An Ethnography of a Social Ecological Systems Team Science Network

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Arts

with a

Major in Anthropology

in the College of Graduate Studies

University of Idaho

by

Amber L. Ziegler

Major Professor: Rodney Frey, Ph.D.

Committee Members: Andrew Kliskey, Ph.D.; Laura Putsche, Ph.D.;

Dilshani Sarathchandra, Ph.D.

Department Administrator: Mark Warner, Ph.D.

May 2017

Authorization to Submit Thesis

This thesis of Amber Ziegler, submitted for the degree of Master of Arts with a Major in Anthropology and titled "An Ethnography of a Social Ecological Systems Team Science Network," 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.

Major Professor: _____ Date: _____

Rodney Frey, Ph.D.

Committee Members: _____ Date: _____

Andrew Kliskey, Ph.D.

_____ Date: _____

Laura Putsche, Ph.D.

_____ Date: _____

Dilshani Sarathchandra, Ph.D.

Department

Administrator: _____ Date: _____

Mark Warner, Ph.D.

Abstract

As large-scale environmental issues, such as climate change and its effects, become more pressing, there is growing recognition that they cannot be solved through strictly bounded disciplinary approaches. Many scientists have responded by calling for solutions developed through integrated, interdisciplinary research and application. Social Ecological Systems (SES) approaches attempt to do this through combining ecological and social science methods and perspectives. Using the Mountain Social Ecological Observatory Network, a SES-oriented Research Coordination Network, as an ethnographic case study, this thesis analyzes the interdisciplinarity of SES and provides suggestions for how anthropologists may contribute to its continued development and integration.

Acknowledgements

To my major professor, Rodney Frey, I extend my gratitude for taking me on as a student, mentoring me, and continually nudging me back to the path of thesis writing. Thank you especially for helping me keep my viewpoint on what matters, and reeling me back when I get caught up in everything that is just so interesting. To my other committee members, thank you for your help and support in getting this thesis to where it is today. Dilshani Sarathchandra, your mentorship has meant so much to me, and you have helped me become a much stronger writer. Andy Kliskey and Laura Putsche, your expertise and guidance has been invaluable. Thank you all.

To the MtnSEON Executive and Leadership Team members, thank you for giving me the opportunity to do this research by providing funding and allowing me to pick your brains. I hope I have produced a product worthy of your support.

To the faculty and staff who have mentored me during my time at the University of Idaho, you have my sincerest gratitude. Especially Leah Evans-Janke, my academic cheerleader from the start, and Mark Warner, for always giving me frank advice when I need it. Thank you for everything.

Dedication

To my dearest love, Joseph. Thank you for your continued support as I wind my way down this path.

To my best friends, thank you for reminding me again and again that I can do this.

To my parents and my sisters, thank you for your belief and pride in me. I am proud to be a Ziegler.

Table of Contents

List of Figures

List of Tables

Introduction

In August of 2015, I took a position as a graduate research assistant with the Mountain Social Ecological Observatory Network (MtnSEON). As a Research Coordination Network, MtnSEON facilitates Working Groups focused on developing Social Ecological Systems (SES) science. SES science focuses on human-environment relations from a systemic perspective that attempts to integrate human and non-human system components by bringing together methods and approaches from social sciences and ecology, and is discussed further in the next chapter.

Going into this position, I hoped to join with one of the Working Groups in their research, and develop a thesis out of that collaboration. However, this did not work out and I ended up developing my own research questions and design. Because I am interested in collaborative, interdisciplinary science, I chose to conduct an ethnographic case study of the network itself. As the graduate assistant for the network, I am well situated to conduct this sort of research. With the permission of the network's leadership, I moved forward with this project, which provides a strong context and narrative of the network's history and internal dynamics.

When I first joined MtnSEON, the network leadership believed many of the working groups were lacking a solid social science perspective. As an anthropologist, I felt that there was much my discipline could offer to SES team science, especially the subdisciplines of environmental and applied anthropology. I originally developed research questions based around this, thinking to explore the interdisciplinarity of MtnSEON working groups with the purpose of suggesting ways anthropologists might contribute to SES science. I did find some interesting connections to this inquiry during my data collection, but new, related questions developed through the research process.

The research questions that resulted through this process are: What barriers and challenges has MtnSEON faced in developing SES team science? How do they relate to interdisciplinary collaboration more broadly, and how does MtnSEON act as a case study for SES science in general? And how can anthropologists contribute to navigating these barriers

and challenges in SES team science settings and shape the future development of SES science?

One reason I accepted this assistantship is because I was truly excited to learn about the concept of Social Ecological Systems. I am trained as an anthropologist at the undergraduate and graduate level, but have also taken courses in environmental science and environmental humanities. I am fascinated with how humans relate to and conceptualize the natural world. From hiking and camping with my family as a child, to taking an integrated stream ecology course in high school that allowed me to tromp around the Teton watershed in Southeastern Idaho collecting bugs and conducting water quality tests, I have always felt an urge to understand my relationship with the world around me. I came to this assistantship and my thesis work with a deep-seated hope that over the two years of my master's program I might learn even more about how to study the environment and humans' places in it through the utilization of SES. This is not just for the joy of understanding (although that certainly is important to me), but also with the aim of application. The world faces major environmental challenges and as an anthropologist I hope to contribute to research that will help people respond to them in ways that are good for both humans and non-humans.

This thesis was written for a number of reasons and a number of different people. I wrote it as part of a process of learning to do research, to develop a stronger understanding of interdisciplinarity, and yes, to complete the requirements for my graduate degree. I wrote it for myself, my thesis committee, MtnSEON members, and anthropologists who have an interest in engaging with SES team science.

For these reasons and these people, I have written with a recognizable structure – literature review and background information, methods and results, and discussion. While I am personally fond of more unconventional methods of communicating research, this classic academic layout fits this project best and makes the most sense for my audience and myself. Because I am learning to be a social scientist, I want to learn the conventions of academic writing and learn them well. As a master's student, my greatest concern is learning the basics

of rigorous research. I also chose this approach because this thesis will go to the leadership of MtnSEON. Many of them are researchers strong in quantitative approaches, but unfamiliar with qualitative methods. I want my research to be as accessible and meaningful to them as possible, and choosing to present my research in a way that is recognizable across disciplines and methodologies is an important part of that.

While I have chosen a conventional way to present my thesis research, I am writing somewhat unconventionally by situating myself in it, rather than writing more formally and not referring to myself at all. I continue to intentionally use "I" throughout most of the chapters of this thesis. Explicitly recognizing my role in the network and in the research I have conducted is important because my experiences have shaped the decisions I have made throughout the research process. My position as graduate assistant gave me a good vantage point from which to observe and ask questions, but it has also influenced me in tangible ways. I have only seen certain perspectives in the network. My own impressions and observations are not truly objective nor would they be even if I had talked to everyone in the network. I have my own frustrations, biases, and discontents within my assistantship and have had to be very thoughtful about how I approach my research. When reaching conclusions, I try to ask myself if I am coming from a place of curiosity and recognizing the context of the network rather than letting my questions and interpretations be overly influenced by my personal experiences. Are my interpretations based in rigorous data collection and triangulation, or based on assumptions I have made? These are questions I have grappled with regularly throughout my research, and I believe I have effectively managed to stay in the realm of inquiry, not assumption.

As an anthropology master's student with a focus on qualitative methods, I am something of an outsider among MtnSEON's leadership, who are mostly ecologists with doctoral degrees and many years of experience. My position itself adds to this outsider state because most of what I actually do for the network is administrative work, with conducting my thesis as my main research role. Coming into the network three years into a five-year grant also situated me on the outside, ignorant as I was of the history of the network and its

internal workings. But I am also very much an insider in the network, as I work closely with network leadership, regardless of what kind of work I am doing. I am privy to decision making, have developed familiarity with the grant's history, and I manage communications among many members of the network.

This pull between insider and outsider often feels very much like a liminal space in the network. This in-between space has much in common with the experience more traditional ethnographers have during their fieldwork, I believe – that feeling of having one foot in, and one foot out. Sometimes belonging to the group, and sometimes not quite. This complexity of experience, the not-quite-in-it state, has enabled me to make unique observations and ask new questions. It is in this space that I have been able to notice things no one else in the network has, for the simple fact that it is not a space I wholly belong to. Things stick out as notable; maybe not important, but certainly interesting. Some of it has developed to be important, and some has not. I could not know until I asked questions about it, learned about it, and began to understand how it fits into the larger context.

It is through this lens that I have developed this thesis. Chapter 1 examines literature relevant to the inquiries of this study. An examination of the scholarship of SES and multiple-disciplinarity informs an understanding of what MtnSEON hopes for its working groups to achieve, as well as challenges faced by scientists developing interdisciplinary environmental research. This chapter also presents some critiques of SES science, and briefly discusses environmental and applied anthropology. Chapter 2 provides a short history of MtnSEON. This chapter presents readers with important contextual information, acting as an important base of knowledge for the following chapters.

Chapters 3 discusses the methods used in conducting this study. I used a mixed-methods approach, including participant observation, interviews, and surveys. Chapter 4 presents the results of the data collection and analysis.

Chapter 5 delves into the first discussion of the research questions, considering barriers and challenges faced by MtnSEON, and how these support or do not support considering MtnSEON as a case study for SES science. Chapter 6 provides a discussion of the

contributions of anthropology to SES science, considers how anthropologists might help navigate the barriers and challenges discussed in Chapter 5, and explores ways anthropologists might shape the future of SES.

This thesis only touches the surface of many issues raised during data collection and analysis. It is my hope that it will serve as a starting point for continued inquiry into the interdisciplinarity of SES and anthropology's role in it.

Chapter 1: Literature Review and Conceptual Framing

"The move toward integrated research is often motivated by the realization that any single way of knowing is insufficient for understanding the complexity of the world" (Miller et al., 2008).

There is widespread recognition that complex environmental problems cannot be solved with analysis and application from one specific discipline, but require integrative, interdisciplinary responses that consider interactions and overlaps of social and ecological systems; biophysical disciplinary approaches alone are not comprehensive enough for solving complex ecological conundrums (Berkes, Colding, and Folke 2003, Binder et al. 2013, Collins et al. 2011, Miller et al. 2008, Ostrom 2009). Fostering cross-disciplinary, collaborative relationships among scientists is essential for facing complex, multi-factor problems such as climate change and its effects (Alessa et al. 2015, Ostrom 2009, Stokols et al. 2008).

Social Ecological Systems

One attempt to meet this need for integrative, interdisciplinary research and application has manifested in the development of Social Ecological Systems (SES) science. SES science is a growing set of interdisciplinary or transdisciplinary integrated approaches to researching and understanding social ecological systems. The concept of SES grew out of general systems and complex systems theories (Berkes, Colding, and Folke 2003). Thus, SESs are nonlinear, multi-scalar, and self-organizing, exhibit emergence, and function with uncertainty. Most scholars who study SESs, both practically and theoretically, agree on this basic understanding. SESs are not just "natural" systems. They are understood to include humans: their communities, their social processes, their interactions with the natural world. Because of this integrated definition, SES science is inherently multiple-disciplinary (Alessa et al. 2015, Berkes, Colding, and Folke 2003).

Alessa, Kliskey, and Altaweel (2009, 31) define social ecological systems as "complex, integrated systems of humans within the ecosystem… An SES is comprised of feedbacks among human values, perceptions, and behaviors and the biophysical components of the ecosystems in which people live." Ostrom (2009, 419) posits that "SESs are composed of multiple subsystems and internal variables within these subsystems at multiple levels

analogous to organisms composed of organs, organs of tissues, tissues of cells, cells of proteins, etc." An earlier definition, given by Anderies, Janssen, and Ostrom (2004, Defining a Social Ecological System), defines an SES simply as "an ecological system intricately linked with and affected by one or more social systems." All definitions of an SES have this as the core: the inseparable linkage between the "social" and "natural" worlds, viewed from a systemic perspective.

One of the founding ideas of the SES concept is resilience, as introduced to ecological literature by Holling (1973) and further developed by other scholars. The Resilience Alliance, as quoted by Berkes, Colding, and Folke (2003), describes resilience as the amount of change a system can absorb while retaining function and structure, the system's capacity for self-organization, and the potential for increasing capacity for learning and adaptation. Resilience is seen as essential in dealing with disturbance and "is an important element of how societies adapt to externally imposed change" (Berkes, Colding, and Folke 2003, 14). One of the major hallmarks of a complex system that is undoubtedly inherent in SESs is uncertainty, and resilience provides the capacity to adapt to surprise (Gunderson 2003). Alessa et al. (2015) advocate for moving beyond a theoretical, rhetorical definition of resilience to an applied resilience, which can actively inform management and policy decisions.

Frameworks

There are many ways to conceptualize, describe, and analyze SESs. When doing so, it is virtually impossible to include all possible elements of a single SES due to the multi-scalar complexity of systems. There are some frameworks that provide steps for how to develop SES research, but to date many researchers in SES science have developed their own concept of how a specific SES functions in order to choose the ecosystem functions, resources, etc., that best fit their research question (Alessa et al. 2015). Thus, there have been a variety of approaches to SES science that have been developed and applied, including some that focus on resilience and adaptive management, modeling human drivers which impact an ecosystem or resource, or combine material, energy, and economic flow (Binder et al. 2013).

As Binder et al. (2013) point out, these various approaches do not all share the same goal, disciplinary background, scale, applicability, or conceptualization of SESs.

Binder et al. (2013) have developed a spectrum of approaches to SES analysis and research, based on whether the approach gives emphasis to ecological or social phenomena or data, or if it treats both with equal depth. They also categorize SES frameworks as either analysis or action oriented. One well known analytic framework is Elinor Ostrom's (2009) Social Ecological Systems Framework, which has the goal of providing a common framework and language to organize the findings of SES analyses. This particular framework is concerned with management of common resources and analyzing the sustainability of SESs. It is built around four subsystems of an SES, including resource systems, resource units, governance systems, and users. These subsystems are defined for the specific SES in question, and are made up of variables upon variables. Analysis of the chosen subsystems and variables provides important information about feedbacks among them. The goal of this approach is to enable researchers to reach conclusions about whether SESs are managed in a sustainable way or not. This framework "also provides a common set of variables for organizing studies of similar SESs" (420). Binder et al. (2013) classify the Ostrom framework as weighted to the social science end of the spectrum, in addition to being analytical. This classification is supported by responses in the literature arguing that this SES framework does not adequately address ecological complexity (Vogt et al. 2015).

Like the Ostrom framework, much of the work in SES science to date has been analytical. However, a main goal of some SES frameworks is to develop suggestions and/or plans for potential interventions in management (Alessa, Kliskey, and Altaweel 2009, Castree et al. 2014, Collins et al. 2011). One example is the "Press-Pulse Dynamics" (PPD) framework, which aims to integrate biophysical and social sciences in order to understand the dynamics of how human behaviors affect ecosystem processes (Collins et al. 2011). This framework is meant to generate transdisciplinary knowledge to inform long-term research that situates humans as affected agents in SES systems, rather than simply external drivers of ecological

change, and with the knowledge produced inform interventions to solve ecological problems.

