live. As one individual described, "We're hurting. There's not the working families. Working families can't afford to live here" (Environmental activist). Many discussed how friends or family have to commute outside the community to for work.

Future prospects are not seen to be bright. Those with kids expressed doubt that their children will come back to the MRV after going away for school or to find work. One father commented:

I think most parents, when their kids get to the graduating point they say you need to go some where and check other things out You can always come back but there's better economy in other places, we're in a rut here. I think it'll turn around. I have hope (Gippo logger).

Retirees

As working class families have left, local residents have witnessed an influx in retirees and vacation homeowners. The transition has been so dramatic that almost everyone interviewed commented on how the community can now be seen as a retirement community.

There's virtually no logging families on the river now and there's an awful lot of retired folks. It's become kind of a retirement community (Logger).

Now it's pretty hard to make a living up here so it's really turning into more of a retirement community (Life-long resident).

Census data provided by the Oregon Community Explorer indicates that the percentage of households within the MRV that receive social security income has increased from 28.8 percent in 1990 to 41.3 percent between 2005 and 2009

(<http://oe.oregonexplorer.info/rural/CommunitiesReporter/>).

One local resident who found a little extra work during the summer of 2010 conducting surveys of local properties for the U.S. Census Bureau was amazed at the number of summer homes he came across. This same individual runs the local paper and commented:

A lot of these older generation people are those retirees that have come from other areas. They vacationed here in the past and then decided to locate here. That's something we see with the paper; we'll get subscribers that may start out as snowbirds and take off in the wintertime. Then they'll become residents versus these other ones who are owners of properties that don't end up moving here. They've

already got their property here and another one somewhere else (Community observer).

This increase in retirees has increased individuals' feeling that they are less connected to the community. One individual who has lived in the MRV her whole life commented about the change:

For me it's I don't feel like I know as many people as I used to in the community. There used to be a lot more people that, right now I could go up and down the road I live on and I don't know a lot of the people because a lot of the people are retired and only here a few months out of the year. So I don't feel as connected to the community in that way as I used to (Life-long resident).

Californication

Most comments about the increase of retirees in the MRV were accompanied by a belief that the people who are moving into the area are Californians.

When logging ended people sold out, it was kind of a joke up here that every time the ground shook the Californians moved in (Ex-logger).

Lot of folks from California have moved up and continue to do so. It is a retirement destination. It has changed the demographics of our community up here in a lot of respects (Former old growth timber faller).

The changes are not always seen as desirable. The influx of Californians is seen to have altered the culture and raised the home prices.

A lot of people moving up of course are from California, and a lot of people try and Californicate Oregon. They have their ideas and maybe they work down there but they may not add much up here. A lot of them don't add much to the community. They just take from the community (River guide).

Another women, checking to make sure I wasn't from California, began expressing frustration at how Californians moving into the area "really like to make it like California" (Community member).

Several of those interviewed, while expressing frustration at the general influx of residents from California, acknowledged being friends with some and sympathizing with why they would want to leave life down there to live in the MRV.

When you get these people from Californian coming in, they're good folk, we have lots of friend up here from California, but they come up here to get out of the rat race down there, and I don't blame them (Landowner).

Poverty

Several interviewees discussed the amount of poverty in the area. This is not seen as a new phenomenon, probably poverty has always been there, but is something they have become more conscious of. One interviewee discussed how a local nun has organized assistance for those in need, providing food and other essentials to an estimated 40-60 families every other week. Many

of these folks are believed to be homeless or living out in the woods. One resident described the situation:

It's always been here [homelessness]. I think it probably has gotten worse over the last few years, especially with the economy the way it is. There's a lot more people taking the LTD bus up here and finding a place out in the woods, especially in the summertime (Life-long resident).

Changing Community Values

Respondents also expressed personal beliefs that shaped more specific management beliefs and opinions. Comments were often made contrasting their personal values with others, either new residents to the MRV or individuals who had opposing views of how the landscape should be managed.

Locals

It was common for individuals to stress their concern and care for the environment, noting their love of trees, the rivers, and the wildlife. This care and concern was placed within the reality that most of those interviewed had been connected in some fashion to logging, a practice that residents perceived that others see as not being environmentally friendly. For almost all respondents you can be both a logger and an environmentalist. As one old-timber logger continually reiterated "Here I was a logger and a tree farmer but was also an environmentalist." Another timber landowner expressed how being an environmentalist did not mean having to halt logging, "I'm not an environmentalist, while actually I am an environmentalist, I'm not a preservationist."

These concerns for environmental well-being were combined with a belief, and sometimes pride, in logging. A former old growth logger commented:

I took pride in cutting timber. I feel I did a good job and do I look back, sure we should have done some things different but there was a demand and we were meeting it and we did a good job. I feel good about some of the things I did even though there is a lot of feeling otherwise. So I don't look back on it like I was the scourge of the earth like we were called in some cases.

This same individual took time to pull out a framed picture of him cutting large timber in the MRV. As he talked about the picture he discussed the deep sense of public trust he felt logging timber on public land. For him, that public trust came with a need to care for the landscape in a way that required he protect the timber from being damaged while falling it, and in making sure the forest would be able to return again in the area that he logged.

Often statements were made that contrasted an individual's beliefs as logger or someone who had been associated with logging with those who have opposed logging. The most common statement was for an individual, when talking about how they had logged, to clearly assert that they were an environmentalist and cared for the landscape just as much as those fighting to halt logging practices.

A lot of people call themselves environmentalists. They're not. I'm an environmentalist. I love the woods. I like to live in it. I like to work in it. They're an extremist. They don't want you to do anything with the trees. They don't want them

cut. If they were only to look back and see all the products made from it, paper, all kinds of things that they use very day (Truck driver).

Another former logger commented, “As much as I love timber I’m not a tree hugger,” highlighting the belief that being an environmentalist did not mean agreeing with all environmentalism (Retired log truck driver).

Newcomers

Another group of comments, though less common than environmental value comments, pointed toward a perceived difference in values between the older residents, and the newer retirees and vacation homeowners. These newer residents are commonly viewed by respondents as having less concern about the utilitarian nature of the landscape, instead being focused on the aesthetics of their immediate surroundings. Interviewees see evidence of this in the fact that newer residents are more concerned with building homes near the river than being concerned about the flood plain and ecological properties of the river bank. One landowner recalls taking her daughters down toward the river when it flooded years ago and pointing out to them that all the houses that were flooded were the new ones that people had decided to build closer to the river, all the older residents had built their homes on higher ground where they weren’t susceptible to floods.

Another former logger discussed how he used to fall trees for clearing homes as a side job. The newer residents along the river would want everything cleaned up so they could see the river. About a year after he cleared out the timber to improve a landowner’s view the landowner called

upset because a neighbor across the river was doing the same thing and it was ruining her view. He added:

Working class people didn't, they didn't place the value on seeing the river. They wanted to keep the banks stable so it didn't flood their house . . . Before the working people didn't have time to manicure their lawn down to the river. Plus they wanted to maintain it and let it be natural. Now they manicure their lawn down to the river cause that's all they have do is maintain it and drink their totty's and watch the river go by (Ex-logger).

Changes in Community Social Institutions

Changes in community social institutions were represented by comments about organization, venues, or schools that were or still are social focal points in the community. The two themes that emerged here regard changes in the local school and a loss of social venues to interact with others in the community.

Declining Enrollment

The most common way respondents talked about community change was by describing the transformation the local school has undergone. McKenzie is home to one school that is kindergarten through twelfth grade. In the 1930's and 40's the size of graduating class was relatively small. As one individual recalled, he had eleven people in his graduating class. When timber harvesting and dam building picked up in the late 50's, 60's, and 70's, enrollment and class sizes witnessed a dramatic increase. A couple of individuals commented that enrollment climbed to nearly 1,000 students. But once dam building stopped, and later as the timber harvests

declined on federal land, school enrollment began to drop. Describing the hill above the school she lived on one long-time resident stated:

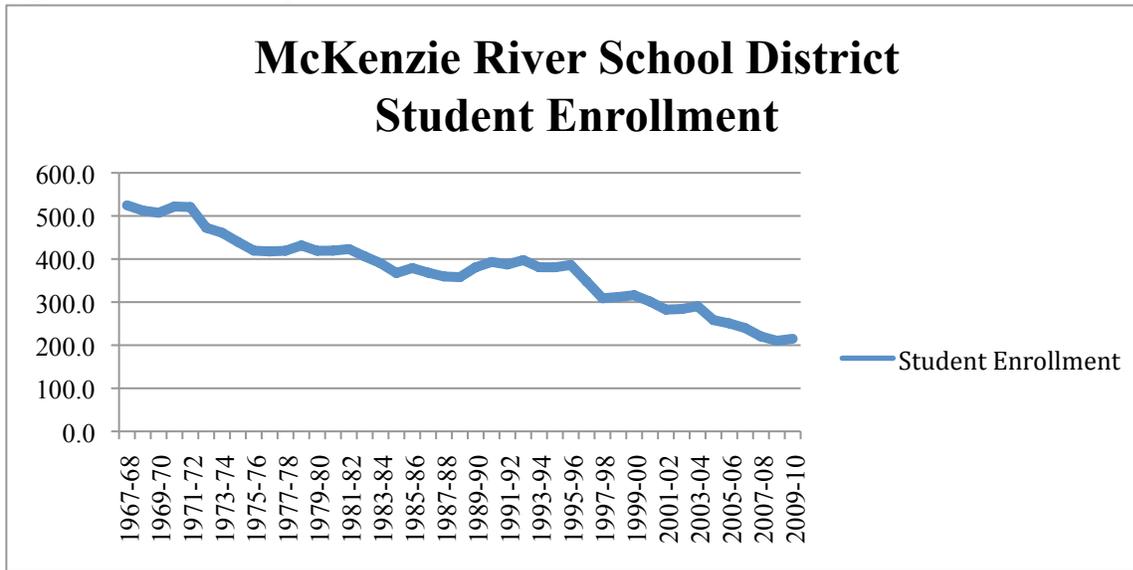
There were 13 kids on this hillside that went to school. Now there are a couple over there but they are home schooled. So really there isn't anybody up here that goes down to the school. Of course when they had road construction they had a thousand kids going to the school. The average was probably 400 or even 450. Now we're lucky if we have 200 for the whole year (Community member).

Several cited current enrollment numbers being much lower, with graduating classes of 12 or 13 each year. Many of those interviewed expressed concern about the ability of the school to stay open given declining enrollment and loss of funding. The school has already reduced instruction to four days a week. One individual described the evolution of the schools as thus:

Our schools were thriving and the community was busy. It was evolving into a community and with all these restrictions and the controversy that had gone on, that has dwindled to where is hard for our schools to stay open, it is hard for our business' to stay open. Blue River has gone from a thriving community to a ghost town of sorts (Former old growth timber faller).

Another individual whose children graduated from McKenzie was bleaker with his assessment claiming, "We're losing the school" (Environmental activist). Figure 6 describes the decline in student population in the MRV.

Figure 8: Student Population in the MRV



Source: Oregon Department of Education

Part of the challenge residents see is the decline in funding. In part they say that is driven by the loss of federal timber payments from Oregon and California Railroad Land grant funds, which communities receive from logging on federal lands. As was described, schools used to be “funded with timber dollars that are no longer. This school used to be one of the highest funded schools per student in the state and that’s no longer the case” (Ex-logger and USFS employee).

The second part of the funding challenge is a result of the demographic change in the MRV. Several individuals commented on the difficulty of passing local funding measures for the school. As one person attests, retirees who are more than willing to support local emergency service funding, but find it more difficult to support school funding. When describing the loss of working class people and influx of retirees’ one man put it bluntly, saying “We don’t have the people voting for school measures, we have the retirees that don’t way to pay anymore taxes” (Ex-logger).

We'll Drink At Home

Throughout the course of interviews, residents would mention the loss or gain of different venues or events that would or could form a center for community gatherings. The MRV is host to a number of restaurants and inns along the river. Interviewees spent little time talking about those venues and more about the number of watering holes that have been lost to the community. Many focused on the actual town of Blue River that once was seen as a thriving little town with a hotel, multiple filling stations, and several restaurants and bars but is now seen as “Going backwards” (Land owner and former logger). One individual had this to say about Blue River:

Years ago Blue River itself had three restaurants, two bars, two gas stations. It was a pretty lively community. That was in the late 70's and early 80's. Now there is hardly anything there. There's a gas station, a liquor store, and a hot dog stand. That's it (Community observer).

The MRV has seen several of its restaurants and bars burn down over the years, limiting the number of places to go socialize with others. One resident described the current social scene:

Yeah, people would gather there [the Log Cabin Inn]. They'd have karaoke and Halloween parties where everyone would come together and it was a community thing. You knew if you wanted to see your neighbors or whatever you'd go down there on a Friday night and you'd run into people. There's not a place like that anymore (Life-long resident).

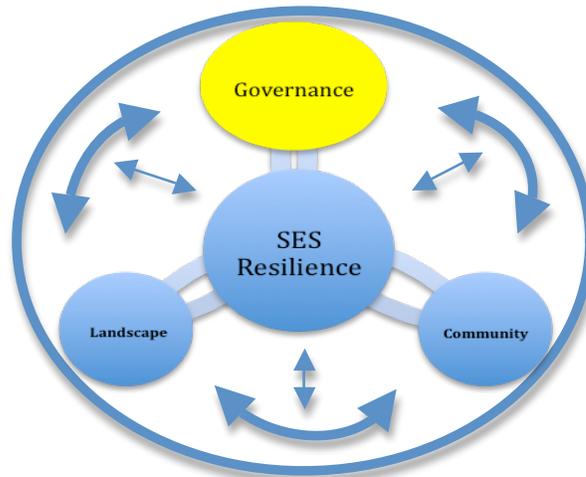
Another interviewee followed this statement up by adding somewhat sarcastically “We'll drink at home alone” (Ex-logger and USFS employee).

Two items of note were mentioned regarding community social venues that were more positive in nature. The first was the recently built community track just outside Blue River near the school. The track site was once a local mill and was donated by Aaron and Marie Jones, owners of Seneca Land Trust, a local timber company. For many of those interviewed the track is a site of pride, with them proudly sharing information about the quality of the track and that it has the same surface as the University of Oregon track used for the Olympic Trials. One interviewee asked me if I'd seen the track saying:

Of course we now have, where the mills used to be and the pond, we got the number one track. Did you notice that? Isn't that neat. Supposed to have the same thing as the University of Oregon. It's for school and local people (Community member).

