A Social-Ecological Systems Approach to Understanding Environmental Changes, Impacts, Learning, and Well-Being in Rangelands

A Dissertation
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by
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Authorization to Submit Dissertation

This dissertation of Amanda L. Bentley Brymer, submitted for the degree of Doctorate of Philosophy with a Major in Environmental Science and titled "**A Social-Ecological Systems Approach to Understanding Environmental Changes, Impacts, Learning, and Well-Being in Rangelands,**" has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

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Abstract

Rangelands in the western United States are complex systems of dynamic social and ecological change comprising multiple laws and scales of environmental governance. Concepts and theory foundational to ecosystem services provide a useful way of thinking about the ways people benefit from the structure and functions of rangelands, but ignore fundamentally human structure and functions like *social system services.* Public and privately managed areas face similar ecological drivers of environmental change like the Western juniper expansion, cheatgrass invasion, and wildfire. However, public lands are unique in their management for multiple interests and conservation for future generations. Currently, three key issues stand out for decision-making about public lands: 1) Most assessments of potential impacts from proposed changes to public lands management fail to integrate ecological and socio-economic components and thus fail to fulfill requirements of the National Environmental Policy Act (NEPA), 2) public engagement in planning, assessment, and management of shared resources has been improved with collaborative and deliberative settings that foster social learning, however we know little about how social learning occurs within and between individuals, and 3) in addition to social learning processes, legally-based adversarial processes occur in public lands and natural resource management, however we know little about the role of litigation or the nature of its function within social-ecological systems. To address these issues, our interdisciplinary team developed a participatory social-ecological impact assessment (SEIA) to document perceptions of current and future conditions for human well-being under alternative scenarios of Western juniper removal. The SEIA was conducted during stakeholder workshops for the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project proposed by the Bureau of Land Management (BLM) in

southwestern Idaho. The same workshops provided an opportunity to investigate processes of social learning at an individual-scale. Dialogic interactions of workshop participants were analyzed for changes in cognitive, relational, and epistemic understanding. Aside from deliberative workshops, semi-structured interviews were conducted to understand litigation as a social change process and its influence on human well-being. Based on our results, we present an extended SES model that integrates social theory for a more holistic conceptualization of system structures, functions, and relationships.

Acknowledgements

conference room space, and personal and professional contacts, Neil and his wife Sue helped me experience many different cultural elements of southwestern Idaho: the Cattlemen's Association meeting in Silver City, the Caldwell Basque Dance, and the Caldwell Night Rodeo, to name a few. Neil, thank you for being there for our Sagebrush Team, and thank you for showing me the ropes.

Through our team research and my individual work, I interacted and corresponded with dozens of people living and working in southwestern Idaho. I am grateful to all for sharing their time and their knowledge with us. In particular, I'd like to thank John Biar, Joe Hinson, Margaret Soulen Hinson, Jerry Hoagland, Gretchen Hyde, Scott Jensen, Mike McGee, Dustin Miller, Lance Okeson, Jason Pyron, Brenda Richards, John Robison, Karen Steenhof, Art Talsma, and Wally Butler for their help and support.

My committee - like my parents, in a way - let me go and let me thrive. I am thankful for the space they gave me to develop ideas with my research team and on my own. Janet Rachlow provided incredibly rich context and balanced structure through her course assignments and two intense field trips to the sagebrush-steppe. It was with Janet that I first saw Greater sage-grouse strutting in a lek. With Tim Link's guidance, I grew to understand the complexities of the relationships between juniper, water, and high-arid deserts. It was with Tim that I tested my interdisciplinary (and trivia) thinking during an intense state-and-transition modeling course. Mark Brunson, with his timely and thorough replies, empowered me to think critically and holistically about the issues of the day. It was with Mark that I moderated a conference session on transdisciplinarity and learned how to feel at home in heterogeneity.

I've heard that a doctoral education can be rather isolating due to the intense pressure to venture into unknown intellectual territory. There were moments when loneliness crept into my life, but they were fleeting thanks to my research team - my colleagues and my friends - Alex Suazo, Ryan Niemeyer, and Joe Holbrook. How do I begin to summarize our lives together thus far? I can think of so many moments and milestones that we worked for and struggled together to achieve, yet what matters most to me now is the meaning each of you have imbued into my life. Thank you, to each of you, for being yourselves. You are all respectful, kind, and inspiring. Thank you for pushing me to be a better scientist. Thank you for your unwavering commitment to our shared experience. Thank you for your unflinching support when Rhett and I decided to grow our family. I believe that, while this document signifies our ultimate collective goal, our collaboration and our friendship will grow as we move on and find new and different mountains to climb. Let 'er buck!

While interviewing for a position in the last IGERT cohort, I was mulling over advice from friends that I find an advisor with whom I could connect professionally and personally. I thought this might be challenging, as I was at least superficially aware of the numerous factors that would add up to the right IGERT team equation. When I first met Dr. J.D. Wulfhorst, his calm demeanor in the midst of the intense IGERT interview process resonated with me. I knew that I wanted to work with such a person who could clearly articulate the uncertainties - and discuss ideas for coping with uncertainties - when choosing to take one path or another. J.D.'s deep respect for our team's growth *and* for my professional and personal experiences enabled our creativity, autonomy, and success. Over the years, I learned that J.D. and I share southern and peripherally mid-western upbringing, similar inclinations to communicate at length via several portals (though I have room to improve in this area), and a

constant quest for balance and sustainability for our selves and for our families. Most of all, J.D. taught me that *it ain't all figured out yet* - and that's okay, and I do not need to apologize for it. As a woman in academia, and now a new mother, I've suffered only from self-doubt. Once I released my fears, I found that I was already empowered by so many - J.D., most of all. Thank you, J.D. Your capacity to give structure and freedom simultaneously is a rare gift. Like our work and camaraderie with Joe, Ryan, and Alex, and the entire Sagebrush faculty, I hope that we can continue our exploration of the sagebrush sea and all who dwell in it.

Finally, with all my heart and devotion I thank Rhett, my dear husband and partner in academic life, parenting, and all our eclectic adventures. This is the second doctoral experience Rhett has endured, which is to say he is the strongest man I know in body, mind, and spirit. Rhett, thank you for believing in me (when I did not), for helping me to see and think about things in new ways, for all the late nights laboring (through writing and through Luke's birth!), and for encouraging me to see this through to the end - and on to the next adventure. Your unconditional support and love is the greatest gift of all.

Dedication

For Luke, who shows me how to be well.

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CHAPTER 1: INTRODUCTION

Nearly 150 years ago when national parks were initially established as unique areas full of intriguing biodiversity and breath-taking landscapes worthy of the protection of the United States government, the dry and dusty rangelands were considered leftovers. Protections for the arid sagebrush steppe and Great Basin were slow to develop, and the region was stressed by unregulated livestock operations and drought. As public opinion danced around preservationist and conservationist values, the Dust Bowl and the Great Depression served a twofold blow to western ecosystems and to communities across the country.

Progressive efforts to reestablish social and economic sustainability included new regulations for agricultural industries. Such protections were designed to pull the ecosystem back from the "tragedy of the commons" and to ensure standard practices. Once considered the leftovers, rangelands became – quite literally – the meat and potatoes for thousands of people who live and work in the western U.S. and for millions of people across the continent who rely on rangelands for everything from food and fiber to spiritual fulfillment.

Modern Complexities of U.S. Rangelands

Like all social and ecological systems, rangelands are not static; they evolve and shift into new states in response to environmental drivers of change. At a global scale, climate change is altering temperature and precipitation patterns that influence changes in fire frequency across rangelands. At a local scale, invasive and encroaching plant species are exacerbating wildfires and altering habitat to the detriment of humans, native plant communities, and species like the Greater sage-grouse (*Centrocercus urophasianus*) and the Pygmy rabbit (*Brachylagus idahoensis*).

Drivers of change can be social in nature, too – particularly laws and policies designed for environmental governance. Much of the landscape across the western U.S. is managed under a multiple-use mandate that requires public administrative agencies like the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) to ensure that the land will continue to benefit people living now and future generations. Given the diverse people and interests among western populations and our uncertainty of future needs for people who are not yet born, such management is challenging and ripe for conflict.

A Mosaic of Public and Private Lands and Interests

People do not agree, nor do people get along - these are not absolute rules, but they are two of the most basic and intractable problems facing systems of humans living in the same space and sharing the same resources for survival. Like the branches of our biological evolutionary tree, our societies have evolved with varying structures and purpose. At a global scale, we question how these diverse societies – many enduring extreme poverty or war – can share this planet and its resources. For rangelands in the western U.S., we question how diverse communities and interests can be sustained by stressed landscapes over which we have designated a mosaic of land management and utilization strategies.

<div align="center">

Complexities of Social-Ecological System Research

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Social and ecological systems (SES) around the world are inextricably linked, and particularly so across rangelands where the sustainable functioning of social and economic components depends upon the sustainable functioning of ecological components. A tip of balance in one area can send a cascade of effects into others. This is the focus of social-ecological approaches to understanding natural resources and their utilization and management: how do the social and ecological structures and functions relate to each other

and respond to change? Further, how do we assess the trade-offs of our actions for social, economic, and ecological dimensions of life, and how do we sustain well-being while adapting to irreversible change?

The prevailing assumption behind SES research is that complex feedbacks occur between social systems comprising people and communities and ecological systems comprising species and habitat (Carpenter et al. 2009). Feedbacks are conceptualized as the relationship between ecosystem structures and functions and social system structures and functions, including actor strategies (Diaz et al. 2011). As social actors benefit from certain functions of the ecosystem, or ecosystem services, social actors also make decisions about how to use and manage the ecosystem. The availability of ecosystem services can influence the decisions social actors make, and the decisions social actors make can impact the availability of certain ecosystem services, thus illustrating the feedbacks in a closed loop (Figure 1.1).
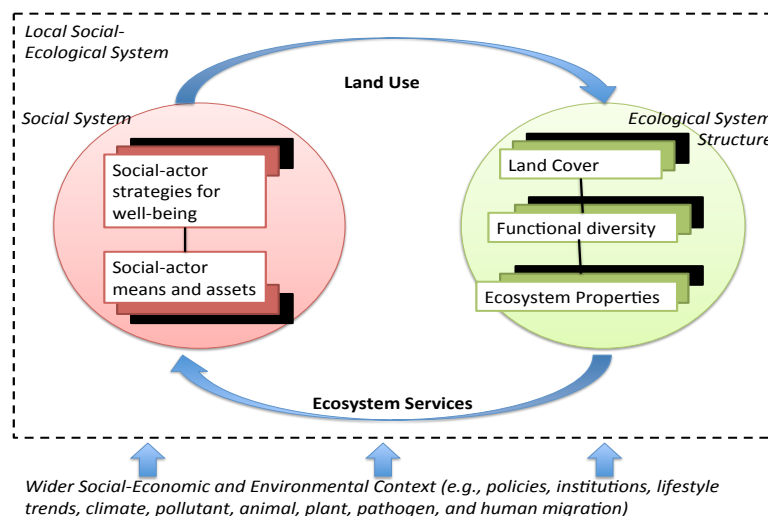
Figure 1.1. A conceptual framework from Diaz et al. 2011 explains how social-actors and social structures are linked to ecological structures and functional diversity through social actors' use of the land and through the provisioning of ecosystem services. Different social-actors rely on different ecosystem services to support their human well-being while they adapt to dynamic influences within their local social-ecological system and from the wider social-economic and environmental context.

Ecosystem services are defined as the benefits people obtain from ecosystems (MEA 2005), including benefits people perceive and those they do not (Costanza 2008). Ecosystem services are conceptualized as the processes that support human well-being, or "means to the end of human well-being" (Costanza 2008, p.350). Human well-being is defined as a multi-dimensional state opposite of poverty and comprising basic material for a good life, health, security, good social relations, and freedom of choice and action (MA 2005, Carpenter et al. 2009). These definitions of ecosystem services and human well-being will be challenged and expanded based on the results of this dissertation in the chapters that follow.

The rangelands of the western U.S., including sagebrush-steppe, make up a dynamic SES where land management decisions affect the provisioning of ecosystem services (Havstad et al. 2007). In turn, ecosystem services support human well-being, but we do not fully understand all the nuances of how.

Shifting Paradigm, Unbalanced Insights

As the science of natural resource management shifted from command-control approaches to ideas about complex systems and adaptability, theoretical foundations for adaptive and resilience thinking were born out of ecological theory and the ecosystem services approach described above. While this conceptualization of the role of ecological structures and functions and explanation of how ecosystems relate to social systems (and vice versa) are helpful, we are left wondering: how do social processes, or functions, interact within the social-ecological system, and to what end? What role do social actors with agency and capacity to learn play in setting the trajectory of social processes that ultimately affect ecosystems and the provisioning of ecosystems services back to the social system? In other

words, how can social theory help us better understand human dimensions of social-ecological systems?

We begin asking these questions of rangelands, and three key issues stand out: 1) most assessments of potential impacts from proposed changes to public lands management fail to integrate ecological and socio-economic components and thus fail to fulfill requirements of the National Environmental Policy Act (NEPA), 2) public engagement in planning, assessment, and management of shared resources has been improved with collaborative and deliberative settings that foster social learning, however we know little about how social learning occurs within and between individuals, and 3) in addition to social learning processes, adversarial processes like lawsuits and litigation occur in public lands and natural resource management, however we know little about the role of litigation or the nature of its function within social-ecological systems. To address these issues, a blend of interdisciplinary and disciplinary approaches were used integrate social theory for a more holistic conceptualization of system structures, functions, and relationships, and thus to elaborate the social dimensions of social-ecological systems.

A Research Road Map

For the chapters that follow, Table 1.1 provides a snapshot of my efforts to integrate social and ecological foundations across three research perspectives. It illustrates commonalities across chapters and points of disciplinary focus within chapters.

Overview of Chapter 2

Chapter 2, "*A social-ecological impact assessment for public lands management: application of a conceptual and methodological framework,*" is the culmination of four and a half years of collaboration with an interdisciplinary team of students and faculty – the NSF-

IGERT Sagebrush Team (National Science Foundation – Integrated Graduate Education and Traineeship). Together, we identified a problem that required insights from each of our disciplines – wildlife ecology, plant ecology, hydrology, and social science – and we applied our perspectives to the design of a social-ecological impact assessment for public land management. SES research provided a foundation for our approach, and we integrated concepts from ecosystem services and social change processes to expand current understanding of social-ecological relationships. Our integrated framework guided the design of a questionnaire that we implemented during workshops with stakeholders convened to deliberate potential management actions in a project proposed by the Boise District Office of the BLM. As a result, our social-ecological impact assessment is included as the social impact analysis within the draft environmental impact statement (DEIS) required of the BLM by the National Environmental Policy Act (NEPA). This produced a more comprehensive DEIS, which often neglect to include analyses of social or economic impacts.

While working together in this public lands context to assess dimensions of sustainability that support human well-being and to understand how changes in the environment might change human well-being, these workshops provided an opportunity for me to explore the communicative, interactive nature of the social system.

Overview of Chapter 3:

For Chapter 3, "*Assessing dialogic interactions for evidence of social learning in a deliberative setting for public lands management,*" I drew upon social and psychological theory to inform my understanding of the structure and function of learning between individuals communicating in a group setting. To better understand how learning occurs during and results from group dialogue and interactions, I analyzed workshop transcriptions

for dimensions of cognitive, relational, and epistemic change among individuals deliberating natural resource management values and strategies. The results of this chapter inform individual-centric conceptualizations of social learning in natural resource management contexts with implications for how learning occurs in deliberative group settings and moves beyond groups to wider communities of practice.

Overview of Chapter 4

For Chapter 4, "*Public lands litigation and its direct and indirect influence on human well-being: an extended model for social-ecological research*," I used the integrated concepts from our interdisciplinary chapter as a springboard for building theory about the role of social processes within SES, including their direct influence on human well-being, and their indirect influence on human well-being via cascading changes from land management to ecological structures to ecosystem services. At a network level, I wanted to understand how social processes influence change in social and ecosystems and what those changes mean for social well-being. At an individual scale, these changes translate to dimensions of individual well-being: how does individual well-being change when ecosystem services and social processes change, and why?

Overview of Chapter 5

At the conclusion of this dissertation, I will share concluding thoughts and explain where this body of work fits within the emerging literature and theoretical scholarship about SES. Opportunities for future research building off of this work will be discussed.

Table 1.1: Research perspectives and integrated frameworks applied in this dissertation, including investigated phenomena and units of analysis.

Research Perspective	Integrated Frameworks	Phenomena under Investigation	Unit of analysis / Location of phenomena
SOCIAL-ECOLOGICAL IMPACT ASSESSMENT			
System and Individual	**System** Concepts • SES, ecosystem services + social processes Theoretical foundations: • Feedback loops in coupled human-natural system and resilience thinking **Individual** Concepts • "Social impacts" as human experiences of physical and perceptive change • Dimensions of sustainability Theoretical foundations • Ecosystem services	Potential changes to human well-being under three future environmental scenarios	• Perceptions of SES structures and functions • Perceptions of environmental intervention • Perceptions of causal chain of influence between environmental intervention and human well-being • Perceptions of direction of influence on human well-being • Perceptions of place values and meanings
SOCIAL LEARNING			
Network and Individual	**Network** Concepts • Social learning settings, processes, and outcomes Theoretical foundations • Micro-foundations **Individual** Concepts • Dimensions of cognitive, relational, and epistemic change Theoretical foundations • Communicative action	• Changes in cognitive, relational, and epistemic understanding between individuals in a group setting • Discussion and learning topics	• Workshop participants' dialogic interactions • Perceptions of workshop process and outcomes
LITIGATION & HUMAN WELL-BEING			
System, Network, and Individual	**System** Concepts • SES, ecosystem services, social change processes Theoretical foundations: • Feedback loops in coupled human-natural systems and resilience thinking **Network** Concepts • Dimensions of social well-being Theoretical foundations • Symbolic interactionism ("mind, self, and society") • Ecosystem services **Individual** Concepts • Dimensions of individual well-being Theoretical foundations • Symbolic interactionism • Ecosystem services	• Drivers of SES change - specifically, litigation as a social process • Individual and social dimensions of human well-being (HWB)	• Perceptions of SES structures and functions • Perceptions of litigation • Perceptions of HWB • Perceptions of causal relationships between these multi-scale phenomena

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CHAPTER 2

A social-ecological impact assessment for public land management: application of a conceptual and methodological framework

Submitted to *Ecology and Society*

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Abstract

According to the U.S. National Environmental Policy Act of 1969 (NEPA), federal action to manipulate habitat for species conservation requires an environmental impact statement (EIS), which should integrate natural and social sciences in planning and decision-making. Nonetheless, most impact assessments focus disproportionately on ecological impacts rather than an integration of ecological and socio-economic components. We developed a participatory social-ecological impact assessment (SEIA) that addresses the requirements of NEPA and integrates social and ecological concepts for impact assessments. We cooperated with the Bureau of Land Management in Idaho (USA) on a project designed to restore habitat for the Greater sage-grouse (*Centrocercus urophasianus*), which is a candidate species for listing under the Endangered Species Act. We employed questionnaires, workshop

dialogue, and participatory mapping exercises with stakeholders to identify potential environmental changes and subsequent impacts expected to result from the removal of western juniper (*Juniperus occidentalis*). Via questionnaires and dialogue, stakeholders identified 46 environmental changes and associated positive or negative impacts to people and communities in Owyhee County. Results of the participatory mapping exercises showed that the spatial distribution of social, economic, and ecological values throughout Owyhee County are highly associated with the two main watersheds, wilderness areas, and the historic town of Silver City, Idaho. Our SEIA framework also highlighted that perceptions of spatial and temporal scale varied among participants, emphasizing that specificity in scales is needed when discussing proposed projects. Overall, our SEIA framework generated substantial information concerning spatial and temporal impacts associated with habitat treatments for greater sage-grouse. Our SEIA is transferable to other conservation contexts, and by applying our framework land managers will better satisfy the requirements of NEPA as well as develop a more effective management plan to achieve their conservation goals.

Key Words: social-ecological systems; impact assessment; public lands; National Environmental Policy Act; NEPA; deliberative workshops; public participatory GIS; PPGIS

Introduction

When federal actions aimed at species conservation are anticipated to cause significant impacts to the environment, land and resource managers in the U.S. are required by the National Environmental Policy Act of 1969 (NEPA) to assess potential impacts, develop mitigation strategies, and report their findings in an environmental impact statement (EIS). NEPA stipulates an interdisciplinary approach so that the entire environment is included in planning and decision-making (CEQ 2007). Even so, a typical EIS tends to comprise more

ecological than social impacts; integrated assessments that include primary social science data are uncommon (see Burdge 2002; Whitfield et al. 2011).

A social impact is defined as a physical or cognitive effect experienced by humans and their communities and caused by a change in the social or ecological environment (Vanclay 2002). Traditionally, secondary sources such as Census data were analyzed to identify potential social impacts (Becker 1997), but secondary data can be inappropriate when sources are outdated or lack information on specific community needs or cultural issues (Esteves et al. 2012). Consequently, typical social impact assessments (SIA) often lack current, primary data (Lockie 2001) and rarely invite stakeholders to actively engage in planning or assessment processes (Vanclay & Esteves 2011). The deficiency in SIA for fulfilling the NEPA requirements not only contradicts NEPA's objectives, but also limits the efficacy of management plans to achieve conservation goals.

Effective SIA facilitates the evaluation and management of social issues associated with planned interventions (e.g., management or land use change) and are participatory, supportive of populations affected by interventions, and increase the populations' capacity to respond to change (Vanclay 2003; Esteves et al. 2012). However, Esteves et al. (2012) identified a set of issues that persist in SIA, including inadequate public participation and analyses that do not identify spatial or temporal distributions of impacts. Research has demonstrated that dialogue-based approaches to SIA such as interactive community forums and participatory modeling can help to overcome these limitations by providing a more comprehensive and deeper understanding of social values, sense of place, and perceived impacts (Becker et al. 2003; Harris et al. 2012; Whitfield & Reed 2012). Rather than predicting impacts from secondary data sources, an emerging paradigm of SIA seeks a

community-based process that empowers affected people with 1) improved understanding of a project, and 2) increased capacity to negotiate outcomes with the project managers or developers (Vanclay & Esteves 2011).

Reconciling the shifting SIA paradigm and the requirements for NEPA processes highlights the need for novel methodological approaches that can capture social dynamics like political tensions among different interest groups, as well as diverse perspectives on changing ecological conditions. The development of such approaches should assist public land managers in developing socially and ecologically comprehensive management plans that aid in decision-making and ultimately help achieve conservation goals. Our research objective was to develop a social-ecological impact assessment (SEIA) framework and that addresses the requirements of NEPA and embodies the emerging SIA paradigm calling for more participatory, dialogue-based approaches. Our conceptual framework builds on previous work (i.e., Slootweg et al. 2001; de Groot et al. 2002, 2010; Vanclay 2002) by merging ecosystem service concepts with social process concepts to better represent the interdependent relationships between humans and ecosystems. The methodological approach directly engages diverse stakeholders and builds on previous work (i.e., Becker et al. 2003; Gunderson & Watson 2007; Harris et al. 2012; Lowery & Morse 2013; Whitfield & Reed 2012) by deliberating project alternatives to identify stakeholders' perceptions of potential impacts, and by adding a spatial dimension with participatory mapping to include values across the landscape and project area.