When researching or analyzing an SES, it is common to reduce the system to relevant parts, usually a resource (or two, maybe three), a user group specific to the resource, and a governance system (Alessa, Kliskey, and Altaweel 2009). This makes analysis simpler, but does not reflect the inherent complexity and uncertainty of an SES, meaning that prescriptions for action are not as effective as they could be. This is the reason that Alessa, Kliskey, and Altaweel (2009) suggest developing a typology of "messy" SESs – conceptualizing them in a way that reflects their nonlinearity, uncertainty, etc. They argue that developing a typology of different types of SESs (which is constructed as a continuum, rather than specific categories with explicit boundaries) may help move the field of SES science from abstraction to application.

Multiple-Disciplinary Science

Regardless of how balanced between social and ecological perspectives SES science is, or if it is applied or analytic, it is inherently multiple-disciplinary. Interdisciplinary research is a at the top of many agendas in the science world right now, as evidenced by National Science Foundation (NSF) awards aimed at fostering interdisciplinary research and organizations such as the National Socio-Ecological Synthesis Center (SESYNC), but it is surprisingly hard to nail down what exactly people mean when they call something interdisciplinary. Taking other referential terms into account such as multidisciplinary and transdisciplinary obscures the issue even further. In the literature, there are a variety of definitions. For example, Stokols et al. (2008) define multidisciplinary research as scientists of different disciplines working independently and coming together occasionally to share individual perspectives. Interdisciplinary research brings scientists from different disciplines together in a way that integrates perspectives, but the scientists remain rooted in their own specific expertise. Research may be defined as transdisciplinary when "team members work together to develop shared conceptual and methodologic frameworks that not only integrate

but transcend their respective disciplinary perspectives" (Stokols et al. 2008, 579). Obviously, the differences among the varied levels of disciplinarity are subtle and hard to measure.

Miller et al. (2008) argue that interdisciplinary research, while involving greater integration than multidisciplinary through co-definition of the research problem, sharing methods, and creating new questions, also regularly privileges one specific discipline or set of disciplines ("epistemological sovereignty"). Overcoming this epistemological sovereignty is when research crosses into transdisciplinary work, as it "transcends entrenched categories to formulate problems in new ways. Collaborators may accept an epistemological perspective unique to the effort, redrawing the boundaries between disciplinary knowledge" (Miller et al. 2008, Disciplinarities).

While not vastly different from the definitions above, this thesis uses multidisciplinary, interdisciplinary, and transdisciplinary in a way that matches the definitions provided by Pooley et al. (2013) and Roy et al. (2013). According to Pooley et al. (2013), multidisciplinary research brings together individuals from different disciplines to work in parallel on a common issue or question. Interdisciplinary research involves crossing disciplinary boundaries and developing new knowledge and theories in pursuit of a common question or goal, and transdisciplinary research efforts go beyond just academia, bringing together "academic researchers from unrelated disciplines, and nonacademic participants, in pursuing a common goal, and creating new knowledge and theory" (23). Roy et al. (2013) specify that interdisciplinary environmental research is problem-driven and integrative, while multidisciplinary research is additive.

Challenges to and Methods for Conducting Multiple-Disciplinary SES Science

Whatever definition one uses, either of SES science or interdisciplinary research, there are various challenges to conducting multiple-disciplinary (including multi, inter, and transdisciplinary) environmental research. These challenges have been discussed widely in literature looking at the science of team science.

The struggle to resolve conceptual or methodological differences is often related to disciplinary boundaries and epistemologies. Gieryn (1983) presents a compelling analysis of boundaries and boundary-work, examining how science

demarcates itself from other intellectual pursuits. Boundary-work is also employed within science, seen in the way different disciplines demarcate their work from others (Lamont and Molnár 2002). The demarcation of science from other intellectual pursuits, or of disciplines within science, happens in ways that seem natural in a sense, such as through educational curriculum, criteria at funding institutions like the NSF, and criteria for publishing in disciplinary peer-reviewed journals. Gieryn (1983) argues that boundary-work is largely rhetorical in the sense that specific characteristics are selected to be focused on, which further the interests of science or a specific discipline while demarcating it from non-science or other disciplines. He further states that scientists are likely to engage in boundary-work when they are trying to expand their authority or expertise, when aiming to monopolize professional authority and resources, or when trying to protect autonomy in their professional activities. Perhaps most importantly, these boundaries are constructed and arbitrary. Thus, they are flexible and inconsistent; sometimes even porous (Gieryn 1983). These boundaries shore up disciplinary bodies of knowledge and are continually constructed, creating territory internal and external to the discipline in question.

According to Miller et al. (2008, Disciplinarities), "Disciplinary researchers are characterized by a shared and, to a certain extent, bounded way of apprehending the world. Whereas any given discipline is dynamic and composed of different theoretical and methodological approaches, it will tend to share a language, a set of tools, and epistemological commitments." This results from individual researchers typically being trained within what they call "epistemological silos." Disciplinary training gives precedence to the specific knowledge and approaches developed within that discipline, and socializes students into their prospective discipline by distinguishing between insiders and outsiders (Collins 1979, Pellmar and Eisenberg 2000). It is often difficult to organize collaborative research in a way that allows space for the various researchers' disciplinary epistemologies

and cultures, while providing opportunities for bridges to be built across disciplinary boundaries.

Disciplinary boundaries and epistemologies are reinforced by institutional policies and structures, which also present other specific barriers to collaborative, interdisciplinary research. The Committee on Facilitating Interdisciplinary Research (CFIR 2004) identifies several common institutional barriers to interdisciplinary work, including evaluation techniques and incentives systems, policies and procedures, and requirements for time and funding. Tenure and promotion policies are perceived by academic researchers to give more credit to individual, disciplinary work than collaborative, interdisciplinary efforts, providing a significant obstacle to career advancement for those researchers who engage in interdisciplinary research (Pellmar and Eisenberg 2000, Roy et al. 2013). For this reason, early career scientists often perceive collaborative research as risky (Bennett and Gadlin 2012). There are also difficulties with obtaining funding for collaborative work, and perceptions that the peer-review system put interdisciplinary work at a disadvantage (Pellmar and Eisenberg 2000).

In addition to the challenges presented by disciplinary epistemologies and boundaries and institutions, multiple-disciplinary research faces methodological challenges. Pooley et al. (2013) identify several important methodological challenges related to the issues of time and phasing. For example, researchers rarely keep up with methodological development outside their own discipline. This means they must spend extra time in the initial stages of developing interdisciplinary or transdisciplinary projects, in order to find common ground with other researchers and lay the foundations for integrated frameworks, theories, methods, etc. Time spent this way can be costly because it might slow down individual productivity, in terms of discrete products such as publications, relating back to the issue of academic incentive systems and evaluation policies.

Scale can also be a time and phasing issue when trying to integrate ecological and social science approaches (Pooley et al. 2013). Time scales required for data collection can vary significantly between disciplines, making time budgeting for an interdisciplinary

project difficult. Additionally, a range of temporal and spatial scales are required to incorporate social and ecological components of a research problem. Mismatches between scales can make it hard to know which data to collect at which scale, as well as how to integrate the data once they are collected.

It makes sense that interdisciplinary research groups take the time at the beginning of projects to resolve conceptual differences between disciplines represented, but this is made difficult by the perceived but often unacknowledged power hierarchies that exist among different disciplines. "Despite calls to integrate the social sciences into research and management of social-environmental systems, scientific institutions and natural scientists retain their preeminent social authority as mediators of truth and knowledge on environmental matters" (Pooley et al. 2013, 27). This has much to do with the perception of mathematical, quantified data collection and analysis as more objective and scientifically rigorous than social science approaches which acknowledge observer subjectivity. Social scientists find it particularly frustrating that many natural scientists working in multiple-discipline settings seem to view the social sciences simply as a means to "communicate their findings or change the behavior of their target audience" (28), rather than a valid method of data collection and analysis.

Another issue identified by Pooley et al. (2013) that occurs when trying to bridge both biophysical, ecological disciplines and social science disciplines is that social scientists are often not engaged until later phases of the research process (after the initial development of questions and funding requests) because of the view that social science can act in a supplementary way to ecological approaches. Thus, they are often seen more like consultants than collaborators, making true integration difficult. As we will see in chapters 4 and 5, this is an issue that is very familiar to MtnSEON.

As SES is a relatively new development in the academic and environmental management worlds, there is not a strong consensus on what SES science is, what it ideally looks like, and what its goals are. This can be both a strength and a weakness. With such a wide variety of frameworks and approaches, SES research is highly adaptable to individual

research problems. However, it can also be challenging to identify exactly how to go about SES research without a formalized canon of theory and methods (Alessa et al. 2015).

The challenges listed above are pronounced. In a survey of scientists involved in collaborative environmental research, Roy et al. (2013) found that individual researchers find the greatest challenge of interdisciplinary work to be communication difficulties. They identified other challenges, including lack of time and/or funding, difference in perspectives, difficulty getting research off the ground, and a lack of existing methods. Among both social and natural scientists time and funding were most frequently identified as the greatest obstacle to interdisciplinary environmental research. Other obstacles include "negative perceptions of interdisciplinary research by traditional disciplinary specialists… disciplinary boundaries, communication difficulties, institutional barriers, and limits to career advancement and publishing" (748). However, participants in the survey also identified why they find collaborative research rewarding, including intellectual stimulation and developing new perspectives and knowledge, connecting different types of knowledge, research that is more relevant, collaboration itself, and personal gain and interest.

Along with identification of the challenges, there is much discussion in the literature about how to effectively develop and conduct collaborative research. Bennett and Gadlin (2012) argue that individuals engaged in team science should have strong self-awareness and the ability to expand that awareness to the people around them, an understanding of the various methods of team formation, and trust in their fellow researchers. They also contend that teams themselves should develop a shared vision for the project that is adaptable and flexible to inevitable changes over time, co-develop a conflict management plan, schedule regular evaluations and assessments, and determine early on how recognition and credit will be allocated.

In order to address the issues unique to bringing together social and biophysical scientists, MacMynowski (2007) suggests utilizing a three-step process. First is specifying the differences in the various approaches, methods, etc., involved in the project. Ultimately, this is meant to help the team recognize the diversity of perspectives and knowledge types

engaging with the research question. The second step is clarifying the actual purpose of the research and the choices made within the project design, and last, the actual synthesis. Similarly, Miller et al. (2008) argue for the inclusion of a framework of epistemological pluralism, the intentional valuing of different types of knowledge, in the research design.

Critiques of SES Approaches

There have been critiques of SES science and research, especially from people who feel that it has not engaged in important conversations about power, agency, or inequality (Castree et al. 2014, Cretney 2014, MacKinnon and Derickson 2012). These critics argue that SES tends to lack attention to whose values and powers count when determining the best pathways to sustainability. Science itself is not inherently value free, and thus it is important for interdisciplinary pursuits to reflect on whose values and goals are being included in a research plan, and whose are being excluded, whether intentionally or not (Castree et al. 2014). Additionally, as MacKinnon and Derickson (2012) note, "resilience" as a goal in a particular context is often defined by power structures themselves, through government agencies or expert analysts, and thus privileges existing social relations.

Cote and Nightingale (2012, 475) take issue with the implicit assumption in much SES science "that social and ecological system dynamics are essentially similar." They argue that overemphasizing similarities between social and ecological system dynamics obscures the role of normative factors such as power relations and cultural values in understanding how adaptive dynamics of SES are affected by governance and social change. Examining the functioning of institutions and types of governance is not enough; analysis of SES adaptive capacity must also include the normative factors that support these structures.

Some scholars who have critiqued interdisciplinary, collaborative research focused on global environmental issues believe it does not adequately engage with humanities or the more humanistic, less positivist social sciences (Castree et al. 2014). According to Castree et al. (2014), the argument that an integrated knowledge formed by bringing together social science and ecological knowledge centered around the concept of complex systems does not actually ensure objective representation of the human dimensions of environmental issues.

Rather, it lends itself to partiality by leaving out key concerns related to human dimensions (identified by those humanistic disciplines), as well as providing potential for complicity because "researchers may implicitly endorse the societal status quo by neglecting to question it fundamentally" (764). As SES continues to develop as a scientific framework, critiques will continue to be made and addressed. For now, those listed above are the most prominent.

Environmental and Applied Anthropology

Some disciplines in the social sciences that focus on the environment are interdisciplinary as a sort of default. One of these disciplines of particular interest to this thesis is environmental anthropology. This specialization within anthropology developed over the last sixty or so years and examines human-environment relations from a wide variety of perspectives, with a recent focus on applied research driven by concern about environmental issues (Kopnina and Shoreman-Ouimet 2011). Orlove (1980, 235) defines ecological anthropology as, "the study of the relations among the population dynamics, social organization, and culture of human populations and the environments in which they live." He specifies that ecological anthropology takes a materialist perspective of human behavior and thus has much in common with other materialist scientific approaches.

Early environmental anthropology was influenced by various schools of anthropological thought, as exemplified through the works of Julian Steward (cultural ecology), Marvin Harris (cultural materialism), Roy Rappaport (functionalism, ecological ethnography), Clifford Geertz (systems approach), and others (Kopnina and Shoreman-Ouimet 2011). Contemporary environmental anthropology ranges from developing grounded case studies of human-environment interactions, to identifying missing elements of study (such as native understandings of nature), to addressing global politics and development, to understanding historical and cultural perspectives of human-environment relationship, to developing theories and methods specific to environmental anthropology (Kopnina and Shoreman-Ouimet 2011). These various approaches are influenced by other disciplines, including ecology itself, geography, political studies, and others. According to

Kopnina and Shoreman-Ouimet (2011), environmental anthropology is inherently interdisciplinary, and the field is moving forward in explicit recognition of this.

Environmental anthropology scholars focus on many aspects of human-environment relations that are considered in SES science, or conceivably could (perhaps should) be, including decision making and risk assessment (Checker 2007), biodiversity (Orlove and Brush 1996), environmental disaster (Adams, Van Hattum, and English 2009), community-based collaborative research (Austin 2004, Klenk et al. 2015), socioeconomics (Blount and Pitchon (2007), water management (Casagrande et al. 2007, Treitler and Midgett 2007), traditional or indigenous knowledge (Anderson 2011), environmental policy (Charnley 2010, Haenn and Casagrande 2007), and others.

As can be seen from the list above, many environmental anthropologists engage in applied work. Applied anthropologists, regardless of their specific focus, engage in research or practice that is problem- and action-oriented (Van Willigen 2002). According to Van Willigen (2002), applied anthropologists work for a variety of organizations, including non-profits, governments, consulting firms, universities, and more, in a variety of roles. Sometimes those roles include research and analysis, sometimes they include being an evaluator, project manager, planner or cultural broker. Whatever role they take on, an applied anthropologist applies their disciplinary training in anthropology to understand and solve problems. Many applied anthropologists work collaboratively with communities or other specific groups (Van Willigen 2002). Van Willigen (2002, 102) states that this type of work is "an involved-in-the-action process," based on the assumption that the research being done should provide something important to the group that is subject to study, not just contribute to a broader pool of scientific knowledge. Applied environmental anthropologists sometimes work with communities impacted by issues such as environmental disasters, pollution, or poverty and social justice, or in the realm of policy and management (Ervin 2000).