The second item was a story shared by one individual who discussed a gathering some local farms have organized called a gathering of friends. At this gathering local farmers meet at one of the local farms and trade different goods that they have grown or made. Everything that does not get consumed in the community trade is left at a little farm stand to sell with the farm's other fruits and vegetables. It's a small story but is one example of people pulling together in this geographically stretched area to find community.

Governance Structure



Governance structure in the MRV is seen as the social and institutional structures that influence system rules, structures, and processes. This includes both governmental and non-governmental organizations, regulatory regimes, and market and industry structures. In the description below residents describe both governance structures that reside within the MRV and those elements that are external to the system. Internal system structures described below include discussions of the various land management entities that influence landscape conditions. External forces are drivers of change that originate outside of the MRV and are influencing actions and behavior to the larger systems of the MRV. This includes regulation of larger timber industry and market forces that the timber industry is influenced by. As already demonstrated in the above sections discussing local knowledge, residents of the MRV are keenly aware of the impact these larger forces are having on the MRV.

Land Management Structures

The MRV largely consists of three different types of landholdings: small private homesteads, large private forested ground, and state or federal property (see Figure 2 depicting land holding in the MRV).

To varying degrees, interviewees described the characteristics of landowners or groups that used and managed the different classes of landscape.

Personal Land Management

Many of those interviewed lived on or managed small pieces of land in the MRV. These plots could range from an acre to several hundred acres and were covered in timber to varying degrees. All those with land to manage expressed value in maintaining the forest on their property or the property they actively managed for another landowner, primarily through timber harvests. As one private landowner and former logger says, he would counsel private landowners who owned a timber resource “to keep growing trees, to have a resource, to have all the amenities that go with having a viable forest” (Former old growth timber faller).

For those who had more significant plots of land that could be actively managed as a commodity resource, the land was often managed for harvests with varying degrees of intensity. One family who has lived in the basin since 1914 and owned their current land of several hundred acres since shortly after World War II, has tried to keep their land on a sustained yield basis and only log when the family needs money, timber needs to be salvaged, or when timber prices are too high to ignore.

We’re not seeing anything that we can log, that we logged 50 years ago. We still got too much standing stuff. We haven’t went back in to re-log any of the logged over areas. We try and stay on a sustained yield basis. Not log anymore than what’s growing (Landowner).

For another local who owns a small piece of timbered property but manages a couple of hundred acres for a neighbor, management decisions are based on absolute need. On his own small piece

of property he noted how he will “take out ones that are diseased. Have a couple with root rot, but I’m fighting it. I love my big trees” (retired log truck driver). On the larger piece of property this individual manages for a neighbor, he has counseled the owner to only cut the timber if he really needs the money. Cutting for the sake of harvest or just to have extra money in the bank account is seen as a waste of a good resource.

Why harvest a tree if you don’t need it or it doesn’t need to be taken out for health reasons. Let the timber industry that raises timber do that. This is a natural forest . . . It’s money in the bank for the landowners and also its good for the environment (Retired log truck driver).

None of these individuals expressed interest or desire in liquidating their resource on a one-time basis. Instead, the emphasis was on managing the land, both for the health of the resource and for the benefit of future users.

Timber Industry Structure

The local timber industry is described as having three components; two with direct ownership rights and a third that actively worked the land and had more indirect ownership rights to the land. The first group is what is often described as the “industry.” This group consists of large timber companies that own vast tracts of land, mostly in the mid to lower portions of the MRV. Groups most often mentioned include Weyerhaeuser, Rosboro, Giustina Land and Timber Company, and Senecca Timber Company. Over time ownership has occasionally changed as land passed hands from one timber company to the next. As one former log company owner and land manager claimed, “Logging was controlled big share by industry.” Another former log truck

driver and mechanic commented on how Weyerhaeuser was “such a giant in the woods industry you couldn’t give em any guff. They did what they wanted” (Truck Driver).

Many residents perceived the prime motivation for these companies was seen to be financial profit.

I suspect Rosboro does exactly what Weyerhaeuser does, when the bottom goes out of the market they want to cut more so they have the same profit level (Environmental activist).

It’s just another way to make money. From Blue River to Springfield and Eugene should be paved with gold with the amount of money they’ve made (Gippo logger).

For some, the results of industry management have led to strong opinions about their role in the MRV.

I don’t know what your feelings are but in my opinion your timber industry as a whole stinks . . . I’m a logger and a tree farmer but to me there’s right and there’s wrong (Land owner and former logger).

That’s a good illustration of private land versus federal land. You have Giustina property on Old Foley and you’ve got Rosboro land just south of Highway 126, in the Blue River/Finn Rock area. Since we [USFS] stopped logging obviously the price of timber goes up and the next thing you know everything they just clear cut. It’s a source of frustration with us as locals, just saying alright log the whole stinking mountain and they do. It’s irritating (Ex-logger and USFS employee).

But the picture of the industry held by respondents is more complicated. One former logger whose father was a forester for one of the large timber companies described his motivations overseeing the company land:

He was a forester he knew what was the best for the land. He wasn't just looking at the bottom line looking for profit. He was looking at what would be best at getting trees growing back and the whole diversity of the wildlife (Ex-logger).

Another former logger and retired log truck driver who worked for several different companies in the timber industry commented:

The timber industry itself, I didn't work with many people out there that wanted to cut and run. I don't know one actually and I've worked with a lot of people over the years. We are just as environmentally conscious as other folks.

These large timber companies actively managed their land, harvesting the timber for its commodity value. As will be discussed below on management practices, the larger timber industry was subject to a great deal of change over the course of the last half century impacted their role in the MRV. Additionally, as will be highlighted below on landscape management beliefs, much of the disagreement over the industries role in the valley stems from disagreements or inconsistencies in how individuals feel the landscape should be managed.

The second segment of the local timber industry that interviewees consistently mentioned was several mid-sized timber companies that were active in purchasing USFS timber sales and small to mid-size portions of land to log and develop. Interviewees when talking about groups that had influenced landscape change in the MRV consistently discussed one operation, McDougall

Brothers Incorporated. This group was often singled out for its prominent role in purchasing small to mid-sized plots of land, cutting all of the timber and dividing up and selling the land.

Speaking of the McDougal brothers one resident described how:

He goes out and buys farms and stuff like that that have big tracts of timber in the back, cuts it all and sells the place and subdivides it. Makes a lot of money. Not's the best thing for the land. (Ex-logger).

The impact of mid-sized companies will be discussed in more detail below on speculation that occurred in the basin.

The third and final group mentioned was small logging outfits, or gippos, as they are commonly called. This group was more predominant prior to the slow down in the timber industry in the early 1990's, and would purchase smaller USFS timber sales to log or would work on a contract basis for the larger industry groups to log specific patches of land. As one individual described, "There was a lot of old gippo outfits up here. It was easy for them to get sales and log in this valley" (Ex-logger and USFS employee). As the industry has been altered, the number of gippo outfits left has dwindled, "You see a few, but very few" (Truck driver). A couple of gippo outfits have been relegated to small clean up projects for the USFS or finding another means to get by. Comments about gippo loggers mostly focused on their existence and decline. Little was said that distinguished their land management practices from other resource users in the valley.

Forest Service

The third group discussed frequently as a crucial influence on landscape management in the MRV was the USFS, which controls much of the land in the upper portion of the valley. In it's

early years, the USFS, as one landowner described, “Was basically a timber salesman. They were trying to sell all the timber they could sell because that was bringing lots of money into the coffer” (Landowner). In addition to selling timber, the forest service was focused on building roads and overseeing the building of roads that facilitated timber harvesting and fire protection on federal lands.

But as most interviewees agreed, the role and function of the USFS has changed dramatically as political and environmental conditions have changed. Now as one individual highlights:

Timber sales used to be their [USFS] program. Now I walk in to look at a timber sale and the front ladies don’t hardly know what a timber sale is. They have to call somebody and find the right person. Before you could walk in and that’s what they did (Local timber cruiser).

What residents began to see after pressure by environmental groups and by changes in regulation was an increased focus on more active management of the landscape and of being conscious of how the landscape appeared.

We noticed a change in the general outlook of the forest service on being conscious of their landscapes appearances and how much damage they could have visible in the landscape at a time and where (Environmental activist).

Their [USFS] biggest area now is recreation and fish and wildlife . . . Sale administration is down pretty low (Retired USFS employee).

I think we're trying to do so some different things with our management activities that we didn't do in 91 because we were so busy logging. We're doing some wildlife activities on a small scale, trying to restore meadows by cutting trees along meadows (Biologist)

Government Regulation

Respondents see government regulation as a dominant force shaping behavior and action in the MRV. Time and again residents attributed behavior change, and thus landscape change to regulation.

I remember when Rosboro did that (cut their timber down to the creek bed) . . . They could see the regulations coming where the government was going to tie up their land so they couldn't log it so they went in and cleaned it out (Landowner).

Seems like there's more trees growing now than there've ever been because of the cut back on federal land (Local timber cruiser).

Market Forces

A second key external force consistently mentioned by interviewees as affecting system dynamics is the influence the timber market has on management decisions and practices. This is tied to changes in the timber industry that both adapted to and drove changes in market conditions.

Market Dynamics

Whereas government regulation is described as being on a linear path gradually increasing, market regulation is described in a non-linear fashion, constantly ebbing and flowing as prices and values increase and decrease, influencing decisions on when to harvest, how much to harvest, and what species to harvest. When prices are up people log, when prices are down the decisions become more complicated and depend on who owns the land. Describing industry thinking one local environmental activist commented “It’s when the dollar is driving they don’t seem to have enough brains to look at the big picture.” Almost every individual interviewed, when discussing logging decisions, cited the price of timber as a driving factor.

The logging of non-Douglas fir species is illustrative. In the 1940’s, 50’s, 60’s, and 70’s the price of many of the hardwoods common in the basin was too low for industry officials to have an interest in harvesting these species. Instead it would be cut and used to cushion the fall of the more economically valuable Douglas fir. Gradually, as new markets developed for hardwood products the price of that timber increased, raising the incentive for landowners to harvest non-Douglas fir species found in the MRV.

One mill manager discussed in depth the impact the global market had on timber prices and sales in the area. When markets were in need, like during a Japanese shortage in the 1990’s, demand for local timber increased. Other times, competitors stepped into the timber market and were able to offer a similar product to those produced locally but at a reduced price as happened with Chinese plywood, and yellow poplar from the Southeastern United States.

Local landowners were aware of the influence foreign markets could have on the price of their timber. One small timber owner stated:

The Japanese and Chinese buying logs was a better market. I had a bunch of stuff blow down on my place about 15 years ago. I was getting like \$1200 a thousand for export and was only getting like \$800 for local. I was exporting everything I could export (Landowner).

As both timber supplies has decreased and technology has improved there has also been an increase in alternative wood products that can entirely supplement timber or require a smaller quantity to produce a product similar to an all timber product. One product mentioned was OSB, a plywood alternative that uses 50-60% less wood fiber than a typical plywood panel.

Industry Changes

Many of those interviewed spoke of changes in the timber industry that have impacted how the landscape is managed. Changes include the conversion of mills, the loss of small timber companies, and changes in technology.

Industry Realignment

As old growth harvests were reduced on all federal lands, not just those in the MRV, the timber industry began to adapt by converting their mills to equipment that could handle the smaller logs being brought in from the woods. One former logger and timber cruiser for a small mill recalled:

You could see it [the transition from old growth to small diameter timber] coming in the 80's. The emphasis was shifting at that point, particularly in the 90's, early 90's.

There wasn't a lot of old growth mills left in the early 90's in this particular region.

That's where we were headed (Former old growth timber faller).

One local environmental activist noted how "as I understand it now there is only 9 dinosaur mills (old growth) left in Oregon" (Environmental activist). With fewer mills capable of handling large timber further pressure was added to harvest small diameter timber capable of being processed in the new mills. A timber land owner commented:

In the 90's the whole spotted owl thing, the late 80's early 90's when that was all going on I remember thinking as a private land owner that if they lock up all the federal wood, what's that going to do to us. I thought that might be good. Without a lot of wood it would drive up the price for the private sector, or would it hurt us. Well it has hurt us because there are no mills. There is no where to sell old growth anymore (Timber land owner).

A couple of individuals also highlighted the fact that as access to federal timber declined and it became more competitive to access the timber supply that was available, it became more difficult for small companies to stay afloat. Several of the individuals interviewed who were loggers have left the timber industry while those still logging have experienced a severe reduction in amount of work during this time period. One local noted how "It diversified into big companies eating up small companies. Small companies had no way to compete; they were just gobbled up or ran out of business" (Truck driver).

Technology Shifts

Most of those interviewed spoke of the technological transformation that has altered the logging process, making timber harvesting more efficient, less damaging to the landscape, and reducing the number of workers needed in the field. Several of the individuals interviewed could recall logging by hand, using cross cut saws and spring boards. Gradually, saws were replaced by spring boards, and now logging operations are using large mechanized equipment like feller bunchers that have replaced the need to have a person on the ground cutting the timber. On steep terrain that used to be logged by Cats, logging outfits can now use skyline rigging equipment or in some cases if the company is profitable enough, helicopters. On a drive outside of the MRV one local noticed a patch of land that had been covered in timber only a few weeks before that had suddenly been logged. She was surprised at the speed they were able to log that piece of land and commented “It made me kind of sad cause it was like a lawn mower went through there” (Timber land owner).

While improved technology has quickened the logging process and may have lessened its impact on the landscape, it has also posed some challenges for small companies trying to stay competitive. One gippo outfit operator spoke of the difficulty staying afloat saying:

It was hard to with all this new logging equipment and everything went to mechanized logging. We didn't want to take that chance to spend a couple of million on logging equipment and not know if we had a job in a few years.

Change and Capacity in the MRV

Laced throughout individual interviews were general comments about change that provide a glimpse into interviewees' beliefs regarding the ability for the situation to continue to change in the MRV. Comments indicated three things: 1) the change that has occurred in the MRV is there to stay; 2) some individuals are interested in being active change agents; and, 3) a few organizations exist in the MRV that can facilitate the development of local capacity to adapt. Taken together these comments hint at an acceptance of the current situation and some local capacity to adapt.

No Going Back

An overwhelming majority of those interviewed expressed a belief and acceptance of the fact that the conditions in the MRV are not going to return to the days when the community was booming and lumber was king. For some this acceptance, while being a bit reluctant, is seen as a good thing. One former old growth timber faller continually emphasized the need for the community to change; speaking of old days he said:

Those days are gone; at least right now and probably for a good reason cause we were probably not managing the resource as we should back then . . . You have to constantly change to some degree. Take the best thing and work with that. Don't be unwilling to admit you make mistakes.