We apply our SEIA framework to a high-profile conservation context in the western U.S., greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) habitat restoration. As of January 2015, the Bureau of Land Management (BLM) has been developing

a draft EIS focused on improving habitat for sage-grouse by removing conifer trees. Sage-grouse are a sagebrush ecosystem obligate currently being considered for listing under the Endangered Species Act (USFWS 2010) due to >50% habitat loss since the mid-1800s (Knick et al. 2003). We embedded our integrated SEIA into the BLM's active NEPA process, illustrating the potential of this approach for other EIS processes aimed at species conservation on public lands.

Proposed Action: Sage-Grouse Habitat Restoration

The proposed study region for the treatments of sage-grouse habitat was in Owyhee County in southwestern Idaho, USA (Fig. 1). Owyhee County is comprised of 76% public land (managed mostly by BLM), 2,092 km^2 (11%) of which is designated wilderness (Owyhee Initiative 2012). Agriculture comprises 26.1% of total employment in Owyhee County with two-thirds of that sector engaged in ranching (University of Idaho Extension 2015). Most ranches are not economically viable with private land alone; these operations rely on permitted grazing on BLM allotments (Bartlett et al. 2002). Although the Owyhee region is vast and rural, it is in close proximity to the greater Boise metropolitan area (Mackun & Wilson 2011), from where many people travel for hunting, fishing, rafting, bird watching, hiking, and off-highway vehicle riding.

The habitat treatment plan proposed by the BLM was termed the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project, and the goal for the project is to improve or maintain sage-grouse breeding habitat (i.e., area surrounding leks) by removing junipers (*Juniperus* spp.) that are expanding. Conifers, including junipers and pinyon pines (*Pinus* spp.), are dominant trees in Great Basin woodlands that have expanded into sagebrush habitats (Tausch et al. 1981; Romme et al. 2009). Tree expansion can negatively affect sage-grouse breeding

habitat (e.g., Baruch-Mordo et al. 2013), which has prompted management actions to remove conifers.

The BOSH project proposes to remove low-density western juniper (*Juniperus* spp.) stands that are within 10 km of 63 active sage-grouse leks within Owyhee County (Fig. 2.1).
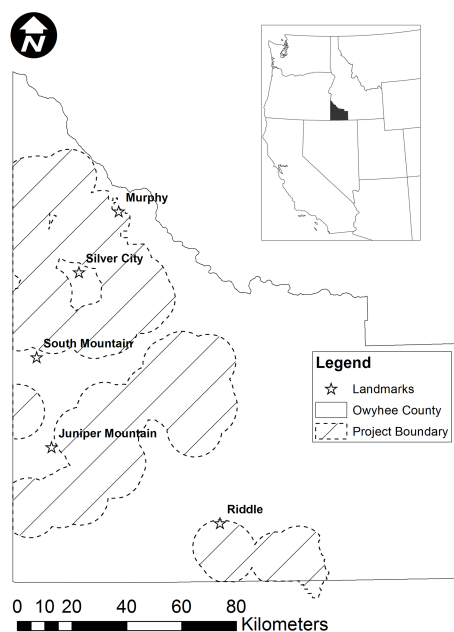
Figure 2.1: Inset map shows the western USA with Owyhee County, Idaho, in dark grey. Map of Owyhee County shows the proposed project boundary and five landmarks for the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project.

The BLM and Idaho Department of Fish and Game (IDFG) define active leks as those that have been visited by at least two male sage-grouse in at least one of the last five years. The BLM chose the 10 km buffer because approximately 80% of hens nest within 10 km of their lek. The proposed project boundary covered 708,200 ha (1.75 million acres) of southwestern Idaho and included 93,078 ha (230,000 acres) of wilderness. Proposed treatments included cut and scatter, mastication, and jackpot burning. Cut and scatter involves cutting down trees and scattering the branches, while mastication uses heavy machinery that shreds the above ground tree biomass and spreads the mulch (Cline et al. 2010). Jackpot burning also employs heavy

machinery to stack cut trees and burn the piles when fire risk is low (Huffman et al. 2009). In accordance with NEPA, the BLM developed treatment alternatives that included: 1) no action: no juniper removal, 2) full-suite: cut and scatter, mastication, and jackpot burning where deemed necessary and appropriate, and 3) cut and scatter: cut and scatter where deemed necessary and appropriate.

<p style="text-align:center">SEIA Development</p>

Conceptual Framework

To build the SEIA framework, we merged previously developed conceptual frameworks that emphasize the connection between humans and ecosystems. First, we applied concepts from the de Groot et al. (2002, 2010) ecosystem services framework that provides a standardized typology for describing and classifying ecosystem functions, goods, and services: 1) provisioning, 2) processing, 3) supporting, and 4) cultural. Second, we used Vanclay's (2002) conceptualization of social processes to integrate economics, governance, and empowerment concepts with ecosystem services concepts. The combination of these concepts provides a more comprehensive framework for assessing potential social-ecological changes and impacts in complex systems. These aforementioned concepts have been defined and discussed in community development contexts, but have rarely been integrated in a regulatory context on U.S. public lands.

We adapted a flow diagram from Slootweg et al. (2001) to serve as a guide for the identification and description of cause and effect pathways and to aid in the articulation of potential impacts to people and communities. For example, removal of juniper (*Juniperus* spp.) trees from a landscape exemplifies an intervention that causes social-ecological change (Fig. 2). A stakeholder might perceive that a reduction in juniper cover will lead to improved

sagebrush habitat for sagebrush obligate species, and for people who appreciate sagebrush obligates, an improvement in obligate species habitat might lead to a positive perception of juniper removal (Fig. 2.2). Examples illustrating two additional pathways are provided and described in the flow diagram (Fig. 2.2).
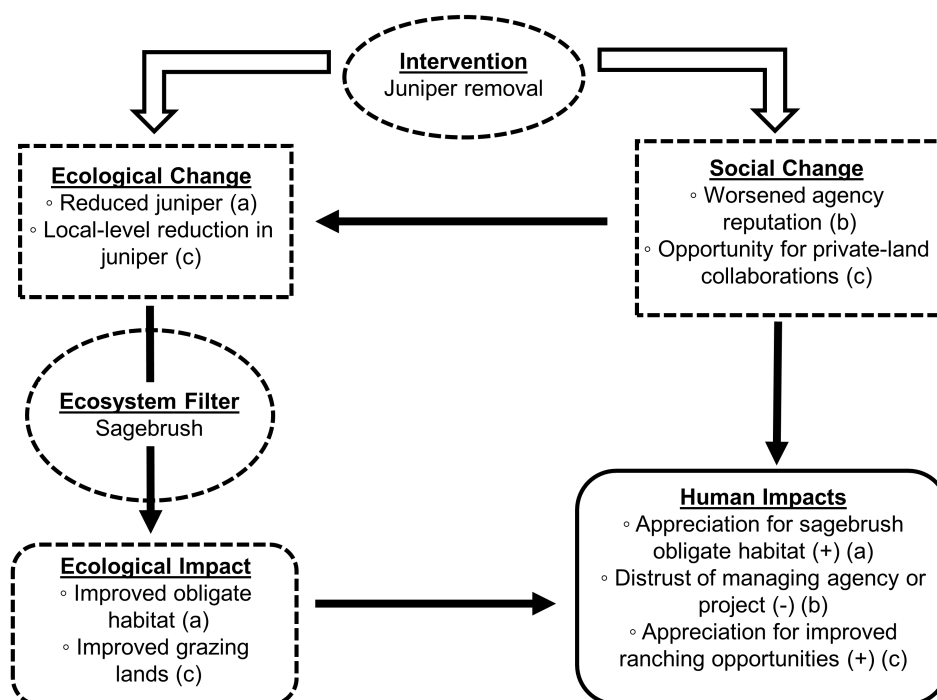
Figure 2.2: Flow diagram of the social-ecological impact assessment (SEIA) framework (modified from Slootweg et al. 2001). The diagram begins with an intervention (e.g., juniper removal), which ultimately generates social or ecological change through three pathways. (a) First, an ecological change might be a reduction in juniper. This change is filtered through an ecosystem (e.g., sagebrush) and results in an ecological impact such as improved habitat for sagebrush-obligate species. This ecological impact could then result in a positive (i.e., +) human impact in terms of appreciation of habitat for sagebrush obligates. (b) Second, an intervention might generate social change that degrades an agency's reputation, which directly generates a negative (i.e., -) human impact in terms of public distrust of the management agency. (c) Lastly, an intervention could produce social change in terms of generating opportunity for private-land collaborations. This collaboration could results in additional local-level juniper removal. This change is then filtered through the ecosystem and generates an ecological impact of improved grazing lands. The human impact via this last pathway is positive (i.e., +) in that it generated an appreciation for improved ranching opportunities. Human impacts are in solid lines and all other components are in dotted lines. All arrows represent pathways to human impacts.

Methodological Approach

The SEIA approach also merges a deliberative workshop setting and participatory mapping activities to better understand differing perspectives among people who live and work in the Owyhee region and to identify spatial dimensions of their values. Public participation GIS (PPGIS) is a method to spatially represent public knowledge, sense of place, or values by including members of the public in the mapping process (Talen 2000; Brown 2005). We merged participatory, qualitative approaches to SIA (Becker et al. 2003; Harris et al. 2012) and PPGIS methods (Gunderson & Watson 2007; Lowery & Morse 2013) because 1) there is a need and legal mandate to involve the public in planning processes (Brown & Weber 2011; Brown & Donovan 2013), and 2) human-ecosystem interactions and planning are inherently geospatial. These methods have rarely been applied together to understand potential impacts as required by NEPA on U.S. public lands.

We implemented two workshops to foster discussion about the alternatives drafted by the BLM, general stakeholder values, and benefits stakeholders receive from the ecosystem (i.e. the Owyhee region). In the first workshop, we structured questionnaires and dialogue directly around the conceptual framework and flow diagram. Using a workshop protocol similarly structured to interactive community forum formats (Becker et al. 2003), participants were prompted to deliberate the proposed juniper treatment alternatives, how each alternative might cause changes to ecosystem services, (e.g., provisioning, processing, supporting, and cultural services), and/or changes to social processes (e.g., economic, institutional and legal, or empowerment processes), and how those changes might positively or negatively impact people and communities. In the second workshop, we asked participants to spatially draw

values associated with social, economic, or ecological characteristics or processes fundamental to their relationships to the ecosystem.

Methods

The sampling frame included local, state, and federal resource managers, as well as organizations involved in a long-term collaborative effort in the Owyhee region (i.e., The Owyhee Initiative), which served as a clearinghouse of parties interested in resource management in the Owyhee region. Prior to our agreement with the BLM, a stakeholder group comprising managers from the BLM and Idaho Fish and Game, restoration conservationists from non-governmental organizations, and representative from the Owyhee County Sage-grouse Local Working Group had already been formed by the project lead (Group 1). To broaden the range of perspectives for the SEIA, we purposively sampled 27 stakeholder groups whose members are concerned with ecosystem functions in the Owyhee region to create an additional workshop group (Group 2). Group 1 and Group 2 separately participated in a two-workshop series. Each workshop spanned an average of 5 hours. We followed ethical guidelines for working with human subjects, and the University of Idaho Institutional Review Board approved our project #12-357.

Deliberative Workshops

The first workshop began with an overview presentation of the BOSH project and four rounds of questionnaires with subsequent deliberation (Appendix D). The first round assessed participants' baseline perceptions of the current structure and function capabilities of the Owyhee region in terms of ecosystem services and social processes, while the subsequent three rounds of questions revealed stakeholders' perceptions of future structure and function of the Owyhee region under the three BOSH project alternatives.

Quantitative and qualitative analytical approaches were employed. Questionnaires included seven questions related to ecosystem services and social processes. All four questionnaires were identical, but while completing the four questionnaires participants were asked to consider the structure and function in the present state (i.e. baseline) and in the future under the three project alternatives. For the present state and future conditions under each management alternative, participants rated items from 0 – "as bad as it can be" – to 10 – "as good as it can be." To compare the perceived benefits or costs of juniper treatment, we normalized each participant's ratings by subtracting their "baseline" rating from the three alternative ratings. The last question related to the level of acceptability for each treatment in wilderness areas, which was different than the other questions because there was no baseline condition and the scale was from 0 – "extremely unacceptable" to 5 – "extremely acceptable." Thus, we analyzed the wilderness question separately. Data were analyzed with R statistical software (R Core Team, 2014).

Workshop dialogue was recorded and transcribed for analysis in NVivo 10 (QSR International Pty Ltd. Version 10, 2012). First, the integrated social-ecological conceptual framework was used to categorize participant responses into statements about particular ecosystem services and social processes. Second, a grounded theory approach was used to review the transcriptions and allow descriptions of potential impacts to emerge from participants' deliberations. For a social-ecological impact to be included in the analysis, it had to 1) be explicitly stated, and 2) include the direction of effect (e.g., positive/better, negative/worse, no change).

PPGIS Workshops

We implemented a qualitative approach to PPGIS (e.g., Brown & Pullar 2012, Lowery & Morse 2013). We presented participants with laminated 61 x 91 cm aerial photographs (USDA, National Agriculture Imagery Program 2011) at a scale between 1:400,000 and 1:500,000. We asked each individual to map areas throughout Owyhee County that they perceived as valuable for social, economic, and ecological reasons. Next, we presented a separate set of maps that displayed the BOSH project boundary and asked participants to identify areas where they did not want the project executed and to explain why. We then took photographs of each map to create a county value map by digitizing polygons within ArcGIS 10.1 (ESRI 2012). Each polygon had attributes indicating the group and participant number and whether it was based on social, economic, or ecological justification. We analyzed overlapping polygons in ArcGIS (Honeycutt 2013) across a 30 m^2 grid overlaid on Owyhee County and the BOSH boundary.

Results

The sample consisted of 20 participants in total; 16 participated in the deliberative workshops and ten also participated in the PPGIS workshops. Everyone who participated in a workshop also completed the four questionnaires. Four participants completed questionnaires but were unable to participate in the workshops. As self-described, participants represented diverse user groups including conservationists (6), wildlife biologists (4), livestock ranch land owners (2), restoration coordinator (1), archaeologist (1), natural resource manager (1), land management supervisor (1), retired fire fighter (1), cartography technician (1), self-employed individual (1), and one individual who did not self-identify an occupation.

Questionnaire Results

The average observed range of responses for all four questionnaires was 81.6% (Fig. 2.3), indicating that the sample of participants revealed a broad range of perspectives. On average, participants' ratings for future social-ecological conditions in the Owyhee region under the no action alternative were 1.4 points (SD 1.9) lower than their baseline ratings. This suggests most workshop participants perceived that if there were no action to remove juniper trees, future social-ecological conditions in the Owyhee region would deteriorate. Participant ratings for the full-suite and cut and scatter alternatives were on average 1.4 points (SD 2.8) and 0.3 points (SD 2.3) higher than their baseline ratings, respectively. This suggests many workshop participants perceived that implementation of either treatment alternative will improve future social-ecological conditions, but for some participants the full-suite alternative will lead to a higher degree of improvement, bringing the Owyhees closer to "as good as it can be."
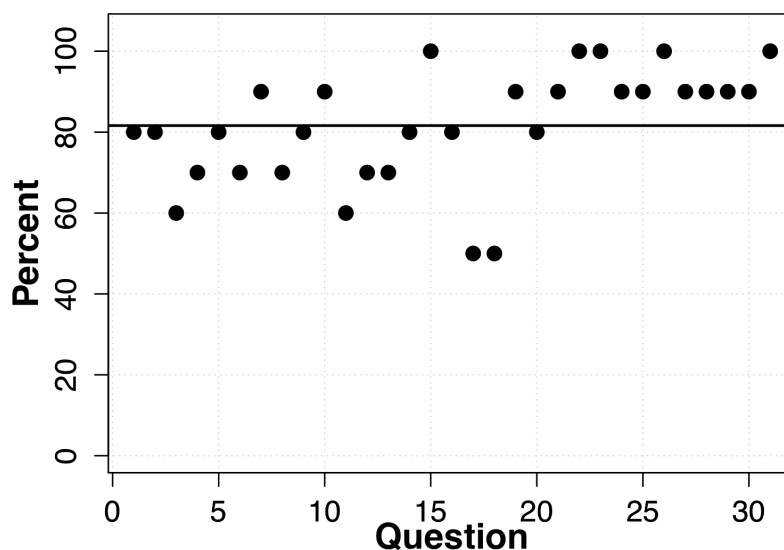
Figure 2.3: Percent of the total range observed for responses for each question. For example, for question 1 we observed a minimum score of one and a maximum score of eight, which translates to 80% range observed. Horizontal line is the average range observed across all questions.

Some social conditions (e.g., economic, institutional and legal, and empowerment processes) were rated higher in a future with either the full-suite or cut and scatter alternative by almost all participants (Fig. 2.4e, f, & g), in contrast to some ecological conditions (e.g., supporting service: open space, cultural service: opportunities for spiritual enrichment and recreation), which were rated inconsistently across participants (Fig. 2.4c & d). On the acceptability of juniper removal within wilderness, participants' responses displayed substantial variation indicating little consensus.
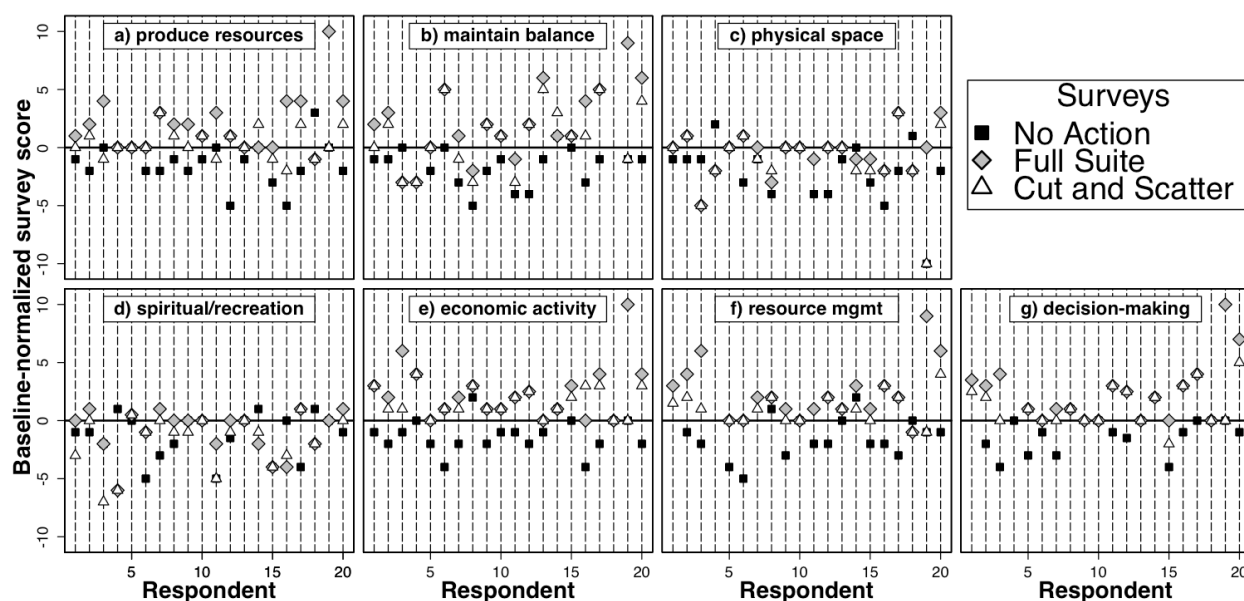
Figure 2.4: Participant responses to seven questions (Appendix D, except for question #8) concerning the current state of Owyhee County (i.e., baseline) and the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project alternatives: no action, full suite, and cut and scatter. Displayed scored as baseline-normalized by subtracting the participant baseline score form his/her alternative score. Responses about alternatives were normalized to baseline scores (e.g., Participant 1 baseline score is 7, full suite score is 8, and the baseline-normalized score is 1).

Deliberative Workshops Results

Workshop participants described 46 environmental changes and associated positive or negative impacts that they anticipate to result from the BOSH project alternatives (see Appendices A, B, and C). Of the 18 changes to ecosystem services and social processes

anticipated from the no action alternative, fifteen changes were perceived to lead to negative

impacts and three changes were perceived to lead to positive impacts to people and their sense

of well-being (Table 2.1).

Table 2.1. Perceived changes to social processes and ecological services, and the direction of subsequent impacts, concerning the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project in Owyhee County, USA.