Conclusion

Social Ecological Systems science is an approach to understanding and responding to environmental issues that takes into explicit account social systems that are embedded in and linked with ecological systems of various scales. It aims to meld social science approaches with ecological in order to have a more holistic and systemic perspective of the phenomena, resources, etc., that a specific project is focused on. It has not always been effective at integrating these seemingly very different disciplinary genre, and has been the target of a number of criticisms. However, as a growing integrated approach it is moving along toward more standardized language and frameworks. Many scholars within SES argue for a more applied, action-oriented approach, often with the perspective that SES should move in the direction of transdisciplinary scholarship by co-producing science with non-academics.

Environmental anthropology is a discipline that recognizes the need for and has established methods and theories to bring human activity and culture into environmental research (or vice versa). "Understanding human motivations and behavior requires more than engaging with just the cognitive, behavioral, and physiological dimensions of our interactions with the environment. It requires an engagement with culture(s)" (Pooley et al. 2013, 26). Cultural values impact engagement with the environment. Unique to environmental anthropology is its approach to human-environment relations through the lens of culture. This takes different shapes depending on the research question, theoretical framing, etc., but an important thing to recognize is that anthropologists understand that culture is not just passive reception of homogenous social knowledge – there is variability between and within cultures, which can be thought of as "variably distributed patterns of modularly constrained cognitions within given populations" (Atran, Ross, and Medin 2005). While some researchers do approach their studies with the conception of cultures as discretely bounded groups or entities, many take the approach that it is sometimes more useful to focus on processes of cause and effect within a group (Atran, Ross, and Medin 2005, 745). Environmental anthropology efforts that focus on patterns of stability and change and the cultural causal processes that contribute to those patterns fit snugly into the developing paradigm of SES science.

Chapter 2: Context and History of MtnSEON

The Mountain Social Ecological Observatory (MtnSEON) has changed significantly from its inception several years ago to its state during the last months of its award. This might be the easiest way to understand the network and its context. Much like the social ecological systems its Working Groups hope to understand, MtnSEON has faced uncertainty and disturbances, dealing with issues and challenges in a dynamic way. This short history of MtnSEON provides important context for the following chapters, especially chapters 3-5, and was built from network historical documents and other materials, and informed by my own working knowledge and discussions with network leadership. It is not a wholly comprehensive history; due to space and time constraints, it only touches on those elements of MtnSEON's evolution that are most relevant to the research questions developed in the introduction.

There were at least three unfunded precursor proposals to MtnSEON. Those proposals had varying levels of social and ecological integration, before striking the right balance with the version that was finally awarded. This Complex Mountain Landscape Research Coordination Network (RCN), later named MtnSEON, was funded from 2012-2017 (this chapter will refer to the network as the RCN during the description of the first year, and MtnSEON thereafter). The National Science Foundation (NSF) offers the RCN award with the purpose of fostering new collaborative, interdisciplinary relationships. According to the NSF's website, the RCN program is not meant to support networks or collaborations that already exist, nor does it support primary research. As the name indicates, it is strictly a networking award.

Funded Proposal

The network structure and questions of focus laid out in the 2012 proposal were developed from a series of workshops that brought together scientists, economists, and resource managers from the Northern Rockies region. These workshops resulted in the identification of emergent critical issues related to climate and land-use change in complex mountain landscapes, which were rolled into the aim of the proposal.

The main question developed in the proposal asks, "How can we reduce the vulnerability, improve resilience, and support sustainability of natural and human systems in complex mountain landscapes?" (RCN Proposal). Mountain landscapes were chosen because they face unique environmental and social challenges, partly driven by exurbanization and changing demographics and industries in mountain communities Resilience in this context refers to the definition provided by the Resilience Alliance (quoted by Berkes, Colding, and Folke, 2003). Resilience is not seen as a stable end-state, but as the ability of the system to respond to change and disturbance without losing essential social and ecological functions. Essential to this understanding is the explicit recognition of SESs as dynamic, not static.

The main goal of the RCN, as outlined in the funded proposal, is to "…effectively network multiple sources of knowledge on how processes function within and between ecosystems elements of complex mountain landscapes for the purpose of improving social and ecological resilience and sustainability" (RCN Proposal). The RCN aimed to bring together individuals and organizations involved in "engineering, environmental science, information management, communication, education and outreach, both nationally and internationally" (RCN Proposal). Rather than develop new approaches and build a network to do research from the ground up, the original vision saw the RCN networking existing sources of knowledge, data, and expertise through partnerships of universities, agencies, Native American tribes and non-governmental organizations. This network was then intended to leverage existing efforts in order to demonstrate a collaborative, social-ecological approach to understanding the impact of land-use and climate change on mountain systems, using the Northern Rockies region as the model study area. The original builders of the proposal were responding to the growing perspective that humanity is entering an era of major uncertainty and change, with a plethora of accumulated data but very little integration of the different types of data in order to make them applicable to policy and management. They saw potential to address this need by capitalizing on potential to couple data streams and grow capacity for novel models and visualizations to advance science and improve public understanding. Ultimately, they hoped to develop an efficient regional network of

linked personnel, knowledge, and data that would influence policy and management decisions, which could then be scaled up to an international network.

In order to reach this broad goal, the proposal laid out three key objectives. The first objective aims to "facilitate coordination, integration, and syntheses for existing programs and studies regionally and internationally," by developing a mechanism to coordinate various research efforts in a cost effective, complementary way (RCN Proposal). By working with long term research and education programs in this effort, there would be opportunities to leverage studies and data already being created. The second objective in the proposal is "design collaborative interactive research, education, and governance projects with partners for the region and with other regions of the world," and the third is, "create partnerships linking new informatics to produce linked, scalable models and methods that will help inform management decisions and better link non-governmental and governmental constituents who affect the resilience of these mountain systems" (RCN Proposal). These objectives also depend heavily on developing partnerships with various organizations and programs in order to build up the RCN.

In order to facilitate the success of these objectives, assist with meeting the main goal outlined above, and to guide the development of the network, the proposal lays out six questions to drive the direction of the network (Table 2.1). These questions were not developed to be all-inclusive; they were intended to be refined and changed as the RCN developed.

At the heart of the envisioned network structure was a Steering Committee, which would oversee communication among the network during the five-year award and administer the disbursement of funds to individual working groups within the network. The Steering Committee was charged with coordination of activities to ensure the success of the RCN, including organizing meetings and other activities, establishing working groups, recruiting new network participants, developing methods for evaluation, and other administrative duties. The Steering Committee was composed of the original PI and four co-PIs, as well as six other scientists who were meant to represent a cross-section of various

Table 2.1 Initial Questions to be Addressed by the Complex Mountains RCN

1. What landscape elements or conditions are most sensitive to climate- and land-use changes? In what ways do changing social conditions such as community and public perceptions, economic and governance structures impact the ecological resiliency of these areas?
2. What are the effects of a changing precipitation regime on natural (wilderness) and managed terrestrial and aquatic systems in complex mountain landscapes? What opportunities exist for better application of natural science and resource management for mitigating adverse conditions with a goal of sustainability of resources and ecosystem services?
3. What are the most relevant data sources and information systems to analyze and visualize coupled natural and human changes? How do we share information internationally?
4. How should models be structured that merge social, economic, and ecological processes to create learning institutions to improve the governance and stewardship of complex mountain landscapes?
5. How can we create more sustainable, adaptive, and interconnected land-use and water resource systems to improve the effective response to climate and land-use changes that interact with disturbances (fire, insect/disease outbreak, etc.) across mountain landscapes and human-environmental well-being?
6. How will climate- and land-use changes interact with disturbances (fire, insect/disease outbreak, etc.) to alter connectivity across mountain landscapes? These interactions are likely to be nonlinear and scale dependent.

Source: RCN proposal

network partners. Initially the main PI served as the chair of the Steering Committee, and the position would then rotate biennially to another member elected from within the committee.

There were several other committees and groups suggested in the proposal, including an external advisory committee, which consisted of three people outside of the network who would provide feedback about the research and education components of the network; an international steering committee to promote and guide international collaboration and communication; research and education working groups to design studies meant to capitalize on RCN resources and which would be reviewed by the Steering Committee; and an information management committee to oversee policies and protocols for envisioned databases.

Implementation and Evolution of the Network

Leadership and Structure

Early meetings of the Steering Committee saw a lot of enthusiasm, with discussion about various ways to implement the aims of the proposal. They found consensus on the importance of building relationships with Native American tribes and their agencies and entities, such as tribal colleges, and engaging with stakeholders at the beginning of the process. They hoped that this would assist in identifying relevant research questions and issues and facilitate transdisciplinary collaboration with groups outside of academia. Steering Committee members also agreed that the focus of the network should be on developing products that would be applicable to actual environmental interventions, such as through policy and management. Additionally, there were a wide variety of ideas and individual priorities expressed, as well as suggestions for how best to focus management of the RCN and methods for facilitating multiple disciplinary collaboration.

Over the first year of the award, Steering Committee members attended various external organization meetings to give presentations about the RCN and invite participation. They continued to meet regularly over conference calls and lay out plans for growing and strengthening the network. During this first year, the name of the RCN changed from the Complex Mountain Landscapes RCN to the Mountain Social Ecological Observatory Network.

During 2013, the Steering Committee began to shift to function more as a Leadership Team. The network's first general meeting was hosted in August of 2013, and the external advisors attended to observe and make suggestions. At the end of the meeting, the Steering Committee met with an external advisory group, who suggested that the network would benefit from clearer leadership and organizational structure. The original structure was seen as a bit muddled, and that could be a barrier to furthering the momentum of participant efforts. External advisors and Steering Committee members both expressed worry that without a stronger core leadership, the network would not have a clear trajectory and participants would have less interest in engaging. The conceptual shift to a Leadership Team,

which would provide a more stable top-down structure, was one part of the response to this concern. Another aspect of this response was a bylaws document developed in 2014, which laid out the governance process and operating principles. This document defined the Leadership Team as "the means by which collective decisions are made on matters relating to MtnSEON" and provided a basic outline for the functioning of the Leadership Team (Bylaws and Guiding Document). This document added basic objectives for the network (see Table 2.2), and provided general requirements for Working Group funding proposals. The three main objectives in the original proposal were still important guiding items, but not included in the new unifying document.

Table 2.2. Basic Objectives of MtnSEON

1. Improve understanding of the effects of environmental change (climate, land-use, invasive species, disturbance regimes, economic, political) on pattern and process of coupled natural and human systems in mountain landscapes;
2. Focus on environmental and social issues that constitute sustainability challenges such as adapting to climate warming or water shortages;
3. Simultaneously consider the socio-cultural, economic, biophysical and ecological aspects of mountain landscapes and develop conceptual and formal models that test hypotheses about sustainability issues;
4. Develop, assess, and document partnerships among academics, managers, tribal/indigenous governments, NGOs, and local-regional stakeholders in an adaptive management and collaborative spatial-governance structure to:
    a. Integrate and test theories that would develop and promote best management practices; and
    b. Advance socio-ecological literacy of managers, government officials, and local stakeholders
5. Model how to combine, in investigation and application, local, place-based, and indigenous knowledge and social and self-governance systems with national and state systems and academic science knowledge.

Source: MtnSEON Bylaws and Guiding Document, April 2014

The shift to a Leadership Team also involved a shift in some of the personnel involved in that group. Some Steering Committee members did not continue in a Leadership Team role, and new members were brought on. Additionally, in this general time period of 2013-2014, the first of several changes in co-PIs occurred, with one original co-PI replaced by another person. This was repeated in the 2014-2015 period, with another co-PI leaving the network and being replaced by a new researcher. Some of these personnel shifts were

logistical, with changes being made to meet institutional requirements for grant governance. Others were more individual, with people leaving the network because of the time required or a lack of interest in the direction the network was headed.

In September and October of 2014, more structural changes occurred, with an attempt to initiate sub-groups in the Leadership Team, grouping members into areas of oversight of efforts related to biophysical, social, integration, and resource management. This was in response to the new base objectives developed in the Bylaws and Guiding Document, and a need to communicate more effectively and work better as a team, as noted by the Leadership Team members and external advisors. Based on the updated objectives and as part of this new development, an extensive work plan was drafted, with roles and tasks for each Leadership Team member, as well as tentative timelines. The development of this work plan was fraught with questions of time allocation and compensation for time dedicated by sub-group chairs and Leadership Team co-chairs. At the time, multiple Leadership Team members expressed frustration with an imbalance of what had been taken on by the group and how much time each individual could commit without being paid or compensated in some way.

After deliberation among the Leadership Team over the time issue, and a recognition that they were struggling to collaborate and lead effectively, the Leadership Team structure was altered again. Although the External Advisors had suggested completely disbanding the Leadership Team and rebuilding, due to conflict within the group, it was decided instead to split into a core Executive Management Team (more regularly referred to as the Executive Team), people who would oversee the administration of the award and have final decision-making power, and a Leadership Team, who would liaise directly with specific Working Groups and function in an advisory capacity to the Executive Team. This is the structure that has stuck through to the final months of the award. The work plan document was updated to reflect the new structure, but fell by the wayside in terms of guiding Executive and Leadership Team activities. After the last reorganization, communication among the Executive and Leadership Teams has waned, especially in the last year of the award.

Working Groups and Extended Network

The focus on stakeholder engagement and collaboration rolled into a workshop held in August of 2013. Forty-two participants included Steering Committee members, External Advisors, and invited tribal, agency, and NGO representatives. Researchers who were involved in the workshop represented a wide variety of disciplines, including forest ecology, plant community ecology, fire science, cultural anthropology, systems ecology, economics, engineering, and more. Loose Working Groups formed at this meeting focused on water, disturbance and land-use change, and human trajectory, with important discussions about the nature of the network and moving forward with Working Group efforts. These groups were invited to develop proposals for workshops and other activities and submit funding requests to the Steering Committee. These groups did not match completely with those originally suggested in the proposal, reflecting the Steering Committee's aims of being democratic and allowing the groups to define their own goals.

Over the second year of the award, Working Groups continued to develop, and by the time the 2013-2014 Annual Report was submitted to the NSF in July 2014, there were nine functioning groups with more specific areas of focus: 1) student-led initiative in Traditional Ecological Knowledge; 2) social dynamics of wildfire; 3) governance structures and jurisdictional issues; 4) human impacts on and interactions with large lakes in the Western United States; 5) social perspectives on bark beetle outbreaks; 6) human-large carnivore conflicts; 7) effects of climate change on Columbia River Basin river habitats and fisheries; 8) socio-ecological patterns and processes in the Blue Mountains Ecoregion of the Pacific Northwest; and 9) development of an SES Training and Education Program, or SESTEP (2013 Annual Report). In July 2014, six of these Working Groups had submitted funding proposals which had been approved.