For others, their acceptance of the way things have changed is done begrudgingly. These individuals are not optimistic that things will go back to the way they were but they hope that

one day, as one ex-logger says, “It’ll swing back around. People will get tired of this” (Ex-logger).

One individual stressed the belief that not all those believed they lost the fight over logging saying:

Some people feel like they won the battle, maybe they’re outside interests, maybe it’s not so much the locals that were economically dependent but a lot of people think its going the right way too. It’s very polarized. There’s locals too that think it’s being improved now too as far as there being less clear cuts on federal land (Biologist).

Individual Capacity

Of those interviewed many discussed how they are actively working to educate and improve the community. One individual uses his role as an educator to work with kids to educate them about landscape biodiversity and the role different organisms play in landscape health. Another works with the local watershed council to educate farmers about the impacts of spraying pesticides on riparian health. Others expressed their continued willingness to monitor landscape health and hold land management institutions accountable.

Several of those interviewed discussed their past participation and willingness to participate in land management discussions with the USFS or other groups. One environmental activist had been active in the past in timber management dialogue groups hosted by the USFS that worked to build relationships between management, industry professionals, and environmental groups. Others participated in a recent effort by the USFS to establish a Forest Stewardship Program to assist non-industrial private land owners develop long-term management plans for their land.

While the program was unsuccessful, participants discussed a need to continue discussions between the USFS and local residents.

Most of those that did not discuss an interest in actively participating in activities to help manage change in the community were retired or nearly retired.

Knowledge Transmission

One issue that may limit local capacity is the lack of knowledge transmission occurring between those that have experienced changes in the MRV and others. All those interviewed were asked what they did to share their knowledge of landscape and community change. An overwhelming majority of individuals indicated that very little is done to share knowledge of change in the MRV. Several of these individuals expressed regret that their knowledge was not being shared. Two individuals expressed a desire to write a book that told their personal history of living in the MRV.

The handful of people that did say knowledge was shared indicated they told stories of change to their kids. Two individuals work through the local school to inform kids about landscape and community change.

Institutional Capacity

Interviewees discussed a range of institutions, both formal and informal, that play a role in the community's ability to learn and adapt. The primary formal institutions mentioned were the USFS and the McKenzie School District. Also mentioned were the McKenzie River Watershed Council and Eugene Water & Electric Board, which both focus on riparian related issues, the

H.J. Andrews Experimental Forest, and the Oregon Department of Forestry. The key informal institution that residents consistently cited was the role science plays in their decisions.

Each of the institutions discussed was done so in a variety of contexts. The USFS was discussed in its role as the preeminent land management institution in the area and the various programs it runs or has attempted to establish like the Youth Conservation Corps (YCC) or Forest Stewardship Program. The Watershed Council was discussed in light of its efforts to educate the community and improve riparian health. EWEB was mentioned several times regarding efforts to study the river and help improve local conditions. One individual described assistance provided by EWEB staff in applying for grant funds for the local fire department. As he describes:

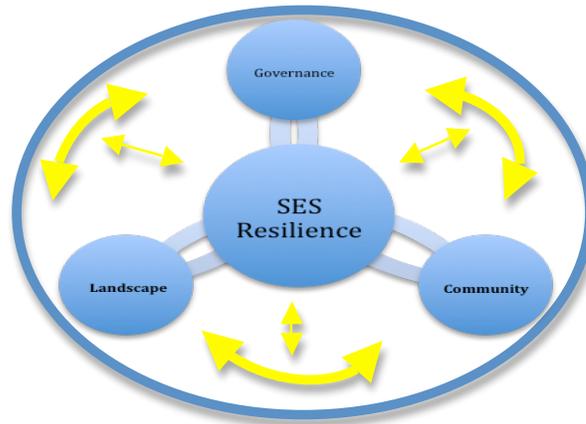
We worked with EWEB, our local utility . . . Been a great partner. They've helped me write grants, put together probably half million dollars in watershed grants to buy spill equipment, education (Ex-logger).

Many mentioned studies being done at the HJ Andrews Experimental Forest overseen by Oregon State University. The Oregon Department of Forestry (ODF) was brought up by one man describing their increased communication with the community and work to help private homes implement fire prevention methods on their property.

The one non-organizational institution consistently discussed by interviewees was the role of science. When discussing landscape and management decisions, individuals would highlight that decisions were made based on the best science at the time or that science needed to be included in making appropriate decisions about how the landscape should be managed. This was often

complimented with references to the scientific work being done at that HJ Andrews Experimental Forest.

System Interactions



System interactions consist of various ways the different subsystems interact and in effect produce outcomes that then affect the larger system dynamic. As shown in the model above system interactions both influence the system outcomes and act to reshape and influence their relevant subsystems. Interviewees discussed several system interactions. Below are descriptions of residents’ knowledge and beliefs regarding land management practices, user conflict, and employment.

Knowledge of Management Practices

Resource users described conditions in the landscape through the various ways they have managed the land. Doing so highlighted both the actual practices that have been used in managing the resource and what local residents saw as the drivers of landscape change. Management practices represented a range of different practices as well as an evolution in methodology that mirrored changes seen in the landscape. Four categories of management

practices were discussed: fire, timber harvesting, replanting and increased ecosystem management, and land speculation.

Fire

Most individuals discussed the role fire has had in shaping the landscape. When discussing the landscape prior to intensive commercial logging, residents often highlighted the belief that Native American populations who were seasonal inhabitants of the valley used fire to improve hunting and berry harvests.

Some of the old pictures I've seen from some of the older residents in the area show a lot of burning along the rivers themselves and up along the edges of the hillsides and such where the indigenous people, the Indians, would burn to increase grassland and forests such as that for game and to aid hunting (Former old growth timber faller).

Comments regarding the more recent use of fire were predominantly focused on continued efforts to suppress fires and how it has increased density of forests, particularly on federal land.

We had a fire up here and they spent forever mopping up and rehabbing and all that. Well it's because there's so much fuel down low. It's not like it used to be before we'd decided we'd manage this forest where you'd pop a fire and it would burn through and burn the under stuff and the trees would be fine. Now every time we stop that underbrush, yeah, if something decided to pop here I think it would be a big issue (Ex-logger and USFS employee).

Not many individuals commented about the difference between federal and private land but a few did note a difference that is attributed to the more dense stands of timber on federal land. As one individual stated, and others agreed, when comparing fire conditions there's a "huge difference in the land moving from federal to private (Biologist).

Logging

Logging practices have undergone a tremendous change over the course of many interviewees' lifetime as technology, regulation, and resource value has changed. Several individuals who began logging in the 1930's and 40's can recall using spring boards to log the large trees common at that time in the valley. The area began to be heavily logged in the 1940's to meet the demand driven by World War II. At that time loggers were generally only interested in large fir trees, cutting down hardwoods or trees with conks or other blemishes to clear the way. Some of that timber was later salvaged but the practice of leaving less economically valuable timber behind appears to have continued for several decades.

Logging practices used to be terrible. Coming from a logger I know I'm not supposed to say these things but it's the truth. Hale brothers logged up the south fork of the McKenzie . . . this was in the early 50's south of Hidden Lake they cut that drainage in there. They cut all the hemlock and cedar first and then went back and fell all those great big fir trees on top of it, so it would break up the cedar and hemlock so they didn't have to take it out. Today it is a sin to do that. But there was no market for it. (Retired log truck driver).

In those early days when there was an abundance of old growth timber, many individuals remember log trucks filling the highway. As one resident recalled “I remember when there used to be 2-300 loads a day going down the highway.” Many loads were often only able to carry a single log in a load. One former log truck driver recalls hauling “loads of one log, 5,000-6,000 board feet of timber” (Truck driver).

Logging gradually increased in the MRV, peaking in the 1970’s and 80’s. Much of the logging that occurred tended to be accomplished through clear cutting.

The timber industry was peaked from the 70’s through the 90’s and extraction was one of the primary focuses on what they were doing up here. They were logging quite a little bit and on private ground too. And the primary way of doing that was clear cutting. There was not so much emphasis on stand improvement or those kinda things through thinning . . . they had some thinning projects but most of it was clear cutting (Former old growth timber faller).

Weyerhaeuser was always, you could drive up here behind my place and look for days and not see a tree. They flattened it. There was nothing up there. Now after you log a section they make you have to green it up before they let you log next to that section. I think that helped a lot. (Truck driver)

Prior to the reduction in timber sales on federal land many of the large timber companies in the valley supplemented harvests from their own land with purchases of USFS timber sales in the valley.

Rosboro . . . had what you call sustained yield where they had it figured out they were always growing more trees on their land than they were cutting every year. To do that they had to mix in a little forest service timber with their own. (Ex-logger).

At first gradually, and then quite precipitously, due to a variety of reasons cited by residents, from altered market conditions to increased government regulation, timber management practices in the basin shifted and harvests declined.

I think everyone came to the realization they were overcutting, they were cutting too fast . . . You drive through the Willamette National Forest and you can see that. Back in the 60's and 70's they were just going for it. There was no management. Then it got into being more of an ecological, environmental thing (Gippo logger).

On federal lands a court ordered injunction halted logging. When logging did return to federal lands after the creation of the Northwest Forest Plan, management practices were dramatically altered, moving the management goals away from commodity production and timber sales to ecosystem health. For residents this transformation has been witnessed a reduction in clear cuts and increase in thinning, smaller timber being harvested, and increased recreational management.

My personal experience, cause I was involved in that as a timber faller and such, and it [transition from clear cutting to thinning] become more prominent in the mid 90's where we actually started to see more thinning regimes coming in . . . part of that was in response to the past clear cutting exercises on the national lands and state lands (Former old growth timber faller).

As has been mentioned, when logging slowed on federal lands, impacts and management practices were altered on private lands as well. In large part the change was driven by the need to increase harvests to meet demand that had previously been met with timber from federal lands. For several, the distinction between federal and private land is seen to be that private land is still being managed. While in some cases this led to increased thinning, in general private land owners continue to clear cut but do so on shorter harvest rotations.

When they [Rosboro] started running out of Forest Service timber the price started going up so high they couldn't bid anymore and they started cutting more of their own and realized they couldn't do that . . . And now Rosboro isn't on a sustained yield anymore. They're having to cut a lot more of their own timber to stay in business. It's like Weyerhaeuser now, they just give up saying the hell with sustained yield. They'll just cut it all and move out, come back in 100 years when its better. (Ex-logger).

What happened is, what I saw going on and what happened is folks like all the big landowners, Weyerhaeuser, GP, IP, Giustina, they were going through their old growth pretty rapidly. I'm not sure whether they thought they could go through their old growth rapidly and then get on federal . . . They liquidated pretty fast so there was a lot of logged over land down there [private land in mid and lower MRV] that was all coming back into this little tiny shit reprod stuff that had no value at all because all the mills were set up . . . to peel real logs. When the Forest Service quit selling timber, the demand didn't go away the supply went away . . . That reprod these folks

had been growing some 50 or 60 years, that meant the price of that skyrocketed (Logger).

Replanting and Increased Management

Despite the increased harvests discussed above, most residents feel there are more trees than ever growing in the MRV. In large part that is the result of replanting and other management practices. As many residents commented, both the Forest Service and timber industry are seen as always having done a good job replanting areas that had been logged. A former gippo logger that worked for Rosboro at various times noted, “they’ve always done a good job of reforestation.”

Residents of the MRV also report a greater emphasis on building back in the natural diversity of the forest when replanting, particularly on federal and state lands.

The federal government and the state government are going into more replanting with diversity of species. They are cognizant of the fact those stands are stronger with diversity; not just in species but also in age classes (Former old growth timber faller).

Many interviewees discussed the general change in site management practices, highlighting how practices have changed in part because of improved science and in part because of regulation. Residents mentioned changes to logging equipment to reduce soil compaction, increased effort to salvage marketable timber while leaving slash for the soil regeneration.

I remember taking a D4 Cat right down the middle of a stream to take out all the debris. Took it right down the middle. Did a great job taking out all the debris and

probably the salmon habitat while we were at it. But that was the best science at the time. Now we don't do that . . . It changed to where now we have to leave so many down woody debris on the ground, standing snags, that sort of thing (Former old growth timber faller).

You used to burn everything. Well you don't do that anymore. They're trying to change from just old hammer and nails to trying to save the land and keep it more productive (Truck driver).

Speculation

Comments about speculation described how small to mid-sized tracts of land, often family properties, were purchased, stripped of the timber resource, and subdivided and sold off. The group generally described as responsible for these activities were mid-size industry operators, such as the McDougall Brothers but Rosboro, Giustina, and others were also mentioned. What drove speculation in the MRV was the reduction in timber sales on federal land, which is seen to have increased the value of timber on private land, making it very tempting for some landowners to liquidate their timber. One former logger described an example of the process that often occurred:

There's a nice strip of timber behind the hatchery. There was an old farm house there. The guy farmed ten acres next to the house, the other ten was all timber. McDougal went in and bought that. Paid the guy \$199,000 for it. He logged \$200,000 worth of timber off, sold the original home for \$149,000, split the rest up and sold them for \$100,000 each, making is a subdivision. Now that nice stand of timber is gone. Ten

houses in that 20 acres and no timber. You know what caused that? The price of timber jacking up so high because the federal government stopped logging.

No one was able to quantify how much land was converted in this fashion. There did seem to be a general sense that noticeable amounts of land were affected. As the same individual quoted above said, “we lost tons and tons of land just because of that” (Ex-logger).

Management Beliefs

Often accompanying interviewees’ descriptions of landscape conditions and management practices were beliefs regarding landscape management and its related impacts on both the forest and dependent community. Beliefs were both retrospective, assessing the management of the last half century to the present, and prospective, prescribing how the landscape should be managed, as well as, delineating clear lines about how their personal values affect their views on management. Comments are grouped into three thematic categories: past management practices, prescriptions for future management, and user values.

Past and Current Management Practices

Individual opinions about past and current management practices was mixed. There were those that believe logging practices had been at times damaging and too intensive for landscape health. One woman who had lived in the area since the 1940’s voiced the simple opinion that “They were cutting too many trees” (Community member). Another gippo logger later added, “Yeah, they were cutting too much. That was unsustainable at the rate they were cutting” (Logger). Commenting on the decline of the timber industry one local logger noted that “People started to realize we can’t keep going at this rate or there will be nothing left” (Gippo logger).

Disapproval of the amount of timber harvesting or practices did not necessarily translate into concerns about the long-term health of the landscape. Several individuals commented that logging practices used to be terrible but that despite that the landscape is naturally resilient and capable of regeneration.