Process/Service	Direction of Effect		
	Positive	**Negative**	**No Change**
	SOCIAL		
	No Action:	*No Action:*	*No Action:*
	-None described	-Less opportunity for local economy	-Same opportunity for local economy
		-Tension on livestock operators	
Economic processes	*Full Suite:*	*Full Suite:*	*Full Suite:*
	-More opportunity for local economy	-None described	-No change in ability to make a living
	-Ability to make a living: improved		
	Cut and Scatter:	*Cut and Scatter:*	*Cut and Scatter:*
	-More opportunity for local economy	-Weakening of local livelihoods	-None described

		-Reduced range and grazing	
	No Action:	*No Action:*	*No Action:*
	-None described	-Disheartening to land managers	-None described
		-Endangered listing of Greater sage-grouse	
Institutional and legal processes	*Full Suite:*	*Full Suite:*	*Full Suite:*
	-Improved management	-Worse management	-No change in management
		-Worsened agency reputation	
	Cut and Scatter:	*Cut and Scatter:*	*Cut and Scatter:*
	-None described	-Diminished management effectiveness	-None described
	No Action:	*No Action:*	*No Action:*
	-None described	-Less opportunity for stakeholder collaboration	-Same opportunity for stakeholder collaboration
Empowerment processes			
	Full Suite:	*Full Suite:*	*Full Suite:*
	-None described	-None described	-None described
			Cut and Scatter:

	Cut and Scatter:	*Cut and Scatter:*	-No change in stakeholder decision-making
	-None described	-None described	
ECOLOGICAL			
Provisioning	*No Action:*	*No Action:*	*No Action:*
	-Impact to ecosystem	-Decline of historic plant communities	-None described
	Full Suite:	*Full Suite:*	*Full Suite:*
	-Improved range and grazing	-None described	-None described
	Cut and Scatter:	*Cut and Scatter:*	*Cut and Scatter:*
	-Improved ecosystem health and characteristics -Increased water availability	-None described	-None described
Processing	*No Action:*	*No Action:*	*No Action:*
	-None described	-More difficult to balance or restore landscape/ecological processes -Reduced functionality of	-None described

	watershed		
	Full Suite:	*Full Suite:*	*Full Suite:*
	-Increased watershed functionality	-Increased fire danger	-None described
	Cut and Scatter:	*Cut and Scatter:*	*Cut and Scatter:*
	-Increased watershed functionality	-Increased fire danger	-None described
	No Action:	*No Action:*	*No Action:*
	-None described	-Loss of biodiversity and habitat -Loss of sage-grouse habitat	-None described
Supporting	*Full Suite:* -Increased biodiversity -Improved wildlife habitat -Improved sage-grouse habitat	*Full Suite:* -Degraded wildlife habitat	*Full Suite:* -None described

	Cut and Scatter:	*Cut and Scatter:*	*Cut and Scatter:*
	-Improved wildlife habitat	-Degraded sage-grouse habitat -Increased cover for sage-grouse predators	-None described
	No Action:	*No Action:*	*No Action:*
	-Availability of areas without treatment for study -Improved general enjoyment of the Owyhees	-Loss of open space -Limits on recreation -Less aesthetic enjoyment -Diminished hunting -Diminished spiritual experience	-No change for general enjoyment of the Owyhees -No change in spiritual experience
Cultural	*Full Suite:* -Improved general enjoyment of Owyhees -Improved hunting -Improved viewshed -Improved spiritual experience -Maintained culture	*Full Suite:* -Recreation: disrupted -Degraded viewshed	*Full Suite:* -No change in solitude -No change in recreation -No change in viewshed -No change in spiritual experience

	tied to cowboy and sage-grouse		
	Cut and Scatter: -None described	*Cut and Scatter:* -Degraded viewshed	*Cut and Scatter:* -No change in general enjoyment of the Owyhees

For example, if there is no action to remove juniper from the landscape, people anticipated experiencing negative impacts due to reduction of watershed functionality, loss of biodiversity and habitat (particularly sage-grouse habitat), diminished spiritual experience, less opportunity in the local economy, and less opportunity for stakeholder collaboration. Positive impacts were expected to derive from the availability of areas without juniper removal for control group studies and from the improvement of overall enjoyment of the Owyhee region. The most striking split in opinion among participants related to perceived impacts that no action will have on their overall enjoyment of the Owyhee region. Some participants enjoy the Owyhee region when they know it is managed and junipers are removed – particularly due to the belief that reduced juniper cover improves sage-grouse habitat. Other participants emphasized that junipers are native and that we are managing too much. For them, the knowledge that nothing is being done to remove juniper is comforting and improves their overall enjoyment of the Owyhees.

We found participants' perceptions of potential social-ecological changes and subsequent impacts from the full-suite and cut and scatter alternatives to be mostly similar,

though a few key differences stood out. Workshop participants described five similar environmental changes that they perceived could be caused by both alternatives leading to negative impacts: increased fire danger, degraded wildlife habitat, diminished viewsheds, and worsened agency reputation and diminished management effectiveness, primarily for the BLM. Workshop participants described three similar environmental changes that they perceived could be caused by both alternatives leading to positive impacts: improved watershed functionality, improved wildlife habitat, and more opportunity in the local economy. For the full suite, some participants anticipated additional positive impacts, some of which included improved management, viewsheds, general enjoyment of the Owyhee region, and the maintenance of culture tied to cowboys and sage-grouse.

Contrary to those who anticipated both alternatives to cause certain social and ecological changes, other participants described that in a future under the full suite alternative, there would be no change in some stakeholders' ability to make a living, no change in management, and no change in viewshed or spiritual experience. The split in opinion about anticipated environmental changes was based on participants' varying perceptions of project scale and juniper removal tools. For example, some participants expressed concern that mastication would be applied across the entire project area, while others understood that mastication was proposed for roadsides only.

PPGIS Workshops Results

The PPGIS workshop comprised mapping activities based on two key questions: 1) "What areas across Owyhee County are important to you for social, economic, and/or ecological reasons?", and 2) "Within the BOSH Project boundary, where do you not want juniper removed?" Results from the first mapping activity ("county values map," hereafter)

show that the overall distribution of perceived values (social, economic, and ecological combined) throughout the Owyhee region is highly associated with the two main watersheds (Owyhee and Bruneau-Jarbidge), wilderness areas (e.g., Owyhee River and near Juniper Mountain), and the town of Silver City, Idaho (Fig. 2.5). Silver City is a historic mining town with a deep history and many cultural traditions. The Owyhee and Bruneau-Jarbidge watersheds are within significant portions of the Owyhee River and Bruneau-Jarbidge wilderness areas (see point 1 and 2 in Fig. 2.5a).
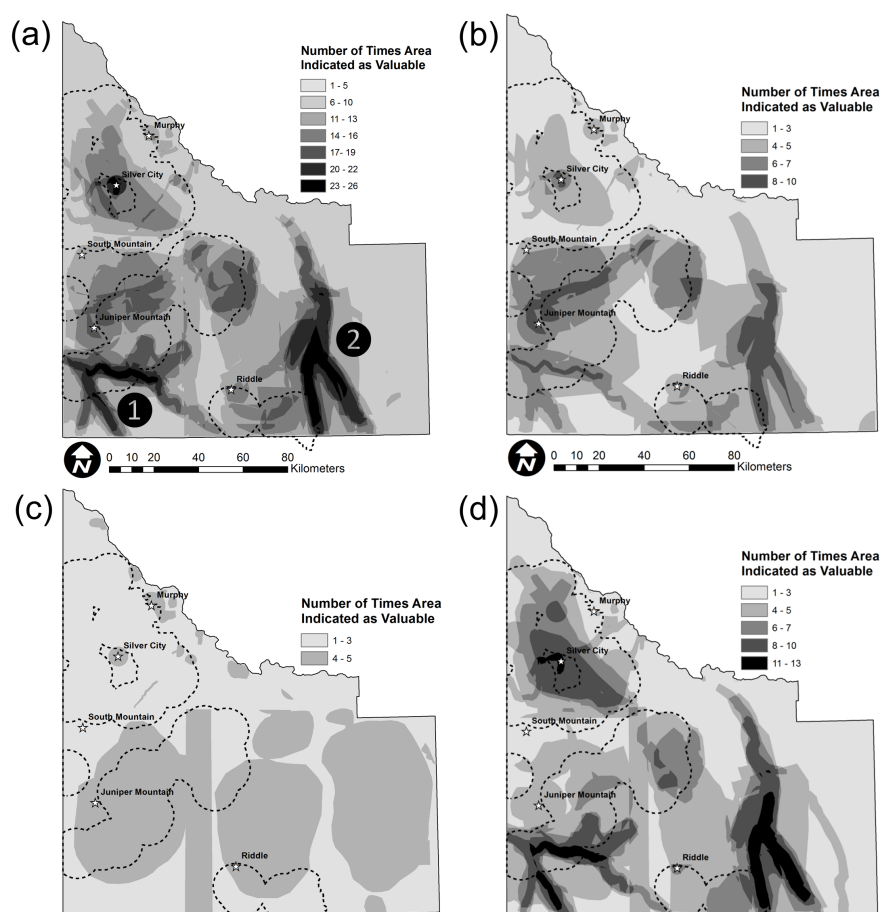
Figure 2.5: Frequency of the polygons derived for all values combined (a), social values (b), economic values (c), and ecological values (d) in Owyhee County, Idaho, USA. The proposed project boundary for the Bruneau-Owyhee Sage-grouse Habitat (BOSH) project is indicated by the dotted lines. Point 1 and 2 in panel (a) indicate the Owyhee and Bruneau-Jarbidge watersheds and associated wilderness areas.

Economic polygons were mapped to highlight the value of the ranching and farming industry, as well as tourism and the military. Ecological polygons were drawn across areas that stakeholders find valuable for resource connectivity, wildlife and fisheries habitat, and biodiversity.

The second mapping activity ("no treatment map," hereafter) served as a social setting filter, much like the ecological filter that narrows the scope of issues related to an intervention (Slootweg et al. 2001). The majority of participants indicated that the BOSH project will be positive and therefore did not draw any polygons; these participants support juniper removal over the entire project area. Some suggested no treatment around Riddle, Idaho, because this area would be a lesser priority due to essentially no juniper present. Others identified areas near Juniper Mountain, Idaho, because they are culturally valuable to Native Americans. Finally, some participants indicated they are against executing the BOSH project entirely because they questioned the BLM's ability to complete the project goals without unintended consequences (e.g., spreading invasive species and half-finished projects).

Discussion

We combined a conceptual framework and multi-method process that upholds the requirements of NEPA to generate a more intricate understanding of social-ecological impacts associated with habitat conservation plans. In the context of our project, the general discussion of perceived impacts from juniper removal alternatives were difficult to understand without incorporating spatial data. Incorporating the spatial dimension of stakeholders' environmental values via mapping allowed land managers to understand where stakeholders' interests and concerns were located within the Owyhee region. This information can be useful for identifying and prioritizing the most relevant issues to address with mitigation strategies.

In our case, potential impacts associated with watersheds, wilderness, and historic towns were the top priorities for the BLM to address with mitigation. Mapping data can also serve project managers as a decision-making tool concerning where to stage juniper removal phases since the 1.75 million acre project area will not be treated simultaneously. Moreover, by coupling dialogue data and spatial mapping we were able to identify the relative scope of potential impacts associated with stakeholders' values. For instance, our data suggest that the scope of impacts is narrower within the BOSH project boundary compared to the scope of potential impacts at the county level. Collectively, these data provide BLM managers with a better understanding of how proposed land actions influence social perceptions, which will allow for the development of a more holistic environmental impact statement for sage-grouse conservation.

Our SEIA process also advanced some of the major shortcomings of conventional EISs, including the lack of social-ecological integration. Rather than consider characteristics of the social system separate from the ecological system, we merged ecosystem service concepts and social process concepts to achieve an integrated framework that represents the complexity of interdependent social-ecological systems. The SEIA conceptual framework was intuitive to the study participants, and most agreed that it was a useful tool for articulating ways that juniper removal alternatives could impact their lives. The range of topics covered in the workshops demonstrated the importance of a social-ecological framework for public lands where individual and community well-being depend upon the environment. Most EIS to date are relatively devoid of social impacts, much less integrated with ecological and/or biophysical concepts in public land management contexts (Slootweg et al. 2001; Burdge 2002; Whitfield et al. 2011). Given that NEPA requires an interdisciplinary approach for the

preparation of EISs (42 U.S.C. § 4331), the lack of social impacts puts current practice into question.

In addition to improving social-ecological integration, there is a need to add a spatial dimension to environmental assessments – specifically, the identification of areas that are socially, economically and ecologically valuable. Values are the fundamental building blocks of perceptions about how one might be impacted by a management intervention and environmental change, and visualizing this information on a map is helpful because public land management is done in a spatial context (Lowery & Morse 2013). During PPGIS activities, we observed workshop participants discussing areas of value and finding common ground around rivers and wilderness areas. Participatory mapping also allowed for clarification of misconceptions about the project, identification of unnecessary project boundaries, and deliberation of areas to prioritize or disregard for juniper removal. These observations are consistent with previous research on qualitative approaches to PPGIS that reported benefits, such as positive synergy among participants and clarified perceptions of project scale (Lowery & Morse 2013).

The PPGIS activities coupled with deliberative workshops also addressed the need to improve stakeholders' role in impact assessment processes. Deliberations of potential impacts revealed a key point: addressing multiple spatial and temporal scales throughout a project can clarify project purpose and inform a more comprehensive design of mitigation strategies. The benefits of these workshops are consistent with previous research that observed improved opportunities for community members to share their perceptions about proposed actions and potential futures in a deliberative setting (Becker et al. 2003; Harris et al. 2012). Typical scoping processes, during which stakeholders write or call the planning agency with their

concerns, normally do not identify such nuances. A deliberative approach to SEIA can enhance scoping in a NEPA process by providing an opportunity for stakeholders to elaborate their concerns or support for a project, as well as to identify a comprehensive list of issues to address with mitigation strategies.

The novelty and strength of this approach is the application of a social-ecological conceptual framework within a deliberative setting that includes questionnaires, dialogue, and PPGIS. By merging the integrated conceptual framework and methodological approach, the SEIA process enabled triangulation of multi-scale social-ecological impacts associated with the proposed BOSH project. In addition, discrepancies in perceptions of the scale of the project emerged from the dialogue in the deliberative setting. For example, when anticipating changes to a viewshed as a result of juniper removal, participants described different perceptions of trail-level, ridge-line, horizon and aerial views. While an agency may frame a proposed project in one scale, we observed stakeholders framing potential impacts of the BOSH project in several scales, which fostered some ongoing confusion and is indicative of how even interested publics may misgauge project goals and objectives. Precisely characterizing scale is a recognized issue in the field of ecology (e.g., Levin 1992), but our data suggest the same level of precision is needed when discussing social-ecological impacts associated with land management actions.

Our SEIA is not designed to replace a traditional ecological impact assessment for which ecological and biophysical monitoring data are analyzed, nor do we intend for SEIA to replace traditional economic impact assessments. Rather, SEIA is meant to complement other assessments by defining the connections between people and their environment and highlighting how those connections might be weakened or strengthened by land management

decisions. We support the notion that impact assessments are context-dependent (Vanclay 2002), and we recommend a modification of social-ecological concepts in the framework and/or the tools for data collection depending on environmental characteristics, politics, and power dynamics specific to the project area (Ross & McGee 2006). Continued applications of integrated frameworks such as SEIA within public land management would better satisfy NEPA requirements and facilitate more holistic mitigation strategies, both of which should assist managers achieve conservation goals. The advancement of conservation efforts relies in part on our ability to comprehensively assess social and ecological consequences of human interventions on public lands (e.g., sensu Brashares et al. 2014). The SEIA process we described contributes to this broader conservation goal.

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Appendices

Responses to the no action alternative (Appendix A), responses to the full suite alternative (Appendix B), responses to the cut and scatter alternative, (Appendix C), and the deliberative workshop questionnaire (Appendix D) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

Appendix A. Response to the no action alternative, including potential changes to social processes and ecosystem services with related direction of impact and quote from deliberative workshop dialogue.

Social-ecological system characteristic	Direction of Impact	Potential Change	Example Quote
Economic Processes	Negative	Local economy – less opportunity	"[Local people might be] counting on the logging jobs."
Economic Processes	No Change	Local economy – same opportunity	"[The BOSH proposal] does not deal with economic issues driving the Owyhees."
Economic Processes	Negative	Tension on livestock operators	"The only thing for me that I perceive changing with a no action alternative would be the future economic activity in the Owyhees, including the way people make a living. With the potential listing of sage

			grouse, if sage grouse are listed, that puts an added tension on especially livestock operators, which is the major economic activity in the county."
Institutional and legal processes	Negative	Disheartening to land managers	"So if you're not going to do anything, it's really disheartening to everybody that worked all those years, and biologists, and it's in every plan, the Owyhee [Initiative], the Governor's task force, the state plan. It would be a big discouragement to everybody."
Institutional and legal processes	Negative	Endangered listing – Greater sage grouse	"But I think there's, what I like to say is that, the impact to the people I think may not be as much related to, okay we're going to have more juniper out there, but it may simply be how a (sage grouse) listing decision affects the community out there."
Empowerment processes	Negative	Stakeholder collaboration – less opportunity	"There is a lot of agreement that some action is needed and if nothing happens, folks may feel disenfranchised."
Empowerment processes	No Change	Stakeholder collaboration – same opportunity	"Collaboration efforts exist but litigation will always be a challenge."
Provisioning	Positive	Impact to ecosystem	"More trees – cooler streams, let nature take its course."
Provisioning	Negative	Decline of historic plant communities	"The resources itself – historic plant communities, those types of things, they're going to decline."
Processing	Negative	Ability to balance or restore landscape / ecological processes – more difficult	"…the ecological site condition will continue to deviate from the historical condition affecting watershed, range & grazing, wildlife."
Processing	Negative	Reduction of watershed functionality	"When juniper encroaches on springs and streams, it reduces their functionality. There's at least plenty of anecdotal evidence of juniper leading to springs drying up, reducing water output."

Supporting	Negative	Loss of biodiversity & habitat	"The area will lose diversity as juniper monocultures develop."
Supporting	Negative	Loss of sage grouse habitat	"Are we able to actually effectively manage the habitat for sage grouse to offset these big losses we're going to have?"
Cultural	Positive	Availability of areas without treatment for study	"And as far as not taking trees out, I think that would be great. I realize that it's actually maybe it gives you an area that you can actually do some studies to figure out what's going on because you haven't messed with this, you can have this area that hasn't had a treatment on it, maybe somebody can get in there and figure out what was really going on."
Cultural	Positive	General enjoyment of the Owyhees – improved	"Because there won't be this specific manipulation in wilderness."
Cultural	No Change	General enjoyment of the Owyhees – no change	"Action or no action will have minor effect if any"
Cultural	Negative	Loss of open space	"There would be loss of open space…you would lose the sagebrush views."
Cultural	Negative	Limits on recreation	"[Big impact to Owyhee County] on recreation…everything from motorized, which a lot of people use down there…no hunting season for the sage grouse."
Cultural	Negative	Less aesthetic enjoyment	"Aesthetic enjoyment would decrease for me [due to] loss of sagebrush/sage-steppe."
Cultural	Negative	Hunting – diminished	"Areas will have reduced value for human activity as juniper continues to expand = decreased recreation, hunting, decreased quality areas for wildlife."
Cultural	Negative	Spiritual experience - diminished	"I think the [spiritual] opportunities available now are a result of the landscape available if it changes these may cease to

exist,"

Cultural	No Change	Spiritual experience – no change	"You know for me with the exception of the spirituality portion because I think you can find the spirituality of it whether they're sagebrush, sage grouse, junipers – there's a beauty in whatever aspect of it."

Appendix B. Response to the full suite alternative, including potential changes to social processes and ecosystem services with related direction of impact and quote from deliberative workshop dialogue.

Social-ecological system characteristic	Direction of Impact	Potential Change	Quote
Economic Processes	Positive	Local economy – more opportunity	"Grazing will be improved and juniper control could hopefully prevent ESA listing thereby preventing regulation and control of producers."
Economic Processes	Positive	Ability to make a living - improved	"More jobs for loggers."
Institutional and legal processes	No Change	Ability to make a living – no change	"I don't see much in that change…the ability for people to actually make a living out there. If we're focusing on just these Phase I, Phase II [juniper stands], visually, as I go out there, I'm not going to see that much of a difference. I'm not going to experience that much change because we're talking about small scale."
Institutional and legal processes	Positive	Management – improved	"Management would be better through active work on the ground."
Institutional and legal processes	Negative	Management – worse	"And we have enough problems as it is and when we do stuff like that it makes us look even worse, especially this thing here…You know we have our plan it sounds great on paper, but when we don't get the money from Congress or whatever to follow through, then we end up dealing with this next thing that happens."

Institutional and legal processes	No Change	Management – no change	"The future of the efficiency – of the effectiveness of the management of our supply of natural resources aren't going to change by us simply removing the junipers…at some point in time once the juniper are gone and we've created this habitat for sage grouse, let's go back to doing something that's not going to bring the juniper back again."
Institutional and legal processes	Negative	Worsened agency reputation	"I work for the BLM, that's my job. I'm not here representing the BLM, but I actually work for the BLM. And we have enough problems as it is and when we do stuff like that it makes us look even worse."
Empowerment processes	Positive	Stakeholder collaboration – more opportunity	"People will see the fruits of the labor and will want to keep collaborating if their contributions are influencing positive change."
Provisioning	Positive	Range and grazing - improved	"I think if it's implemented, we're trying to get this juniper removed, that will improve range conditions, and it will improve grazing. It will improve ranching operations. And I think if we're able to use equipment and masticators and stuff, then we can have a bigger impact on juniper encroachment and reduce it at a bigger scale than what we're limited to hand crews and stuff."
Processing	Positive	Increased watershed functionality	"Increased watershed and overall ecological health."
Processing	Negative	Increased fire danger	"But when it gets down to actually implementing it I'll bet you we end up with a bunch of dead trees out there that look like crap that maybe you're going to end up catching or actually causing the fire because now you've got all this dead wood that you've left laying around."
Supporting	Positive	Increased biodiversity	"Taking action in areas where we will see the most positive + cost effective benefits

			= more habitat for wildlife, lands for hunting/recreation; hopeful treatment/action to improve sage-grouse habitat – keeping it from being listed, and more diversity."
Supporting	Positive	Wildlife habitat – improved	"I think it's agreed that sage grouse is kind of a keystone species that if the habitat is improved for them, deer and elk and a vast majority of other species kind of are also positively benefitted," "A lot of blue birds, chickadees other birds that are cavity nesters, they need junipers to nest in. So they would definitely be affected…"
Supporting	Negative	Wildlife habitat – degraded	"One of the issues, if you do have a lot of mechanical treatment, you do have to worry about noxious weeds. And hopefully the outcome is good. And you do have to worry about soil disturbance. And also disruption of wildlife and if it's a sensitive nesting time or things like that."
Supporting	Positive	Sage grouse habitat - maintained/improved	"I think it's agreed that sage grouse is kind of a keystone species that if the habitat is improved for them, deer and elk and a vast majority of other species kind of are also positively benefitted."
Cultural	Positive	General enjoyment of the Owyhees – improved	"Increased diversity of animals and habitat will create better experiences for more people with diverse interests,"
Cultural	No Change	Solitude – no change	"I'm trying to keep in mind the scale of what we're talking about as far as Phase I, really early Phase II juniper. Yes, it'll be a success for us if we're actually able to do something out there, but as far as any other changes that are occurring, I guess personally I don't see much in that change… as far as… people's feeling of solitude."
Cultural	Positive	Hunting – improved	"Taking action in areas where we will see the most positive + cost effective benefits

= more habitat for wildlife, lands for hunting/recreation; hopeful treatment/action to improve sage-grouse habitat – keeping it from being listed, and more diversity."