There were also developments that were tangential to the Working Group efforts. In May 2014, a meeting was held in Montana to discuss the development of a potential Mountain Research and Education Institute (MREI). This meeting was basically early-days planning for developing an institute to grow out of MtnSEON and other programs' and

organizations' efforts. There was a recognized need for an institute dedicated to better understanding and managing mountain systems, and during this meeting twenty-six people from management agencies, universities, and non-profits met to discuss how to meet this need through the development of the conceptual institute. Follow up discussions suggested developing MREI like a Working Group proposal, in order to be funded as a networking activity. While it has remained a topic of potential discussion, it was never moved forward in a formal way.

During the middle of the award, around 2014, network leadership began to see the Working Groups as the core effort of the network. As the main PI at the time said, "Although our proposal speaks to developing the region as a model for use elsewhere, the actual work needed in data, modeling, etc. does not have the funding in the RCN award to do it. The other proposals that result from the Working Groups may be the way we can do this" (email, October 2014, quoted with permission). The priority was now facilitating the Working Groups in their efforts to develop SES research and products, and support the groups themselves as networking entities, hoping to roll their efforts into something larger than each of them alone. While there was still the underlying aim of keeping a trajectory toward the original goals and objectives, the day-to-day administration shifted to focus on Working Group activities, cross-collaborations, and sustaining the momentum that was being developed beyond the end of the award.

The 2014-2015 Annual Report touched on more change among the Working Groups. New Working Groups had been formed, including one with a focus on invasive plant species, and another engaging in a project related to buffalo restoration in tribal communities. These Working Groups were among the last developed, and rounded out the diversity of focus in Working Group efforts.

Current State of the Network

In the last two years of the award, MtnSEON has settled into a final form. The Working Groups that are still active are putting out various types of products, and there are

some tangential or spin off items being developed. Most Working Groups have an active chair or co-chairs, a core group of participants, and a larger group network.

Current Working Groups

There are ten Working Groups that have been active in the last two years of the MtnSEON award (Figure 2.1).

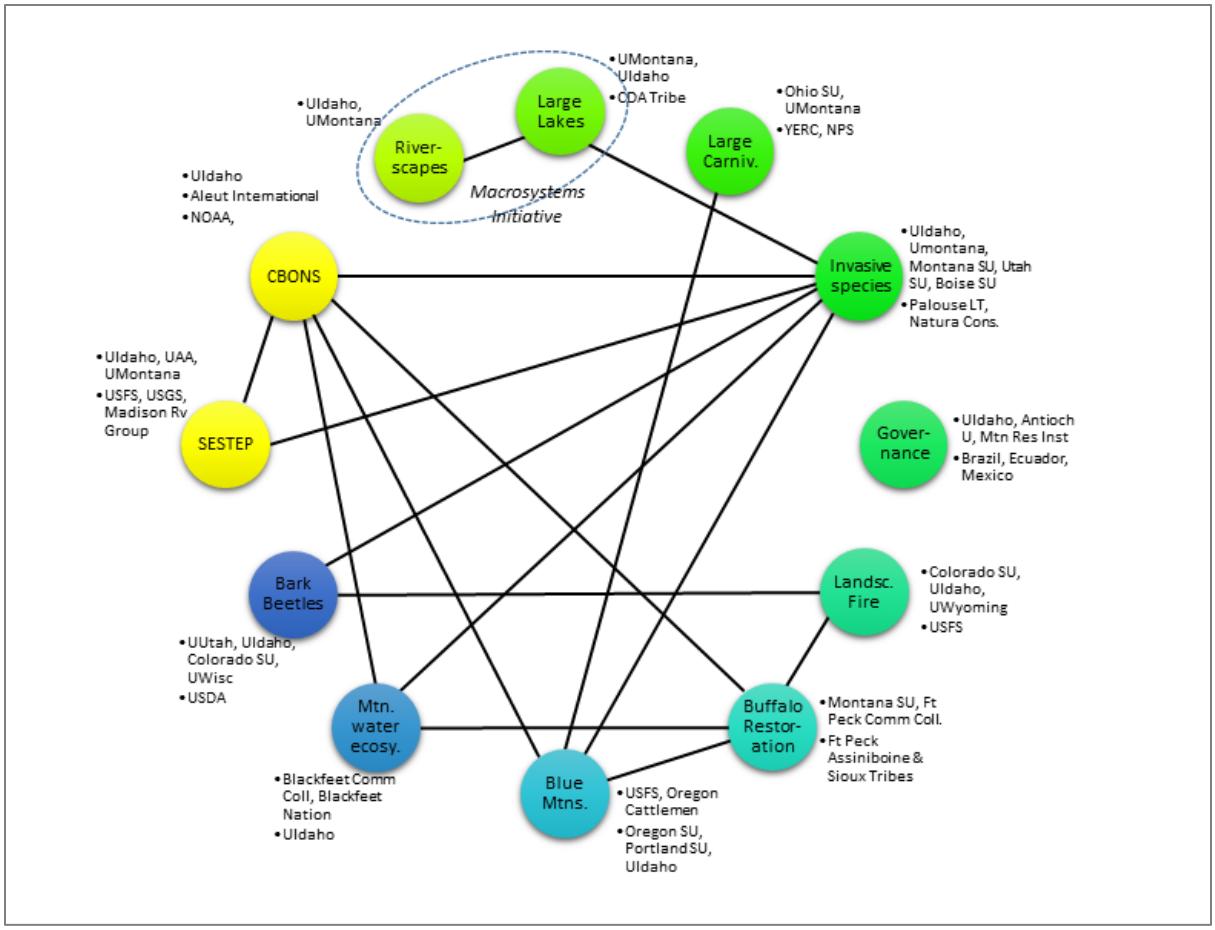


Figure 2.1 Active Working Groups in MtnSEON final two years. (Alessa et. al, In Press, used with permission.)

1) Bark Beetle – The Bark Beetle Working Group aims to understand social factors in and perspectives of bark beetle outbreaks in the American West, especially over long temporal scales and in the context of global climate change. Their collaboration aims to identify key gaps in knowledge about the social-ecological dynamics of these outbreaks. They have conducted two workshops, submitted four research proposals, and produced at least seven manuscripts, several published. Working Group participants represent ecology, the social sciences, and management agencies.

2) Blue Mountains – The Blue Mountains Working Group aims to bring together researchers and local stakeholders to co-develop research which capitalizes on long term ecological research data. They hope to provide integrated approaches to developing "new knowledge to aid in reducing vulnerability, fostering adaptation, improving resilience, and supporting the sustainability of natural and human systems within the complex mountain landscapes of the Blue Mountains and beyond" (MtnSEON website). They have developed at least one manuscript, one funding proposal, and three workshops with both stakeholders and scientists involved. There are two sub-groups within the Blue Mountains Working Group, that focus on grazing on public lands and ungulate ecology. This Working Group is led by agency researchers, and its core group includes graduate students, agency and university researchers in ecology and the social scientists, who work with the broader network of community participants.

3) Buffalo Restoration – The Buffalo Restoration Working Group is based on the Fort Peck Reservation, and has brought together a network of participants representing local grassroots community groups, government and tribal agencies, international wildlife NGOs, and university researchers to better understand the impact of buffalo reestablishment on community health and resilience. They have produced at least four manuscripts or reports, given one presentation, and held a large summit on the Fort Peck Reservation, along with other ongoing efforts that have not resulted in this sort of quantifiable project but do contribute to on-the-ground relationships and application.

4) Governance – The Governance Working Group applies an SES framework to understanding how scientific knowledge can support resilience-oriented decision making, and how institutions at various scales apply different types of knowledge (especially local and indigenous knowledge) in decision making. They use an analytical framework to focus on issues of equity and governance at different scales, especially in the context of watershed governance in mountain landscapes. This

Working Group has developed relationships internationally, working with established programs and organizations committed to engaging with stakeholders and growing capacity for governance at local and regional scales. They have written several manuscripts, submitted at least five proposals, and presented at various international conferences.

5) Invasive Species – The Invasive Species Working Group aims to develop a framework for understanding plant invasion in the Western United States as a social-ecological phenomenon, and is developing an active SES research project for the invasive plant *Ventenata dubia*. Their Working Group participants represent universities, agencies, and conservation non-profits. They have produced at least four manuscripts, submitted a funding proposal to the USDA, and hosted four workshops to develop stakeholder input.

6) Large Carnivores – The Large Carnivore Working Group has developed a conceptual model for understanding social and ecological dynamics of large carnivores (such as wolves, bears, or mountain lions), with the aim of better understanding how humans and these animals compete for resources and how to further research these conflicts. In addition to their model, they have hosted a three-day event which brought together ecologists and social scientists to develop a case study centered around wolves, developed at least five manuscripts, and submitted a NSF Coupled Natural-Human Systems proposal. Their Working Group participants include both researchers and stakeholders.

7) Large Lakes/Riverscapes/Macrosystems – These interrelated groups focus on water issues in the Columbia River Basin, and have developed two separate proposals for the NSF Macrosystems award. One proposal aims to examine Iconic Lakes in the Columbia Basin, and the other focuses on glacier dependent first-third order watersheds undergoing climate change. This Working Group has brought together researchers from several universities and research organizations in Washington, Montana, and Idaho.

8) Social Ecological Systems Training and Education Program (SESTEP) – The SESTEP Working Group was created to develop a curriculum to establish an SES training and education program. The idea for SESTEP grew out of the MREI planning workshop, hosted in May 2014 by the MtnSEON Leadership Team. Attendees at this meeting identified a strong need for the development of a mechanism for training and education in the theory and practice of SES as applied to resource management issues. The pilot course of SESTEP ran from October 2016 to April 2017, with an initial cohort made up of agency personnel from throughout the United States and graduate students from the University of Idaho.

9) Student Led Initiative on Mountain Water Systems (SLI) – The SLI Working Group is based at Blackfeet Community College (BCC), and is a student led effort to learn from their community and bring together local knowledge about mountain and water systems. To achieve this, they have hosted a community summit, bringing together management professionals, BCC faculty and staff, Blackfeet elders, and other community members to share their knowledge and perspectives about mountain and water systems within the Blackfoot Reservation.

10) Wildland-Urban Interface – This Working Group focuses on the interactions of human processes with ecological disturbances, the effects of those interactions over the gradients of wildland-urban interfaces (WUI) in the Northern Rockies, framing WUIs as social-ecological systems. They have developed multiple manuscripts, and submitted proposals to facilitate the development of an international working group to sustain their efforts beyond the award period of MtnSEON.

Some Working Groups are more active than others, have developed more products, such as funding proposals, workshops, and submitted manuscripts, and will probably collaborate longer after the end of the award. Some have found external funding for proposals and other activities, and some have had their requests denied or struggled to find the time and personnel to develop funding requests. Some Working Groups were initiated by ecologists asking ecological questions, who then realized a social science perspective

would be necessary to their research questions, and others were developed from a social science perspective. All aim to bring together social scientists and ecologists to develop integrated SES research.

Non-Working Group Efforts

There are several initiatives and outgrowths of effort that are not specifically associated with a single Working Group.

1) Frontiers in Ecology and the Environment Special Issue – MtnSEON has worked with the journal *Frontiers in Ecology and the Environment* to develop a special issue, featuring the work of several MtnSEON Working Groups and other initiatives. Articles by various participants in MtnSEON have been submitted and are under review, with the issue forthcoming.

2) EyesNorth – EyesNorth is a new RCN related to MtnSEON, which is led by and will include participants from some MtnSEON Working Groups (see Figure 1). This effort grew partly out of an idea for a cross-Working Group collaboration that didn't take off within the parameters of MtnSEON. EyesNorth aims to develop Community Based Observing Networks to monitor social-ecological change, utilizing key concepts of resilience and adaptation and developing transdisciplinary collaboration in the implementation of these networks.

3) SES Current Practices Archive (SES-CPA) – Early in the award period, MtnSEON leadership and participants identified a need for a repository or archive of SES projects and frameworks, to support future SES initiative and to avoid having to "reinvent the wheel." This fell outside of the purview of MtnSEON, but participants from the network who run a permanent center at the University of Idaho obtained funding to develop such an archive. The SES-CPA is now in beta version, and is being populated by various case studies.

Conclusion

In its current state, the Mountain Social Ecological Observatory Network looks quite different than initially envisioned. Over the time of the network award, the leadership structure and overall focus shifted to become less centralized, with priority being placed on developing strong Working Groups and relying on their group networks to fill out the RCN. There was hope that the Working Group efforts would be fertile ground for collaboration among the groups (not just within), and some has occurred, although perhaps not as much as network leadership hoped for.

Working Groups have developed their own objectives, some guided by the questions and objectives developed in the original proposal and subsequent Guiding Document, and others coming together more independently. At the end of the award, some Working Groups have become much less active, falling out of touch with the central Executive Team, and not attending the 2016 Annual Meeting. Others have continued to expand their research efforts, look for funding, and further SES as a viable research framework.

Network leadership has shifted significantly over the five-year award period, from a core Steering Committee with ten members at the beginning of the award, to an Executive Team of five members with decision-making authority at the end. This shift was influenced by conflict, time constraints, and changing priorities, among other factors. Communication among the Executive and Leadership Teams has lessened as Working Groups have solidified their own participant groups and research foci, and now even the Executive Team does not meet as regularly as it did. As the award winds down, those Working Groups which are still going strong are more independent and there are fewer administrative tasks requiring immediate attention.

MtnSEON has seen a lot of change over the five years of its award, but this is not necessarily a bad thing. It has developed into a solid network of Working Groups doing unique and important work advancing SES approaches. As the award ends and the Working Groups do not have the central leadership of MtnSEON, some will likely dissolve, while others will continue their efforts, building their networks, and demonstrating SES as an

important and valuable approach to understanding human-nature relations and developing interventions appropriate to managing for resilience. MtnSEON has always been a dynamic network, and its components will continue to be, even after the end of the formal award.

Chapter 3: Methods

The main research questions for this project are, what barriers and challenges has MtnSEON faced in developing SES team science? How do they relate to interdisciplinary collaboration more broadly, and how does MtnSEON act as a case study for SES science in general? And how can anthropologists contribute to navigating these barriers and challenges in SES team science settings, and shape the future development of SES science?

To answer these questions, this research project utilizes mixed methods. This approach reflects the goals of SES and MtnSEON, with the aim to integrate a variety of research perspectives and approaches. Mixed methods were also chosen as a tool to facilitate stronger, more accurate conclusions. I collected multiple types of data to try to triangulate methods, with the hope that this would assist in identifying and mitigating my own biases. Because I play a specific role in the network and come to the project from my own personal context, my experiences and impressions have informed how this study was conducted. Ideally, the comparison of the different data sets helps remove as much individual assumption and bias as possible. Of course, my perspective cannot be totally removed; thus, it is advisable to explicitly recognize my positionality. For this reason, I use self-referential language regularly throughout this methods chapter, and occasionally throughout the results and discussions chapters.