We logged up Blue River in the early 50's . . . They logged with a Cat, big Cats.

Those Cats could hardly stay on the hillside and they logged that and you talk about erosion and such as that. And we think what a horrible thing it was. The streams would run brown and everything but the timber would come back great up there.

They burned it again. Timber and reprod come back great (Retired log truck driver).

Even though many believed that past management practices were too intensive and that current management limit the past destruction, respondents do not necessarily believe that current management is all-good either.

Part of the opinion on current management surrounds distinctions between management on public lands and management on private lands. Public lands are seen as being locked up, whereas private lands are still being managed. One timber land owner, describing management practices said:

You have to be careful and you have to be good stewards. It's not unlimited . . . but I really do think they could manage it a whole lot better than they have been locking it up. Look at the wildfires. That's not managing it (Timber land owner).

Speaking of management by private timber companies another timber land owner and former logger stated:

I think they [big timber companies] are doing a good job. They understand what they have to do. I think those big timber companies are doing a good job; Same with Seneca (Landowner).

A small group had very clear opinions that forest management practices had been fine, or at least were being adjusted as need be by the industry. One timber industry employee described:

I never have [believed we were logging too much]. I think we were fine. I think we were replanting, everyone was following the rules and managing the forest. My opinion is we don't manage it very well anymore because we've taken clear cut out of the equation. Sometimes a clear cut is not bad. Sometimes thinning is better. It depends on the area and the stand and what kind of area you're in. A tool for the forest service has been taken out because it avoids litigation (Local timber cruiser).

Prescriptions for Future Management

Almost regardless of opinion of past and current management practices, interviewees felt management needs to be changed to move forward. Beliefs regarding future management practices involved two key changes: increasing logging on federal lands using a mixture of methods, and cutting older timber.

Start Cutting

Almost all those interviewed expressed the need to more intensively manage the federal landscape and often did so with a recognition that management needs to be more holistic than it once may have been, managing for sustainability and the specific needs of the area being

managed. Speaking of what needs to be done differently in landscape management one former old growth logger commented:

Just doing things different in order to maintain sustainability . . . You have to look at each acre differently. Not to say that there isn't a hundred acres of ground out there you can treat the same. Whatever your treatment regime is you can do it. But look at it as what is best for that ground at this time.

Another gippo logger stated:

The only type of ground you should log on is that that can be sustainable. Will hold trees. That means don't log a piece of steep hillside that has rock bluffs on it.

Part of what that means to manage the landscape is to increase the amount of land that is logged, but to do so with a range of techniques that includes thinning.

Yeah, don't get me wrong, I like to see more woods than less. I hated seeing a bunch of clear cuts around but if we're talking about thinning, if we're talking about managing our forest to keep it from being so combustible and at the same time having some sort of industry up here then I think that would be great (Ex-logger and USFS employee)

There's lots of thinning opportunities. There's lots of old plantations that need fixing (Environmental activist).

For several, key is the belief that timber is a natural resource and can be managed similar to other commodity crops.

It's like a crop. It's like corn, just on a long rotation. It's on a 200-year rotation instead of a 90 day rotation (Ex-logger).

If you take care of it and produce it right and treat it right it'll be here forever. If you don't it'll all be gone (Truck driver).

A few interviewees were clear that for there to be a healthy forest, clear cuts needed to be included into management practices.

The other thing with Douglas fir is it does real well in the open areas so it either has to be logged clean or burnt clean. Then it grows back really well. If you don't do that and let it stand and get old, die of disease and die slowly you end up with a hemlock forest (Ex-logger).

Speaking specifically of forest service practices and their reliance on thinning, one logging industry employee states:

Forest Service has a problem because all they do is thin. They can't take anything 80 years or older . . . They've got a problem; they're thinning themselves out. What are they thinning for? They're thinning because they can get timber sales through and can get some money back in there, but I know they want a diversified forest but they're thinning and not clear cutting anymore. When they're done thinning then what? (Local timber cruiser).

Stop Cutting the Young Stuff

Several interviewees discussed the belief that what needs to be logged are the older trees and not the young trees. Old growth is seen as having value for a variety of reasons including ecosystem health and for its existence value but is also seen as dead and dying timber with the greatest commodity value. The smaller timber currently being logged is seen as less valuable, with its real value being other ecosystem services it currently provides and its future potential as a commodity.

My way of thinking is that the old growth is what you need to be logging. It's good timber, makes good boards, boards without knots . . . When you start logging six to eight inch stuff you are actually logging your next generation of trees . . . Not to say it needs clear cut but it needs selectively logged so it looks nice and is healthy and you're going to get much more benefit out of the trees than you are a six inch pole (Truck driver).

The thing about the old growth is it is just going to stand there and rot and die. It would be better to cut it and get nice new little trees than to let it sit there and rot and waste (Landowner).

It's important to note that not all interviewees mentioned the need to log old growth timber. But most did at least express sadness at the fact that what is being logged tends to be the young, small trees.

Land Management Conflict

Comments regarding changes in the landscape were often discussed within the conflict that in many ways precipitated changes in management practices. Conflict arose over competing views on how the landscape was managed and has ultimately resulted in a reduction in logging on public lands in the MRV and a shift to management practices that focus on ecosystem health as opposed to commodity production.

Conflict Description

Three specific conflicts were discussed by many of the participants; the French Pete controversy, the spotted owl and logging on federal lands, and private land management practices.

French Pete

French Pete was a controversy that stretched from the 1960's until 1978. The struggle was over an effort to re-designate 53,000 acres, known as the French Pete area, as a wilderness preserve in the upper portion of the MRV. The conflict incited fierce debate between groups that sought to protect the wilderness and those wishing to log the area. In part, the USFS was relying on aerial photos that showed significant portions of timber that was dead and believed to be in need of cutting. One former USFS employee describes:

They [USFS] didn't have a good case. They had their aerial photos of dead pine, mostly red patches. Well, the Save the French Pete group flew it, took new aerial photos and there wasn't any of those things in there. It had healed up and so that was the big reason for going in there wasn't there anymore (Retired USFS employee).

The conflict was seminal for one local gippo logger and land owner. He describes his transformation into a more vocal environmentalist thus:

I started changing more or less when the Forest Service took 53,000 acres out of the proposed wilderness up here and a lot of them folks at the University with Doctor degrees were fighting it. I went to the school and had a petition from the small loggers on the river. Most of them agreed to save the wilderness. We can have both. I'm for logging but I'm for wilderness too. Why not? (Landowner and former logger)

Logging Public Land

The second key conflict identified was the protracted debate surrounding logging on public land. At it's core the debate was about the intensity of logging on public lands. But publicly the battle became one between the spotted owl and the timber industry. Comments about the spotted owl were not dwelled on or discussed in great detail. Often the spotted owl was mentioned but within the broader context of the decline in logging and shift away from old growth timber harvesting. Describing the conflict a local landowner commented, "The impact of the spotted owl up here basically reduced the cutting quite a bit" (River guide). Several individuals cited how the courts are where the battle is fought.

That's what I see happening, it gets held up in the courts. They're [USFS] afraid.

They're not putting up those kinds of ales because their afraid they're going to get flack for it (Logger)

Logging Private Land

The final conflict identified that has already been discussed in other contexts, is over general management practices, particularly as it affected private land. Individuals noted how beginning in the 1970's logging began to change as federal and state legislation was passed. One former logger discussed in detail how pending regulation drove timber companies to beat the regulation by logging stretches of land that they'd soon be prohibited from logging.

What happened is sometime, I think it was right around 1992 or something they were going to pass that new forest practices act that didn't allow them to log within 200 feet of a stream. So what Rosboro did is they went out and cut every streambed, every stream bed they had they cut out bare (Ex-logger).

Another landowner commented, "I think environmental policies are good. I just think it gets too heavy handed and you get over regulated and it puts everything out of balance. I think common sense has been lost" (Timber land owner).

Accountability: Conflicting Parties

Accountability for management practices in the MRV was seen to come from a variety of places. The individuals engaged in conflict over how the landscape should be managed in the MRV are not easily placed in one of the two stereotypical camps: loggers or environmentalists. Instead, what are described are diverse groups representing the different institutions with an interest in the valley. They ranged from outside interests such as environmental groups and Congress to more local members of the local timber industry, USFS, and community.

In the French Pete controversy discussed above many loggers were noted to be involved in fighting to protect the wilderness designation. One interviewee commented on how during the controversy he was elk hunting through the French Pete area with his father, he would “get salivating seeing a big eight footer out there and wondering what he could do with his saw.” As the two walked down through the big old growth in the French Pete the man’s father pulled out every surveying stake laid out for logging the area.

Another long-time resident that had been active fighting USFS timber sales and working to improve land management practices in the MRV spoke of the wide array of individuals who were involved in the fight to protect the local forests. His family would get calls from resident across the community tipping them off to situations that needed to be monitored. He described how “In the hay day in the owl fights we got a lot of tips from Forest Service personnel; not wanting to be identified but didn’t think that was right” (Environmental activist). These tips were then used in concert with information gathered by local members of the environmental group Oregon Natural Resource Council, now Oregon Wild. Most often though, the loosely defined “environmentalists” were identified as having driven the fight against the USFS and timber industry to improve environmental regulation. One former logger described:

I bet you can’t tell me a case where the Forest Service pulled the plug on the Forest Service. No. And you won’t either. It was always the environmentalist that pulled the plug when they were cutting and they shouldn’t (Landowner and former logger).

Another former logger describes the situation a bit differently but still indicating the role environmentalists played in driving change in the MRV. “The best thing for this country is

education that the loggers got on how to log . . . I hate to admit it but it's true, the environmentalist did a lot (Retired log truck driver).

A few others voiced a belief that the timber industry was evolving and adapting on their own, providing a certain level of self-accountability. A former logger described the creation of the Oregon's first Forest Practices Act in 1972, saying:

Believe it or not it was mostly foresters and private forest companies that helped write that act that actually did the protection of the forests and demanded that the trees be replanted after so many years (Ex-logger).

Evolution of Conflict in the MRV

For many the conflict that was so dominant for so long in the MRV has improved. The same logger mentioned above described the evolution saying that:

I really appreciate seeing the timber industry and the environmentalists getting along better than they did . . . I just think the two of them finally got to the point of impasse where neither one of them got stronger than the other. Had to come to terms . . . We all must admit that somewhere along the screeching and the hollering of the environmentalists they got us into better mill practice where we didn't cut just large dimensional timber anymore, we got into the smaller, we salvaged the saw dust, we salvaged the bark, now we're salvaging the limbs . . . Who pushed that? Environmentalists. No I don't like environmentalists but on the other hand it takes every kind of person to make something work (Retired log truck driver).

For others, the current situation is the result of a situation where the USFS is too afraid to log, essentially avoiding any potential fights. A local landowner and former logger commented that the “Forest Service hasn’t been able to put up so many sales. There are appeals from some of these environmental groups that have slowed down a lot of the logging on Forest Service land.”

Beliefs Regarding Conflict Management

A few individuals interviewed spent some time discussing their belief that there needs to be more consistent and sustained effort to bring all voices and interests to the table to discuss management issues. Several individuals mentioned recent failed attempts by the USFS to put in place a local Stewardship program that has seen some success in other areas like the Siuslaw National Forest. Despite this setback everyone desired efforts continue working with the local population and continue discussing shared problems and challenges.

We’ve tried some stewardship stuff that hasn’t worked out. Well we need to make it work out and bring all the different parties to the table and have those opinions shared and work through compromise in some fashion to come up with some sort of plan. Not one or the other is going to dominate. Perhaps that is the best way we are going to collaborate (Former old growth timber faller).

Changes in Employment

Employment opportunities in the MRV have undergone a dramatic shift. When almost all of those interviewed began working there was an abundance of opportunity for an individual to find work. One individual who began working in the late 1960’s and early 70’s after returning to the MRV from college recalled an era:

Where you could stand out alongside the road in the morning and have two or three job offers. I can remember waiting for my crummy to pick me up and having two or three trucks stop by and offer me a job saying ‘hey what are you getting, we’ll offer you 50 cents more (Former old growth timber faller).

Another local said even “Before in the 50’s and 60’s it was work work work, all kinds of work. You could get fired here today and go to work here tomorrow” (Truck driver).

Most of the work people found was in some way connected to the timber industry or dam building. As one individual recalled, “At one time you had six or seven mills between here [Blue River] and McKenzie Bridge. Some of them very small . . . Those are all gone” (Retired USFS employee). Another former logger spoke of how “Everyone worked in the woods almost. Almost 100 percent of the people worked in logging activity or something that worked towards that” (Ex-logger).

A range of employment options were described including a small gippo logger, employee of one of the big timber companies in the MRV, working for the USFS, or possibly working as a river guide on the McKenzie river. While many of those interviewed described following parents into the timber industry, most described also their reasoning for working in the timber industry because they loved working in the woods.

Beyond positions in the woods or on the river there was employment in service industry fields working as carpenters, running the local newspaper, or working for one of the local Inn’s or restaurants in the community.

As the timber industry began to retract due to changes in the economy and reduction in logging on public lands, interviewees describe a dramatic transformation in employment opportunities. A former logger describes the change:

It used to be we were a more economically vibrant community. With the restrictions on the national forest and with the change in the market and with the changes in demand for wood products this community has gone through quite a transition (Former old growth timber faller).

Another community member described the difference between then and now saying “There was jobs then. There aren’t jobs locally other than the Forest Service and some summer employment with the resorts, seasonal. Year round employment is very little” (Community observer). But as several noted, even jobs working for the USFS have declined.

Another former industry employee claims:

A lot of people had to look for other employment just to make ends meet. Jobs in the woods right now are pretty hard to come by. It’s hard to get people that want to work in the woods cause there’s nothing there anymore. There’s no future. Used to be that’s all there was. As time went on the logging dwindled and then if you don’t come up with something else to do then you’re out of luck (Truck driver).

Of those interviewed who earn (or earned) their paycheck working in the woods, two work at the USFS, another USFS employee was given early retirement because his division was no longer needed and he was only a year or two away from retirement, a couple left logging to find other work, one with the school and another with the fire department, one has bounced around in

positions working for the larger industry players, and a couple of gippo loggers find ways to scrape by piecing together small salvage jobs or driving dump truck. One gippo logger who ran a small logging crew with his father for many years described his employment odyssey:

Our bread and butter was our salvage logging operation. There wasn't enough of that going on to stay busy all the time. There were times I'd go to work for somebody else just to make things come out you know . . . Up until 93 or 94 it was all in the McKenzie Valley. That's when the federal timber started going, things really started to go haywire with that. We started tramping all over the state doing private jobs. Did that for a couple of three years. The last time we ran a crew was in 95 (Logger).