Cultural	Negative	Recreation – disrupted	"The treatment activities will be disruptive to recreationists for a period of time."
Cultural	No change	Recreation – no change	"For instance, well it hasn't changed the future physical space that's suitable for human activities. I guess it depends on what human activity you want. If the junipers are there, there's a human activity that can still be used whether it's watching birds or it's hunting whatever the case. You remove those junipers, to some degree, those human activities are still available – may not be the *exact* same."
Cultural	Positive	Viewshed – improved	"…for me personally, it would improve because I'd be able to go out to that lek and not see that juniper stand there anymore. So for me personally, I'm going to get to go out and be like, "Wow, this is awesome." I feel like we accomplished exactly what we set out to do. I can stand and look at those birds and not see the juniper in the background."
Cultural	Negative	Viewshed – degraded	"I know when I was at a Wildlife Refuge eight years ago, BLM came in around that area and cut down all the juniper trees, and they just laid there for years. And eventually they went and they started burning them up, but that was such a black eye for the BLM. The locals around there, they're all like, "Freaking waste." All these trees lay and it looked like crap."
Cultural	No Change	Viewshed – no change	"…the average Joe is still going to drive into Mud Flat Road and see exactly what they've always seen. They're not going to realize that on the ground, there have been people that have been removing junipers out there to improve sage grouse, or for

			whatever. Most people aren't going to notice that."
Cultural	Positive	Spiritual experience - improved	"But for the scope of this project, it will improve my personal spirituality or whatever, if you will, because I can actually now visually see this – no more trees within this area, this lek, these encroaching junipers are gone,"
Cultural	No Change	Spiritual experience – no change	"Again I go back to the fact that I can find beauty in a butterfly on a juniper as easily as I can find beauty in a butterfly on a sagebrush. So that aspect of my spiritual portion of it doesn't change by the fact that we do or do nothing to it."
Cultural	Positive	Culture tied to cowboy & sage grouse - maintained	"It's not just the cowboy aspect. I love sage grouse, you know. And I think having all the tools available, having all the resources available is from the get-go probably the best option."

Appendix C. Response to the cut and scatter alternative, including potential changes to social processes and ecosystem services with related direction of impact and quote from deliberative workshop dialogue.

Social-ecological system characteristic	Direction of Impact	Potential Change	Quote
Economic processes	Positive	Local economy – more opportunity	"More jobs."
Economic processes	Negative	Weakening of local livelihoods	"BLM regulations would probably still be a limiting factor in ranching operations."
Economic processes	Negative	Range and grazing – reduced	"Ranchers/cowboys would not do well grazing would be reduced / riding the range reduced."
Institutional and legal processes	Negative	Management effectiveness – diminished	"The efficiency of management would be reduced since mastication and jackpot burns are useful tools for juniper

			encroachment," and "So if those tools aren't available, you may not treat the acres you'd like or as effective as you'd like."
Empowerment processes	No Change	Stakeholder decision-making – no change	"A change is not possible – unless litigation process is changed."
Provisioning	Positive	Ecosystem health and characteristics - improved	"In 5-15 years there would be some improvement in soil and water resources. Grasses would improve also."
Provisioning	Positive	Increased water availability	"…getting that functioning ecosystem we can pretty much all agree on…without water, nothing functions…water is the sustaining thing of life, period."
Processing	Positive	Watershed functionality - improved	"slowed on fields and hills" and when "you get snow blowing up against the back end or on the north face, then you've got extra protections."
Processing	Negative	Increased fire danger	"…increased fire danger, fuel after it dries out, which would have a big negative impact," and "I think leaving all the wood down is a fire hazard and probably has other environmental consequences."
Supporting	Positive	Wildlife habitat – improved	"…at least we're getting trees cut and slashed, and that's great. That's a lot better than doing nothing. A whole lot better, in my book, than doing nothing," and "We're talking about mostly Phase 1. We're talking small trees – those can get dropped pretty darn low to the ground, and there won't be a lot of fuel buildup in those areas. So there are going to be a lot of positives, even if that's what we were to do for the sage grouse."
Supporting	Negative	Sage grouse habitat - degraded	"…if it's [juniper branches] left laying there, the sage grouse are not going to walk through that probably either."
Supporting	Negative	Increased cover for sage grouse	"…it's cut and scatter, so that'll take some of the cover away. It'll leave more of the

	predators		just the bowl, and the branches will be scattered out. But there's the potential it could create more cover."
Cultural	Negative	Viewshed - degraded	"Negative visual impact to the public. A pile of dead trees laying on the ground… it just doesn't look natural," and "I will see those trees still lying down in some areas that will not necessarily improve sage grouse habitat."
Cultural	No Change	General enjoyment of the Owyhees – no change	"Landscape features would be about the same as cut trees would take a long time to decay. If trunks are used for fire wood or other purpose this would help in this area."

Appendix D. Deliberative workshop questionnaire, including seven questions related to ecosystem services and social processes. Participants completed the same questionnaire four times while considering the present state and potential future states of the Owyhees under the three project alternatives.

1. …the ability of the Owyhees to produce useful resources for people will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

2. …the ability of the Owyhees to maintain or restore its balance through physical, biological and chemical processes and interactions will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

3. …the availability of physical space and environmental conditions that are suitable for human activities will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

4. …the ability of the Owyhees to provide opportunities for spiritual enrichment, aesthetic enjoyment, contemplation, meditation and recreation will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be

Why?

5. …the economic activity in the Owyhees – including the ways people make a living – will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

6. …the efficiency and effectiveness of organization(s) in and around the Owyhees that are responsible for the management or supply of the natural resources upon which stakeholders depend will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

7. …the ability of stakeholders to contribute to decision-making that affects their lives will be:
As bad as can be   1   2   3   4   5   6   7   8   9   10   As good as can be
Why?

8. Implementing this alternative in Wilderness areas within the project area boundary is (please circle one):

Extremely Unacceptable	Somewhat Unacceptable	Neutral	Somewhat Acceptable	Extremely Acceptable
Why?				

CHAPTER 3

Assessing dialogic interactions for evidence of social learning in a deliberative setting for public lands management

To be submitted to *Ecology and Society*

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Abstract

The purposes of this research is to document the occurrence of social learning during deliberative workshops for natural resource management using variables that measure three dimensions at the individual scale: changes in cognitive, relational, and epistemic understanding. Our objectives are: 1) to evaluate the dialogic interactions of deliberative workshop participants for indicators of social learning, and 2) to describe social learning outcomes of the deliberative workshops. Our research questions are: 1) in a workshop setting that incorporates conditions that enable social learning processes, do individual participants demonstrate cognitive, relational, and/or epistemic change in their dialogic interactions, and 2) what is learned during dialogic interactions, and 3) what are the outcomes of the deliberative setting and individuals' interactions? Results will contribute to our conceptual and theoretical understanding of social learning phenomena oriented toward an individual-centric approach with implications for social learning research at higher levels of analysis and for social learning practice among natural resource managers.

Introduction

Complex problems involving multiple ways people use and manage shared landscapes and natural resources are increasingly addressed through public engagement options within planning and decision-making. Dialogue-based processes designed to gather citizens and key stakeholders into a common space to discuss the issues and deliberate actions foster open exploration of problems and solutions and enable a phenomenon called *social learning* (Christensen & Krogman 2012). Here, we work from a general definition of social learning provided by Reed et al. (2010): a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks.

Research in natural resource management and the role of the public and key stakeholders has turned a keen eye toward social learning throughout the last decade (Rodela 2011, 2013; Cundill & Rodela 2012; Rodela et al. 2012). Definitions for the term social learning vary quite substantially throughout natural resource management literature (Rodela 2011, 2013). Despite efforts to clarify a definition (Reed et al. 2010), social learning research remains a quagmire of conceptual and theoretical foundations, epistemological lenses, and methodological approaches (Rodela 2011, 2013; Cundill & Rodela 2012; Rodela et al. 2012).

Recently, social learning scholars Georgina Cundill and Romina Rodela published a string of reviews and syntheses to help us wade through the vast past social learning research and to help scholars situate future research in clear domains of natural resource management literature, theoretical foundations, research perspectives, epistemological approaches, and methods. The following sections invoke these domains to explain where this study fits within -and departs from - social learning scholarship.

Fitting this study within social learning research

With this paper we contribute an analysis of individuals' dialogue-based interactions in deliberative settings for evidence of individual-centric social learning processes and outcomes. The purpose of this study is to document the occurrence of a social learning phenomenon using variables that measure three dimensions of social learning at the individual scale: changes in cognitive, relational, and epistemic understanding. Our objectives here will: 1) evaluate the dialogic interactions of deliberative workshop participants for indicators of social learning, and 2) describe social learning outcomes of the deliberative workshops. Our research questions are: 1) In a workshop setting that incorporates conditions that enable social learning processes, do individual participants demonstrate cognitive, relational, and/or epistemic change in their dialogic interactions?, and 2) what is learned during dialogic interactions?, and 3) what are the social learning outcomes? Insights gained from a record of cognitive, relational, and epistemic change at the individual scale and specific topics of learning will inform more comprehensive planning and decision-making processes for environmental management.

Social learning in natural resource management literature

Social learning has emerged as a prominent concept in three domains of environmental and natural resource management literature: adaptive management, collaborative management, and adaptive co-management (Cundill & Rodela 2012). Each of these paradigms is influenced by different ideas about humans' relationship with nature and our role in managing it (or not). Cundill and Rodela (2012) found that ideas about social learning processes and outcomes have developed from these paradigms in five ways, two of which are our focus here: 1) social learning takes place through deliberative processes

involving sustained interaction between individuals, and the sharing of knowledge and perspectives in a trusting environment, and 2) social learning improves decision-making by increasing awareness of human-environment interactions and by building relationships and the problem-solving capacity of stakeholders (Cundill & Rodela 2012, p. 11). Based on a review of social learning in natural resource management literature, this study fits in the collaborative management paradigm. Our investigation is designed around the assumption that social learning takes place through deliberative processes that, in turn, improve decision-making by increasing awareness of human-environment interactions.

Within collaborative management literature, scholars assert that social learning is triggered by inclusiveness, extended engagement, opportunities for information exchange, opportunities for dialogue and interaction, opportunities for participants to define and control the agenda, open communication and equal participation (Muro and Jeffrey 2012). These conditions for a social learning process are also found in collaborative management literature as criteria for effective or successful collaborative management processes (Conley and Moote 2003, Schusler et al. 2003) (Figure 3.1).

Yet Delli Carpini et al. (2004) highlight benefits and pitfalls of deliberative processes: while deliberation is "expected to lead to empathy with the other…through an egalitarian, open-minded and reciprocal process of reasoned action," deliberation can also be "infrequent, unrepresentative, and disconnected from actual decision-making" making it an "impractical mechanism for determining public will…" (p. 320). If we are to make claims about tangible outcomes of a social learning process and whether they are positive or negative, we must first document the occurrence of social learning and explain the context in which it was observed (Rodela 2013).
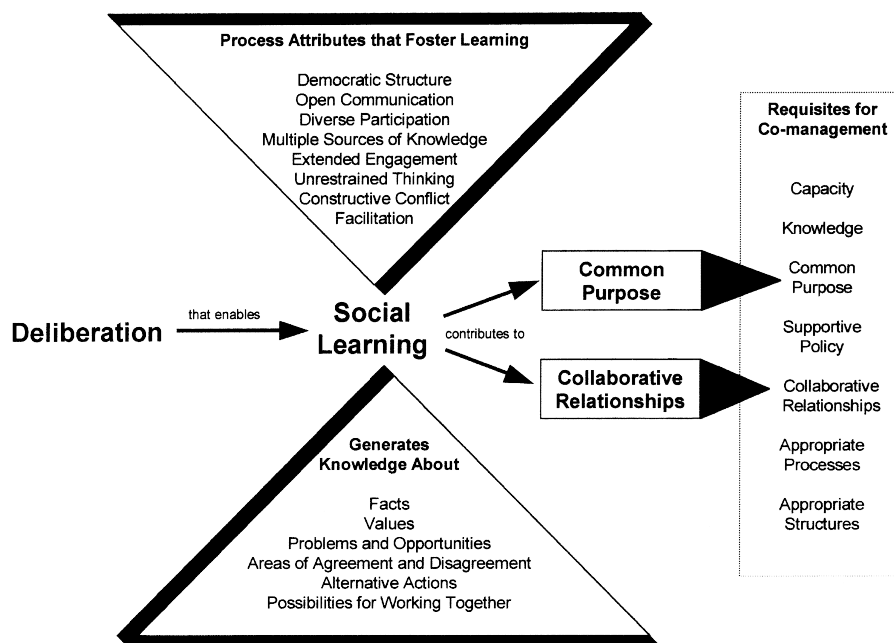
Figure 3.1: From Schusler et al. (2003), illustrating the process conditions that enable social learning and generated social learning outcomes that collectively contribute to requisites for co-management.

Research perspectives for social learning and theoretical foundations

Aside from theorizing how social learning processes lead to social learning outcomes, past investigations have been built upon an array of theoretical foundations that support distinct branches of research perspective including different operationalization of social learning and levels of analysis (Rodela 2011, 2013). Three social learning research perspectives identified by Rodela (2011, 2013) are individual-centric, network-centric, and systems-centric (Table 3.1).

Our investigation fits in an individual-centric approach to understanding social learning based on the theory of communicative action. Communicative action is a process of interactions between two or more individuals who aim for shared understanding of a situation (Habermas 1984). Social learning occurs where there are interactions, deliberations and

knowledge co-production among stakeholders (Steyaert et al. 2007). Habermas (1984)

developed the theory of communicative action to explain how those multiple interactions

between individuals affect social systems through language, relations to the social world and

Table 3.1: Main characteristics of three scale-based approaches to social learning, from Rodela (2011, 2013).

	Individual-centric	Network-centric	Systems-centric
Social Learning Process	Participatory processes	Past experiences; observations of others' experiences and practices	Emerges from a social-ecological system
Social Learning Outcomes	Change in participants' reflexivity and behavior	Change in resource use or management	Shift of system toward a sustainable state
Unit of Analysis	Individuals	Networks	Systems
Operational Measures	Changes in cognitive, relational, and moral dimensions; trust	Changes in organizational behavior and relationships	Changes in policy
Theoretical Foundations	Deliberative democracy: Habermas' theory of communicative action	Adult education and organizational learning: Kolb's experiential learning and Wenger's communities of practice	Complex adaptive systems: Holling and Meffe, Folke

claims of speech validity (i.e., is a statement true, correct, or sincere). Interactions and critical

thinking through participatory processes and integration of different knowledge can lead to

changes in participants' cognition or knowledge (Schneider et al. 2009). Arguably, social

learning processes create a space and context for communicative action, and examining

changing patterns of communication and interactions between participants can lead to a better

understanding of how social learning processes might change individual understanding and

transform shared understanding and knowledge into collective decision-making or action

(Pahl-Wostl & Hare 2004, Rist et al. 2006). In this vein, social learning occurs in the "public sphere" of a deliberative democracy, which takes the form of public engagement in collaborative natural resource management.

Within the domain of collaborative management, individual-centric social learning research has relied on tenets of deliberative democracy to locate social learning and observe the phenomenon in its constructed "habitat." But what established theory might inform our understanding of cognitive, relational, and epistemic change within a social learning process and how those changes contribute to social learning outcomes? This area of social learning research contains a large variance in operationalization. In her extensive review of social learning in natural resource management literature, Rodela (2013) found evidence for authors' borrowing the term social learning from behavioral psychologist Albert Bandura, but no borrowing of his posited and supported theoretical relationships between cognition and behavior or other theories of psychology to inform frameworks or analysis.

Despite a dearth of psychology theory in individual-centric approaches to social learning, past studies that evaluated the quality of social learning processes and outcomes did so by measuring participants' perceptions and recall of their own cognitive and relational understanding. These dimensions of social learning are operationalized in various ways throughout the literature with common variables identified listed in Table 3.2. As a point of departure from previous individual-centric collaborative management research on social learning, this study 1) borrows ideas from psychological research on question-answer learning through conversational agents (Graesser et al. 1992, 2014) to inform the analytical strategy of dialogic interactions between workshop participants, and 2) adds the little-studied epistemic dimension to the conceptual framework of social learning domains (Table 3.2).

Table 3.2: Common dimensions and variables of social learning to be applied in this investigation; drawn from Blackmore (2007), Conley and Moote (2003), Muro and Jeffrey (2008, 2012).

Dimensions of Social Learning	Variables
Cognitive	Knowledge of facts, values Identification of factors contributing to management problem Knowledge of alternative actions
Relational	Perceptions of others Trust-building Identification of opportunities to work together
Epistemic	Knowing; individuals' interactions with things of the social and physical world

Methods

Data Collection

To investigate dimensions of social learning in a deliberative setting, we observed the dialogic interactions of participants in five workshops coordinated for the Bruneau-Owyhee Sage-grouse Habitat Project (BOSH) in Owyhee County, Idaho. In the fall of 2014, the Boise District Office of the Bureau of Land Management (BLM) proposed a plan to remove juniper (*Juniperus* spp.) from low-elevation areas in order to conserve habitat for the Greater Sage-grouse (*Centrocercus urophasianus*). We implemented five workshops designed to facilitate discussion and deliberation of the drafted juniper treatment alternatives, to identify spatial distributions of social, economic, and ecological values across Owyhee County and the BOSH project boundary (Figure 3.2), and to assess potential social-ecological impacts from the BOSH project (Bentley Brymer et al. *unpublished manuscript*). The workshops also served as

opportunities to observe stakeholders in a deliberative setting and to apply an individual-

centric perspective in the assessment of their conversation for evidence of social learning.
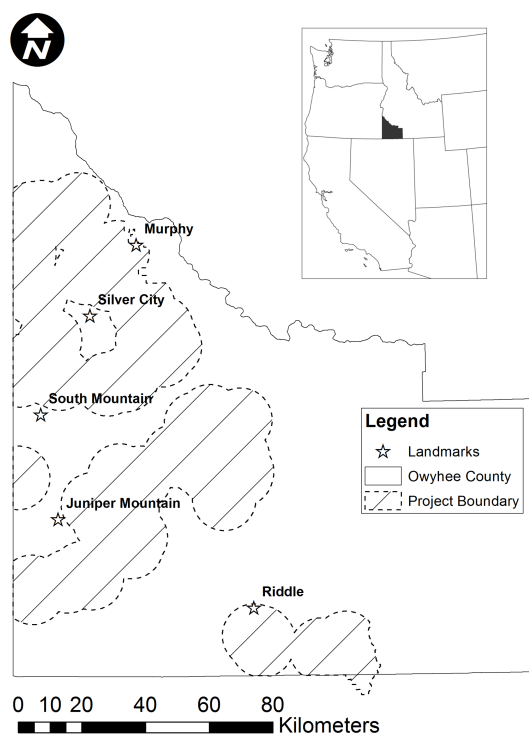
Figure 3.2. Owyhee County, Idaho and the BOSH project area and boundary.

We developed a sampling frame to include local, state, and federal resource managers,

as well as organizations involved in a long-term collaborative effort in the Owyhee region

(i.e., The Owyhee Initiative), which served as a clearinghouse of parties interested in resource

management in the Owyhee region. Prior to our agreement with the BLM, a stakeholder

group comprising managers from the BLM and Idaho Fish and Game, restoration

conservationists from non-governmental organizations, and representative from the Owyhee

County Sage-grouse Local Working Group had already been formed by the project lead

(Group 1). To broaden the range of perspectives for the social-ecological impact assessment,

we purposively sampled 27 stakeholder groups whose members are concerned with ecosystem

functions in the Owyhee region to create an additional workshop group (Group 2). Group 1

and Group 2 separately participated in a two-workshop series. Due to low turnout from Group 2 for their second workshop, we hosted a third workshop for Group 2, thus resulting in Group 1, Group 2a, and Group 2b, and a total of five workshops to observe for dimensions of social learning. Each workshop spanned an average of 3 hours. We followed ethical guidelines for working with human subjects, and the University of Idaho Institutional Review Board approved our project #12-357.

The first workshop for both groups (Group 1 Discussion and Group 2 Discussion) began with an overview presentation of the BOSH project followed by four rounds of questionnaires and related discussions to understand participants' perspectives of future scenarios under the proposed juniper treatment alternatives. The second workshop for both groups (Group 1 Mapping, Group 2a Mapping, and Group 2b Mapping) entailed two participatory mapping exercises to identify the spatial distribution of values across Owyhee County and the BOSH project area and to identify areas of juniper that participants did not want included in the project area. All five workshops were audio-recorded and transcribed for analysis in NVivo 10 (QSR International Pty Ltd. Version 10, 2012).

Data Analysis

Workshop dialogue was coded in two rounds: first, for general statements of cognitive, relational, and epistemic understanding, and second, for evidence of changes in cognitive, relational, and epistemic understanding.

During the first round of coding, when a participant shared information, opinions, or values regarding a discussion topic, his or her statement was coded as *cognitive understanding*. When a participant shared his or her perception of other workshop participants or other people involved in juniper or sage-grouse issues, or when he or she identified

opportunities to collaborate or to build-trust with others, his or her statement was coded as *relational understanding*. When a participant shared information, opinions, or values associated with his or her way of knowing about a discussion topic, or his or her interactions with the social and physical world, then his or her statement was coded as *epistemic understanding.*

The first round of coding focused on statements made by one individual explaining his or her perspective or knowledge of the discussion topic. The second round of coding focused on question-answer exchanges between participants to identify instances of change in cognitive, relational, and epistemic understanding. When a participant asked a question meant to fill a gap in his or her knowledge or to clarify details regarding a discussion topic, the exchange between the participant questioning and the participant(s) answering was coded as a *change in cognitive understanding*. When a participant asked a question of another participant about his or her experiences, perspective, community connections, interest in collaborating or other personal details, the question-answer exchange was coded as a *change in relational understanding*. Finally, when a participant asked a question about science or a person's way of knowing about the world, the question-answer exchange was coded as a *change in epistemic understanding*.

To identify the topics of social learning, all data coded for changes in cognitive, relational, and epistemic understanding was inductively coded for themes and patterns of discussion subjects. As explained above, Discussion workshops included four rounds of questionnaires and discussion that were structured around an integrated framework of ecosystem services and social processes to better articulate and understand how environmental changes impact human well-being, and Mapping workshops were structured

around social, economic, and ecological values and place meanings (Bentley Brymer et al. *unpublished manuscript*). Thus, when topics of learning included ecosystem services and social processes, the integrated frameworks that informed the questionnaire design and mapping activities were applied as deductive analytical frameworks.