This project also pulls from grounded theory methodology, developing conclusions based on what has emerged from the data analysis, rather than testing explicit hypotheses. Recognizing that there is divergence among scholars on how to define and implement grounded theory (Ralph, Birks, and Chapman 2015), I do not claim to be completely true to its history or philosophy. Rather, my methods are inspired by the essential methods of grounded theory, including interviews and coding (Ralph, Birks, and Chapman 2015), and hypothesizing about the relationships in the group being studied based on what is found in the collected data, rather than bringing preconceived hypotheses to the table (Martin and Turner 1986). This approach is an appropriate and effective option for this study because it aims to understand how MtnSEON can be understood as a case study of SES research and

application on a broader scale, rather than testing specific hypotheses about the network's functioning. This methodology also works with my position in the network, where I am well placed to observe as an insider-outsider, having access to decision-making meetings and developing rapport with the people being "studied." With this trove of materials, I chose to design this research to use the process of collecting and analyzing three different data sets, defining what is common among those data sets, and then using that to inform conclusions, rather than developing hypotheses based on early assumptions which might not be flexible to developments along the way.

An important aspect of engaging in this research is practicing reflexivity throughout the project. Reflecting on my position within the network – both as a functioning organization and as a social structure – and how I balance my roles as observer and participant assisted in identifying areas in my research where I actively filled in questions of uncertainty with my own biased perspectives. This practice of reflexivity is important because, combined with my multiple sets of data, it allows me to attempt to work beyond the urge to assume my experience in MtnSEON is representative of the larger whole. Rather, I aim to see myself as one part of a larger network of experiences and perspectives. Participant observation, interviews, and surveys, supplemented by information from MtnSEON historical documents and self-reflection through the recognition of my own positionality, are important tools in developing a significant piece of the network's story.

This research is limited in clearly identifiable ways. Because I work so little with the Working Groups themselves, my observations are almost exclusively of the functioning of the upper levels of the network. Also, I am not familiar with the work done by the Working Groups, aside from the products we have listed in the last two Annual Reports, nor am I familiar with their individual structures, functioning, or participant groups. This presents a dilemma in interpreting the various data collected because my knowledge and experience in the network is rooted in the leadership perspective, making me more inclined to interpret things from that viewpoint. As a graduate assistant with little research experience of my own, I have certainly been influenced by the attitudes of the Executive Team members with

whom I work most closely. Hopefully the various attempts to temper these limitations are effective; however, it must be noted that this analysis simply cannot apply to every aspect of the network.

Data Collection

Participant Observation

Participant observation was conducted from August 2015 to February 2017. As the main graduate assistant for MtnSEON for this time period I am closely involved with the network leadership. I work most closely with the Executive Team, a group of five people who maintain oversight of the network, approve and allocate funding, and coordinate network-wide efforts (such as the annual meetings). To a lesser level, I work with the Leadership Team, four researchers who function in an advisory capacity to the Executive Team, and the Working Group Leads, who oversee Working Group proposal and research efforts.

As graduate assistant I have had the opportunity to engage in participant observation from an interesting perspective. This is facilitated by my being something of an outsider-insider. I came into the network at the beginning of the penultimate year of the award, so I completely missed the first three years of the network's development. While sometimes personally frustrating, because there was so much history and context I was unaware of initially, it also gave me an opportunity to see the network with "fresh" eyes, unencumbered by past shake ups. Positioned as I am among the Executive Team, I have access to regular decision making meetings, as well as past documentation of MtnSEON's activities. From this insider perspective, I have been able to develop, if not a completely nuanced understanding of the network's evolution over time, at least a general understanding of it, supplemented by network historical documents and interviews and other conversations with Executive and Leadership Team members.

Interviews

Most data for this study comes from semi-structured interviews conducted with seven of the nine Leadership Team members. While the aim was to interview each Leadership Team member, scheduling times with the last two was not possible in the necessary time frame. For each of the interviews, the interviewee was asked the same ten basic questions (see Table 3.1) with follow up and clarifying questions as appropriate to the conversation. These interviews were variable in length; the shortest was around half an hour, the longest about 90 minutes. In order to try and capture as much relevant information as possible, and to capture elements of the network dynamics that I had not identified on my own, I closed each interview by asking the interviewee if there were any questions they felt I should have asked but did not.

Table 3.1 Leadership Team Interview Questions

1. How long have you been associated with MtnSEON, and what is your role in the network?
2. Please describe any experience you have conducting Social-Ecological Systems research, outside of MtnSEON. Or, what other sort of engagement have you had with SES type research, even if you haven't conducted it yourself?
3. Please describe any other experience you have with interdisciplinary team science, outside of MtnSEON.
4. Do you consider yourself an interdisciplinary scientist? What motivates you to be involved in interdisciplinary research?
5. When you consider the structure and products of MtnSEON, what would you say are its greatest strengths?
6. When you consider the structure and products of MtnSEON, what would you say are its greatest weaknesses?
7. What role or perspective would you like to see social scientists provide in SES approaches?
8. Do you believe MtnSEON working groups would benefit from engaging more with qualitative research, quantitative research, or that they've found a pretty good balance?
9. Have you ever worked in a team science setting with anthropologists? If so, can you please tell me about that project and your experience?
10. Is there anything you think I should have asked, but haven't?

Executive and Leadership Team Survey

Two surveys were distributed as part of this study. The first was developed for the Executive and Leadership Team members. It was distributed as a Qualtrics survey, with a

link sent to each Executive and Leadership Team member through an email. Seven of nine Leadership Team members responded, a response rate of 77.8%. Because survey responses were collected without identifying information, I cannot be sure if these were the same seven people I interviewed. The Leadership Team survey included eight questions, including multiple choice, Likert scale, and open ended question types. These questions pertained to MtnSEON as a network and its individual Working Groups, and also asked for specific information about the respondent's experience and perspectives related to SES in general. For a full list of questions, see Appendix A.

Working Group Lead and Participant Survey

The second survey was developed to obtain more data about the perspectives and experiences of people actually conducting research as part of a Working Group team. It was distributed in two groups. The first was distributed in paper copy to all Working Group participants and guests who attended the 2016 Annual Meeting, resulting in eleven responses. In order to try to get a large enough sample size to conduct hypothesis testing, a second batch of responses was collected through Qualtrics. The link was sent to Working Group Leads through email, who then forwarded it on to their specific participants. Though I requested to be copied on the forwarded message, I was not included and so am unware of how many participants received the link. Thus, I cannot estimate a response rate. Ten responses were collected through Qualtrics, bringing the total sample size to 21. With a very rough estimate of a population of one hundred (ten participants per Working Group, although each Working Group is not necessarily active at this point in the award and some are larger than others) this would make the sample size about 20% of the population. Additionally, most of the respondents are actually Working Group leads, not simply participants. This, combined with the small sample size, means the sample is simply not representative of the broader network.

Despite these issues, there is still useful information to be gathered. But it must be noted that my data does lack the perspective of participants at the farthest reaches of the network, and any conclusions reached will take that into account. Like the Executive and

Leadership Team survey, the participant survey asked a variety of question types, including multiple choice, Likert scale, and open ended questions. For the full list of survey questions, see Appendix B.

Data Analysis and Interpretation

Coding

Coding was applied to interview transcripts, open-ended survey responses, and my fieldnotes. After each interview was conducted, I took notes to remind myself of important impressions and things to follow up on during data analysis. Each interview was recorded and then transcribed by hand to facilitate a deeper familiarity with the data. I then read through each transcript a few times, as well as my notes, and developed six initial coding categories based on the questions asked and themes that stuck out immediately after conducting the interviews. These categories are 1) Barriers and challenges to conducting Interdisciplinary and SES Science; 2) MtnSEON strengths; 3) MtnSEON weaknesses; 4) Evolution of MtnSEON as a network; 5) Quantitative and qualitative research; and 6) Potential contributions of the social sciences, specifically anthropology, to SES science. The transcribed interviews and open ended survey responses were reviewed again, using a color-coding system to note any part of the interview that fell under those initial categories. After compiling each of these comments by interviewees, they were separated into subcategories. For a map of subcategories, see Figure 3.1. For a full concept map of each category, see Appendix C.

During this subsequent review, emergent categories were identified, themes that developed on their own throughout my interviews, rather than imposed by my initial expectations or impressions. Some of these emergent categories did coincide with questions I asked, though I had not expected them to result in main themes. These emergent themes are: 1) Roles played by Executive and Leadership Team members in previous SES-related projects; 2) Tools and strategies for strong SES science and application; 3) What it means to be an interdisciplinary scientist; 4) Value of interdisciplinary research and motivation for

being involved with it. For a map of subcategories, see Figure 3.2, and for the full concept map, see Appendix D.

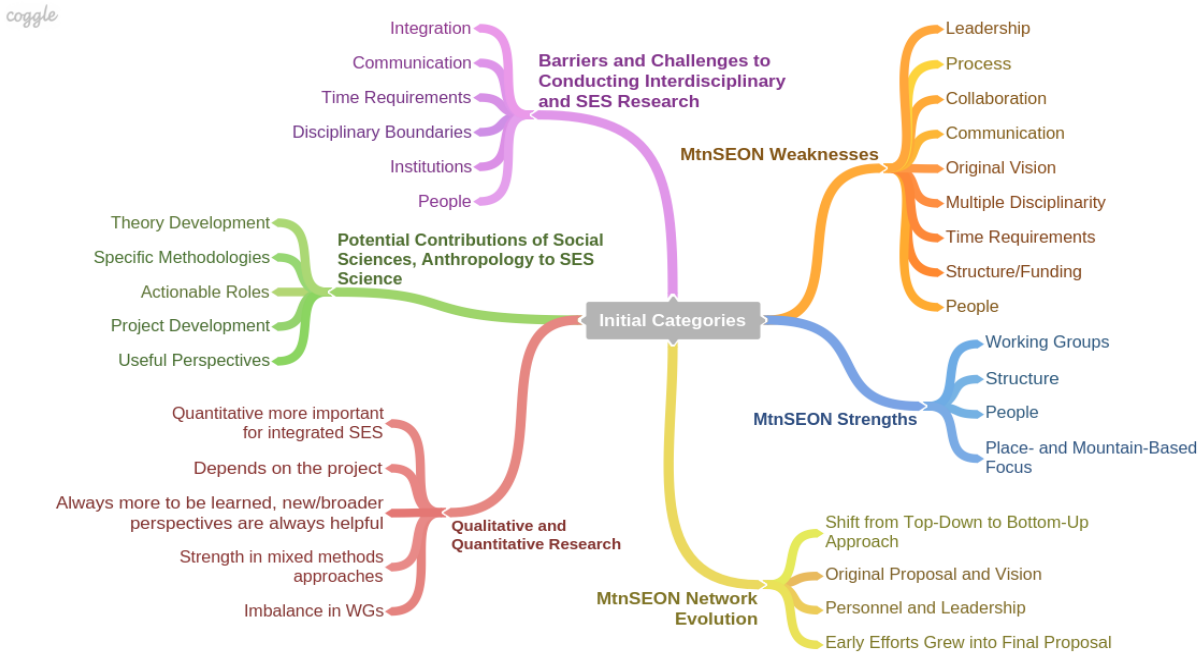


Figure 3.1 Initial Coding Categories and Subcategories

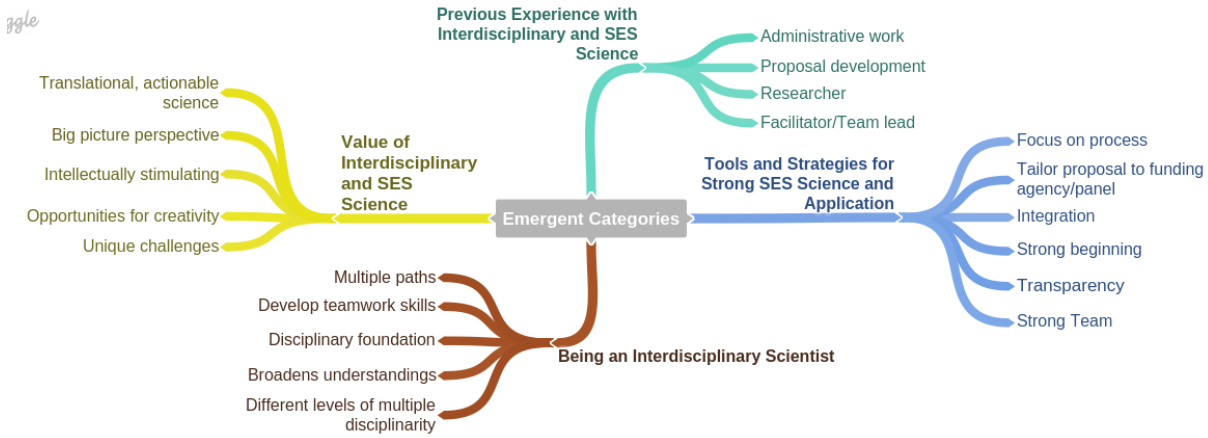


Figure 3.2 Emergent Coding Categories and Subcategories

Statistical Analysis

Due to its very small sample size, the Leadership Team survey was analyzed only using descriptive statistics; no hypothesis tests were conducted. For the participant survey, analysis consisted of descriptive statistics for all variables. For ordinal data from the Likert scale questions, bivariate correlation was used to calculate Pearson's r to discover any

correlations existing among the sample variables (for the full correlation matrix, see Appendix E). Again, no hypotheses were tested statistically. Because neither survey is considered representative of the network in general, all analysis and interpretation is applied only to the sample for each survey.

Interpretation

The themes developed from coding provide the main framework for the results presented in the next chapter. The coding themes are the elements of this thesis most influenced by grounded theory methodology, being developed based mostly on what was recorded in my observational notes and said in the interviews and survey responses, rather than decided ahead of time. Statistical data is interpreted in the context of these themes, comparing results within the samples to the broader themes and considering whether they converge or if there is conflict. Of course, it must be noted that I developed the interview questions based on my experience in the first year of my assistantship, so my own perspective of what was important did influence what data was collected. This demonstrates the need for regular reflexivity, and also fits in the overarching methodology of grounded theory, as it "allows the researcher to consider his or her ontological and epistemological position" (Ralph, Birks, Chapman 2015, 2) and to orient themselves philosophically to the phenomena or interactions being studied.

Conclusion

Recognizing that it is not the general convention to refer to oneself as the researcher in academic writing, I have chosen to place myself in the narrative provided in this thesis as appropriate. As a member of the network about which I write, it makes sense to include myself here. It is also fitting to explicitly acknowledge myself knowing that my audience will likely be made up of many of those network members, as well as future anthropologists and other social scientists hoping to become engaged with SES. Situating myself in the research provides a way for my readers to consider how my perspective has influenced the design of this study, and the conclusions I have reached, which will be discussed in chapters five and six.