After he and his father stopped running a crew he continued to piece together work hauling rock, using his Cat to fight fire for the USFS, and doing the occasional small logging jobs. As he says about his current situation, "That's what this has become, an expensive hobby. Luckily my wife has her government job to support my logging habit" (Logger).

Indeed data from the US Census provided by the Oregon Community Explorer claims employment in natural resource occupations, agriculture, forestry, fishing, and mining decreased from nine percent in 1990 to just over three percent between 2005 and 2009. In that same period employment in manufacturing positions, likely to include work in local mills, decreased from just over 17 percent to 4.8 percent. At the same time employment in tourism based industries like arts, entertainment and recreation jumped from under two percent to over eleven percent (<http://oe.oregonexplorer.info/rural/CommunitiesReporter/>).

When describing current employment opportunities, interviewees discussed the reality that more and more people have to commute into Eugene or Springfield. One industry employee said, “It’s hard to move into this community and support yourself. Usually have to drive to town to find a job” (Local timber cruiser).

What many see as the new industry in the MRV is recreation and tourism. When asked about local employment one resident stated “Well tourism, that’s the business up here now; you know guides and rafters, lots more on the river” (Community member). The problem with the recreation and tourism industry that several people raised is the fact that those industries don’t provide a lot of family wage jobs. Typically they provide employment or income for a couple of months during the summer but then income drops dramatically in the winter. When discussing employment in the MRV one former logger and guide said:

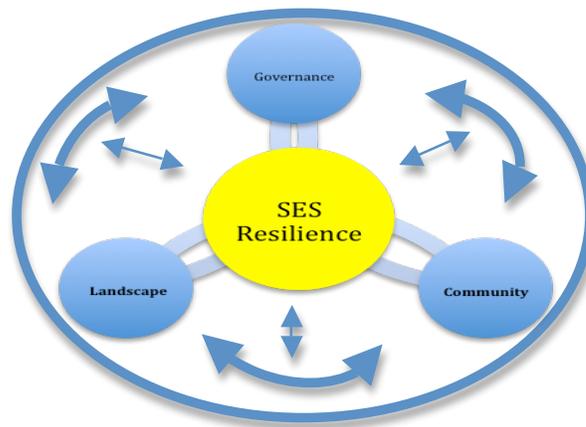
Hardly any jobs up here. There’s tourism but that is 3-4 months at the best. The joke with the little store like Leaburg store, that guy is a friend of mine and he’s losing money in the winter. He’s gotta make it in the three months in the summer or he isn’t going to make it. There isn’t really any living wage jobs on the river. There’s cleaning cabins, there’s rafting and guiding . . . But that’s a short season (Ex-logger).

A couple of interviewees expressed some frustration at the fact small local jobs put out to bid by the USFS were not being awarded to locals living in the MRV. Instead the projects are being awarded to large crews of Hispanics from outside the area. For other projects like the remodel of the local USFS ranger station and work done on the dams the same things is noticed, MRV locals are not able to secure work on these projects.

In general, for many the employment outlook was portrayed as being quite bleak. When discussing opportunities for the young, kids or grandkids, most were not optimistic that there would be much opportunity to find work in the MRV.

DISCUSSION

The purpose of this study was to catalog local knowledge of change in the social-ecological system nested within the MRV and identify key processes driving change and affecting the resilience of the couple social-ecological system. Using semi-structured interviews, long-time local residents of the MRV were able to articulate the issues they saw as influencing change in the MRV. In addition the study provides an assessment of local ecological knowledge, its value, and its relationship to spatial analysis. Using a modified version of Ostrom's framework for the analysis of social-ecological systems, the report is able to provide policy recommendations to enhance the resilience of the MRV. Below is a discussion of each of the research questions that drove this analysis



What does long-term ecological knowledge reveal about resilience of the SES in the MRV?

Resilience thinking proposes that social-ecological systems move through four phases; *exploitation, conservation, release, and reorganization*, in a process known as the adaptive cycle (Walker and Salt 2006). In the MRV interviewees hinted at an initial period of *exploitation* as the valley was settled by individuals who established their niche, guiding, logging, or in some cases providing services to the people that lived in the valley. At this time management practices were

aggressive as groups logged the landscape for only the most valuable commodities. Often this meant diverse forests were logged, falling hardwood trees such as western red cedar and hemlock, a low value resource at the time, only to help cushion the fall of the more valuable Douglas fir.

This was followed by a longer period of *conservation* and growth as system users became more efficient and wealth and connectedness increased. During this period of conservation the forest service was active building roads and infrastructure throughout the valley and the community experienced tremendous growth as logging increased and dams were built. Small downturns in harvesting and in the community would occasionally occur as market conditions would reduce demand but the overall trajectory of the system was on a linear path upward.

At the same time, the timber industry was increasingly dominated by a handful of companies along with the Forest Service dominated landscape management. The focus for both the Forest Service and the timber industry was managing the landscape as a crop to maintain consistent harvest levels. Gradually, growth began to decline as the system became more vulnerable and less resilient due to its reliance on timber harvests. From an ecological vantage many, though not all, residents saw the landscape as being under intense pressure from years of over logging and extraction based management. Various groups and individuals began to object to land management practices and gradually policies began to be passed that allowed for more public participation and oversight of management on federal and private lands. From a social perspective, industry restructuring, increased mechanization, and competition from foreign markets began to reduce employment and at times reduce timber harvests. The result was a community that slowly began to lose young families and some of its shared identity.

The pressure building within the system culminated in a quick *release* phase in 1991 when the spotted owl was listed on the endangered species list. Though residents recognize the gradual system decline that occurred prior to the listing, the spotted owl listing is seen as the seminal moment that led to system transformation. Harvests on federal land all but ceased and shifted to private land, and employment in traditional industries dropped dramatically.

This release phase can spawn a creative phase, which in turn helps to fuel system *reorganization* or *renewal* (Walker and Salt 2006). Interestingly, in the MRV the release phase initiated by the listing of the spotted owl can be viewed from two different perspectives that highlight a degree of decoupling of the social and ecological components of the system. From an ecological perspective, most interviewees would probably support the claim that the MRV has not witnessed a shift from one system to another; that is, it has not altered its essential feedbacks or ecosystem services it provides.

Ecologically you could argue that the transition from large and diverse old growth forests that were once more common in the MRV to younger even-aged and homogenous stands of timber represents a shift from one basin of attraction to another. Such an argument highlights the difficulty in defining system boundaries as well as the multiple vantage points from which a system can be viewed. Using the ball in the basin metaphor (Figure 3), the results of intensive logging and commodity management have shifted the ball in the basin to a state of younger, less, diverse, and denser forests, but has not shifted into a new basin with new feedbacks and ecosystem services.

To be sure, the system may have been headed in a direction that would have precipitated a transition from one basin of attraction to another. There are still significant stresses placed on

current ecosystem services. As residents testified, streams near logging sites run thick with mud during rainstorms, private lands continue to face pressure from large clear-cuts, fuel for potentially dangerous forest fires continue to mount on federal lands, and development along waterways threatens riparian dynamics. But active intervention by policymakers, the public, and some timber industry personnel helped shift management regimes to an ecosystem management perspective that focuses on health and diversity and management of populations. As interviewees contend, the landscape is being managed for overall ecosystem health and no longer for narrowly focused commodity production particularly on federal land.

From a community perspective, the reorganization phase initiated by the system release compelled the coupled human community into a new basin of attraction. Young families that were part of a blue collar logging culture have mostly left and been replaced by retirees and vacation homeowners shifting the MRV from a logging community to a retirement community. Resource dependency has been replaced by a hodgepodge of activities that include a mix of the traditional – logging, guiding, and forest service work – with more recreation and service industry work, as well as an increase in commuting to nearby metropolitan areas that can provide work. This social shift can be more appropriately viewed as one that crossed a system threshold and transferred the MRV into a new basin of attraction. It also highlights the community's low resilience due to its overreliance on a single industry.

As the system has reorganized it has entered relatively uncharted phases of development and has struggled to fully identify the shared link between the landscape and the traditionally dependent community. Ecologically, landscape managers have experienced nearly twenty years of experimentation with ecosystem management that emphasizes the iterative process of adaptive

management. The landscape continues to provide a range of ecosystem services and is subject to new pressures from climate change and altered management practices. Managers have experienced varying levels of success and failure (Shindler and Mallon 2006).

Socially, the ecosystem has shifted to include its recreational value and ability to provide ecosystem services, yet neither of these values has been able to economically sustain families that have been a key component of the community's history. What is apparent from talking with interviewees is that socially the MRV is sitting within a new stable state, in a new basin of attraction and that neither the parameters of this new system or its essential feedbacks are clear.

What does this mean for the resilience of the MRV social-ecological system? As has been discussed, resilience is a normative concept: A system can be resilient, yet be so in a manner that is neither beneficial nor desired. The MRV is in a unique position in which, from a systems perspective, it appears relatively resilient. That is, its characteristics are relatively stubborn and will be difficult to shift into an essentially new system. This is challenging because the system appears to be resilient but in two different states. Ecologically the system can be seen as relatively healthy, while socially, particularly for long-time residents, economic opportunity is limited and the current relationship is not fostering much economic opportunity.

The social system has structural issues that bring into question its relative resilience. A primary issue of concern is the ability of the system to self-organize, a key concept in resilience thinking, which is relatively low in the MRV given its lack of existing local governance institutions. As the literature indicates, resilience is fostered by the existence of multi-layered governance structures that foster local decision-making and have the flexibility and capacity to navigate local challenges. Governance in the MRV, an unincorporated area, is for general governance purposes,

overseen by distant county, state, or federal office. The one local governance institution is the McKenzie River Watershed Council.

The USFS, private land managers, the BLM, and the Oregon Department of Forestry oversee local land management. While having a local presence, this management structure also limits the ability of the system to self-organize. This was been particularly evident during the later part of the conservation phase and into the release and reorganization phases in the MRV. During this time, the system was battered by outside influences, primarily market conditions and federal regulation. Interviewees stressed how management decisions were largely influenced by state and national politics on federal land and by corporate shareholders interests on private commercially owned timber land. Without the ability to influence management decisions locally, the diverse land ownership interests ensure management strategies lack a systems oriented focus.

Leadership to self-organize could come from organizations outside of more traditional governance institutions. There are several local organizations to assist the community such as the Blue River Community Development Corporation and the McKenzie River Chamber of Commerce. The relative capacity of these organizations to aide in community development is unknown, although few respondents perceived them as strong leaders in the MRV.

More research is needed on federal and state regulatory structure to understand how the two systems interface and to identify ways in which they could be better aligned to ensure management on federal and private lands provides for system health. Regardless of regulatory interface, the lack of local capacity to influence the management of the system limits the systems overall resilience and ability to adapt to future management problems or those induced by forces such as climate change.

What is the continuing role of long-term ecological knowledge in terms of the management of coupled social-ecological systems?

Literature in several academic disciplines highlights the value of local ecological knowledge in shedding light on variables and processes that provide feedbacks at the local level (e.g. Berkes et al. 2000; Gadgil et al. 2000; Olsson and Folke 2000). This study gathered local ecological knowledge from a specific section of the MRV community: long-time residents with experience or understanding of landscape changes. In part, the findings from this study are assessed in relation to spatial analysis conducted in phase one of the MALS project. Results indicate two key values in terms of local ecological knowledge's value in landscape management. First is the ability to describe the more granular cascading effects of system changes that ultimately become drivers for both landscape and community change. The second is the value gained by understanding the local relationship to the landscape and what that may or may not imply for system management.

As mentioned, this analysis was undertaken in relation to earlier spatial analysis of the MRV. Individuals were given an opportunity to view maps developed in phase one of this project and describe what they perceived to be accuracies or inaccuracies in the spatial analysis. What was revealed in that process was that the spatial analysis was often too coarse. Maps were often able to capture general shifts or disturbances in the landscape (e.g. decrease in harvests on federal land) and an increase on private land, but were unable to capture or explain shifts in landscape management that resulted from increased market competition, improved harvest technology that limited more intrusive harvest practices, or increased land speculation fueled by rising prices on

private land when harvests slowed on federal land. These social changes surely led to landscape changes, but were not apparent through spatial analysis.

Relying on spatial analysis of the MRV provides a picture that highlights the seminal *release* moment in the system but fails to capture the gradual changes that individuals described as being a part of the decline of the local social-ecological system. Locals were able to describe in almost granular detail how change transpired on the landscape.

Two examples are illustrative. The first involves what has been termed speculation in this paper. As many locals described, when timber sales on federal lands halted, the value of private timber jumped causing not only private commercial timber operators to log more heavily but also increasing the value of small family plots of land (small to mid-sized acreage plots). These landowners were encouraged to sell their property, often by unscrupulous organizations. Once sold, the property was stripped of the timber, divided up into small lots, and sold. The former owner received a small chunk of change while the developer reaped a windfall.

To some degree spatial analysis can depict the increase in development that occurred as a result of the closing of federal lands, but the analysis does not make the link between the increased forest land cover on federal land and increased development on private land. Researchers at the USFS Pacific Northwest Research Station are developing more refined methods to track land cover changes (Kennedy, Yan, Cohen 2010) but until then, and maybe beyond, local knowledge provides a valuable source of information for understanding drivers of landscape change.

The second example is the community transformation that has been experienced in the MRV. After the MRV experienced its release phase an industry that had provided jobs and a cultural

identity to those in the McKenzie River Valley began to fade. This in turn is perceived by locals to translate into potentially different land management priorities and thus a different group of stakeholders to engage in land management processes. Yet, while the maps can display the land cover change that has occurred after the release phase they don't articulate the rural restructuring process that the land cover change helps to fuel.

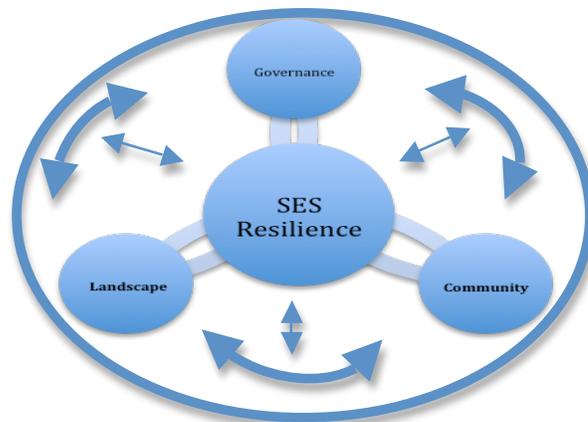
The second key value of local ecological knowledge relates to its ability to explain local relationships to the land. When interviewees began discussing the landscape in the MRV, their discussion was intertwined with discussions of community and identity. This quickly made it apparent that the MRV has been a working landscape, a place where people live, work, and play. Separating changes in the landscape from changes in social experiences is in many ways arbitrary when taking a systems perspective to analysis.