Results

Evidence of dimensions of social learning in dialogic interactions

We observed cognitive, relational, and epistemic understanding across both workshop groups and workshop activities. While these statements of understanding are important for forming explanations of knowledge, our main interest is in the interactions and question-answer exchanges between participants indicating *changes in understanding.* Figure 3.3
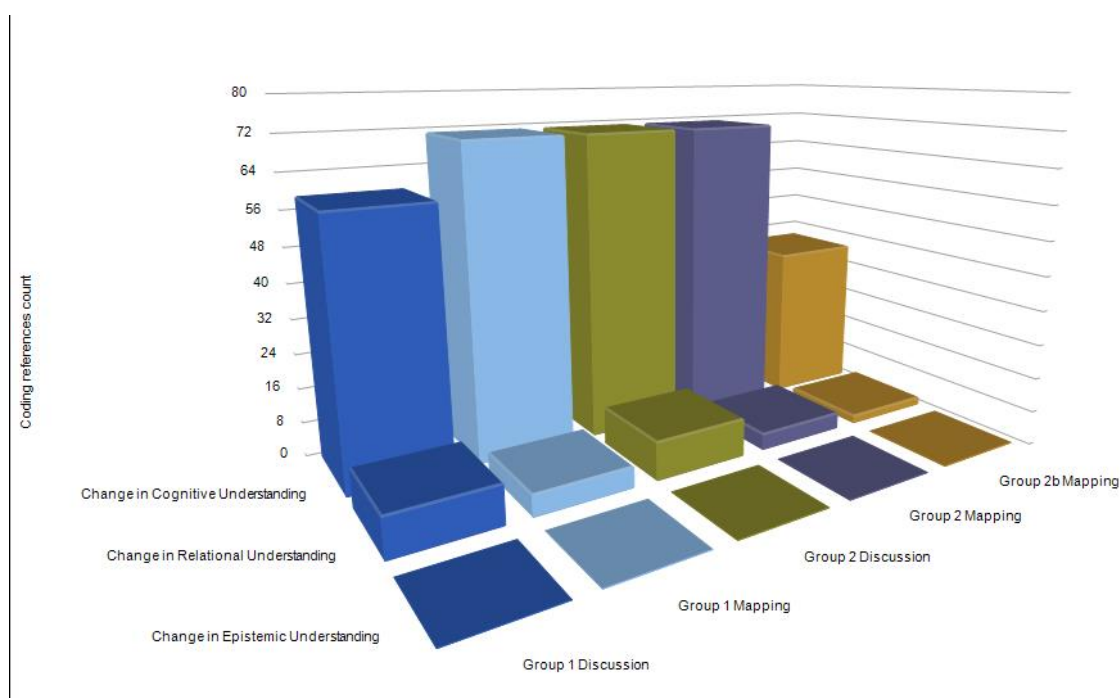
Figure 3.3. The number of dialogic interactions (by coding reference count; Y axis) demonstrating change in cognitive, relational, or epistemic understanding; X axis) across workshop groups (Group 1, Group 2a,b) and workshop activities (discussion, mapping) (Z axis). No change in epistemic understanding was observed.
Comparison of three dimensions

shows the observed number of dialogic interactions indicating changes in cognitive, relational, and epistemic understanding and compares these dimensions across groups and workshops.

Change in cognitive understanding was the most-frequently observed dimension of social learning across all groups and activities (Figure 3.3, back row). These were dialogic interactions during which people asked and answered questions about general knowledge including facts and values associated with the BOSH project. Change in relational understanding was observed far less than the cognitive dimension (Figure 3.3, middle row). These were dialogic interactions during which people asked and answered questions about each other, including verbalizations of perceptions of other workshop participants and of non-participants, expressions of trust in other participants, and identification of opportunities to work together in the future. Change in epistemic understanding not observed. While we did observe participants describing their way of knowing (e.g., scientific method, experience, faith), we did not observe question-answer exchanges about epistemologies (e.g., "How do you know that is true?, How did you acquire that information?"), nor did anyone describe a changed way of knowing as a result of conversing with another workshop participant.

Comparison of Group 1 and Group 2

There was little discernable or meaningful difference between Group 1 Discussion, Group 1 Mapping, Group 2 Discussion, or Group 2a Mapping for any of the dimensions of social learning and workshop activities, with some slight exceptions. First, with respect to change in cognitive understanding, participants in Group 1 demonstrated less change through dialogic interactions in the Discussion workshop compared to the Group 1 Mapping workshop, and less change than was observed in the Group 2 Discussion or Group 2a

Mapping workshops. This difference could be explained by the fact that the first half of the workshop was a presentation about the BOSH Project, so it was lecture-oriented rather than question-oriented. Also, Group 1 was comprised almost entirely of public land managers with biology and rangeland management backgrounds and previously obtained knowledge of the BOSH project, so it is not surprising that they did not ask many questions about the social-ecological dynamics or sage-grouse habitat problem. Second, with respect to change in relational understanding, Group 2 demonstrated slightly more change in relational understanding during their Discussion workshop than in their Mapping workshop (Group 2a Mapping) or either Group 1 workshop. One participant in Group 2a was particularly gregarious and inquisitive, and often asked other participants about their backgrounds and about opportunities to volunteer in rangeland restoration projects. These questions seemed to lead the discussion and mapping exercises into a more relational domain several times throughout the workshop.

Participants in Group 2b appear to have demonstrated significantly less change in cognitive or relational understanding than any of the other groups or workshops. This can be explained by a few factors. First, Group 2a included two participants who got along well and shared many viewpoints. Group 2b also comprised two participants who were civil toward each other but shared polar opposite viewpoints on topics like livestock grazing and the functional traits of juniper in watersheds. Also, one participant in the Group 2b Mapping workshop rarely spoke while drawing polygons, even when prompted by researchers and the facilitator, and did not speak at all during the other Group 2b participant's turn to draw polygons. Less dialogue means less opportunity for question-answer exchanges, explanation, argumentation, or learning (Graesser 1992). Finally, one participant in the Group 2b Mapping

workshop did not want to see any juniper removed from the landscape, so this participant did

not draw any polygons on any maps during the Group 2b Mapping workshop. When other

participants took 10-20 minutes drawing and explaining their values and place meanings

across the maps of Owyhee County and the BOSH project, this participant in Group 2b

Mapping took only seconds to explain a perspective that covered the entirety of the county -

and the planet:

<div align="center">Participant:</div>

"It just gives me peace of mind knowing that there's some place on the planet that
we could all disappear and that place would be fine; would probably be better for
it…"

<div align="center">Researcher:</div>

"Are there any areas outside of wilderness that you feel that away about?"

<div align="center">Participant:</div>

"Oh sure, I feel that way about the whole planet, actually."

This example shows a dialogic interaction during which the Researcher asked a question

about the Participant's values, and the Participant spoke clarifying and potentially new

information to the Researcher, thus presenting an opportunity for change in the Researcher's

cognitive understanding about the Participants' values. This is distinct from a change in

relational understanding that, as explained above, is demonstrated by, for example,

verbalizations of trust and question-answer exchanges about opportunities to work together.

Social learning topics

Given the structured design of the workshop questionnaires and the semi-structured

design of related dialogue, several similar topics were discussed in all five workshops (Table

3.3. For example, in all five workshops, evidence of change in cognitive understanding was

observed when participants asked-answered questions about the BOSH project, ecosystem

services, social processes, and potential impacts of the project. During the discussion

workshop, Group 1 demonstrated change in cognitive understanding regarding the National Environmental Policy Act (NEPA) and its requirements for environmental impact statements (EIS), as well as the questionnaire instrument provided by researchers during the workshop. Distinct social learning topics for Group 2 included value and place meanings like cultural appreciation for historic mining towns within the BOSH project boundary.

During the mapping workshops, we observed evidence that participants in Group 1 experienced change in cognitive understanding about social processes like collaboration and litigation, while participants in Group 2a and Group 2b experienced change in cognitive understanding about economic processes like livelihoods and the local economy in Owyhee County.

Table 3.3: Topics covered during dialogic interactions between participants during all workshops and demonstrating changes in cognitive and relational understanding

	Discussion Workshop		Mapping Workshop		
	Group 1	Group 2	Group 1	Group 2a	Group 2b
Change in Cognitive Understanding	BOSH: Objectives, timeline, funding, temporal scale, spatial scale, proposed treatment alternatives, perceptions of project (within and outside workshop) NEPA: EIS timeline, process, analysis Ecosystem Services: Provisioning Supporting, Regulating, Cultural	BOSH: Proposed treatment alternatives, project summary document, perceptions of project (within workshop) Ecosystem Services: Provisioning, Cultural	BOSH: Objectives, temporal scale, spatial scale, proposed treatment alternatives, perceptions of project (within and outside workshop), problem definition, cost analysis Ecosystem Services: Supporting, Cultural	BOSH: Objectives, proposed treatment alternatives Ecosystem Services: Provisioning, Supporting, Cultural	BOSH: Objectives, proposed treatment alternatives, problem definition Ecosystem Services: Provisioning, Supporting, Regulating, Cultural

	Social Processes: Institutional and legal, geographical, economic		Social Processes: Emancipatory and empower-ment	Social Processes: Economic	Social Processes: Institutional and legal, economic
			Owyhee region: General facts, ecological context	Owyhee region: General facts	Owyhee region: General facts, BLM politics, conservation versus preservation
	Impacts of Project to: Ecology, individuals, communities	Impacts of Project to: Public, communities	Impacts of Project to: Ecology, public, communities		Impacts of Project to: Ecology, individual
		Values and Place Meanings	Values and Place Meanings	Values and Place Meanings	Values and Place Meanings
	Workshop Activities: Questionnaire		Workshop Activities: Mapping	Workshop Activities: Mapping	Workshop Activities: Mapping, logistics
Change in Relational Understanding	Perceptions of others (within and outside workshop), of BLM leadership, EIS process Opportunity for field trips, to share research and papers, to work with BOSH critics, to continue SEIA workshops	Perceptions of others (within and outside workshop) Opportunity to work together on other projects	Perceptions of others (within and outside workshop) Opportunity to work with / to not work with BOSH critics	Perceptions of others (within workshop) Opportunity to stay connected	Perceptions of others (within workshop)
Change in Epistemic Understanding	--none--	--none--	--none--	--none--	--none--

For example, on the topic of social processes, one participant asked another:

Participant 1:
"If you were to get a really world-class negotiation specialist or facilitator to one of those meetings, what would it be like? Would it be any different or would that person still not be able to handle it (conflict between participants)?"

Participant 2:
"Well, with the collaboratives, most all the ones that are successful, they have a very good facilitator. They have that, but also it's building trust. If somebody isn't willing to build trust with the group, they don't belong. That's what's underlying to it, building trust with each other. You understand you don't have the same views, that's okay. You build trust to get to a decision commonly."

Interestingly, Participant 2 reflects on the critical issue of trust during a dialogic interaction based on Participant 1's cognitive-oriented question designed to change understanding about Participant 2's values, but the interaction about trust did not in itself serve to build trust or change relational understanding in either participant - at least as far as we can observe based on what was spoken between participants.

In all groups across all workshops, we observed participants changing relational understanding about their co-participants, but members in Group 1 also discussed and changed relational understanding about non-participants, or stakeholders related to the BOSH project and to the Owyhee region that did not participate in the workshops. This could be explained by the homogenous representation of land managers in the majority of Group 1. Federal and state land managers often receive formal and informal comments from members of the general public regarding new or revised management, so it is not surprising that the members of Group 1 expressed awareness and a new understanding of others' perceptions of the BOSH project. However, despite evidence that changes in relational understanding occurred in terms of new or revised perceptions of others within or outside the workshops, the matter of trust-building remains an elusive aspect of social learning. The more homogenous

Group 1 demonstrated the same amount of dialogic interactions relating to changes in relational understanding as the more heterogeneous Group 2, but conversation in Group 1 centered more on alternative views that were perceived to exist outside and in opposition to views expressed among workshop participants. It appears that a reinforcement of shared negative views of "the other" emerged in the Group 1 Discussion and Mapping workshops that may have in fact built or strengthened trust between like-minded individuals, but it is unclear if the development of this *kind* of trust is a causal mechanism for social learning outcomes like collective action (collective among whom?) or changes in resource management (for whom?).

Discussion

Social learning dimensions

Learning a lot about facts, a little about each other, and nothing about ways of knowing

While our investigation revealed distinct instances of change in cognitive and relational learning (but no changes in epistemic learning), we find that social learning is not as linear as Figure 3.1 suggests. Learning is a circular, iterative, and repetitive process - not necessarily an aggregation of interactive exchanges. Interestingly, when prompted to openly reflect on their workshop experience, most participants reflected on what they learned about other participants. In other words, workshop participants commented more on changes they experienced in relational understanding than on changes they experienced in cognitive understanding, even though dialogic interactions indicating change in cognitive understanding were far more numerous that interactions indicating change in relational understanding. This means changes in relational understanding are probably underrepresented in the sample since

we could count only what people verbalized and not what they were thinking about other participants.

Social learning setting – structure and participants matter

In comparing discussion and mapping workshops, we found that changes in relational understanding occurred more often during the discussion workshops than in the mapping workshops, but not significantly so. This is not surprising given the one-on-one nature of the mapping activity between participant facilitator with little opportunity for participants to interact with each other. Kwok, Ma, and Vogel (2000) in Bandy and Young (2002) theorized that intentional and meaningful subject feedback in a collaborative learning group promotes assimilation of new information, which in turn stimulates learner interaction and promotes accommodation of new information to restructure, or one's view of the world. This invokes a "chicken or egg - which came first?" analogy: does one assimilate new information to enhance interaction, or does one interact to enhance the assimilation of new information? Perhaps in either case an individual's mental model is restructured, which is to suggest that social learning has occurred either way. The point here is that *interactions* create more fruitful space for learning than one-way communication, and this kind of dialogue for decision-making is an important mechanism for changing perspectives and (possibly) behavior (Beratan 2007). Rowe and Frewer (2005) use the term *public engagement* to encompass all forms of participation based on the nature and flow of information. *Public participation* is defined as a two-way exchange between members of the public and sponsors (i.e., the party initiating public engagement) that "serves to transform opinions in the members of both parties (sponsors and public participants)" (p. 256). This is differentiated from *public communication* (information conveyed one-way from sponsors to public) and *public*

consultation (information conveyed one-way from public to sponsors). Considering this information-centric view, the structure of the Discussion workshops produced more two-way communication than the Mapping workshops. However, given the primary role of the researchers in facilitating all workshops and prompting dialogue between participants, we cannot determine the extent to which dialogic interactions between facilitators and participants and/or between two or more participants served as causal mechanisms for individual-centric social learning outcomes (i.e., change in participants' reflexivity and behavior) that theoretically underlie network- and systems-level social learning processes and outcomes.

Thus, our evidence supports claims that *who* is interacting in social learning environments matters as much if not more than the structure of interactive setting. We found that a heterogeneous workshop group in terms of conflicting points of view (Group 2b) produced fewer dialogic interactions indicating changes in either cognitive or relational understanding. A homogenous group in terms of shared interests and values for public lands (Group 2a) produced more dialogic interactions indicating changes in cognitive and relational understanding. Some of this could be explained by participant personalities – for example, in Group 2, a gregarious participant made efforts in both discussion and mapping (2a) workshops to get to know other participants, and these efforts helped shape the nature and direction of dialogue, particularly changes in relational understanding. However this evidence seems to contradict past research claiming that process characteristics like inclusive participation and representation of diverse interest groups will lead to improved social learning outcomes (Conley and Moote 2003). Overall, our evidence supports the notion that social learning occurs through changed understanding of complex issues in an environment of

conflict (Daniels and Walker 1996). It also suggests that, in addition to the consideration of diversity and representation (*who* is at the table), we should pay more attention to *how* participants converse and with whom (e.g., rounds of questions and answers in a lively environment, or a few quiet exchanges of polar opposite opinions followed by silence). In other words, you can bring diverse stakeholders to a conversation, but how will they converse and thus learn? It might seem like all a manager needs to do to transform knowledge is to host a meeting and facilitate small group discussions, but social learning outcomes in terms of cognitive or relational change cannot be imposed (Rist et al. 2006). Emphasis should probably be placed on designing activities and meeting structure that can create more opportunities for interactive exchanges within the engagement process *and* on recruitment of diverse representation, rather than focusing only on gathering all the necessary parties around a table and expecting them to build trust or even talk.

Conclusion

Limitations and Future Research

As an alternative to surveys or experimental design, this observation-based approach can be applied *post hoc* to assess transcripts of dialogue for evidence of individual-level social learning within decision-making or planning processes designed to foster social learning. Our analysis of workshop dialogue provides an alternative approach to social learning research that can complement knowledge informed by interview and questionnaire-based approaches.

Our analytical strategy was limiting in that analysis of dialogic interaction focuses on verbal communication while ignoring non-verbal communication. This analysis did not consider speakers' tone or attempt to interpret participants' attitudes toward others. We cannot say for sure whose understanding changed – the person who asked the question? The person

who answered? Both? Was it a change in cognitive understanding for the questioner, but a change in relational understanding for the answerer? There are probably several dimensions of learning occurring simultaneously. Future research that applies an individual-centric perspective to social learning will benefit from mixed-methods approaches that include both observation of phenomena and a survey of participants' perceptions and reflections of the social learning process. It would be fruitful to integrate analysis of dialogic interactions and pre-post surveys for analysis of self-reflection to triangulate dimensions of learning based on the phenomenon in its "habitat" and what the people learning took away from the experience.

Future research should also endeavor to measure changes in dimensions of social learning beyond the initial social learning process. According to Reed et al. (2010) a one-time assessment of these variables will not demonstrate that social learning has occurred. There is a need to document a change in cognitive and relational understanding in individuals *and* a diffusion of cognitive and relational changes to social units beyond the original locus of learning. This is an area of natural resource management research that will provide ample opportunity to improve our understanding of causal relationships between social processes and outcomes as mediated by individuals and their actions. Despite numerous claims that social learning processes like open communication and diverse participation in natural resource management contexts contribute to or enable collaborative relationships, collective action, and other positive outcomes (Conley and Moote 2003, Schusler et al. 2003), we do not fully understand how this process works at the individual scale. We remain unable to explain how these macro-level changes occur - and thus, how to replicate positive changes in the future - in the absence of causal mechanisms at the micro-level of individuals (Foss 2011). The evidence presented here is our contribution to furthering an individual-centric

conceptualization of social learning that informs process design and invokes disciplinary roots for growing a more explanatory social learning theory.

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CHAPTER 4

Public lands litigation and its direct and indirect influence on human well-being: an extended model for social-ecological research

To be submitted to *Society and Natural Resources*

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Abstract

Rangelands in the western United States are complex systems of dynamic social and ecological change comprising multiple laws and scales of environmental governance. Social-ecological systems (SES) approaches help conceptualize the relationships between human and non-human environments, specifically land management and ecosystem services. Concepts and theory foundational to ecosystem services provide a useful way of thinking about the ways people benefit from the structure and functions of ecosystems, but ignore fundamentally human structure and functions like *individual agency* and *social services.* The purpose of this study was to explore social processes for public lands management and Greater sage-grouse conservation in southwestern Idaho, and to identify causal connections between those social processes, human well-being, and ecosystem services to continue building theoretical foundations for SES. We interviewed 29 stakeholders and citizens to identify drivers of change to human well-being, then focused on litigation as a case study of social process within SES. Based on our results, we present an extended SES model that integrates social theory for a more holistic conceptualization of system structures, functions, and relationships.

Environmental governance in social-ecological systems

Intractable issues

In a world where space and resources are limited, conflicting ideas about how humans relate to our environment define some of the most intractable problems in environmental governance. For example, how can we extract timber or fossil fuels while sustaining the baseline structure and function of the ecosystem – or at least avoid pushing it into a new, unsustainable state? In the United States (U.S.), conflicting interpretations of our laws can lead to intractable issues, too – for example, does the Wilderness Act require us to garden the land, or guard it? (Janzen 1998, Landres et al. 2000). Nowhere are issues in human-environment relationships and ideas about management more problematic (or opportunistic) than in landscapes that are managed for multiple-use. The term "multiple use" defines the management mandate for public lands in the U.S. like the temperate forests managed by the U.S. Forest Service (USFS) and arid rangelands managed by the Bureau of Land Management (BLM). Like many systems around the world, forests and rangelands face challenges from changing climate patterns and wildfire frequencies as well as shifting political and power dynamics among decision-makers. These challenges are especially visceral on western public lands where diverse people, domesticated animals, and wildlife depend on the same desert and sagebrush steppe system to sustain their lives.

Social-Ecological Systems

To help address multiple interests and to understand complex social and ecological dynamics, rangelands have been conceptualized and analyzed as coupled human-natural systems, or complex adaptive systems (Walker and Janssen 2002, Havstad et al. 2007, Li and Li 2012, Petursdottir et al. 2013). The sustainability or resilience of such systems can be

explained, it is theorized, by the co-evolutionary relationship between humans and their ecosystems as individuals and societies respond to ecological and biophysical changes (e.g., climate change) with management practices at multiple scales (Berkes and Folke 1998). The emphasis is on the *social-ecological system* (hereafter SES) where humans are not separate from nature; they are part of it (Berkes and Folke 1998). These theoretical and conceptual frameworks provide the foundation for a social-ecological approach to understanding how social, economic, and ecological conditions are linked, interdependent, and dynamic within SES (Folke 2006, Chaffin et al. 2014), but they are not without their critics.

When applying resilience thinking and complex systems theory to analyses of SES, a system's response (resilience, adaptation, or transformation) to a shock or stressor is partly determined by the system's structures and feedback processes. But as Davidson (2010) points out, the processes of the social system are unique in that people have individual and collective agency. Therefore, the social side of the feedback loop and the outcome of social processes are not defined solely by social system structure, but also by human will and our interactions with other people.

This interactive and communicative nature of the social system suggests we revisit the way we currently conceptualize and understand the feedback loops within SES. Brunson (2012) discussed some challenges associated with applying current SES models to understand problems across rangelands, including difficulties in bridging methods of social and natural (e.g., ecological, biophysical) sciences. The ecosystem service concept is one way to think through such challenges (Brunson 2014). At a local scale, people are said to derive benefits from ecosystem functions (Carpenter et al. 2009, Diaz et al. 2011). For example, water supply (a benefit) is derived from watersheds and aquifers that store and retain water (an ecosystem

function) (Costanza et al. 1998, de Groot et al. 2002, 2010). These benefits are called ecosystem services, and they are theorized to support *human well-being* (hereafter, HWB) (MEA 2005, Diaz et al. 2011). In SES research, HWB is defined as a multi-dimensional state opposite of poverty and comprising basic material for a good life, health, security, good social relations, and freedom of choice and action (MEA 2005, Carpenter et al. 2009).