Using mixed methods to collect a variety of data that were then analyzed in order to compare themes and develop conclusions supported by each data set has resulted in a rich set of themes and conclusions. While not every piece of information resulting from this data collection is directly relevant to the research questions asked in this thesis, there is much to potentially learn from it all. The following results chapter will discuss those items that are helpful in answering this project's questions.

Chapter 4: Results

Here, I examine the themes developed through the coding process and consider how they relate to other collected data. Within and across themes, many subcategories overlap or are clearly related. Some subcategories even seem to directly conflict (for example, "Leadership" and "People" are subcategories in both MtnSEON weaknesses and MtnSEON strengths.) This is an important reminder of the nature of this case study, with a small group of participants whose opinions and experiences differ widely.

Due to the wide scope of the initial and coding themes, this summary is restricted only to those themes and subcategories directly relevant to the discussion in the next two chapters, which consider MtnSEON as a case study for interdisciplinary SES science, and how anthropologists might engage more fully with future SES projects. While there is certainly more worth discussing, it is outside the scope of this thesis. For a complete breakdown of all the themes, subcategories, and supporting statements, please see Appendix A.

It is important to reiterate that these results are not generalizable to the broader population of MtnSEON participants. Interview data comes exclusively from network leadership, and participant observation nearly so. Even among the participant survey, the mode of respondents is Working Group leads (42.9%), with Working Group participants being the smallest portion of the sample (19.0%).

Barriers and Challenges to Interdisciplinary and SES Research

During interviews, several participants addressed what they saw as general factors that make it hard to conduct collaborative interdisciplinary and SES research. Communication among interdisciplinary teams was one important challenge many participants see to developing SES science. This particular subcategory is closely related to several others because of the various ways that miscommunication occurs. Sometimes team members themselves do not have effective communication skills. It is also often difficult to communicate across disciplinary lines, sometimes because of disciplinary jargon. One participant mentioned during his interview that often, the same words might be used in

several different ways by people with different disciplinary backgrounds, which can be confusing for those involved in the conversation.

A compelling example of this is the MtnSEON proposal itself, which uses the word "model" in at least three different ways. First, it refers to the Research Coordination Network as a model itself, demonstrating the process of networking multiple sources of knowledge and expertise at a regional level. It also uses "model" to refer to quantitative, predictive environmental models. And it refers to the model region of the Northern Rockies, where MtnSEON is focused. When a group is trying to communicate, this type of obscurity in definition certainly does not help.

The struggle to communicate can itself be a barrier to integration. Integration of ecological and social scientific approaches was a major theme identified in all three main modes of data collection (interviews, surveys, participant observation). When asked what barriers he sees to the integration of social and ecological approaches, one respondent said, "I think the inability of the two disciplines [social science and ecology] to talk to each other in meaningful ways. I think that's been the major problem in MtnSEON." Participants from both the interviews and surveys felt that this integration has not yet been achieved in most SES research for a number of reasons.

One reason is the difficulty of bringing together qualitative and quantitative approaches. Often, researchers tend to work toward one end of the spectrum or the other, and have little familiarity with alternative methods or approaches. Thus, they face the challenge of determining what role these different methodologies can play while being biased toward their own preference or practice. As one interview participant told me, "Well, my bias is towards quantitative approaches to anything." In addition to overcoming this individual bias, there are methodological challenges. Part of the struggle here is how to fit qualitative data into quantitative modeling and whether that is actually a useful way to utilize qualitative data.

Participants also identified the struggle to integrate the temporal and spatial scales of data as a major challenge. There is often a difference in scale between social scientific and

ecological data, making it hard to merge these data sets. One participant felt that integrated, interdisciplinary data is extremely difficult to scale up from localized studies to broader regional or global perspectives. (Interestingly, this relates back directly to MtnSEON's original proposal, and its goal to develop an example of a regional scale approach that could then be scaled up to a global perspective.)

Respondents felt that institutions provide challenges to many researchers who hope to engage in collaborative projects. Evaluation systems often reward individual efforts over collaborative work. Many of the participants in this study work in the university system, and several commented on how difficult it is to be recognized and rewarded for collaborative work. This is well illustrated by a response in the participant survey: "Institutional structures, rules, regulations, sometimes do not facilitate the process of collaboration, even though I would be interested [in doing collaborative research]."

A commonly discussed challenge to conducting collaborative research of any kind is the time commitment it requires. During interviews, multiple participants spoke about the struggle to convince people to take the time to sit down and do the work that is necessary to actually collaborate. This work might involve building relationships among team members, developing a common framework for understanding the research problem, learning about each other's disciplines, or other efforts. Researchers are often already very busy, and these types of activities typically do not result in the types of products that they can list on annual evaluations. And with funding for proposals often being hard to procure, there is no guarantee that a person's time commitment will result in any kind of pay out.

It can be a real struggle to get funding. According to one participant, who has sat on a number of funding panels for the NSF, approval rates have reduced significantly in the last twenty years. It can also be hard to gauge what the approval panel will see as worth funding, because the makeup of these panels changes regularly, as does the political context in which awards are decided. Another discussion during an interview centered on the seeming trendiness of interdisciplinary research. Many universities and other institutions pay lip service to its importance and develop programs or initiatives meant to promote it, but this

often pushes up against firm resistance to its implementation, especially when other institutional factors (like evaluation processes) do not change.

People themselves often stand in the way of successful collaborations. As one interviewee succinctly stated, "The problem with interdisciplinary science is people." Personality clashes can lead to conflict, and many collaborations do not have conflict management plans in place to prepare for this sort of thing. People might come to collaborative teams with selfish agendas or without the skills necessary for engaging in team efforts. More broadly, many academics are simply not trained to work with a team.

MtnSEON Weaknesses and Strengths

The theme of MtnSEON weaknesses was the most populated by interviewees and survey respondents. It is labelled "weaknesses" because one of the interview questions asked what the participant saw as the weaknesses of the network, and most subcategories of this theme were developed from the widely varying answers to that question. It might be worth setting aside the label "weakness," however, and considering these items as MtnSEON-specific challenges instead. In fact, many of these subcategories overlap with those of the first theme of general barriers and challenges. MtnSEON Strengths was not as widely populated, but respondents answered the question more consistently. Interestingly, many of the subcategories between the two overlap with each other and with other themes.

Communication is a subcategory of the weaknesses/challenges theme that overlapped heavily with the broader theme of barriers and challenges. Perceiving communication as a weakness of or challenge to MtnSEON was a common sentiment expressed in data collected during interviews, participant observation, and the open-ended survey responses. It came up multiple times during interviews and my observations that researchers often struggle to communicate among disciplinary silos. This is demonstrated by a survey response from a Leadership Team member who said, "[C]ommunication among social scientists and ecologists has improved, but much more needs to be done." At the 2015 Annual Meeting, a major request by attendees was that a workshop be developed to facilitate interdisciplinary and transdisciplinary communication for collaboration. This relates to a

statement by one interview participant who felt that MtnSEON members struggled with communication because there was no time dedicated at the beginning to develop a common vocabulary, or a basic understanding of each other's disciplinary understandings of the problems being considered.

Communication ties closely with the people subcategory of MtnSEON Weaknesses. Personality conflicts and struggles with interpersonal communication have occurred over the course of the award, at one point leading to a restructuring of the leadership group providing oversight of the network (among other factors). It was also expressed that some people may have joined with the network to access funds to set up meetings and develop proposals, and have distanced themselves from the network now that the award is ending and funds are drying up. Another issue related to this is the perception expressed by some participants that the framework or structure of the network did not effectively plan for what people might need to fully commit their time and efforts, especially non-academics.

People were identified as a MtnSEON strength as well as weakness. The diversity of people engaged with MtnSEON Working Groups, especially among Working Groups who work closely with non-academic partners, was cited as an important factor toward the success of the network. And the core group of committed people in active Working Groups are seen by some Executive and Leadership Team members as being the glue that holds the network together. Related to this, Working Groups were identified as a subcategory of MtnSEON Strengths due to several factors. While some Working Groups have become inactive in the last year of the award, several have persisted through time, and maintained their effort and focus. The momentum of their current efforts is likely to result in continued productivity after the end of the award. Several interview participants pointed to this as a major strength, as well as the breadth and diversity of the Working Group perspectives, approaches, and areas of focus. These all were seen as evidence of progress toward developing strong, effective SES science.

Many participants, however, are faced with the struggle of how to allocate their time to a network that cannot compensate them for that commitment. As with interdisciplinary

work in general, the time required to develop effective collaborations is a real issue for MtnSEON. MtnSEON does not pay salary except to a graduate assistant (myself). Thus, all time commitment is volunteered. As discussed in the section above, this can cause a large strain on participants who are required to account for their time and efforts to their employer with specific types of products. This was a major issue for the functioning of the Leadership Team before it was split, with members feeling that they were being asked to commit more of their time than they feasibly could without being compensated in some way. It is also hard to work effectively with people one does not know well, and it takes time to develop those relationships. One Leadership Member stated in his interview, "[I]f we did it again, I think we should take more time on building the, who the people are – the people and the network…I think we need to spend more time…[because] then you get, maybe, where they're coming from, from their perspective."

Another important subcategory identified both as a weakness and strength is Leadership. A member of the Leadership Team stated during their interview that they felt the leadership of the network has been passive in helping Working Groups move out of their research "comfort zone" and develop more innovative and applied SES science. This might have been less of an issue if the leadership had organized workshops to help Working Groups develop or utilize methods for integration and collaboration, as was planned at the beginning of the award. Several Executive and Leadership Team members expressed dissatisfaction with this in their interviews, believing the Working Groups would have produced stronger work earlier on in the award if they had been given these resources. Another Leadership Team member noted that the MtnSEON leadership structure sometimes feels "chaotic," saying it is often hard to know who is in charge or what is expected of the Leadership and Executive Teams. Some interview participants felt that the Leadership Team is too large, making decision making cumbersome.

Despite these critiques, several participants spoke to the consistency and quality of leadership provided by the lead Principal Investigator (PI) for most of the grant, who is now a co-PI and still the main person driving the network forward. This consistent individual

leadership and vision helped shape the Working Group structure of the network, which some participants see as an important strength of MtnSEON, and has been instrumental in bringing in many of the personnel, universities, and institutions engaged in the network.

In interviews, and in many conversations and discussions among the network leadership, many people have spoken of multiple disciplinarity in the network as a challenge or weakness. Though this was coded as a subcategory here, because of the significance of this particular issue to the research questions of this study, it is given its own section later in the chapter.

Tools for Conducting Effective SES Science

An important emergent theme that developed from the data is that of tools for conducting effective SES science. Participants in this study, especially Executive and Leadership Team members, pointed out several things they felt would help future SES projects be more effective in terms of collaboration and integration. Some of these are lessons learned from MtnSEON or other projects, and others are things that feel like common sense to respondents.

Perhaps the most important element of this theme is building a strong collaborative team at the beginning of the research. Participants believe determining team members' strengths and needs as early as possible will facilitate a stronger commitment from them, as will tailoring the team to the project context. Facilitating dialogue among team members and developing a conflict management plan might mitigate personality issues that can crop up later in the life of a project. Most importantly, an emphasis should be made on developing relationships. As one respondent to the Executive and Leadership Team survey said, "Building long term relationships with a team that would commit to a long-term learning/teaching relationship would be key to make a future SES [project] work." This should include academic researchers, agency or tribal personnel, policy makers, community partners or stakeholders who will be engaged with regularly, and anyone else whose perspective on the SES in question is essential. This means the project needs to bring non-

academics in as early in the process as possible – ideally before the proposal is even submitted, so they have a role in co-developing the research questions and framework.

Participants pointed out several other components of projects that should take priority at the beginning of the process. Part of developing strong relationships within the project team is defining data needs, as well as developing a common vocabulary within the team. Essential to this is making sure that social scientists and ecologists are both well represented. "Start with the clear understanding that social [scientists] and ecologists need to develop a preliminary proposal together at the start of discussions. Too often the SES efforts start with one of the disciplines, usually ecology, and then add social scientists as the need arises" (Executive and Leadership Team survey).

Integration of data and perspectives is also essential to doing strong SES research. Some participants noted that it would be helpful to include the specific integrating framework from the beginning of the project development. It is also important to work within the team's strengths and abilities, making sure not to expect things of team members that is beyond their current skills or understandings. For example, one interview involved a discussion about using "baby steps" to help bring together social scientists and ecologists to work on interdisciplinary projects. For some ecological researchers who have not worked a lot with social scientists, it might be more accessible to start with integrating quantitative social data, rather than asking them to work with unfamiliar, strongly constructivist or relativist qualitative data.

Value of Collaborative Multiple-Disciplinary Science

Another emergent theme was that of the value of collaborative, multiple-disciplinary science. Despite the perceived challenges to doing this kind of work, study participants are still very committed to it. From the participant survey, every single respondent said it is important to them to be engaged in interdisciplinary science. 21.1% said it was somewhat important, while 78.9% said it was very important. This also was true among interview participants, who provided several reasons for their motivation to do multiple-disciplinary work.

Some of the value of interdisciplinary work is at a personal level. Participants noted that they find the kinds of questions and perspectives present in multiple-disciplinary science to be more intellectually stimulating than purely disciplinary questions. One interview participant specifically spoke to enjoying the big picture perspective and unique challenges of collaborative, multiple-disciplinary science. Understanding how things fit together is more fulfilling for him than approaching issues from a narrower, deeper understanding. The opportunity for creative thinking and working on the edge of issues is particularly exciting for another respondent.

Multiple-disciplinary work also has perceived value when it comes to application of scientific knowledge. During an interview, one participant stated, "So, I think that interdisciplinary research and science is the only way to produce actionable science… Translatable science… Science that is not just about knowledge in its pure sense, but is actually going to be applicable to the real world." Another participant spoke to his experience that collaborative, interdisciplinary work is more effective at translating current scientific knowledge to actual practice.

Potential Contributions of Anthropologists to SES Science

Another highly populated theme is that of potential contributions of anthropologists to SES science. Leadership Team members who were interviewed were asked what role they would like to see social scientists playing in SES, and participant survey respondents were asked to comment on what they believed anthropology could contribute. Items discussed here refer specifically to anthropology, with the understanding that much of it is also applicable to the social sciences more generally.

Both interview and survey responses spoke to the potential role of anthropology in project co-development. Anthropologists were identified as having skills that would be important to designing project governance in a way that is inclusive and equitable for all potential project participants. They were also thought to be important to projects that aim to integrate Traditional and Indigenous Knowledge and perspectives into the project design. And in general, responses indicated that they would be able to be a productive part of the co-

development of research questions with ecologists and other scientists through collaborative feedback.

Anthropology was also seen as directly relevant to the development of Social-Ecological Systems Theory. Because they have many useful perspectives to SES science, discussed below, it was thought that anthropologists might have important theoretical contributions to make. However, interviewees did not provide specific examples of how this theory might develop, or what shape it might take.