This in turn raises questions about different types of local ecological knowledge, that which can be termed traditional, stemming from long-time residents, and that from newer residents without the same history in the valley. As mentioned in the previous example regarding community change, the social structure of the MRV is in the midst of transformation. Families are declining and many of those interviewed expressed little belief that their children would move back to the community after leaving for college or work elsewhere. With current demographic trends appearing to continue with no end in sight the type of local knowledge gathered in this report appears likely to diminish, particularly given interviewees general belief that long-term ecological knowledge is not widely shared. This long-term ecological knowledge provides a certain longitudinal perspective on land cover change and in many instances a very detailed account of how different pieces of land have been managed.

As the MRV transitions into a retirement community with fewer long-time residents, the knowledge based in the community becomes more general local knowledge. The emerging local knowledge probably contains a different set of land management values and perspectives. As management agencies seek to include more and more local input in land management, how does this shift in knowledge affect landscape management? Again, this information is not easily integrated into current spatial analysis. Future research should assess how shifts in demographic composition in rural communities like the MRV are affecting the social-ecological relationship.

What are the policy implications for systems management in the MRV?

The resilience perspective offers a systems approach to analyze complex social-ecological systems and provides a useful framework to assess adaptive capacity and identify policy responses (Nelson, Adger, & Brown 2007). If we return to the framework for analysis discussed in section above we are reminded there are three core elements of a social-ecological systems: the ecological system, the social system, and the governance system.



The elements of that system interact in a variety of ways that can enhance, maintain, or diminish the relative resilience of the system. In turn, this resilience affects the core subsystems and their

interactions (Ostrom 2009). This system both impacts and is impacted by other systems that are nested within and around the system.

Managing for resilience requires focusing on slow moving variables such as institutional structures and processes (Gunderson 2000). A key part of this is enhancing flexibility and adaptability of institutions and the ability to self-organize (Carpenter et al. 2001). Interviews with long-time residents indicate the MRV SES has been increasingly subject to external forces outside of the immediate system such as changes in timber market conditions, industry reorganization and mechanization, federal regulation of logging, and pressures from rural restructuring and amenity migration. By enhancing the systems ability to self-organize and develop internal capacity to address problems, the system will be better equipped to adapt to changing ecological and social conditions.

While multiple factors exist that could enhance the resilience of the MRV, local knowledge of long-time residents of the MRV indicate three key issues that should be addressed to improve the adaptive capacity of the MRV SES. First, enhance transboundary land management in the MRV. Second, tighten feedbacks between policymakers and the system. Third, develop multilayered institutions for system management. Each is discussed below.

Enhance Transboundary Management

Resilience thinking requires that for management purposes the biophysical, social, and economic components of a region be treated as a single SES (Walker et al. 2009). As depicted in figure 2, the MRV is composed of a variety of landownership characteristics and sits within, and adjacent to, large sections of public land. Consequently land management in the basin is divided amongst

several different land management institutions that include government institutions like the USFS, BLM, Oregon Department of Forestry, Oregon Department of Land Conservation and Development, Oregon Watershed Enhancement Board, Lane County, and the McKenzie River Watershed Council; private institutions such as commercial timber companies and residential homeowners; and non-governmental organizations like the McKenzie River Trust.

As residents indicated, this land ownership/management structure has led to management decisions that have failed to fully account for the fact that the different pieces of land in the MRV function as a linked system and ensure that biophysical, social, and economic portions of the system are not coordinated. The most salient example of this came when decisions were made to reduce timber harvests on public land. As most residents interviewed attest, reductions on federal land simply shifted harvests to adjacent private lands, shortening harvest rotations and in some cases leading to permanent loss of forest and farmland in favor of increased human development.

Oregon has a rich tradition of building transboundary management institutions. In 1995 the Oregon Legislature passed legislation allowing local government entities to create local watershed councils. Oregon now has 88 watershed councils composed of local community members that work, to varying degrees, across jurisdictional boundaries to focus on the health of their watershed. Several of the residents interviewed highlighted the role the McKenzie Watershed Council has played working to develop strategies and solutions that protect the health of the MRV watershed.

While Oregon's watershed councils have functioned with varying levels of success their structure serves as a model for a management institution that can help facilitate transboundary

management within a social-ecological system. They include local knowledge and broad stakeholder engagement, foster an ability for a system to self-organize, create a venue for local decision-making; all key components to a resilient social-ecological system.

Tighten System Feedback

Feedback represents the secondary effect of one variable interacting with another. In the context of the MRV, feedback can be represented by timber industry employment, spotted owl numbers, the size of salmon runs, or a variety of impacts resulting from the interaction of variables in the system. A resilience approach focuses on tightness of feedbacks, which refers to how quickly or strongly the consequences of a change in one part of the system are felt and responded to in another part of the system (Walker and Salt 2006). As the resilience literature indicates, if feedback is not tight enough the impacts of changes occurring within a social-ecological system can be delayed, thus slowing potential management responses. Globalization and centralized government structure have reduced the tightness of feedbacks in systems around the world, including in the MRV.

During the later portions of the conservation phase in the MRV, as timber harvests on federal lands continued to remain high, some residents saw harvest decisions being dictated by federal policy with little regard for local conditions. One logger emphasized the point saying:

Congress needed more money so they kept bumping up the allowable cut. They had foresters out here that figured it was all set up for a sustained yield where you could cut x amount of timber each year and go perpetually. Congress needed more money so they'd bump up the cut.

In such a system where decision-making is conducted without real influence by local institutions where the impact of activities is felt, the system feedback is too distant to impact the process.

When the MRV encountered its release phase in the early 1990's and management of public lands shifted to ecosystem management, management organizations altered their focus to a more inclusive set of variables that focuses on the broader ecosystem, and have made efforts to incorporate the principles of adaptive management. Despite this, there still appears to be considerable distance between policy-makers and local conditions such as declining school enrollment and increased fire danger on public land. In order to improve resilience of the MRV social-ecological system there needs to be tighter links between the institutions making policies affecting the MRV and the local conditions that should be influencing decisions.

Build Multilayered Institutions

A consistent theme in resilient social-ecological systems is the existence of multilayered governance structures that are redundant and organized both vertically and horizontally (Andreis et al. 2004; Langridge et al. 2006; Nelson et al. 2007; Walker and Salt 2006). A structure designed in such a manner increases capacity of institutions to deal with issues across scales, linking nested systems above and below, as well as linking elements within a system. Without a multilayered structure, resilience is diminished.

For instance, in the MRV, as a result of it residing in unincorporated Lane County, no local general-purpose governments exist. General governance is affected by the County, and in some instances, the State and Federal government. The most active governance institutions locally are federal and state landscape management institutions such as the USFS. While linked vertically,

as discussed previously, the link appears to be influenced from the top down, with little local control or ability to impact management.

Furthermore, the primary management institutions located in the MRV are focused on ecosystem management, with little local attention to economic well-being. Both the McKenzie River Watershed Council and the USFS consider the economic well-being of the community in their planning, but that is a different focus than having local institutions focused on the social and economic health of the community. What residents in the MRV described was an institutional structure that is not fully linked vertically or horizontally to provide for system resilience.

Other traditionally resource dependent communities have faced similar challenges and developed responses that are community driven. As has been discussed, residents of Wallowa County united to form Wallowa Resources, an organization focused on developing economic opportunities that benefit the landscape and the community. The MRV faces a different context than Wallowa County. Its close proximity to the Eugene/Springfield area releases some economic pressure to develop internal solutions by allowing individuals to commute or more easily relocate to find work. Nonetheless, the opportunity exists for the development of a local organization focused on economic and ecological health. Many of those interviewed expressed an interest or willingness to effect change within the community. That energy could be capitalized upon to fuel the development of local economic and environmental strategies for enhancing the resilience of the MRV social-ecological system.

CONCLUSION

This study sought to catalog local knowledge of long-term residents of the McKenzie River Valley as it pertains to landscape and community change and provide a general assessment of factors affecting local social-ecological systems resilience. Residents interviewed indicated that dramatic changes driven by market competition, timber industry changes, increased regulation, and rural restructuring have occurred in both the landscape and community. The changes that have transpired as a result have redefined the relationship between the community and the landscape, moving away from local dependence on timber harvests to a relationship oriented around tourism and other ecosystem services. In doing so the community has transitioned from one with a logging community identity to one that has begrudgingly transitioned to a retirement and vacation community.

Resilience thinking, a framework for assessing a social-ecological system's ability to adapt and confront forces of change, indicates that the social-ecological system in the MRV is still in the midst of redefining the systems thresholds and key feedbacks. As a result of low institutional capacity the system is vulnerable to continued drivers of change from outside the local system. In order to facilitate enhanced resilience, policymakers and policy entrepreneurs should take action to ensure transboundary management strategies are put in place, that feedbacks are tightened to include more local influence, and that local institutions are developed that create multilayered institutions organized, both vertically and horizontally.

Study Limitations and Recommendations for Future Research

Methods

This research was designed to be exploratory in nature and intended to target long-time residents of the MRV. As a result, two deficiencies limit the level of specificity that could be achieved.

First, the exploratory nature of the work, while useful in identifying general themes in the MRV, was unable to target with a high degree of specificity variables driving current processes of change in the MRV. In addition it limited a detailed assessment of institutions operating in the MRV to assess their policies and structure.

Second, the desire to target long-time residents limited the more general applicability of conclusions regarding the local SES. More recent residents of the MRV most likely have a different perspective on landscape and community change. Thus, results should not be interpreted beyond the survey population of this study.

Model

Resilience thinking is very much a developing field of study. Models for analysis such as that proposed by Ostrom (2009) are only now beginning to be explored and require continued work to refine. While useful in this study in providing a general model to analyze the MRV, further work is needed to refine the pertinent variables in the study of social-ecological systems and ensure they are properly placed within a functional model. A key development for the field will be the need to further integrate the social, or community aspect of the social-ecological system.

As distinguished in the literature, and apparent in Ostrom's model, the study of social-ecological systems focus has been from an ecological perspective in which the social aspects salient role is

that of resource manager. As traditionally dependent communities continue to struggle or evolve to new economic structures it will be important to elevate the community element within SES thinking. In part this includes greater inclusion of economists and social scientists working collaboratively with ecologists and other scientists to study, understand, and develop better ways of sustaining both the human and ecological elements of our landscape.

Recommendations for Future Research

As a result of this study's findings and limitations I would recommend several issues for future research. First, research should be done that specifically focuses on the array of institutional structures affecting the MRV and other unincorporated rural communities. It would be beneficial to conduct a network analysis that can more appropriately identify strengths and weaknesses of institutional structures to more effectively target the policy recommendations discussed above. Additionally this would include an analysis of federal and state regulations to identify strategies to better coordinate management.

Second, work should be done to understand the knowledge and beliefs of more recent community residents. While this research addresses some questions regarding long-time residents it raises questions about new community members and how this apparent shift in demographics will impact preferences for landscape and community management.

Third, more work is needed to understand the changes that are occurring in the lower portion of the MRV. As discussed, the majority of this study focuses on changes occurring in the middle and upper portions of the valley. The lower portion of the MRV is more tightly linked to the Eugene/Springfield metropolitan area and is subject to more intense development pressures.

Understanding the forces at work in this portion of the valley will be important to ensure the sustainability of the area.

BIBLIOGRAPHY

- Adger, Neil W. (2000). Social and ecological resilience: are they related. *Progress in Human Geography*. 24(3): 347-364.
- Anderies, John M., Marco A. Janssen, and Elinor Ostrom. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society*. 9(1): 18.
- Anthony, Elizabeth K. (2008). Cluster profiles of youth living in poverty: factors affecting risk and resilience. *Social Work Research*. 32(1): 6-17.
- Beckley, Thomas. (1995). Community stability and the relationship between economic and social well-being in forest-dependent communities. *Society and Natural Resources*. 8(3): 261-266.
- Beckley, Thomas, John Parkins, and Richard Stedman. (2002). Indicators of forest-dependent community sustainability: the evolution of research. *The Forestry Chronicle*. 78(5): 626 – 636.
- Berkes, Fikret and Carl Folke. (1998). Linking social and ecological systems for sustainability and resilience. In Fikret Berkes and Carl Folke (eds), *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press. Cambridge, U.K.
- Berkes, Fikret, Johan Colding, and Carl Folke. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*. 10: 1252-62.
- Berkes, Fikret. (2002). Cross-Scale institutional linkages: perspectives from the bottom up. In Committee on the Human Dimensions of Global Change. E. Ostrom, T. Dietz, N. Dolsak, P.C. Stern, S. Stovich, and E.U. Weber (eds). *The Drama of the Commons*. National Research Council, Division of Behavioral and Social Sciences and Education. National Academy Press. Washington, D.C.
- Berkes, Fikret. (2003). Alternatives to conventional management: lessons from small scale fisheries. *Environments*. 31(1): 6-19.
- Browne, Kath. (2005). Snowball sampling: using social networks to research non-heterosexual women. *International Journal of Social Research Methodology*. 8(1): 47-60.
- Carpenter, S., Walker, B., Anderies, J.M., and Nick Abel. (2001). From metaphor to measurement: resilience of what to what? *Ecosystems*. 4: 765-781.
- Charnley, Susan, Ellen M. Donoghue, and Cassandra Moseley. (2008). Forest Management Policy and Community Well Being in the Pacific Northwest. *Journal of Forestry*. 440-447.