Thus, the SES feedback loop is built around land use and ecosystem services, where a social system (including people, their actions, assets, and well-being) influences the state of the ecological system through land use, and the ecological system (including ecosystem properties, functional diversity, and land cover) influences the state of HWB through ecosystem services (Figure 4.1) (Diaz et al. 2011).
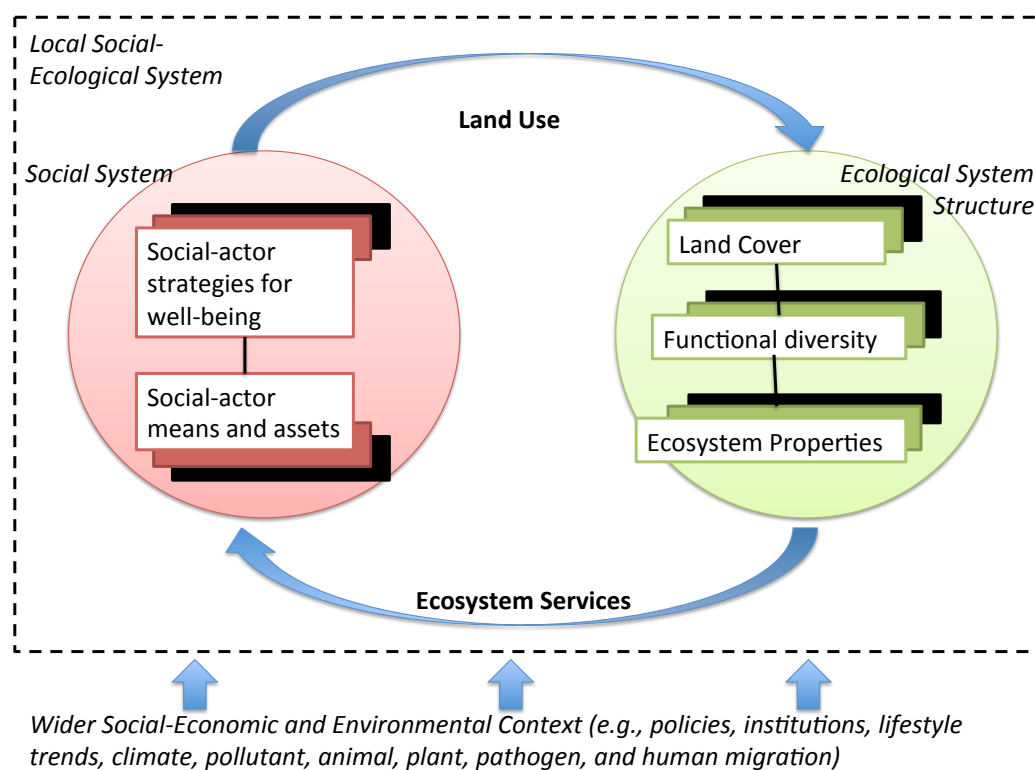
Figure 4.1. A conceptual framework adapted from Diaz et al. 2011 explains how social-actors and social structures are linked to ecological structures and functional diversity through social actors' use of the land and through the provisioning of ecosystem services. Different social-actors rely on different ecosystem services to support their HWB while they adapt to dynamic

influences within their local social-ecological system and from the wider social-economic and environmental context.

While this conceptualization of SES is widely accepted (Cumming 2014), Fish (2011) raised a concern about ecosystem service approaches that sheds light on how we define the relationship between ecosystem services and HWB in SES approaches: "If we look after the services, the framework implies, well-being will take care of itself" (p. 673). In other words, it is assumed that as the ecological system functions, it provides services to the social system in a one-way flow of resources. Thus, when the ecosystem is functioning, we assume that human well-being is supported and sustained. From a social perspective, this assumption is short-sighted because: 1) it ignores the multi-dimensional complexity of HWB and beneficiary groups (the diverse groups of people who benefit from different ecosystem services in different ways); 2) it implies that the cycle ends at sustained HWB, and that the state of human well-being bears no equivalent influence on land use or environmental governance; and 3) it ignores the complex social processes (e.g., laws and policies, litigation, team or group decision-making, learning) that also influence HWB and how those processes ultimately influence the provision of (changed) ecosystem services (Reyers et al. 2013).

To overcome this gap in our understanding of the relationship between ecosystem services and HWB, Reyers et al. (2013) suggest that researchers using a SES approach need to specify beneficiary groups, identify and measure relevant dimensions of HWB, and link changes in different well-being dimensions to benefit flows from ecosystem service bundles (p. 270). Additionally, we suggest that researchers need to link changes in dimensions of HWB to benefit flows from social processes.

For example, a myriad of intractable issues across western U.S. public lands have given rise to new social processes for public engagement and decision-making on natural

resource management. Adaptive management, collaborative management, and adaptive co-management are slightly different recipes for natural resource management that include various flavors of participatory, dialogue-based decision-making to varying degrees (Rodela, 2011, 2013). With their emphasis on collective, social learning and building trust, these social processes for natural resource management have become popular partly based on assumptions that more adversarial processes like litigation will spoil the soup.

The assumption is not completely un-founded, since many high-profile lawsuits aimed at public lands issues have made headlines over the last two decades, often drawing a thick line in the political sands with consequences for people as much as species like the Northern spotted owl (*Strix occidentalis caurina*), the Greater sage-grouse (*Centrocercus urophasianus*) and their habitats (Jones and Taylor 1995, Nie 2008). Yet, litigation is also described as a conservation tool – a way for citizens to enforce federal regulations when administrative agencies stray (accidentally, or not) from their mission or the laws (Nie 2008).

Research Questions

This study provides an opportunity to understand litigation and related social processes in a specific natural resource management setting - specifically, public lands management and Greater sage-grouse conservation in southwestern Idaho - and to explore connections between those social processes, HWB, and ecosystem services to continue building theory foundations for SES. Our research is driven by the following questions: RQ1) How do stakeholders in a public lands context define HWB?, RQ2) How do public lands stakeholders perceive litigation in natural resource management?, RQ3) How does litigation interact with other social processes to directly influence HWB?, and RQ4) How does

litigation interact with the ecological system and flows of ecosystem services to indirectly influence HWB?

RQ2 relates to the gap in our general understanding about a specific social process - litigation - and how people perceive it in a public lands, natural resource management context. RQ1, 3, and 4 relate to the SES approach, our current conceptual understanding of ecosystem services and HWB, our current theoretical understanding of the relationship between ecosystem services and HWB, and our aim to build on theoretical foundations for SES by exploring the role of litigation, associated processes, and their influence on HWB.

Background

Laws and policies

Before we can fully understand the role of litigation in a social-ecological system, review of existing law provides a contextual basis for a contemporary pattern of lawsuits. In the United States, the foundation for public lands management is a set of substantive and administrative laws designed to guide what federal agencies protect, and how (Nie 2008). Three laws stand out from the field as the most influential in current events concerning western public lands and grazing issues: the Endangered Species Act of 1973 (ESA), the National Environmental Policy Act of 1969 (NEPA), and the Administrative Procedures Act of 1946 (APA). The ESA is a substantive law that includes provisions for listing threatened or endangered species and the prohibitions against the taking (i.e., hunting or accidentally killing) of endangered species. Species that require protection under the ESA include plants, insects, fish, and wildlife that are jeopardized by destruction or modification of habitat, overuse, disease, predation, or the inadequacy of existing regulatory mechanisms (16 U.S.C. § 1533a1). In short, the ESA helps determine what federal agencies are responsible for

protecting and conserving. NEPA is an administrative law that requires federal agencies to follow a certain process when assessing potential environmental impacts from proposed land management actions. Agencies must prepare an environmental assessment (EA) to determine the significance of potential impact. If significant, the agency must conduct scoping, analyze potential impacts, draft an environmental impact statement (EIS), and prepare a record of decision before implementing any proposed action (Richardson 1996). As federal laws designed to protect and conserve common and shared resources, both acts contain citizen-suit provisions that enable any citizen to sue an agency (and effectively, the federal government), in order to enforce the laws. Older than the ESA and NEPA is the APA that, for 70 years, has stipulated the ways federal agencies propose and establish regulations and guides federal court review of agency decisions. If a person or group feels unfairly treated by agency action, they can sue for judicial review on the claims that the agency's rule was "arbitrary or capricious," or that the agency did not follow the law in its decision-making process. In other words, the APA is the gateway for judicial influence in environmental governance.

Laws in action in the western U.S.

In the western U.S., the ESA, NEPA, and the APA are invoked throughout long-term debates about threats to habitat of the Greater sage-grouse (*Centrocercus urophasianus,* hereafter sage-grouse). Wildfire, invasive and encroaching species, and development are identified as primary threats to sage-grouse habitat, while grazing, recreation, and West Nile Virus are identified as secondary threats (Idaho Governor's Alternative 2010). In light of these threats, federal agencies, state agencies, non-governmental organizations (NGOs), and private landowners coordinated conservation and restoration efforts to preclude an endangered listing of the species. Concerned citizens claimed that NEPA requirements were

neglected, agency's decisions were arbitrary and capricious, or that the agency's science was

invalid, and thus litigated agency processes and decisions. On September 22, 2015, the

Department of the Interior (DOI) announced that the sage-grouse does not currently warrant

protection under the Endangered Species Act, a decision reached by the U.S. Fish & Wildlife

Service citing successful collaboration among diverse groups for the better part of a decade

(DOI 2015). The DOI also announced that henceforth, national plans for sage-grouse habitat

conservation would be implemented. Following this announcement, the Governor's Office of

the State of Idaho sued the federal government for lack of transparency in collaborating and

drafting the Federal Sage-Grouse Conservation Plans. For the sage-grouse, a final decision

was made, but the ESA, NEPA, and the APA continue to guide judicial review of

collaborations and other decision-making processes for sage-grouse conservation and public

lands management.

Litigation

The public lands and natural resource management literature reveals few case studies

explaining the role, function or structure of active civil lawsuits within a social-ecological

system. Burke (2011) examined a diverse range of organizational attitudes toward decision-

making processes and found that an organization's tendency to collaborate or litigate depends

on its size, professionalism, and environmental value(s). For example, small, less

professionalized organizations with a single environmental value tend to use a confronting

strategy (Burke 2011). Using a census approach, Keele et al. (2006) examined USFS litigation

between 1989 - 2002 for characteristics and outcomes, and documented evidence to support

the claim that, even if a plaintiff loses a case (e.g., suing for less resource use), the indirect

benefits of litigation (e.g., delayed agency action) might be just as important as winning or settling.

Beyond the more specific investigations into the characteristics of litigation and those who engage in it, Nie (2008) provides a helpful review of the reasons for judiciary involvement in natural resource management, a review of the criticism litigation faces from federal and state governments, interest groups and academics, as well as litigation's flaws, and finally a frame of litigation as a conservation policy tool. Nie (2008) claims that litigation can serve as an impetus for other conservation strategies. Successful litigation against an agency and subsequent court decisions have been shown to catalyze on-the-ground changes in the agency's management strategies, like resumed monitoring (Jones and Taylor 1995, Sayre et al. 2013).

Thus, two frames of litigation begin to emerge: litigation is an obstruction to collaborative management and an impediment to conservation progress, or litigation is a useful conservation tool and an authentic form of public engagement (Nie 2008). Still, we know little about litigation as a social process in a social-ecological context or its influence on HWB.

Conceptual Framework and Theoretical Foundations

Recent developments in environmental governance and natural resource management literature provide the conceptual framework and theoretical foundations for this research. Three key areas include 1) characteristics of SES and their connections through land use and ecosystem services, 2) changes to SES characteristics, how they cascade through the system, and to what effect, and 3) characteristics of human well-being. These concepts and theory provide a foundation for exploring new ideas about how social processes function within SES,

relate to ecosystem services, and influence HWB. Thus, we attempt to fill knowledge gaps with this study that is framed by our current conceptual and theoretical understanding and designed to enable potentially new characteristics and relationships to emerge from analysis.

Characteristics of Social-Ecological Systems

As described above, this study uses a SES approach that conceptualizes social structures (e.g., institutions, laws, communities, individuals) and ecological structures (e.g., rangelands, watersheds, habitat, species) as connected through land use and ecosystem services (Berkes and Folke 1998, Folke 2006, Diaz et al. 2011). Ecosystem services are defined as ecological functions that have value for humans and are categorized as provisioning (e.g., water, food), regulating (e.g., clean water, clean air), supporting (e.g., habitat), and cultural (e.g., spirituality, space for recreation) (de Groot et al. 2002, 2010).

In theory, ecosystem services support HWB as people benefit from bundles of ecological function (Reyers et al. 2013). Ecological functions also serve the ecosystem in and of itself; every function need not account for a human benefit. Conversely, every human benefit need not derive directly from an ecosystem service. In addition to the influence of land management on ecosystems, social, political, legal, and economic processes (or functions) can influence the social system in and of itself.

Social processes, also called social change processes, are series of actions that may or may not trigger changes in the SES that ultimately impact humans and influence HWB (Vanclay 2002). Categories of social change processes include economic processes (e.g., conversion of economic activities, impoverishment), institutional and legal processes (e.g., decentralization, privatization), and emancipatory and empowerment processes (e.g., marginalization, capacity building) (Vanclay 2002, p. 193) (Table 4.1).

Table 4.1. Social change processes categories and example processes from Vanclay 2002. This list is not exhaustive; many categories and examples are context-dependent.

Category	Example Processes
Demographic processes	In-migration, out-migration, presence of newcomers, rural-to-urban migration, urban-to-rural migration
Economic processes	Conversion and diversification of economic activities, impoverishment, inflation, concentration of economic activity
Geographical processes	Conversion and diversification of land use, urban sprawl, urbanization, enhanced transportation and rural accessibility
Institutional and Legal processes	Institutional globalization and centralization, decentralization, privatization
Emancipatory and Empowerment processes	Democratization, marginalization and exclusion, capacity building
Sociocultural processes	Segregation, social disintegration, cultural differentiation,

A social impact is defined as a physical or perceptual change experienced by humans at individual and higher scales (Vanclay 2002). So in theory, a social change process triggers a physical or perceptual change (human impact) (Slootweg et al. 2001), that then enhances, maintains, or degrades HWB (Vanclay 2002).

Human Well-Being

All of this hinges on our understanding of HWB and the conditions people need in order to live well. Much of what we know about HWB in SES literature is based on the Millennium Ecosystem Assessment definition: "a multivariate state comprising five dimensions: basic material for a good life, health, security, good social relations, and freedom of choice and action" (MEA 2005). But the definition fails to mention *who* or *what* is sustaining said multivariate state. These dimensions seem to focus on what an individuals needs to sustain well-being, and they ignore the interactive, communicative basis of society:

what does it mean for groups, communities, or nations of people who communicate and interact to live well?

Wilkinson (1991) explored the concept of *social well-being* in rural America and termed its five dimensions: distributive justice, open communication, tolerance, collective action, and communion (Table 4.2). Wilkinson (1991) suggested that individual well-being supports social well-being and that, conversely, social conditions play an important role for individual well-being, though not always a supportive one.

Table 4.2. Dimensions of social well-being adapted from Wilkinson 1991

Distributive justice	Recognition of the *fact* of human equality, actions to remove inequalities
Open communication	Efficient channels for sharing information, communicative interactions that are honest, complete, and authentic
Tolerance	Acceptance of differences and similarities
Collective action	Building social relationships, working together in pursuit of common interests
Communion	Willful entry into celebration of community, joyful response to relationships and shared purpose, purposive involvement

Thinking holistically, Wilkinson (1991) also suggested that "social and individual well-being are achieved in ways that promote ecological well-being… which in a literal sense means the well-being of the 'house' of civilization…" (p. 75). Drawing on Maslow and Mead, Wilkinson (1991) theorized that, from a humanist perspective, social, individual, and ecological well-being complement and depend upon each other and enable an individual to move beyond lower-order needs like food and safety to achieve higher-order needs like social interactions that give meaning to one's self-identify (p. 67-68). In other words, individual well-being is self-actualization achieved through social interactions and supported by healthy social, ecological, and lower-order individual conditions. Forty years from Wilkinson's

conceptualization of dimensions of social well-being, we're calling these related social, economic, and ecological conditions the "triple bottom line" of sustainability (Wu 2013).

Considering the interactive basis of society and the important role social interactions play in developing *self* and sustaining HWB, we turn our attention to social interactions in the context of natural resource and public lands management, specifically litigation. Southwestern Idaho and a municipal region called Owyhee County provide an appropriate case for exploring these practical and theoretical questions.

Methods

Study Site

Currently, the sagebrush steppe SES is faced with unprecedented challenges as a result of climate change (Bradley and Mustard 2006), increases in fire frequency (Brooks et al. 2004, Romme et al. 2009), and biological invasions. For example, an invasive annual grass (i.e., cheatgrass; *Bromus tectorum*) covers 4 to 7 million ha of the total 18 million ha sagebrush system (Knapp 1996, West 2000), which increases fuel loads resulting in additional fires (Brooks 2008). This threat to rangelands has fueled "unprecedented collaboration" (DOI 2015), although social conflicts over land use laws, policies, and litigation are pervasive, and consensus among stakeholders is often difficult. For the purpose of this study, stakeholders include people who depend on public lands for livelihoods (e.g., Bureau of Land Management (BLM) land managers, agency scientists, ranchers), people whose livelihoods are related to public lands (e.g., attorneys, academics, county leadership) as well as those who engage in non-livelihood activities on public lands (e.g., non-governmental groups, hunters and other recreationists).

Data Collection

The sampling frame included public and private entities with missions focused on preservation, conservation, use, and/or management of land and natural resources the metropolitan area of Boise, Idaho and the municipality and rural region to its south known as Owyhee County. Snowball sampling commenced with key informants among local leadership in Owyhee County and managers in the U.S. Fish & Wildlife Service (USFWS) and the BLM. Between August 2013 and September 2014, 33 prospective interviewees were contacted via email and asked to participate in one semi-structured interview in-person or by phone. Interviews were conducted with 29 people who live and work in the Owyhees and the metropolitan area surrounding Boise, Idaho. The average interview length was 55 minutes, ranging from 45 to 120 minutes. Interview participants represented federal land or natural resource management agencies (9), state land or natural resource management agencies (3), non-governmental organizations (3), Owyhee County (2), academic institutions (3), law firms or attorney positions within state or federal agencies (6), and concerned citizens (3). We followed ethical guidelines for working with human subjects, and the University of Idaho Institutional Review Board approved our project #12-357.

Data Analysis

The interview guide (Appendix E) was semi-structured around our conceptual understanding of human well-being, our conceptual understanding of SES, our theoretical understanding of the causal relationship between ecosystem service change and change to HWB, and our assumption that the role of social processes within SES - particularly litigation - needs to be investigated. Probing questions were designed to identify a breakdown in benefits (threats to the sagebrush steppe SES and threats to HWB). While the previously

described conceptual and theoretical frameworks informed our assumptions about the research subject and guided our design of the interview guide, many questions were left open-ended to enable interviewees to describe phenomena in their own terms (e.g., "What does well being mean to you?"; "When you hear the term litigation, what comes to mind?"). Twenty-five interviewees gave consent for audio-recording and four interviewees gave consent for note-taking. All interviews were transcribed for analysis in NVivo 10.1 (QSR International Pty Ltd. Version 10, 2012).

This study is situated in the paradigm of realism research; it is theory-building research based on preconceived understanding of social phenomena and their relationships with an emphasis on meaning. Realism assumes that a "real" world can be discovered - though imperfectly perceived - as opposed to positivism, for example, which assumes reality is real and can be quantitatively measured to test theories. For realism research, multiple perceptions can be triangulated to capture a picture of reality that confirms or disconfirms preconceived theory and informs theory-building (Healy and Perry 2000).

The purpose of this study was to understand litigation and related social processes for public lands management and Greater sage-grouse conservation in southwestern Idaho, and to explore causal connections between those social processes, HWB, and ecosystem services to continue building theoretical foundations for SES. To these ends, two different analytical strategies were employed: 1) deductive analysis to examine the data for manifestations of predetermined concepts or theoretical relationships, and 2) inductive analysis to reveal general patterns and discover common themes across cases (Patton 2015).

RQ1) How do public lands stakeholders define well-being?

First, interviewee responses were inductively coded for themes and patterns of terms relating to a desired state of HWB. Next, to describe the resources that these individuals in southwestern Idaho need to live well, descriptive characteristics of HWB were deductively coded into categories of social, economic, and ecological resources based on the triple bottom line of sustainability. Last, interviewee responses were inductively coded for themes and patterns of threats to the study region and to their HWB.

RQ2) How do public lands stakeholders perceive litigation in natural resource management?

First, interviewee responses were deductively coded for categories of characteristics designed in the interview guide (e.g., costs of litigation, "silver linings" of litigation, options for responding to litigation). Next, responses were inductively coded to allow additional characteristics to emerge from the data. Once the data were categorically coded, each category was inductively coded for emergent details describing the characteristics, functions, and impacts of litigation.

RQ3) How does litigation directly influence the social system and HWB?

First, interviewee responses were categorically coded for types of decision-making processes, including litigation, collaboration, and negotiation. Collaboration and negotiation emerged during data collection as processes relevant to the description of litigation and its role in natural resource management. Once the data were categorically coded, all data coded under "Decision-Making Process – Litigation" and "Threats – Litigation" was inductively coded for emergent details describing the direct causal chain of influence from litigation to well-being, mediated by changes to social system structures and the related social processes. The related dimension and level of well-being were also coded.

RQ4) How does litigation interact with the ecological system and flows of ecosystem services to indirectly influence HWB?

All data coded under "Decision-Making Process – Litigation" and "Threats – Litigation" was inductively coded for emergent details describing the indirect causal chain of influence from litigation to well-being, mediated by changes to land management, changes to ecosystem structure, changes to ecosystem service and changes to well-being. The related ecosystem service and dimension and level of well-being were also coded.

Findings

HWB: Individual and Social

Meaning

Four main descriptors for individual well-being emerged from the interview data: 1) freedom, 2) happiness, 3) health (physical, mental, and environmental), and 4) meaningful productivity (Figure 4.2). Evidence for four dimensions of social well-being were also identified: open communication, collective action, tolerance, and communion. Respondents described 55 social, economic, and ecological conditions needed to support and sustain individual and social well-being (Figure 4.2). This list aggregates interview responses to the question regarding social, economic, and ecological characteristics that need to be in place in order for each interviewee to live well; it is comprehensive, though not exhaustive.
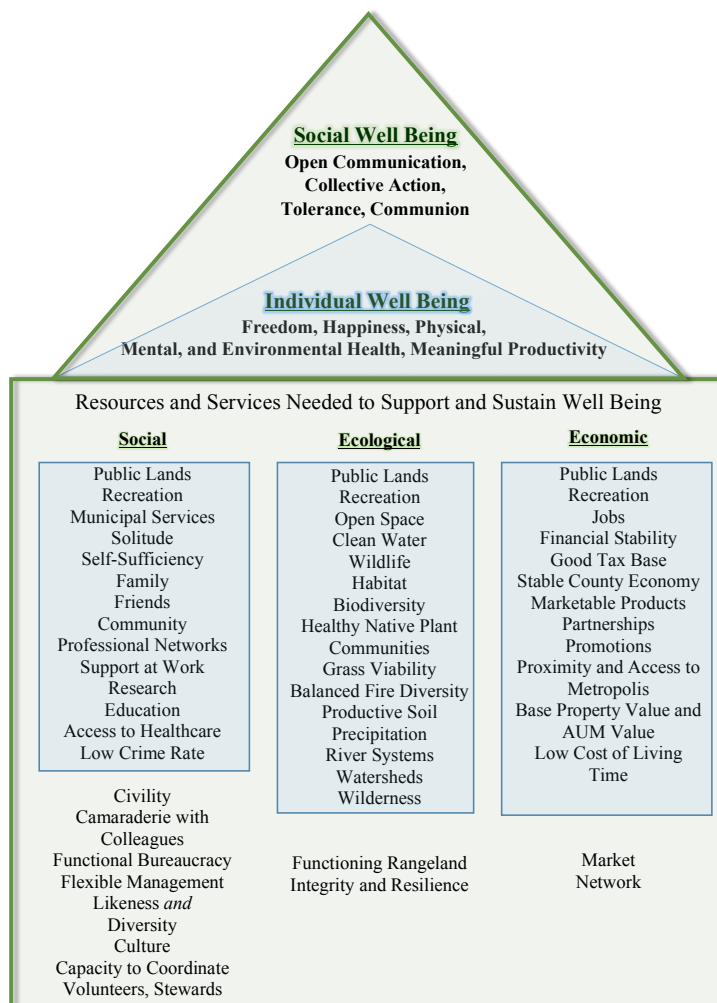
Figure 4.2. General concepts for defining and measuring individual and social well being, supported by social, economic, and ecological conditions that are needed to sustain well being for people living and working in southwestern Idaho, USA. Characteristics in blue boxes support individual well-being; all other characteristics support social well-being.