The useful perspectives provided by anthropologists, identified in both survey responses and interviews, include place-based perspectives and understanding of cultural landscapes, perspectives engaged with the roles of governance and institutions in resource-use rules and decision making, and insight into social and political values. Generally, anthropological approaches to understanding human and cultural diversity were seen as very important, especially in terms of understanding ontology and epistemology – both from a cultural standpoint, and a more reflexive, disciplinary standpoint. Explicitly recognizing that fellow team members come to the table with different disciplinary knowledge sets is seen as a valuable perspective. In a related way, anthropologists are also seen as being able to provide "approaches that cut across the biophysical – social 'divide'" (participant survey response), and the systemic perspective of many anthropological approaches was seen as being very relevant to the systemic understanding of SES.

There were some important action-oriented roles identified for anthropologists, as well. One which might be particularly relevant to applied anthropology is the role of liaison with community partners and stakeholders. Assisted by their perspectives on different types of knowledge, it was thought that anthropologists might be adept at communicating the results of scientific research to the public, or facilitating the integration of up-to-date SES research into management practice.

Multiple Disciplinarity of MtnSEON

Though not a theme on its own, there is important data, especially from the surveys, related to multiple disciplinarity – multidisciplinary, interdisciplinary, or transdisciplinary engagement – in MtnSEON which warrants a dedicated section.

From the two surveys, we can develop an idea of the general disciplinary alignment of the people involved in this study. According to the Executive and Leadership Team survey, 42.9% of respondents identified as ecologists and 57.1% as "Other" (which included "general knowledge seeker" and SES scientist). Of the seven Executive and Leadership Team members who responded to the survey, none identified explicitly as social scientists. From my other interactions with them, I know some of them do have training in certain social sciences, but whether they identify as social scientists might not align with their training. Among the participant survey respondents, 47.4% identified themselves as ecologists, 31.6% as social scientists and 21.1% as "Other." In this case, those who picked "Other" mostly listed their general disciplinary alignment as some sort of interdisciplinary perspective.

Also relevant to this section is the vocational position of the various study participants. All members of the Executive and Leadership Teams are associated with a university, though not necessarily as full faculty. One Leadership Team member works as an independent consultant, and has an appointment with a federal agency. Another runs a nonprofit research station. Among participant survey respondents, 57.1% identified themselves as academic researchers, 23.8% as federal or state agency personnel, and 14.3% as other (which included federal contractor/private sector consultant, academic professional in program management, NGO researcher, and federal scientist).

The surveys in particular tried to gather opinions on whether interdisciplinary, transdisciplinary, and general integration efforts have been viewed as successful. In the Executive and Leadership Team survey, 85.7% of respondents agree or strongly agree with the statement that MtnSEON Working Groups have developed successful interdisciplinary collaborations. Of the participant survey respondents, 50.0% say their Working Group has been very successful at collaborating with people outside of their specific discipline, and

31.3% say they have been somewhat successful. It is important to note here, that the question in the participant survey did not specify the level of collaboration, so it is possible that respondents were thinking of either multidisciplinary or interdisciplinary work. The goal here was to get a feel for how successful Working Group efforts at interdisciplinarity had been, but the survey question did not specifically use the term "interdisciplinary." Despite survey numbers that indicate some perceived success with interdisciplinary collaboration, one respondent to the Executive and Leadership Team survey added, "Working Group efforts have been a mixed-bag, from conceptualization to productivity. Some of the groups have been dominated by social science, others by ecology. Not surprisingly, groups tended to attract engagement from one group or the other, and often not both."

In terms of transdisciplinary efforts, one interviewee commented that MtnSEON Working Groups have not reached their full potential for transdisciplinary, actionable science. This seems in line with some of the participant survey respondents' views. 56.3% say their Working Group has been somewhat successful in collaborating with people outside of academia, while 37.5% say their Working Group has been very successful at this. Some groups have more transdisciplinary participants than others, which might help explain this split between somewhat and very successful.

This sort of lukewarm attitude toward success in transdisciplinary efforts continues when we consider efforts to integrate social and ecological approaches. In the Leadership survey, 57.1% of respondents said they somewhat agree with the statement that MtnSEON Working Groups have successfully developed integrated SES research approaches, while 28.6% agree or strongly agree, and 14.3% somewhat disagree. One of the Executive and Leadership Team survey open-ended responses stated, "mechanisms need to be developed to compel/facilitate more integration of social and ecological research." This matches up with the participant survey relatively well, with 55.6% responding that they somewhat believe their groups has successfully developed an integrated SES approach. 38.9% say yes, they believe they have successfully done this, while 5.5% of respondents said no, their Working Group had not been successful at integration.

Among the participant survey responses, there was no correlation (r = -0.057) between whether a respondent agreed that their Working Group has successfully integrated and agreement that Working Groups have successfully developed collaboration with non-academics. However, a moderate-to-strong, negative correlation (r = -0.553) was found between whether respondents agreed that their Working Group has successfully integrated and agreement that there has been successful multidisciplinary or interdisciplinary collaboration. The more likely a respondent is to believe their Working Group has developed an integrated approach, the less likely they are to agree that their Working Group has facilitated multi- or interdisciplinary collaboration. While intuitively one might expect there to be a positive correlation here, there appears to be some complexity in the sample respondents' experiences with multiple-disciplinary collaboration in their Working Group.

Among the network leadership, it is a common conception that many of the Working Groups were initiated by ecologists and ask basically ecological questions, with social scientists brought in later in a consultant-like role. One respondent in the Executive and Leadership Team survey said, "While there is considerable variation among Working Groups and various projects and activities supported by MtnSEON I would generally describe the integration that has occurred with respect to SES approaches as primarily ecologically driven and/or focused with an add-on to accommodate social science or social processes."

During my time with the network, members of the Executive Team have consistently stated that they believe MtnSEON Working Groups are lacking strong social science perspectives. This perspective is also found in the survey results. 28.6% of Leadership survey respondents strongly disagree with the statement that MtnSEON Working Groups would benefit from engaging more ecologists, while 28.6% somewhat agree with the statement. 85.8% of respondents agree at some level that Working Groups would benefit from more social scientists. Among the participant survey respondents, it is not as clear cut. 29.4% say they are not sure if their Working Group would benefit from engaging more ecologists, while 23.5% say they agree that their Working Group would benefit from this. On the other

hand, 29.4% say they are not sure if their Working Group would benefit from engaging more social scientists, while 29.4% say they agree that that their Working Group would benefit from this.

Among the participant survey sample, there is a moderate-to-strong, positive correlation ($r = 0.558$) between respondents agreeing that their group has developed an integrated approach and agreeing that they would benefit from bringing in more social scientists. The more a respondent agrees that their Working Group has successfully integrated, the more likely they are to think they would also benefit from bringing in more social scientists. This positive correlation does not exist between attitudes toward successful integration and the potential benefits from bringing in more ecologists. There is a weak, negative correlation ($r = -0.295$) between those variables.

Definitions of SES

"Definitions of SES" is a set of answers to one question on the Executive and Leadership Team survey rather than a coding theme of its own, but it is important to note. When asked to define SES science, respondents provided answers that have some similarities, but which differ in notable ways. They all spoke in some way of the collaborative aspect of SES science. Some spoke of the SES itself as one overarching system with social and biophysical components, while others spoke of social and natural systems which are linked in some way. The stated goals of SES science diverge as well, from simply developing interdisciplinary approaches to problem solving. For the complete set of responses, please see Table 4.1.

Conclusion

From general barriers and challenges, to weaknesses and strengths of MtnSEON, to potential contributions of anthropology, to tools for developing SES science, we have seen here a number of important perspectives and attitudes by people within the network. These results are not representative of the entire population of the network, coming mostly from network and Working Group leadership. Even with this limitation and the narrowing down

Table 4.1 Definitions of SES Science from Executive/Leadership Team Survey Respondents

1. The collaborative effort between ecological and social sciences to develop an interdisciplinary approach that can better define, analyze the coupled human-natural environments.
2. Linked study of environmental/ecological and social systems in which questions and answers are generated in feedback loops between the disciplines. In other words, it is not ecology and social sciences working on a common problem separately, but instead, co-generating the science.
3. SES science, writ large, is the study of inextricably linked human and ecological systems, as parts of a single, overarching system. It is different from defining human and ecological functions and then attempting to link them; it is focused on exploring the overall social-ecological system, with a focus on phenomena which affect and are affected by human actions. It is extremely difficult research to engage in: any kind of systems science project can easily be swamped by the noise of innumerable variables; and there exist varying degrees of resistance to the notion that humans and human activities can be validly considered as part and parcel of ecological processes.
4. Integrated studies of human socio-economic interactions with ecological/ecosystem processes across multiple scales.
5. Interested people working together to solve multiple problems that relate to any landscape on this planet. Teams may include social and specialized scientist/engineers/teachers/learners.
6. Team-based, collaborative, and co-developed (with communities) enquiry that explicitly considers dynamics between biophysical processes and social processes to address real-world environmental problems.
7. Led multidisciplinary SES/SETS [social ecological technological systems] programs and projects.

of data to consider here, there is an abundance of useful information presented. The following two chapters discuss the implications of these results for answering the research questions of this project. Chapter 5 considers the interdisciplinarity manifested in MtnSEON, addressing the question of what barriers and challenges the network has faced, and how understanding these helps shape MtnSEON as a case study for SES science more generally. Chapter 6 examines more closely the question of how anthropology can continue to engage with and contribute to SES science.

Chapter 5: MtnSEON, Interdisciplinarity, and SES

This chapter examines the manifestation of interdisciplinarity in the Mountain Social Ecological Observatory Network. As with the previous chapter, it must be noted prominently that this discussion and any conclusions are based on data drawn mostly from the perspectives of the core leadership group. Ultimately, I consider how MtnSEON can be conceived as a case study for SES science. At the heart of this discussion are the barriers and challenges MtnSEON has faced throughout its award. The network has dealt with quite a few, and a solid understanding of them is essential to developing the case study.

MtnSEON Multiple Disciplinarity

This project will not evaluate whether MtnSEON has been successful at developing integrated, interdisciplinary approaches. This is not helpful to answering the research questions, and there is no clear consensus as to what "success" for the network actually is. Over the last two years, there have been several discussions of what a successful MtnSEON might look like at the end of the award. At the 2015 Annual Meeting, during a discussion of meeting attendees, a MtnSEON Working Group member asked how the Leadership Team defines network success. The answer was that they define success of Working Group efforts based on their long-term sustainability, and success of the network as finding a way to maintain network connections beyond the end of the award. They specified that Working Groups have the ability to define specific project success in their own way. "[The Leadership Team] is a guiding mechanism, not a directorship" (2015 Annual Meeting Synthesis).

At this meeting, break out discussion groups talked about success and what it is from their individual understandings. Three separate ideas came forward to the larger group at the end of the session. The first group spoke to the importance of research that is largely relevant, and of being conscious of the broader impacts of Working Group efforts on communities, management practices, and other issues. Another group argued that relationships are the most important outcome of this network, and that a successful network will have strong, long lasting relationships within and between groups. Related to this, the third group said they saw success as continuing collaboration within and between Working

Groups. The concept of success was also discussed at the 2016 Annual Meeting, with many participants agreeing that to measure success, there need to be metrics beyond simple counting of products like proposals and publications.

To date, no evaluative measures have been identified by network leadership to determine the network's level of success. In two of the seven interviews I conducted, interviewees mentioned that they still struggle to see how SES can work successfully, and how to evaluate whether a project has been successful. One said, "I mean, I get it, I understand what it is. But it's often hard for me to figure out how it plays out in a real, mutual feedback sort of way in a real system. I can certainly see that it can be, it's just hard for me to see the nuts and bolts." Conceptually, SES science makes sense to many researchers, but it can be difficult to translate that into practice in a way that allows for an easy or clear definition of success.

Interdisciplinarity

Despite this struggle, results explored in the previous chapter show a loose consensus among survey participants that MtnSEON Working Groups have at least somewhat successfully developed interdisciplinary, integrated approaches to SES. All of the MtnSEON Working Groups have made a concerted effort to develop interdisciplinary teams, though there is rhetoric about the groups themselves being weighted toward either ecology or the social sciences (mostly ecology), and this is supported by the open-ended survey responses of both the Executive and Leadership Team and participant surveys.

This illustrates the concept of "epistemological sovereignty" presented by Miller et. al (2008), demonstrating that interdisciplinary work sometimes tends to privilege one epistemological or disciplinary perspective. As one respondent to the leadership survey commented, Working Groups have mostly been founded by people who are either ecologists or social scientists, and have then struggled to bring in people with complementary expertise. Perhaps this unintentional privileging of one disciplinary perspective is influenced by the institutions in which many researchers work, which house people based on their discipline. University departments tend to house people with their own disciplinary in-

group that uses the self-referential language of a specific disciplinary alignment and reifies that alignment's perspective. Under these circumstances it can be hard to reach outside of that and build relationships with researchers who speak different languages and belong to a different disciplinary group. MtnSEON has aimed to facilitate settings in which those efforts can be made, and groups are developing their own methods for networking and communication. Some Working Groups have been more successful than others at balancing perspectives, but they have all prioritized the effort.

Transdisicplinarity

MtnSEON has emphasized applied research and a transdisciplinary focus, though that has manifested at different strengths in the different Working Groups. The RCN proposal addressed a perceived need for transdisciplinary efforts, and the early Steering Committee agreed that it was an important component to pursue. Several interview participants spoke to the importance of engaging with stakeholders, co-developing research with community partners, and generally moving beyond conducting research about human-nature relationships from a strictly academic standpoint.

This has also been a major topic of conversation during both Annual Meetings that I have attended, with multiple network members at various levels speaking to the need to prioritize engagement and collaboration with community partners, and the importance of developing skills to facilitate that. Engaging with non-academic partners throughout the whole research process is seen by some as essential in order for it to be truly transdisciplinary. Skills at communicating scientific knowledge are seen as important, but several people at the meeting spoke to the need to develop communication skills that move in multiple ways – not just out to the community, but also into the project from the community. Many attendees agreed that simply getting stakeholder input at the beginning of the project to help identify and define questions, or communicating results to the community at the end of the project is not a true partnership. For this to happen, research projects must be informed, developed, conducted, and interpreted by teams made up of both scientists and non-scientists. The synthesis of different types of knowledge is key.

Some Working Groups have made this a major priority, either because of the nature of their project, or agreement among their participants of its importance. Two groups that have stood out due to their engagement with partners outside of academia are the Buffalo Restoration Working Group and the Blue Mountains Working Group. The Buffalo group works closely with Native American communities on the Fort Peck Reservation, researching how restoration of buffalo on the reservation affects community health and cultural resilience. Because of this study question, with its focus on cultural knowledge and context, it is imperative that they build these relationships and co-develop the research.