- Christoffersen, N. (2005). Wallowa Resources: Gaining access and adding value to natural resources on public lands. Chapter 6 In West Lyman, Martha, and Brian Child, (eds), *Natural Resources As Community Assets: Lessons From Two Continents*. Sand County Foundation.
- Common, M. and C. Perrings. (1992). Towards and ecological economic of sustainability. *Ecological Economics*. 6: 7-34.
- Costanza, R., L. Waigner, C. Folke, and K.G. Maler. (1993). Modeling complex ecological economic systems: towards an evolutionary dynamic understanding of people and nature. *Bioscience*. 43: 545-555.
- Dana, Samuel T. (1918). Forestry and community development. USDA Bulletin 638. Washington, D.C. USDA-Forest Service.
- Davis, Anthony, and Kenneth Ruddle. (2010). Constructing confidence: rational skepticism and systematic enquiry in local ecological knowledge research. *Ecological Applications*. 20: 880–894.
- Donoghue, Ellen M. and Richard W. Haynes. (2002). Assessing the viability and adaptability of Oregon communities. Gen. Tech. Rep. PNW-GTR-549. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Donoghue, E., & Sutton, L. (2006). Socioeconomic conditions and trends for communities in the Northwest Forest Plan region, 1990 to 2000. In S. Charnley, E. Donoghue, C. Stuart, C. Dillingham, L. Buttolph, W. Kay, R. McLain, C. Moseley, R. Phillips and L. Tobe (eds.), *Socioeconomic Monitoring Results* (Vol. Volume III: Rural Communities and Economies). Pacific Northwest Research Station, Portland, OR: U.S. Department of Agriculture, Forest Service.
- Donoghue, Ellen M. and Victoria E. Sturtevant. (2007). Social Science Constructs in Ecosystem Assessments: Revisiting Community Capacity and Community Resiliency. *Society and Natural Resources*. 20: 899-912.
- Doppelt, Bob, Hamilton, Roger, Cindy Deacon Williams, Marni Koopman, and Stacy Vynne. (2009). Preparing for Climate Change in the Upper Willamette River Basin of Western Oregon: Co-Beneficial Planning for Communities and Ecosystems. The Resource Innovation Group. Last accessed May 2, 2011 at: <http://www.theresourceinnovationgroup.org/climate-preparedness-pubs/>.
- Egan, Andrew and A.E. Luloff. (2000). The exurbanization of America's forests: Research in rural social science. *Journal of Forestry*. 98(3): 26-30.
- Faugier, Jean and Mary Sargeant. (1997). Sampling hard to reach populations. *Journal of Advanced Nursing*. 26(4): 790-797.

- Fiering, M. (1982). Alternative indices of resilience. *Water Resources Research*. 8: 33-39.
- Folke, Carl. (2006). Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*. 16: 253-67.
- Forest Ecosystem Management Assessment Team. (1993). Forest ecosystem management: An ecological, economic, and social assessment. Portland, OR: U.S. Department of Agriculture, U.S. Department of Interior.
- Freudenberg, W.R. (1982). The impacts of rapid growth on the social and personal well-being of local community residents. In: Weber, b., Howell, R.E. (Eds.), *Coping With Rapid Growth in Rural Communities*. Westview, Boulder, pp. 137-170.
- Gadgil, Madhav, Per Olsson, Fikret Berkes, and Carl Folke. (2003). Exploring the role of local ecological knowledge in ecosystem management: three case studies. In, Fikret Berkes, Johan Colding, and Carl Folke (eds), *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press, United Kingdom.
- Gilchrist, G., M. Mallory, and F. Merkel. (2005). Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds. *Ecology and Society* 10(1): 20.
- Gosnell, Hannah and Jesse Abrams. (2009). Amenity migration: diverse conceptualizations of drivers, socioeconomic dimensions, and emerging challenges. *GeoJournal*. Published online July 8, 2009. Doi: 10.1007/s10708-009-9295-4.
- Gunderson, Lance H. (2000). Ecological Resilience: In Theory and Application. *Annual Review of Ecological Systems*. 31: 425-39.
- Gunderson, Lance H. & C.S. Holling. (eds) (2002). *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press. Washington D.C.
- Hanna, S.S., C. Folke, and K.G. Maler. (eds). (1996). *Rights to Nature: Ecological, Economic, cultural, and Political Principles of Institutions for the Environment*. Island Press, Washington D.C.
- Harris, C., W. McLaughlin, G. Brown, and D.R. Becker. (2000). Rural communities in the Inland Northwest: An assessment of small rural communities of the Interior and Upper Columbia River basins. Ben. Tech. Rep. PNW-GTR-477. Portland, OR: USDA Forest Service, Pacific Northwest Research Stations, and USDI Bureau of Land Management.
- Haynes, Richard W. (2003). Assessing the viability and adaptability of forest-dependent communities in the United States. General Technical Report PNW-GTR-567. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

- Holling, C.S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*. 4: 1-23.
- Holling, C.S. (ed). (1978). *Adaptive Environmental Assessment and Management*. Wiley, London.
- Holling, C.S. (1986). The resilience of terrestrial ecosystems; local surprise and global change. Pages 292-317. In W.C. Clark and R.E. Munn, (eds), *Sustainable Development of the Biosphere*. Cambridge University Press, Cambridge, U.K.
- Holling, C.S., & Gary K. Meffe. (1996). Command and control and the pathology of natural resource management. *Conservation Biology*. 10(2): 328-337.
- Holmes, J. (2002). Diversity and change in Australia's rangelands: A post-productivist transition with a difference? *Transactions of the Institute of British Geographers*. 27(3): 362-384.
- Holmes, J. (2006). Impulses towards a multifunctional transition in rural Australia: Gaps in the research agenda. *Journal of Rural Studies*. 22(2): 142-160.
- Keim, Mark E. (2008). Building human resilience: The role of public health preparedness and response as an adaptation to climate change. *American Journal of Preventative Medicine*. 35(5): 508-516.
- Kelly, Erin C. and John C. Bliss. (2009). Healthy Forests, Healthy Communities: An Emerging Paradigm for Natural Resource-Dependent Communities? *Society and Natural Resources*. 22: 519-537.
- Kennedy, Robert, Zhiaqiang Yang, and Warren Cohen. (2010). Detecting trends in forest disturbance and recovery using yearly Landsat time series: 1. LandTrendr — Temporal segmentation algorithms. *Remote Sensing of Environment*. 114(12): 2897-2910.
- King, A. (1995). Avoiding ecological surprise: lessons from long-standing communities. *Academy of Management Review*. 20: 961-985.
- King, N. (1994). The qualitative research interview. In C. Cassell and G. Symon (eds), *Qualitative Methods in Organizational Research*. Sage. London.
- Lamson, C. (1986). Planning for resilient coastal communities: lesson from ecological systems theory. *Coastal Zone Management Journal*. 13: 265-279.
- Langston, Nancy. (2005). *Forest Dreams, Forest Nightmares: the Paradox of Old Growth in the Inland West*. University of Washington Press, Seattle, Washington.
- Landridge, Ruth, Juliet Christian-Smith, and Kathleen A. Lohse. (2006). Access and resilience: analyzing the construction of social resilience to the threat of water scarcity. *Ecology and Society*. 11(2): 18.

- Lee, R.G. and R. Field. (2005). Introduction: From scientific forestry to community forestry. In, R.G. Lee and R. Field (eds), *Communities and Forests: Where People Meet the Land*. Oregon State University Press, Corvallis, Oregon.
- Ludwig, D., D.D. Jones, and C.S. Holling. (1978). Qualitative-analysis of insect outbreak systems-spruce budworm and forest. *Journal of Animal Ecology*. 47: 315-332.
- Machlis, Gary E. and Jo Ellen Force. (1988). Community stability and timber-dependent communities. *Rural Sociology*. 33(2): 220-234.
- Madhav Gadgil, Per Olsson, Fikret Berkes, & Carl Folke. (2000). Exploring the role of local ecological knowledge in ecosystem management. pp 189-209. In, Fikret Berkes, Johan Colding, and Carl Folke (eds), *Navigating Social-Ecological Systems Building Resilience for Complexity and Change*. Cambridge University Press. Cambridge UK.
- Magis, Kristen. (2007). Indicator 38 – Community Resilience. In Literature and Practice Review submitted to the U.S. Roundtable on Sustainable Forests. Last accessed May 2, 2011 at: <http://www.sustainableforests.net>
- Magis, Kristen. (2010). Community resilience: an indicator of social sustainability. *Society and Natural Resources*. 23: 401-416.
- McKenzie Watershed Council. (2002). The McKenzie River Watershed Strategy. Last accessed May 2, 2011 at: <http://www.mckenziawc.org/projects.htm>.
- McCarthy, J. (2005). Rural geography: Multifunctional rural geographies – reactionary or radical? *Progress in Human Geography*. 29(6): 773-782.
- Moller, H., F. Berkes, P. O. Lyver, and M. Kislalioglu. (2004). Combining science and traditional ecological knowledge: monitoring populations for co-management. *Ecology and Society*. 9(3): 2.
- Morse, J.M. (2000). Determining sample size. *Qualitative Health Research*. 10: 3-5.
- Nelson, Arthur C. and Kenneth J. Dueker. (1990). The exurbanization of America and its planning policy implications. *Journal of Planning Education and Research*. 9(2): 91-100.
- Nelson, Donald R., W. Neil Adger, and Katrina Brown. (2007). Adaptation to environmental change; contributions of a resilience framework. *Annual Review of Environmental Resources*. 32: 395-419.
- Nelson, Peter. (2001). Rural restructuring in the American West: land use, family and class discourses. *Journal of Rural Studies*. 17: 395-407.

- Norris, Fran H., Susan P. Stevens, Betty Pfefferbaum, Karen F. Wyche, and Rose L. Pfefferbaum. (2008). Community resilience as a metaphor, theory, set of capacities and strategy for disaster readiness. *American Journal of Community Psychology*. 41: 127-150.
- Noy, Chaim. (2008). Sampling Knowledge: The Hermeneutics of Snowball Sampling in Qualitative Research. *International Journal of Social Research Methodology*. 11(4): 327-344.
- Obrist, Brigit, Constanze Pfeiffer, and Robert Henley. (2010). Multi-layered social resilience: a new approach in mitigation research. *Progress in Development Studies*. 10(4): 283-93.
- Olsson, Per and Carl Folke. (2000). Local ecological knowledge and institutional dynamics for ecosystem management: A study of Lake Racken watershed, Sweden. *Ecosystems*. 4(2): 84-104.
- Oregon Communities Explorer. (2011). Oregon Communities Reporter: Indicators for your community by city, county and census tract – census tract 1. Last accessed on May 2, 2011 at: <http://oe.oregonexplorer.info/rural/CommunitiesReporter/>.
- Oregon Department of Education. (2011). McKenzie School District Student Enrollment: 1967-2010.
- Oregon Forest Resources Institute. (2010). Federal forestland in Oregon: Coming to terms with active forest management on federal land. Last accessed May 2, 2011 at: www.oregonforests.org/assets/uploads/Federal_Forestlands.pdf
- Ostrom, Elinor. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*. 235: 419-422.
- Perrings, C.A. C. Folke, and K.G. Maler. (1992). The ecology and economics of biodiversity loss: the research agenda. *Ambio*. 21: 201-211.
- Preister, Kevin, Luis Ibanez, Toby Keys, Megan Gordon, Kirsten Saylor, Armando Arias, and James Kent. (2002). Upper McKenzie Community Research Unit. In, A human geographic issue management system for natural resource managers in the Willamette Valley, Oregon. Presented to Willamette National Forest and Siuslaw National Forest. Last accessed May 2, 2011 at: <http://jkagroup.com/methods/willamette-index/index.htm>.
- Regional Ecosystem Office. Northwest Forest Plan Overview. Last accessed May 2, 2011 at: <http://www.reo.gov/general/aboutnwfp.htm>.
- Risley, John, J.R. Wallick, Ian Waite, and Adam Stonewall. (2010), Development of an environmental flow framework for the McKenzie River basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2010-5016, 94 p.
- Robbins, William G. (1994). *Colony and Empire: The Capitalist Transformation of the American West*. University Press of Kansas. Lawrence, Kansas.

- Robbins, William G. (1997). *Landscapes of Promise: The Oregon Story, 1800-1940*. University of Washington Press. Seattle, Washington.
- Robbins, William G. (2004). *Landscapes of Conflict: The Oregon Story, 1940 – 2000*. University of Washington Press. Seattle, Washington.
- Robson, Colin. (2002). *Real World Research: A Resource for Social Scientists and Practitioners*. Second Edition. Blackwell Publishing. Oxford, UK.
- Shindler, B., B. Steel, and P. List. (1996). Public judgments of adaptive management: A response from forest communities. *Journal of Forestry*. 94: 4-12.
- Shindler, B., and A. Mallon. (2006). *Public acceptance of disturbance-based forest management: a study of the Blue River Landscape Strategy in Oregon's Central Cascades Adaptive Management Area*. Final Project Report, Agreement # 05-CR-1061801-013. USDA Forest Service, Pacific Northwest Research Station and Oregon State University, Department of Forest Resources, Corvallis, Oregon, USA.
- Sierra Nevada Ecosystem Project. (1996a). SNEP final report to Congress: Assessment summaries and management strategies, vol. I. Davis: University of California, Centers for Water and Wildland Resources.
- Stauber, K. (2001). Why Invest in Rural America - And How? A Critical Public Policy Question for the 21st Century. Paper presented at *Exploring Policy Options for a New Rural America*, Center for the Study of Rural America, April 30-May 1.
- Sturtevant, Victoria E. and Ellen M. Donoghue. (2008). Community and Forest Connections: Continuity and Change. In Donoghue, E.M. and V.E. Sturtevant (eds.), *Forest Community Connections: Implications for Research, Management, and Governance*. Washington, DC: RFF Press.
- Swanson, Frederick J. and Julia A. Jones. (2002). Geomorphology and Hydrology of the HJ Andrews Experimental Forest, Blue River, Oregon. In, Field Guide to Geological Processes in Cascadia, Oregon Department of Geology and Mineral Industries. Special Paper 36.
- Thompson, M., R. Ellis and A. Wildarsky. (1990). *Cultural Theory*. Westview Press, Boulder, Colorado.
- U.S. Census Bureau. (2010). 2010 Census Redistricting Data (Public Law 94-171) Summary File, Tables P1, P2, P3, P4, H1. Last accessed May 2, 2011 at: <http://quickfacts.census.gov>
- United States Department of Agriculture, Forest Service. (1997). 1997 Northwest Forest Plan Report, An Ecosystem Management Approach: Watersheds, Communities, and People.

Last accessed May 2, 2011 at: <http://www.fs.fed.us/r6/pdx/northwest-forest-plan.shtml>.