Social conditions that sustain HWB

Some of the most common social conditions described by participants to support individual well-being were community and good social relations, opportunities to recreate, and public lands. The elements of community that support individual well-being are feelings of connectedness and support in times of crisis (while elements of community that support social well-being are camaraderie and sense of community, or communion).

Civility was described as a desired condition for social well-being:

> "What bothers me is sometimes the lack of civility in public conversations about things…In our national conversation, which does then affect some of the other values we cherish, say ecological values, the lack of civility means we're not moving towards resolution. We're fighting, and that bothers me."

This description of a lack of civility in conversations aligns with our understanding of the communicative nature of social well-being and a desire among stakeholders to move beyond individual needs toward addressing needs that are for the good of society. This "fighting" that occurs in the national discourse and its impact on ecological values illustrates our understanding of a causal relationship between social and ecological conditions.

Ecological conditions that sustain HWB

Public lands and recreation were also mentioned often in the context of ecological conditions needed to support individual well-being:

> "Public lands become very important to that ecological well-being. You want them in good shape so you can do whatever it is you do on them… We can't overuse them. We can't wreck them, and so that's ecological well-being."

Several ecological conditions necessary for well-being fit in with the categorization of ecosystem services, including clean water, open space and habitat, biodiversity, and precipitation. When these ecological conditions and services are functioning well, they support individual well-being, which enables people to interact and enhance social well-being. The state of individual and social well-being depends on the state of the "house of civilization" (Wilkinson 1991):

> "Clean air, water, resilient plant and animal communities. It's not a National Park, but these are settings that have integrity and resilience. They are important, period – everyone needs these things."

Economic conditions that sustain HWB

Some of the most common economic conditions described by participants to support individual well-being were jobs and financial stability. Given the numerous resource-based livelihoods in the study region, economic and ecological conditions were described in tight connections:

> "Well-being to me means not only the health of our business, which includes the…marketability of our livestock, the health of the natural resource, but also for us in the county that we live in, it includes the well-being of the resource and the economic stability of the county because we are so dependent on federal lands."

The interactive, communicative nature of society is manifested in economic markets. The conditions of a market can directly influence social well-being:

> "…it's dependent on your schools, your local businesses, your markets, where you sell your products…say if you grow hay, you've got extra hay. You sell to other farmers or ranchers, or if you've got corn you can sell, or purchase from those. There is a lot of ties amongst those, even like in my business. Even though it's small, there is certain crops that I need that I don't grow that I can purchase locally…and that connection economically contributes to the social understanding of how everybody is dependent on each other."

Drivers of Change

Interview respondents described 18 threats to their social-ecological system, 8 of which included descriptions that tied the causal chain from a driver of change to an anticipated change to HWB due to potential changes to social, economic, and/or ecological characteristics to the main elements of human well being (Figure 4.3). Additional indirect influence from drivers of change to other conditions can be inferred. For example, interviewees described how an endangered listing of the Greater sage-grouse would directly

threaten current social structures with new federal regulations that would change the way

public land is used:

> "…that's why many people don't want the sage-grouse to be listed, because it
> brings in regulatory agency."

We can infer that this perceived driver of change might directly influence economic structures

for those who depend on public lands for their livelihoods and indirectly influence ecological

structures through changes to management of public lands and associated ecological

structures, but those connections were not drawn in this example by the interviewee, so the

arrows to economic and ecological conditions are not included here.
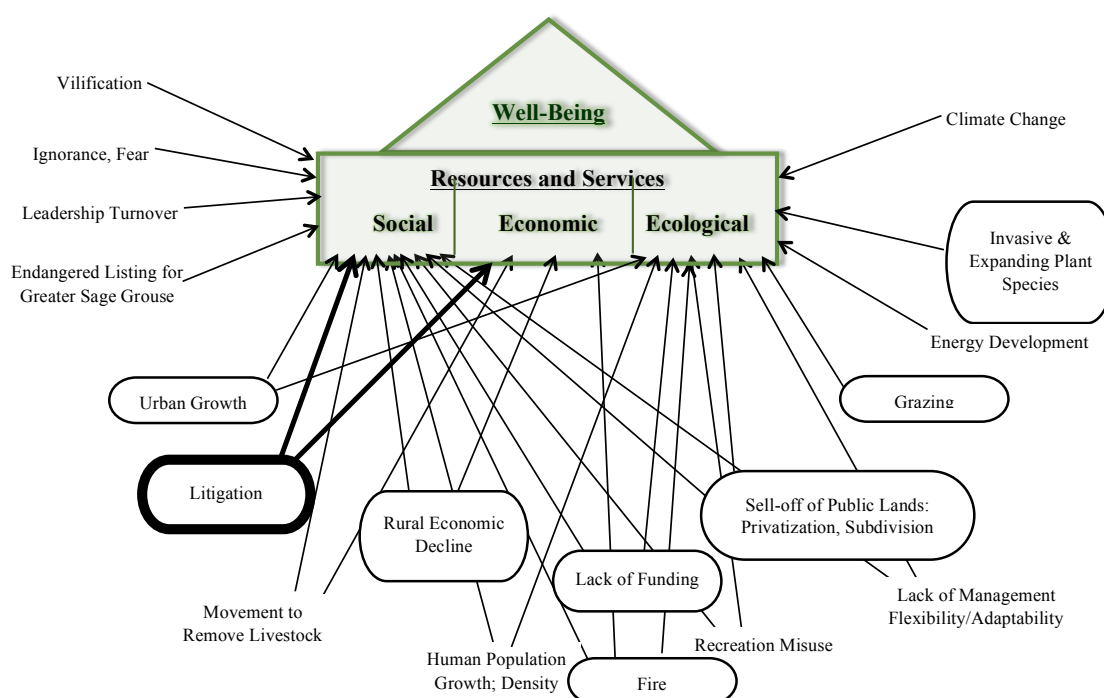
Figure 4.3. Identified drivers of change to social, economic, and ecological conditions that support well-being. Arrows indicate direct influence from driver of change to social, economic, or ecological conditions needed to sustain well-being as described by interviewees.

Drivers of change to ecological conditions

The most common descriptions of drivers of change to ecological conditions that support HWB included fire and invasive and expanding plant species like cheatgrass and juniper spp (*Juniperus occidentalis*). Some descriptions illustrated the causal connection between a driver of ecological change and a change to individual well-being:

> "It is very sad to see huge swaths of country – hundreds of thousands of acres – burn and then come back as annual grasslands that don't provide the aesthetic values that a healthy, functioning desert or forest ecosystem provides."

In the above example, an observation of degrading ecological conditions post-fire degrades happiness and alters the stakeholder's well-being. Other descriptions illustrated the causal connection between a driver of ecological change and a change to social well-being:

> "We have some serious threats – there's potential for fire, we've got juniper encroachment, we've got some other things, but for the most part, we've got fairly vibrant, healthy communities – both on the natural aspect and with our people, but I do feel we are very much sitting on the edge of a cliff. And just a little breath or push either direction could very much shape both – both the natural resource health, and that would reflect back onto our communities."

Livestock grazing was perceived as a driver of varying degrees of change to HWB. For some stakeholders, the presence of cattle on the landscape was annoying, but tolerable:

> "Personally, I've seen pretty serious impacts from grazing. Then I've seen places where there really aren't a lot… It is sad to see a really impacted riparian area or something like that, but I also understand that multiple use is part of our mandate,"

The above example illustrates the dimension of tolerance, or the acceptance of interests dissimilar from one's own. Tolerance is unique among the dimensions that support social well-being. It requires one to ignore what one perceives as negative impact to shared resources and accept that other people have different interests in the resource in order to

support a shared normative standard of behavior for the benefit of society. Other stakeholders

conveyed zero-tolerance for grazing:

> "Native vegetation that is not eaten by cows, no water with e-coli, wild
> landscapes left alone, no predator killing because ranchers can't take care
> of cows."

In this case, perceived degraded ecological conditions created a complete lack of tolerance for

livestock and the ranching lifestyle. In the face of the same driver of change to well-being, the

state of individual well-being for some stakeholders is such that dimensions of social well-

being, like tolerance, are supported and enabled. For others, however, the state of individual

well-being is such that tolerance is seemingly not possible.

Drivers of change to economic conditions

Of the drivers of change to ecological conditions listed above, fire was described as a

driver of change to economic conditions, as well:

> "…ranch based communities. If you take out a lot of their potential forage
> habitat, it can have a bigger impact on people like that, that rely more on those
> federal lands for their livelihood."

In other words, if forage burns up, livestock operators spend money on feed for their sheep

and cattle. This can create financial instability and degraded individual well-being, and

possibly degraded social well-being if the operators and livestock market suffer from a

decline of communion and shared purpose in the market.

Another driver of change to economic conditions that support HWB is rural economic

decline:

> "…economically, a lot of them aren't surviving, so they're selling off their
> ranches…when they sell them they turn into – a lot of them – suburban
> neighborhoods or those little subdivided ranchettes. So there goes your open

space because, granted, they're ranches, they're privately owned, but wildlife
still uses those areas. So then you're losing that, too, and it's a pretty rapid rate."

This example illustrates the causal chain of influence from a threat catalyzing change in the

environmental health dimension of individual well-being via financial instability and loss of

jobs. The changes in these particular economic conditions translate to changes in ecological

conditions, i.e., a loss of open space and biodiversity that are valued as ecosystem services for

people and for the ecosystem itself.

Drivers of change to social conditions

More social conditions necessary for HWB were described compared to ecological or

economic conditions (Figure 4.2). Among all the categories of drivers of change to social

conditions necessary to support HWB, concerns about the sell-off of public lands and

potential changes to mental and environmental health dimensions of individual well-being

were common:

"They'd (the state) like to sell them (lands) for profit even though they say we
manage them…that's why we have all this open space right now is because of
public lands. If you take that away, there goes your quality of life, I think, for a
lot of westerners."

This example connects the perceived change in public lands management to a decline in open

space, which is a necessary ecological condition for the support of HWB and an example of a

supporting ecosystem service. More broadly, this illustrates the complexity of different scales

of environmental governance and natural resource management coupled with distinctly

different laws and policies in action at each scale. Such a shift in public lands management

would, according to nearly a quarter of our interviewees, directly influence individual well-

being and drive additional social change processes like urbanization and urban sprawl and

their subsequent effects to well-being:

> "I worry somewhat about the future of rangelands, and this kind of gets to the
> litigation question as well – that there are well-meaning environmental groups
> that are trying to get grazing off of the rangelands. But my fear is that, without
> that nexus with the lands – that if livestock were removed from rangelands, I
> have a fear that there would be a push to liquidate public lands or privatize
> them. There's a risk of further urban expansion and uncontrolled use. I'm not
> saying that's the biggest threat, but it's in the back of my mind with all the
> litigation that goes on."

In addition to descriptions of impacts to individual well-being, interviewees described

concerns about their perceived threat of public lands sell-off and potential changes to social

conditions necessary for sustaining social well-being:

> "What's really missing is political support for these same quality of life
> measures…There are very few politicians who talk about the real treasure of
> the Boise River and the fact that it's the drinking water. It's not the gold, but
> the fact that we have a currently intact watershed. What's really missing is the
> awareness of political leaders of how valuable the resource is that we have,
> and how other states have lost them, and how we're the envy of many places.
> Instead, their desire is to sell off public lands."

This description hints at a desire to celebrate shared resources and interests in a region and

community, but suggests that communion has not been achieved because of starkly different

environmental structures that underlie diverse stakeholders' values, connections with the

landscape, and sense of community (water versus gold). Conditions are in place to support

individual well-being for both groups in this example - those who desire an intact watershed

and those who desire gold - but the social conditions (e.g., communion, open communication)

are not in place and fall short of supporting social well-being.

Public lands litigation – catalyzing change through the social system

Negative impact to HWB

Among all the perceived and described drivers of change to environmental conditions necessary for supporting HWB, litigation was the third most-common (first: fire; second: sell-off of public lands). This is likely due in part to our focus on litigation as a social process of interest and investigation. As such, we will devote the rest of our analysis and discussion to public lands litigation and employ it as a case for furthering our understanding of social change processes and their role in changing social-ecological system structures and ecosystem services. The evidence reported here explains how public lands litigation impacts social system structures (e.g., federal agencies) and catalyzes change in related social processes (e.g., public lands management), thus changing particular social system structures and processes which then changes dimensions of HWB at individual or social levels (Table 4.3).

As mentioned above, concerns about litigation were often associated with other drivers of change to land management and to HWB. For some interviewees, public lands litigation was perceived to change mental health dimensions of individual well-being for public lands managers and for people who depend on public lands for their livelihood:

> "Probably the biggest threat for us right now is litigation…For us in this county, we've got 78 percent public lands tied to the base property - that's probably our biggest threat… Going hand in hand with that is the fear factor that it puts for the agencies we deal with because they're often drawn into court, their funds go to court litigation rather than to the things on the ground that we need, so it's a very vicious cycle. Probably more so than fire and invasives - litigation is threatening us more than anything."

Table 4.3: Influence of litigation on dimensions of human well-being mediated by social system structure and social process. Related dimensions of social process and well-being and the level of well-being are included. Direction of influence flows from left to right.

Related Social System Structure	Related Social Process	Change to Social System Structure and Process	Related Dimension of Well-Being	Change to Well-Being	Level of Well-Being
Federal agency funding	Economic (Concentration of economic activity)	Less money to spend on the ecological resources	Environmental Health	Degraded	
Federal agency management	Institutional and Legal (Management efficiency and efficacy)	Increased water quality testing	Physical, Environmental Health	Improved	
		Decreased rangeland monitoring	Mental, Environmental Health	Degraded* Improved*	
		Decreased livestock use	Freedom, Environmental Health	Improved	
		New jobs	Meaningful productivity	Improved	
Ranching livelihood	Economic (Concentration of economic activity)	More money spent on litigation; Less money to spend on livelihood	Mental Health, Freedom of choice	Degraded	Individual
	Economic (Impoverishment) + Geographical (Conversion of land use)	Sell-off, subdivide private land	Freedom of choice, Meaningful productivity, Environmental Health	Degraded	
Plaintiffs	Paperwork - Stress*	Heart pressure rises	Physical, Mental Health	Degraded	
	Paperwork - Time*	Lost time better spent on other projects	Mental Health	Degraded	
	Tax base on public lands	Increase in county-level litigation funds / Decrease in programming	Mental Health	Degraded	
General Public	Federal Court	Litigant loses, taxpayers pay court fees through EAJA	Mental Health	Degraded	
Rural community	Demographic (Out-migration) + Sociocultural (Social disintegration)	Cut community bonds	Communion	Degraded	
	Demographic (Presence of newcomers) + Sociocultural (Cultural differentiation)	Shifting school dynamics	Communion	Degraded	Social
Public-private land management relationships	Emancipatory and empowerment (Marginalization and exclusion)	Loss of trust	Open communication + Collective action	Degraded	
Public engagement	Emancipatory and empowerment	Decision-making in public sphere	Open communication	Improved	
Utilitarian-Environmentalist relationships	Sociocultural (Social disintegration)	Polarization, loss of support for a cause	Tolerance	Degraded	
Direction of influence →→→					

These concerns about fear, anxiety within mental health dimension of well-being were associated with the perceived negative influence of litigation on economic conditions necessary for HWB, including the good tax base described above and financial stability for families and businesses:

> "When you are challenged by whatever group – radical group that doesn't want that type of lifestyle, doesn't want cattle out on public lands, it costs a lot of money to preserve that. I mean when we go – these folks go into court, it's not uncommon at all for them to spend five, six figures to defend their way of life."

In terms of social conditions necessary to support HWB, litigation was perceived to degrade four of the five dimensions (Table 4.2), including open communication and collective action:

> "I really struggle to see what good comes from litigation. I'm going to use this as an example. You've got numerous permittees that are appealing this that are very mad, very resentful, very disgusted with BLM. Had the agency had the time… By not effectively communicating, by not working with folks, you may never recuperate that trust… When stuff like this happens, for many, many, many years, regardless of who wins, draws, or ties, whatever, you're going to have that friction. I think the effective cooperative working relationship won't be there in this case. Litigation defines winners and losers."

tolerance:

> "We all understand that it's (litigation) is hard. It became the owl versus the logger. I've been involved in litigation… it becomes the fish versus the farmer. Those kinds of things do not build public support for our cause. The environmental movement wants support for its cause. So when you ask about the cost of litigation, it can be very polarizing. It can inflame emotions. Then it can turn people against environmentalists. So there's certainly a cost of litigation – a broader social cost or risk, I think."

and communion:

> "…ranching communities, rural communities in general, are very resilient and they have very much – when we get together for weddings, or school functions or whatever, we have a tendency to be in the moment. We might talk about it

> (litigation) a little bit, but the camaraderie is very good and the support system
> is huge. When it's a time in need, people are there. So there's good and bad
> sides to it, but it's a very tense issue right now. In our county, you can feel it.
> You can feel it everywhere you go."

These examples illustrate the ways litigation can alter the social conditions necessary for

sustaining HWB. Since social conditions "set the stage" for individual well-being (Wilkinson

1991), we infer that these changes will negatively influence individual well-being.

Positive impacts to HWB

With our focus on litigation as a case study of a social change process, we also

analyzed described benefits of litigation for examples of positive influence on HWB. The

same analysis can be conducted for the other drivers of change identified in Figure 4.3, but

such an effort is beyond the scope of this investigation.

Interviewees described four examples of enhanced individual well-being as a result of

litigation, and each involved changes to federal land management. For example, some

stakeholders perceive that litigation catalyzes land management changes like increased water

quality testing and decreased livestock use, which has implications for physical health in

terms of cleaner water and environmental health in terms of less grazing on public lands. For

some stakeholders, these changes to land management enhance their individual well-being by

stopping actions that are perceived to be harmful to the environment, and thus, we infer,

creating opportunities to improve environmental health:

> "When specific laws are not being followed and the environment is
> harmed…litigation is a way to make the West more liveable and to say ranchers
> don't have carte blanche over everything. It is a battle between public and
> private interests…Litigation over environmental issues is about an economic
> force that wants to do harm to the environment and make money at the public
> expense, regardless of impacts to public health, land, air, or water."

For other stakeholders, changes to land management caused by litigation lead to improved

well-being in terms of mental health:

> "Some of these grazing allotments didn't look very good. That's why we're
> doing this (revising resource management plans), because some of them were
> overgrazed. Some of them needed to make changes. We needed to reduce the
> amount of cattle on some of these allotments in order to provide for rangeland
> health standards. So I think most of it makes sense that this needed to be done…
> So that's, I think, the big part of the litigation. I think it's good in the sense that
> we eventually get stuff done, but it also kind of has a cascading effect where
> you end up not getting other work done."

This example illustrates several nuances of litigation's positive influence on HWB. Litigation

positively influences individual well-being when it is perceived to create opportunities to

address pressing issues and complete tasks at work, which relate to dimensions of mental

health and meaningful productivity. However, over time, other work-related projects like

rangeland monitoring suffer from lack of attention and stress is reported to rise in individuals

dealing with large amounts of litigation paperwork, which can diminish meaningful

productivity and thus well-being (Jones and Taylor 1995, Keele et al. 2006) (Table 4.3). This

is the clearest example of a temporal dimension of a causal chain of influence from litigation

to HWB that we observed: in the short term, litigation can spur action and feelings of

productivity at work, but over time, as stress and paperwork increase, the effect of litigation

on individual well-being becomes negative.

In terms of social well-being, one example of perceived positive influence resulting

from litigation was described:

> "The BLM's public process (NEPA) provides another alternative - not just
> litigation - but the BLM won't engage in the process because the politicians
> hamstring them. Litigation tries to enable open public processes instead of good
> ol' boy back room deal-making. These decisions should happen in the public
> sphere."

Here, litigation is perceived to change social system structure and process by pushing decision-making into the public sphere, thus enabling open communication for decisions about shared resources. Based on this perspective, collaborative efforts are viewed as exclusive processes where the politically and financially powerful make decisions based on their values alone. The assertion is an interesting one, and the analysis of collaborative processes for decision-making and natural resource management is a vast literature replete with praise and criticism for its characteristics and outcomes. Examining the role of collaboration as a social process and its influence on HWB is beyond the scope of this investigation, but its interaction as a catalyst for litigation is pertinent to this report.

Litigation and collaboration: reflexive phenomena

Collaboration emerged as a significant social change process related to litigation, both in juxtaposition with the more adversarial approach to decision-making, and as a potential impetus for it (Nie 2008). The perceived positive and negative influence of both litigation and collaboration on HWB was reflected in interviewees' descriptions of both social processes driving positive and negative changes to social structures processes (Table 4.4).

Table 4.4 Functions of decision-making processes in southwestern Idaho SES

	Changed dimensions of HWB	Catalyst for…
Litigation	Mental, physical health (stress, fear) Open communication (public empowerment)	Community change Management change Resource/landscape change Collaboration
Collaboration	Open communication and collective action (trust *and* distrust)	Community change Management change Resource/landscape change Litigation

The findings described above illustrate the function of litigation within the social system, including examples of how litigation interacts with and catalyzes changes to other social processes like land management, and how those changed social processes then positively or negatively influence individual and social dimensions of HWB.

Now we look to the ecosystem within SES and examine how changes to land management catalyzed by litigation are reported to change ecosystem structures and functions. In other words, we will discuss litigation's indirect influence on HWB.

Public lands litigation – catalyzing change through the ecosystem

Negative impacts to HWB

Interviewees described four specific causal chains of change between litigation, ecosystem services, and HWB (Table 4.5). Fear of litigation was also identified as a catalyst for change to ecosystem services and well-being.

Table 4.5: Influence of litigation on well-being mediated by change to land management, ecosystem structures, and ecosystem services. Related dimensions of ecosystem services and well-being and the level of well-being are included. Direction of influence flows left to right.