- U.S. Long Term Ecological Research Network (LTER). (2007). The Decadal Plan for LTER: Integrative Science for Society and the Environment. LTER Network Office Publication Series No. 24, Albuquerque, New Mexico. 154 pages.
- Usher, P.J. (2000). Traditional Ecological Knowledge in Environmental Assessment and Management. *Arctic*. 53(2): 183–193.
- Vayda, A.P. and B.J. McCay. (1975). New directions in the ecology and ecological anthropology. *Annual Review of Anthropology*. 4: 293-306.
- Walker, Brian, D. Ludwig, C.S. Holling and R.M. Peterman. (1981). Stability of semi-arid savanna grazing systems. *Journal of Ecology*. 69: 473-498.
- Walker, Brian and David Salt. (2006). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Island Press. Washington, D.C.
- Walker, Brian, Nick Abel, John M. Anderies, and Paul Ryan. (2009). Resilience, adaptability and transformability in the Goulburn-Broken Catchment, Australia. *Ecology and Society*. 14(1): 12.
- Walters, C.J. (1986). *Adaptive Management of Renewable Resources*. McGraw Hill, New York.
- Westoby, M., B.H. Walker, I. Noymeir. (1989). Opportunistic management for rangelands not at equilibrium. *Journal of Rangeland Management*. 42: 266-274.
- Wilkinson, Charles. (1992). *Crossing the Next Meridian Land, Water and the Future of the West*. Island Press. Washington, D.C.
- Williams, R. (2001). Public knowledge, preferences and involvement in adaptive ecosystem management. *Forest Resources*. Oregon State University, Corvallis, OR.
- Wilson, G.A. (2001). From productivism to post-productivism . . . and back again? Exploring the (un)changed natural and mental landscapes of European agriculture. *Transactions of the Institute of British Geographers*. 26(1): 77-102.
- Wilson, G.A. (2006). *Multifunctional Agriculture: A Transition Theory Perspective*> Cambridge, Massachusetts.
- Wright, A. S. (2000). Citizen knowledge and opinions about watershed management in the South Santiam Basin in Oregon. *Forest Resources*. Oregon State University, Corvallis, OR.
- Yli-Pelkonen, V. & Kohl, J. (2005). The role of local ecological knowledge in sustainable urban planning: perspectives from Finland. *Sustainability: Science, Practice, & Policy* 1(1): 3-14. <http://sspp.proquest.com/archives/vol1iss1/0407-007.yli-pelkonen.html>.

Zimmerer, K.S. (1994). Human geography and the 'new ecology': the prospect and promise of integration. *Annals of the Association of American Geographers*. 84: 108-125.

APPENDICES

Appendix A: Informed Consent

INFORMED CONSENT FORM

Project Title: Local Knowledge of Land Use and Ecological Change in the McKenzie River Basin
Principal Investigator: Denise Lach, Ph.D
Student Researcher: Tim Inman, MPP Candidate
Co-Investigator(s): Mark Edwards, Ph.D., Hannah Gosnell, Ph.D.
Sponsor: National Science Foundation
Version Date: June 11, 2010

1. WHAT IS THE PURPOSE OF THIS FORM?

This form contains information you will need to help you decide whether to be in this study or not. Please read the form carefully and ask the study team member(s) questions about anything that is not clear.

2. WHY IS THIS STUDY BEING DONE?

The purpose of this study is to gain a better understanding of the knowledge local community members have about how the natural landscape has changed. This knowledge will help researchers and policymakers better understand how communities such as yours adapt to changes in their natural environment.

This study is being conducted to provide a comparison to how other communities around the world have responded to changes in their natural landscape. In addition, the study will help serve as the masters project for the student researcher conducting the interview.

The number of study participants will not exceed 30.

3. WHY AM I BEING INVITED TO TAKE PART IN THIS STUDY?

You are being invited to take part in this study because of your experience living in the McKenzie River Basin and/or your experience working in the natural environment in the basin.

4. WHAT WILL HAPPEN IF I TAKE PART IN THIS RESEARCH STUDY?

If you decide to take place in this research a researcher associated with this study will interview you for a period estimated to not last more than one hour. The researcher will ask you a set of semi-structured questions to learn more about your experience interacting with the natural environment in the basin. Your interview will be one of not more than 30 that researchers will then compile and study to learn how the people living in the basin have experienced changes in the natural environment of the basin. This information will then be compared against other public records and studies, before being put together in a report. The report will be used for the student researchers masters project and will also be used to compare what's happened in the McKenzie River Basin with other experiences around the world.

Researchers anticipate interviews to be completed by the beginning of the fall and that the report will be finalized by the end of winter in 2011. Your participation is only anticipated to be about an hour for the interview. If more time is needed researchers will ask your permission to spend more time talking.

Recordings and photographs: Researchers would like to record your interview. Recordings are only being done to allow researchers to accurately transcribe your interview and to ensure what you say is accurately depicted by researchers.

_____ I agree to be audio recorded
Initials

_____ I do not agree to be audio recorded
Initials

Future contact: We may contact you in the future for another similar study. You may ask us to stop contacting you at any time.

Study Results: Study results will be submitted to the Oregon State Library. If you wish to view a hard copy of the report it can be found at the Oregon State Library. Or, if you would like to receive an electronic copy of the report please inform the researcher.

6. WHAT ARE THE BENEFITS OF THIS STUDY?

This study is not designed to benefit you directly.

7. Are there any potential risks associated with being involved in this study?

The only potential risk is that your information provided is accidentally disclosed. Researchers will take care to retain the confidentiality of any information provided, but nonetheless a risk does exist that information will be revealed.

8. WILL I BE PAID FOR BEING IN THIS STUDY?

You will not be paid for being in this research study. There are no costs associated with participating in this study.

9. WHO IS PAYING FOR THIS STUDY?

The National Science Foundation is providing minimal financial support paying for this research to be done.

9. WHO WILL SEE THE INFORMATION I GIVE?

The information you provide during this research study will be kept confidential to the extent permitted by law. Research records will be stored securely and only researchers will have access to the records. Federal regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. Some of these records could contain information that personally identifies you. If the results of this project are published your identity will not be made public.

Audio recordings of your interview will be kept confidential. The only individuals that will have access to the recordings will be the researchers associated with this study and named at the top of this consent form. As mentioned above, recordings will be kept and could potentially be used for future studies by researchers not associated with this study. Also, according to regulations the principal investigator involved in this study will keep all study related documents for three years. It is possible that electronic records will be saved on the Oregon State University server.

All study participants will be assigned a unique identifier that will be used to identify any information associated with the study participant. Information will be stored on a password-protected computer and only be accessible to members of the research team listed on the IRB protocol statement. A direct identifier will be maintained for each study participant to ensure that participant are able to be contacted for any necessary follow discussions relating to the research. Audio recordings will be stored in a locked space and only accessible to research team members listed on the IRB protocol statement. Upon completion of the study all data and audio recordings will be turned over to staff at the HJ Andrews Experimental Forest for permanent retention in case future studies are undertaken that relate to the social-ecological relationship in the McKenzie River Basin. The use of a unique identifier will maintain participants confidentiality with people outside of the research team. Information shared with the HJ Andrews Experimental

Forest will contain direct identifiers in case you need to be contacted for potential involvement in future studies. If future researchers do intent to use your information for future research, protocol that accompanies the data will expressly request that you are contacted to receive permission to use your information for any research.

9. WHAT OTHER CHOICES DO I HAVE IF I DO NOT TAKE PART IN THIS STUDY?

Participation in this interview is voluntary. If you decide to participate, you are free to withdraw at any time. If you choose to withdraw from this project before it ends, the researchers may keep information collected about you and this information may be included in study reports.

Optional questions: If you do not wish to respond to any of the questions during the interview you can inform the researcher you want to skip the question.

10. WHO DO I CONTACT IF I HAVE QUESTIONS?

If you have any questions about this research project, please contact: Denise Lach, the studies Principal Investigator. She can be reached at 541-737-5471.

If you have questions about your rights or welfare as a participant, please contact the Oregon State University Institutional Review Board (IRB) Office, at (541) 737-8008 or by email at IRB@oregonstate.edu

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study.

12. WHAT DOES MY SIGNATURE ON THIS CONSENT FORM MEAN?

Your signature indicates that this study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Participant's Name (printed): _____

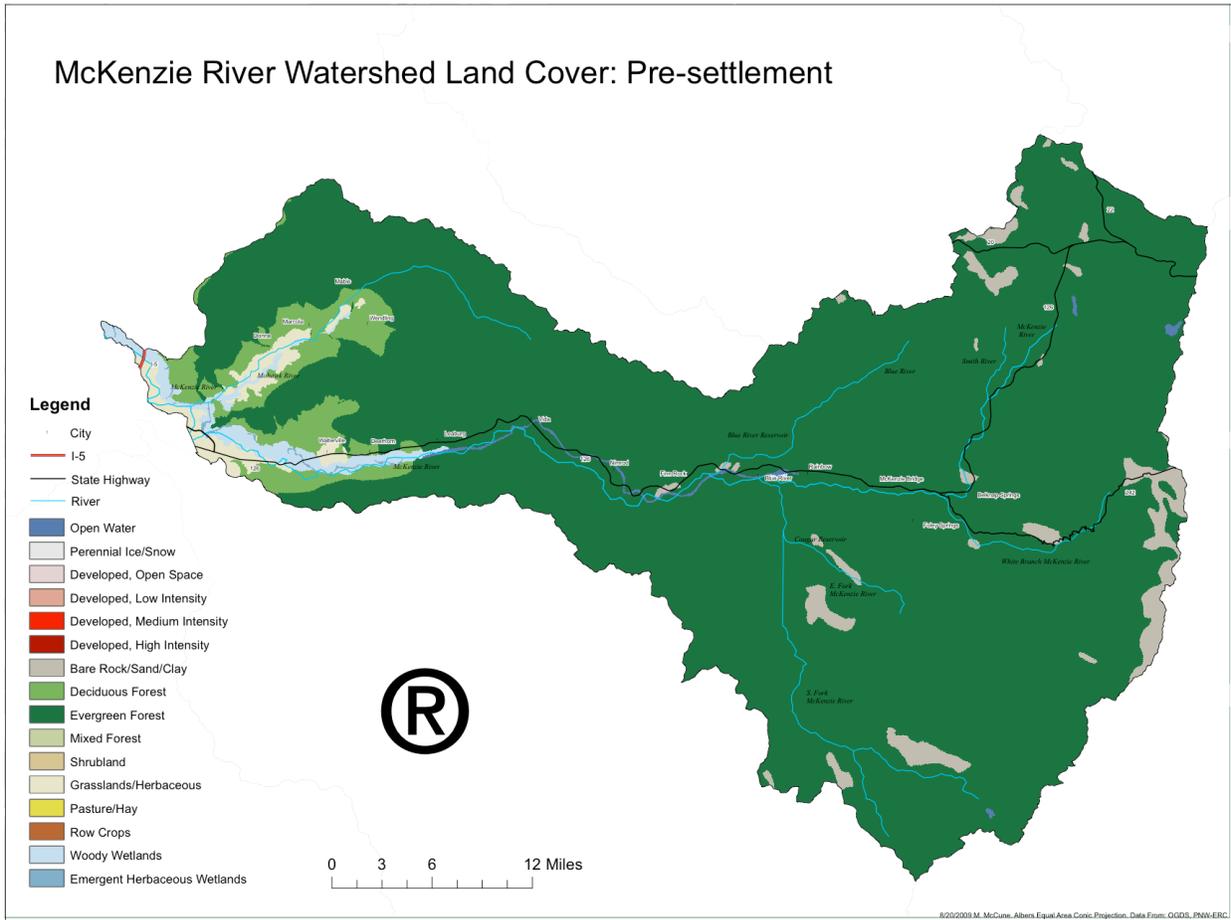
(Signature of Participant)

(Date)

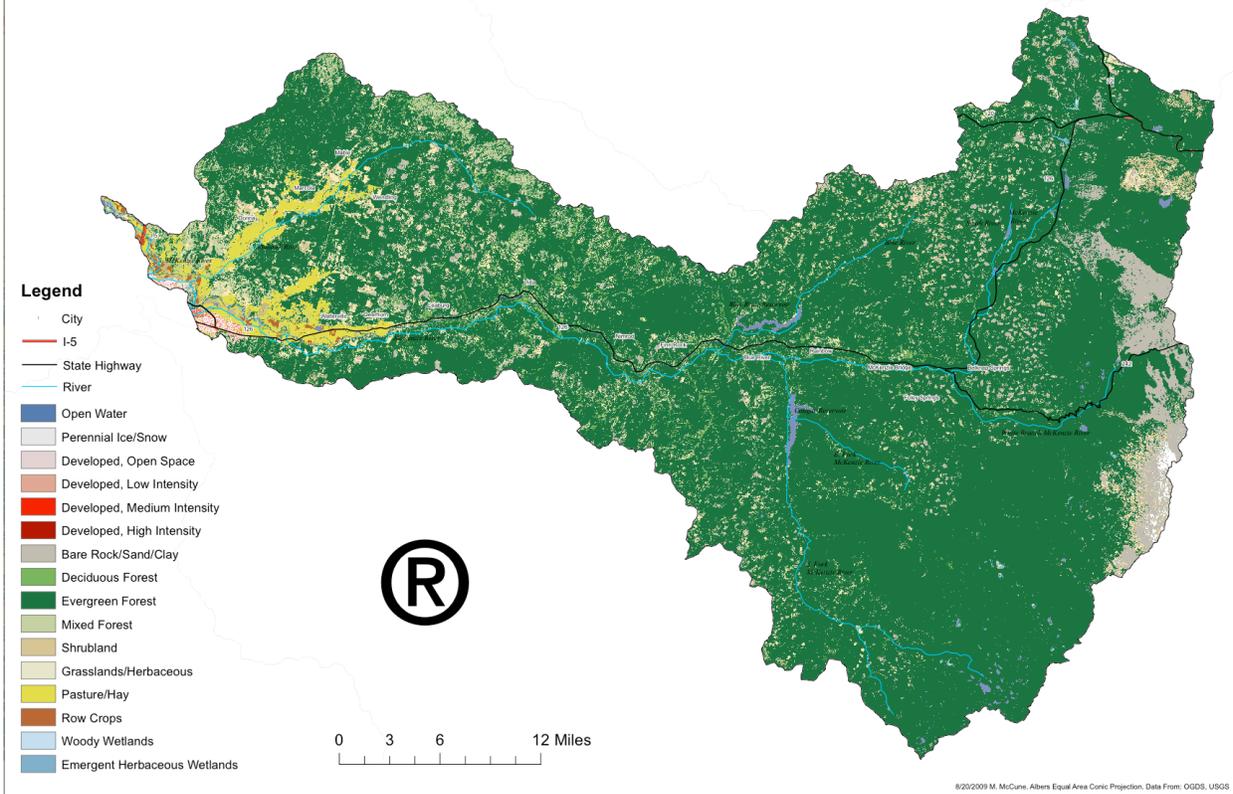
(Signature of Person Obtaining Consent)

(Date)

Appendix B: Phase One Maps



McKenzie River Watershed Land Cover: 1992 NLCD



McKenzie River Watershed Land Cover: 2001 NLCD