Catalyst	Change to Use or Management	Change to Ecosystem Structure	Related Ecosystem Service	Change to Ecosystem Service	Related Dimension of Well-Being	Change to Well-Being	Level of Well-Being
Litigation	Decreased livestock use	Forage burns, invasive grasses spread	Supporting (Habitat)	Habitat, open space degrade	Environmental Health	Degraded*	Individual
		Land rests, time for native plants		Habitat, open space improve		Improved*	
	Status quo management	Species die off	Supporting (Habitat)	Less biodiversity		Degraded	
Fear of Litigation	Status quo management	Sagebrush and other habitat burns	Supporting (Habitat)	Less habitat (for people, livestock, and wildlife)	Environmental Health	Degraded	
Direction of influence →→→							

Of the four indirect changes to HWB described to be catalyzed by litigation, two were perceived to be negative. When public lands litigation results in a change to land use or

management (e.g., decreased livestock use), some stakeholders perceive that forage and invasive grasses will increase with fewer cattle on the land to graze them. Based on this perception, an increase in grasses will increase the vulnerability of the landscape to wildfire. As food and habitat, grasses and open space are classified as provisioning and supporting ecosystem services that help sustain HWB. Degraded food and habitat weakens provisioning and supporting ecosystem services, thus weakening the environmental dimension of individual well-being.

When public lands litigation results in no change to land use or management (i.e., status quo management), some stakeholders perceive that business as usual for species management will not be sufficient to maintain important habitat for species and populations (e.g., sage-grouse, big horn sheep). Based on this perception, diminished habitat and biodiversity weakens supporting ecosystem services, thus weakening the environmental dimension of individual well-being. Interestingly, the *fear* of litigation can result in no change to land use or management. In this case, there is a strong desire to avoid the negative impacts of the litigation process or an assumption that litigation will result in a loss in court, so the alternative is to do nothing:

> "I've heard managers say, 'Oh, if we propose it like that, we're going to get litigated, so we need to not do that or look at something else,' even if it's the right thing for the land."

The result of doing nothing, it was perceived by some, is a negative change to ecosystem structure and function, meaning that status quo management is not sufficient for maintaining habitat and open space for people, livestock, or wildlife, thus weakening supporting ecosystem services and the environmental health dimension of individual well-being.

Positive impacts to HWB

In the examples of negative impacts to HWB described above, public lands litigation was perceived to indirectly impact individual well-being through a reduction in and subsequent changes in ecosystem structures and services. Alternatively, some stakeholders perceived that a reduction in livestock use means that the land will have time to rest, improving forage growth and maintaining open space for habitat:

> "…it (46% reduction of livestock grazing on some public lands allotments) also means that the land is going to get more rest, it's going to get more rotation, it's going to have time to allow more of those native plants and to allow for rangeland health. So that's a positive outcome to me."

In this case, the interviewee was describing revisions to grazing permits as a result of recent litigation challenging the BLM's management of and permittees' utilization of grazing allotments on public lands. Based on this perspective, time for the land to rest will improve rangeland conditions, thus strengthening the provisioning and supporting ecosystem services which, in turn, sustains or even strengthens the environmental health dimension of individual well-being.

Based on these results, perceptions of litigation in southwestern Idaho align with our previous understanding (Nie 2008). One view reveals a perception of lawsuits as counter-productive: when hands are tied, nothing can change, and the resource suffers. This is based on the perception that the ecosystem will continue to degrade without human assistance. In other words, ecological well-being is inextricably tied to humans and management. The other view holds that we should be guardians, not gardeners (at least in Wilderness), or that we ought to be rewinding human influence on the land (i.e., removing cattle). This is based on the perception that humans are arrogant and the ecosystem will continue to function well without

human assistance. In other words, ecological well-being is separate from and not dependent upon humans or management.

In short, this polarization of views about the role of humans in our environment further demonstrates the established need for a framework that more clearly guides the assessment of trade-offs between the wide range of social, economic, and ecological conditions required to support HWB. Based on these results, we present an extended model for SES research in the discussion and conclusion that follow.

Discussion and Conclusion

Merging frameworks of individual and social well-being

Our investigation in southwestern Idaho revealed evidence to support the merger of HWB frameworks that consider dimensions of individual and social well-being. As an assessment-oriented framework (Cumming 2014), the Millennium Ecosystem Assessment (2005) provides some useful concepts for identifying "constituents" of well-being. Interestingly, one MEA concept did not map onto our data: security. We did not find evidence of a need for personal safety or security from disasters, as described by the MEA framework (2005). There was evidence of strong desire for access to resources in terms of some stakeholders depending on access to public lands to sustain their livelihoods and others depending on access to sustain their opportunities to recreate, but these descriptions did not include qualifiers that we interpret as "security." Our findings revealed emergent dimensions of individual well-being in southwestern Idaho aligned with the MEA conceptualization of "constituents" of well-being in terms of freedom of choice and action, health (specific to our findings: physical, mental, and environmental health), and basic materials for a good life.

Two additional concepts emerged from our assessment: meaningful productivity and happiness. First, meaningful productivity was desired with respect to jobs and livelihoods, which fall into the basic materials category in the MEA (2005). The emphasis on not only productivity but *meaningful* productivity suggests that there was a desire among our interviewees for *purpose* in work and in life. This sentiment is somewhat reflected in freedom of choice and action, or the opportunity to be able to achieve what an individual values doing and being, but we suggest that there is a distinction between the opportunity to achieve something and a feeling of purpose while achieving it. Second, happiness emerged as a popular aspect of well-being when we asked people to describe what well-being means to them. We have included it here to further discussion on dimensions of well-being, however the term did not map onto the observed conditions for sustaining well-being. This could be because happiness can not be provided to a person; it is a choice. When considering the state of one's environment (i.e., home, work, a relationship, wilderness), one can choose to be happy or not. The choice is informed by conditions of the environment, but the environment does not provide happiness.

To build on this conceptualization of individual well-being, we merged concepts of social-well being outlined by Wilkinson (1991). We found evidence for four of the five dimensions of social well-being; only distributive justice was not identified. This does not discount its inclusion among dimensions of social well-being - a more structured survey designed to inquire about this specific concept would likely reveal some perceptions of the need for equality in order to sustain societies. Given the power differentials and dynamics described between diverse stakeholders fighting over multiple uses of public lands, it is somewhat surprising that the subject of equality did not emerge. However, we found no

evidence to support the notion that anyone considers another person as unequal or sub-human. Rather, others' values were considered illegitimate, but not necessarily others' humanness.

Taken together, the merged frameworks of individual and social well-being were useful for identifying two scales of HWB in southwestern Idaho, which laid the groundwork for understanding how the structures and functions of SES directly and indirectly change HWB.

Merging conceptual frameworks and theoretical foundations for SES

Our investigation revealed evidence to support the synthesis of particular concepts and theoretical foundations for understanding how social processes and ecosystem services function within SES and directly and indirectly influence change in HWB, as well as how SES respond to change. We merged a conceptualization of social change processes and impacts to HWB (Vanclay 2002), a conceptualization of ecosystem services de Groot et al. (2002, 2010), theoretical foundations for explaining how social and ecological systems influence each other through land use and ecosystem services (Diaz et al. 2011), and theoretical foundations for explaining how SES respond to change (Berkes and Folke 1998, Folke 2006). Our synthesis of these conceptual frameworks and theoretical foundations produced a theoretically oriented conceptual framework to help us fill a gap in knowledge and understand the relationship between ecosystem services and HWB. More specifically, our synthesis produced an analytical framework for identifying the routes of change from ecosystem services to changes in dimensions of HWB.

An extended model for understanding SES

Public lands litigation, a process that takes place within a social system with indirect impacts to the ecological system, provided a helpful case for exploring and furthering ideas

about the relationship between people and their environment and, specifically, the relationship between ecosystem services and HWB.

Traditionally, when the focus is on sustaining individual well-being, we identify conditions that are good for individuals or for groups representing the same interests or mindset. But when the time comes to make a decision about how to manage or respond to a change in conditions, whose well-being will be improved? Whose will be degraded? Consider species-focused management as an analogy: by focusing on the particular conditions that support one species' survival, management strategies arguably ignore what is good for the whole ecosystem. Other species may or may not benefit from the same conditions required for the species in peril. Efforts toward habitat conservation have shown more promise for the conservation a species of concern plus suites of other species that rely on the same habitat, rather than focusing on one animal or plant. We suggest that, in addition to the consideration of conditions necessary for individual well-being, focus be turned toward enhancing conditions that support and sustain social well-being, thus potentially affording society and individuals similar benefits as those achieved under ecosystem-oriented management.

With these dimensions of and interactions between individual and social well-being in mind, we present an extended model for social-ecological approaches to research (Figure 4.4).
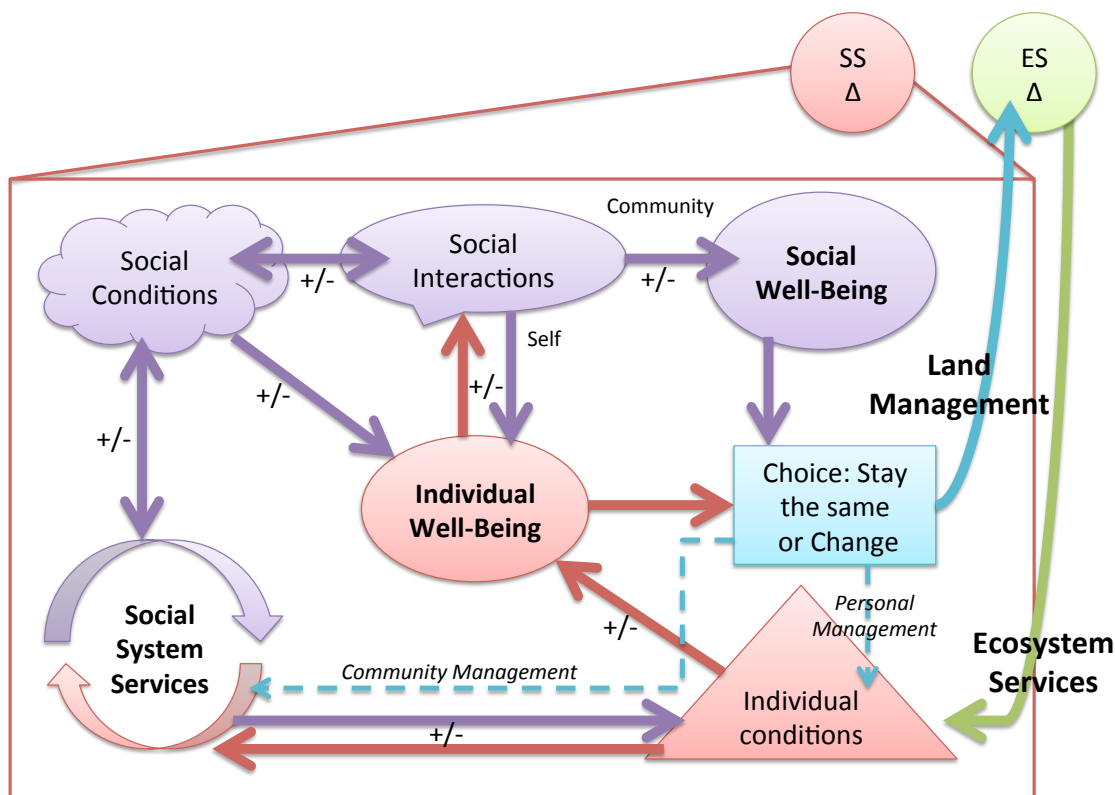
Figure 4.4. An extended model for understanding SES, building on the SES framework provided by Diaz et al. 2011. Arrows indicate direction of influence with positive or negative impacts.

This model introduces theoretical foundations of *self* and symbolic interactionism. Individuals' self-identity and sense of well-being are produced through social interactions (Mead 1934, Wilkinson 1991). In other words, society is where individuals use symbols and language to communicate and interact through meaning-creation and self-identification based on reflections of others' perceptions of self. This matters for social-ecological approaches because it means that people are neither stagnant nor isolated from their social environment. The nature of humanness is communication and interaction, thus well-being is partly related to conditions of society; it is not merely a product of ecosystem services coupled with social-actor strategies, means, and assets as the previously described model suggests (Figure 1.1).

To describe the relationships illustrated in Figure 4.4, we begin with ecosystem services, or the ecological functions from which individuals benefit (green arrow). The individual conditions supported by ecosystem services are also influenced by social system services (e.g., litigation, purple arrow), and any changes to individual conditions can positively or negatively influence individual well-being. Individual conditions also set the stage for social system services (e.g., effectiveness, efficiency), which relate to social conditions that provide the basis for social interactions. Both *self* and *community* arise out of social interactions (Wilkinson 1991) and are positively and negatively influenced by the nature of interactions (e.g., open or closed communication).

Like ecosystem services that function for ecology in and of itself and for people with positive or negative impacts, there are *social system services* that function for society for individuals with positive and negative impacts. We hope that this extended conceptualization supported by established social theory will guide future research for understanding the complexities of our social-ecological system – that is, the complexities of ourselves and of the house of civilization.

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Appendix E

Interview Guide

1.) Tell me about yourself – how long have you lived / worked in the Owyhees?

2.) What does well-being mean to you?
    a. What ecological resources do you need to sustain your livelihood / live well?
    b. What social resources do you need to sustain your livelihood / live well?
    c. What resources does your community need to sustain well-being?
    d. Do you have these resources? What is missing?

3.) What are the biggest threats facing rangelands in southern Idaho?
    a. How do they impact your individual well-being?
    b. How do they impact your community's well-being?

4.) When you hear the term litigation, what comes to mind?
    a. Describe the type of litigation you have encountered relevant to your livelihood. – *the way litigation impacts your individual well-being*
    b. What have you witnessed in terms of litigation's affect on your community?
    c. How does litigation influence the landscape / ecosystem?
    d. How does litigation affect your land management practices?

5.) How do you quantify the costs of litigation?
    a. What does it cost you in terms of time, money, work, effort?
    b. What does it cost your community?

6.) When you learn of litigation that will affect you directly or indirectly, what are your options for coping or response?

7.) Are there any good aspects to litigation? – *silver linings?*

8.) Are there other issues or concerns regarding litigation that we have not discussed? If so, what are they and how are they addressed?

CHAPTER 5: CONCLUSION

Conditions for Well-Being Inform Self, Society, and Choice of Action

The results of this dissertation extend our current conceptualization of SES by focusing on the relationships between individuals and social processes based on the interactive nature of society. Like ecosystems, social systems and the people and societies that comprise them are not static, and they are not solely supported by ecosystem services as the current SES, or coupled human-natural systems, model implies. Rather, individuals within social systems create processes (i.e., laws, policies, litigation, social learning) that can both improve or degrade human well-being. Coupling these *social system services* with ecosystem services and their influence on human well-being, we have a more complete model for understanding the relationship between ecosystem services and the social system. Refining our understanding of this relationship within SES furthers our understanding of the conditions of human well-being that lead to decisions to act, and how those actions manifest in new social processes or land management. Thus, we are better equipped to evaluate the trade-offs of our actions or inaction with respect to public lands and the natural resources upon which we all depend.

Build Social-Ecological Research upon Micro-Foundations

If we consider the social and ecological systems and the relationships between them at a macro-level and thus reducible to individual parts (e.g., people, sage-grouse, rocks, trees), then we must also consider the agency and interactions of individual parts and their links to each other and to macro-level parts. As it currently stands, the SES framework links macro-level variables (ecosystem structure and functions) to other macro-level variables (social system structure and functions). As Foss (2011) explains, there are no causal mechanisms

linking macro-level variables; they are always mediated by individual action and interaction. Our extended model for SES (Figure 4.4) research that incorporates social theory to understand how individual-level interactions and actions change environmental structures and functions aligns with this philosophy. The grounding of macro-level phenomena and theory in *micro-foundations* is not a rejection of the network level of analysis or collective concepts like social well-being or social learning; rather, the suggestion is to reject the use of organization or network-level variables to explain other organization or network-level variables (Foss 2011). For example, attempting to explain the process and outcomes of social learning with process and outcome variables is to characterize a phenomenon and what it has potential to produce, but what *causes* the outcomes, and what else factors into the production of outcomes? There are no macro-level causal mechanisms between social learning processes and outcomes, and there are no macro-level causal mechanisms between ecosystem services and social systems. Thus, we look to micro-foundations for causal mechanisms between individual-level learning and changes within and between learners in interactive environments, and how those changes set the stage for social, network-level outcomes (social learning, Chapter 3). We also look to micro-foundations for causal mechanisms between the effect of ecosystem services on individual conditions and how those conditions set the stage for social, network-level conditions and well-being, and how those changes feedback to the ecological system (social-ecological impact assessment, Chapter 2; social process and human well-being, Chapter 4).

Contribution to Scholarship

Presently, scholars within the fields of environmental governance and natural resources management continue to engage in a broad debate about the applicability of

resilience thinking to social systems and management for sustainability versus management

for adaptability or transformability (Davidson 2010, Harm Benson and Kundis Craig 2014).

Recent literature has begun to push these concepts into network and social-level perspectives

(see Magis 2010, Berkes and Ross 2013), but the calls for integration of social theory persist

(Davidson 2013). For example, Berkes and Ross (2013) endeavor to bridge the gap in our

understanding of the social system and the individuals within it by suggesting integration of

concepts from psychology of development and mental health, but as Davidson (2013) points

out, while we are heading in the right direction, we still need clearer conceptualization and

definitions for *agency*. We support the notion that agency is not a condition but a process

specific to individuals - the pursuit of personal goals - and that individuals reflect on

environmental changes at all levels (Davidson 2013). The focus on community-level

resilience is the right idea at the wrong level of analysis. As Davidson (2013) explains, "This

exchange between structure and agency is one of the fundamental interactions within social-

ecological systems that result in emergent outcomes with direct bearing on whether a system

is likely to be headed for resilience, transformation or collapse. So how do we bring a theory

of agency into studies of community resilience? We can start by not taking the interests and

actions of community residents for granted, but rather bring those interests and actions, which

are enormously diverse, into our research" (p. 23). The purpose and design of this dissertation

align with this philosophy, and our results support the need for SES research to ground itself

in micro-foundations to further our understanding of how people and societies relate to and

benefit from ecological systems.

In addition to the debate about how SES function and how they might be resilient and

governed through change, scholars have recently turned their attention toward our present

laws and legislation - at least in the United States - and their compatibility (or lack thereof) with resilience thinking. For example, according to Harm Benson (2012), the Endangered Species Act should be reformed to focus on systems rather than species and include a style of governance that enables or even encourages reassessment of the way the social system (and individuals within it) relates to the ecological system via land management to optimize benefits. In his reply, Gunderson (2013) agrees and suggests the focus on endangered species management should remain on ecosystems as much as species and populations (rather than systems *instead of* species). If our efforts are to move in this direction, we concur with the call for ecologists and biologists to join social scientists and lawyers in efforts to reform laws for the appropriate scale (Ruhl 2012, Cumming 2013). However, we also caution against changing macro-level laws and processes to suit a conceptualization of SES that has, to this point, ignored the agency of individuals and their relationship with processes and societies that comprise social systems. To reform laws for adaptability and resilience thinking without fully understanding issues of agency and power within social systems is to step dangerously close to an upheaval of social structures (i.e., laws like the Endangered Species Act) designed to ensure that citizens have an avenue for voice and participation in the decisions we make about our actions on public lands and shared natural resources.

Taking a closer look at avenues for individuals' participation in environmental governance, Chapter 4 investigated public lands litigation as a social process that is an arena for social interactions. Litigation also influences conditions for both society and individuals that sustain or degrade human well-being and thus motivation for action or inaction. While litigation is often framed in a negative light due to its monetary, temporal, and health costs among others, the utility of litigation as citizens' tool for regulatory enforcement emerged

from our data as a positive characteristic of its process and outcomes. In comparison, collaboration is often framed in a positive light due to the claim that collaborative environments are conducive for trust-building between participants, but others have experienced collaboration as closed-door deal-making among agents with political power.

Therefore, at the very least, we should strive to understand what the alteration of an avenue for voice within a democracy means for individuals' opportunities to participate in the governance of shared resources. Making such changes before fully understanding macro-level processes (e.g., litigation, collaboration) and their micro-foundations (e.g., how individuals participate in and react to such processes) would be hasty.

Opportunities for Future Research

There remain many opportunities to build on this body of work. First, as explained above, there is a need to understand how social processes and individuals relate within social systems – in effect, understanding *social system services* (coupled with ecosystem services) and their positive and negative influence on human well-being. Perspectives of collaboration emerged during data collection for Chapter 4, often in juxtaposition with litigation, but also potentially reflexive with litigation. Anecdotally, we understand that litigation can serve as an impetus for collaboration, and collaboration does not always produce collective action; to the contrary, it can lead to litigation and other adversarial approaches to problem solving. Applying the extended model for social-ecological research to an investigation on collaboration and its direct and indirect influence on human well-being is a fruitful area for future research.

Second, we should continue to explore opportunities to integrate social theory into social-ecological research. The extended model offered here is not comprehensive. Rather, it

is an opportunity to consider where ideas from other scientific disciplines focused on the human mind and behavior might fit into our understanding of our complex world and provide further direction for how we might assess trade-offs in order to move forward through certain change and uncertain outcomes.

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Appendix F

Institutional Review Board Exempt Certification

University*of*Idaho

Office of Research Assurances (ORA)
Institutional Review Board (IRB)

July 10, 2013

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To: Wulfhorst, JD
Cc: Bentley, Amanda; Holbrook, Joseph; Niemeyer, Ryan; Suazo, Alex

From: IRB, University of Idaho Institutional Review Board

Subject: Exempt Certification for IRB project number 12-357

Determination: July 8, 2013
            Certified as Exempt under category 2 at 45 CFR 46.101(b)(2)
            IRB project number 12-357: Exploring Dynamic Processes of the Sagebrush-
            Steppe Using Philosophy and System Dyamics Modeling

This study may be conducted according to the protocol described in the Application without further
review by the IRB. As specific instruments are developed, each should be forwarded to the ORA, in
order to allow the IRB to maintain current records. Every effort should be made to ensure that the
project is conducted in a manner consistent with the three fundamental principles identified in the
Belmont Report: respect for persons; beneficence; and justice.

It is important to note that certification of exemption is NOT approval by the IRB. Do not include the
statement that the UI IRB has reviewed and approved the study for human subject participation.
Remove all statements of IRB Approval and IRB contact information from study materials that will be
disseminated to participants. Instead please indicate, "The University of Idaho Institutional Review
Board has Certified this project as Exempt."

Certification of exemption is not to be construed as authorization to recruit participants or conduct
research in schools or other institutions, including on Native Reserved lands or within Native
Institutions, which have their own policies that require approvals before Human Subjects Research
Projects can begin. This authorization must be obtained from the appropriate Tribal Government (or
equivalent) and/or Institutional Administration. This may include independent review by a tribal or
institutional IRB or equivalent. It is the investigator's responsibility to obtain all such necessary
approvals and provide copies of these approvals to ORA, in order to allow the IRB to maintain
current records.

This certification is valid only for the study protocol as it was submitted to the ORA. Studies certified
as Exempt are not subject to continuing review (this Certification does not expire). If any changes
are made to the study protocol, you must submit the changes to the ORA for determination that the
study remains Exempt before implementing the changes. The IRB Modification Request Form is
available online at: http://www.uidaho.edu/ora/committees/irb/irbforms