The Blue Mountains Working Group is unique among the other Working Groups because it is headed by Forest Service scientists, not university researchers. They work with ranchers and other stakeholders as well as university scientists to co-generate research questions and study designs that capitalize on long-term ecological data developed at the Starkey Experimental Forest and Range Research Station and other sites in the Umatilla, Malheur, and Wallowa-Whitman National Forests. Their larger goal is developing new knowledge to inform management practices that reduce vulnerability, enhance resilience, and support sustainability of the SES in focus. By working with communities that utilize public lands, the Working Group includes people who both impact and are impacted by the health of the systems in question.

Barriers and Challenges

There is a lot of overlap between the struggles MtnSEON has faced in trying to facilitate the development of SES research and the barriers study participants see for interdisciplinary environmental work in general. These issues include communication, disciplinary language, integration of social and ecological approaches, time requirements, institutional barriers, and people themselves.

The issue of leadership did not come up within barriers and challenges faced by interdisciplinary efforts generally, but is a significant one for MtnSEON itself. This particular issue has much in common with that of "people," because many of the dilemmas faced by MtnSEON leadership over the course of the award were things identified specifically in the

People subcategory. One major challenge is relationship building, and taking the time to learn to work together as a team. As noted in Chapter 2, there are several different reasons that people were involved in the network at its beginning, and some of those people left because their individual needs did not match up with the overall direction and focus of the network trajectory. There were also personal conflicts that were major hurdles for the Leadership Team; one person interviewed said they wished they had taken the time to iron out differences, rather than jumping straight to splitting into an Executive and Leadership Team.

Inconsistency in the leadership structure was confusing for members of the Executive and Leadership Team itself. As mentioned in Chapter 4, a member of the Executive Team stated that sometimes the leadership element of MtnSEON felt chaotic, and that it was hard to know exactly who was in charge or what was going on at that level. One of the early observations I made was that the network seems to lack clear, consistent leadership. At the time, I was not sure how to make sense of that perception, but after delving into the history of the network, it seems that it was probably the residual effects of the various changes that took place in the leadership structure.

One of the changes that I actually witnessed was the transfer of the title of lead Principal Investigator (PI). Not long after I joined the network, institutional requirements resulted in the role of lead PI moving to a different member of the Executive Team. The previous PI stayed on as a co-PI and still works as the central voice to keep consistent oversight, but engagement from the Executive and Leadership Team members has waned significantly in the last year of the award. This observation is probably related to the fact that the award is ending, so things are winding down and people are focusing their attention on other projects. To quote my field notes from September 2016, "It does seem as the award has gotten closer to its end, people on the leadership end of things have been less engaged. There's been a pretty significant decrease in communication among [Executive and Leadership Team] folks in the last year..." Since then, it seems like most of the Executive and Leadership Team members have moved on to new pursuits. While I have come to terms with

this in my own position, I do wish I could have been a fly on the wall while MtnSEON was being envisioned, to see what excitement existed about possibilities, and people looking forward to a future with a new project and new connections.

Broader "people" issues in the network are also related to communication and collaboration. Integration of social science and ecology has also been a serious obstacle for MtnSEON. Much of this relates to issues identified in Chapter 1, especially considering disciplinary boundaries. From my experience with the network, it seems that some of the methods of demarcation of disciplinary silos are shifting. Things like educational curriculum, and publication and funding criteria are becoming more open to and even promoting interdisciplinary work. MtnSEON was funded because the NSF wanted to see proposals that would bring together social and ecological perspectives to develop practical, applied research that might be able to help address looming environmental dilemmas.

The mechanisms for shoring up disciplinary boundaries might be less rigid in some ways. However, there appears to be some lag in how interdisciplinary pursuits move forward, partly because of institutional obstacles, many of which were discussed in my interviews and surveys and within the general rhetoric in MtnSEON. Much of this is because of the institutional requirements placed on academic researchers, such as the need to get funding and publish to be considered for promotion and tenure. It probably also has much to do with the entrenchment of people trained in disciplinary understandings, and the struggle to collaborate outside of those because of the jargon, self-referential communication, and specific ideological assumptions within disciplinary science.

In the survey conducted by Roy et al. in 2013, discussed in Chapter 1, researchers involved in interdisciplinary environmental science identified communication as the biggest barrier they have faced. This certainly matches the data collected in this study. They also identified other challenges, including institutional barriers, lack of time and/or funding, difference in perspectives, difficulty getting research off the ground, and a lack of existing methods. Each of these are issues that MtnSEON has struggled with.

It takes time and effort to build relationships among members of an interdisciplinary team, and those relationships are essential to making collaboration work. MtnSEON did not develop a process at the beginning for the core leadership members of the network to communicate and understand each other's perspectives and motivations, and then did not prioritize workshops or other methods to help Working Group participants overcome these same issues. Many participants felt that without those efforts, Working Groups faced even larger hurdles in developing rigorous SES science. This demonstrates just how difficult it can be for groups to overcome disciplinary divides, and is a salient example of the fact that academics are limited in their time and resources. This combination of factors can be a major barrier to putting in the time and effort required to build a strong foundation for a collaborative project.

MtnSEON as a Case Study for SES Science

MtnSEON leadership has advocated for SES science to be well integrated in terms of social and ecological methods and perspectives. Even with the various data I have collected, I am not sure when the emphasis on a balance between social and ecological sciences became so central to the MtnSEON mission. While the original proposal does state that it is necessary to engage with social sciences because of the interconnection of human and natural systems it does not state that it is essential to balance the social and ecological perspectives equally. However, at least since I have been a part of the network, it has been a priority among some of the network leadership to see the Working Groups developing well-balanced research. This ideal was never defined explicitly, but was communicated as more of a conceptual guide. Executive Team members regularly speak of wanting to see Working Groups with mostly equal numbers of social scientists and ecologists, and equal weight given to the different methods and approaches used by each. However, there was never any kind of rubric to determine what successful balance looks like.

The implications of this for Working Group participants is varied. At the 2016 Annual Meeting, I was a part of a discussion group that focused on the challenges Working Groups have faced. A Working Group Lead, who has an academic background in ecology,

mentioned that he felt his group was not yet actually doing SES science because they have not achieved a balance of social and ecological. This particular group came to MtnSEON with an ecological research agenda, and found they needed to have a social perspective in order to truly develop research appropriate to their issue and questions. They have faced the dilemma of integrating after the research question has been developed. This is an issue faced by some Working Groups and they have not necessarily been well served by the consistent rhetoric that SES integration is most effectively achieved by developing a well-balanced, integrative framework at the beginning of the project. While this is probably the easiest, most efficient way to make strong SES science happen, that is an ideal that is not within reach of a lot of research teams.

In this meeting discussion, the group talked about what SES is, and whether research can still be called "SES" if it has not achieved perfectly balanced integration. This conversation related back to the literature on SES, especially publications like Binder et. al (2013) which put SES efforts on a spectrum, rather than arguing that it has to be perfectly integrated. I pointed the discussants to that particular piece of literature, and the Working Group lead who initiated the discussion expressed relief that there are multiple ways to approach this type of research while still being under the SES umbrella.

The fact that several Working Groups have started from an ecological perspective and subsequently tried to bring in a social science component is seen as a weakness – though an unavoidable one – by interview and survey participants. This is partly because it reflects an overall lack of social science input to project development, from the perspective of some of the Executive and Leadership Team members. To some extent, it might also demonstrate the tendency of natural scientists to often see social scientists' role as supplementary to their own, as noted by Pooley et al. (2013). When asked specifically what roles they would like to social scientists play in SES, some interview and survey respondents identified roles that aren't necessarily research roles, but are more like service roles. For example, one interview participant saw social scientists as important for communicating up to date research to

policy makers and the public. This is a skill some social scientists have developed, but it is not a research skill in itself.

Even with the charge to develop SES research that is balanced between social and ecological sciences, MtnSEON participants have found various ways of developing their efforts. Some have aimed from their conception to co-generate research questions and study designs. Others came into the network with previously developed research questions based in either ecology or social science and have tried to integrate the complementary view. Whatever the start, all have faced challenges in how to integrate, communicate, and collaborate.

Of course, the issue of what SES science is and how to conduct it is not unique to MtnSEON. In SES literature, there is not a conventional, consistent definition of an SES or how to do SES science. This is certainly reflected in MtnSEON, with the various approaches the Working Groups have taken, and the variety of definitions provided by MtnSEON Executive and Leadership Team members (Table 4.1). These responses reflect the larger discourse surrounding SES, with some focusing on the concept of a single integrated system as the subject of study, or fully integrated approaches to studying an SES. Others focus more on a perspective of conceptually linked or coupled but differentiated systems, and an approach to studying these that links social science and ecology together to pursue a broader understanding.

Is this a problem, at the MtnSEON level or a broader one? Is there a pressing need for a consistent, conventional definition of SES science, or is it sensible for it to keep that dynamism and uncertainty? All of the definitions of SES science provided by the Executive and Leadership Team members prioritize the interdisciplinary, co-generative aspect of SES, recognizing that a single disciplinary approach simply is not enough to understand the dynamics of an individual system, let alone prescribing policy or management practice. Perhaps this is the more important aspect of SES science, and it is one that MtnSEON has strongly developed.

MtnSEON doesn't only demonstrate the challenges and dilemmas of the broader reach of interdisciplinary environmental research. It also reflects the value that people find in doing collaborative research, and reiterates lessons learned for how to do effective science of this kind. Among the struggles faced by MtnSEON Working Group members are also stories of people finding fulfillment and broadening their perspectives. This is well illustrated by two open-ended responses in the participant survey. The first states:

> This MtnSEON experience has changed the way that I approach research, teaching, and science in general. Before I engaged in this RCN I was very narrowly focused and only had limited interest in interacting outside my own discipline. While good research will always be valued whether it fits cleanly into a disciplinary bin (or not), I strongly believe that a regional, integrated SES approach is well equipped to address many of the challenges and changes that lay ahead.

And the second says,

> The experience I've had with MtnSEON has greatly expanded my horizons and research network. The ability to organize a workshop on this topic also put me in direct contact w[ith] land managers and other agency personnel – while I'm interested, I'm not sure how this would've occurred otherwise.

Perspectives regarding the importance and value of engaging in multiple-disciplinary research were related during the interviews as well. Participants see this sort of research as valuable both personally, finding it fulfilling and intellectually stimulating, and applicable, believing that interdisciplinary environmental research is particularly important for developing translatable, actionable scientific knowledge. This aligns closely with Roy et al.'s (2013) survey findings, in which participants identified very similar reasons for finding collaborative, interdisciplinary environmental research rewarding.

MtnSEON leadership and Working Group members have also gleaned important lessons for how to do effective collaborative interdisciplinary research. These include the necessity of maximizing the impact of the beginning of the project, building strong research teams, utilizing effective methods of integration of different perspectives, and emphasizing

the importance of the research process rather than products. Bennett and Gadlin's (2012) suggestions for effective team science have much in common with the suggestions of my study participants, especially the importance on team building and relationships. Their emphasis on trust among team members is one that rings particularly true when considering the effect of interpersonal conflict on MtnSEON's personnel interactions at the leadership level early in the award. Bennett and Gadlin (2012) also stress a deliberative process, co-developing an adaptive project design as well as a conflict management plan. MacMynowski (2007) and Miller et al. (2008) also advocate for using an intentional process to facilitate the integration of seemingly dissimilar disciplinary knowledge sets.

Conclusion

Considering the similarities between the challenges faced by MtnSEON, SES, and interdisciplinary environmental research, the comparable suggestions for how to mitigate these challenges, and the common questions of definition and approach that MtnSEON has dealt with compared to the literature on SES science we can confidently say MtnSEON acts as a case study for SES science. This is of course with the caveat that this understanding is at the network level, and not arguing for anything regarding the Working Groups individually. All of these barriers and challenges – especially those related to communication and integration across disciplinary boundaries – reflect issues dealt with by collaborative science more broadly. And perhaps more importantly, MtnSEON's specific dilemmas of how to define SES research, what to prioritize in its development, and how to move forward from that uncertainty, are not unique to the network. Rather, these practical questions and theoretical demands reflect important discourse occurring in the broader world of SES science.

Chapter 6: Anthropology and SES Science

A major question I had going into this study was what roles anthropologists might play in collaborative SES science. As the study went on and I adjusted my questions, my interest in connecting anthropology and SES grew beyond just how anthropologists have and can continue to contribute to conducting research. It became important to also consider how they might be able to use their skills and roles to navigate the barriers that exist in SES and shape the directions of SES into the future. Because of my focus on anthropology and SES, I asked interview and survey respondents to identify roles they wanted to see social scientists, anthropologists specifically, fill in SES science. MtnSEON leadership and participants identified several ways that they believe anthropology could contribute to SES research (see Table 6.1 for open-ended answers from the participant survey). They relate to several different aspects of anthropological theory and research methodologies, demonstrating the variety of ways that anthropologists might be instrumental to developing and conducting SES science and facing challenges within it.

Anthropologists are already doing research that can be qualified as Social Ecological Systems or very similar. For example, researchers working on local, collaborative environmental research and application (Austin 2004, Haenn et al. 2014), considering tension between institutional and local ecological knowledge (Haenn et al. 2014, Fernandez-Gimenez et al. 2008), examining the social-ecological dynamics of cultural shifts (West 2010), or studying the ecological and cultural context of land-use change (Brondizio 2004) are all engaging in research that has much in common with SES pursuits, though based on different assumptions or theoretical foundations. Others, like Casagrande et al. (2007), who aim to demonstrate integrating anthropology and ecology through adaptive experimentation, rely on concepts that are prominent in SES science, such as resilience, uncertainty, and complexity, and some environmental anthropology researchers take an explicit SES perspective (Barton et al. 2012, Lansing et al. 2014, Redman 2014, Tschakert and Shaffer 2014). As Kopnina and Shoreman-Ouimet (2011, 3) observe, there is a "…current move in environmental anthropology towards supporting local, regional and global conservation

efforts by providing well-rounded analyses of human-environment interactions by emphasizing the links between biological ecology data, cultural dynamics, and human behavior."

Table 6.1 Participant Survey Responses to Open-Ended Question About What Anthropology and Ethnography Might Contribute to SES

1. Understand the social and cultural and institutional aspects of human behavior and impacts on human communities of ecological change, in contrast to an individualized approach. Understand decision making and policy implementation. Understand what is comparable and what is not across places. Understand the DYNAMICS of SES, not just models of agent based actions.
2. Yes, they can provide 1. Approaches that cut across the biophysical - social "divide", and 2. Provide temporal thinking via paleo, archaeological, and historical data and approaches.
3. Yes, I took quite a few anthro courses as an undergrad but it never really fit into my grad program work. However, lingering in the back of my mind throughout the MtnSEON project was that anthro and TEK have a lot to offer to our SES work, particularly in mapping out conceptual frameworks. These perspectives were not represented in our Working Group though at such a nascent stage of our collaborations we would have been clueless as to how integrate that voice into the conversation. I don't mean that as disparaging ... it is just that many (most?) ecologists and social scientists work on very short timescales, where a decade is a long time. Yet there are other 'deeper time' perspectives like TEK, enviro/cultural anthro, and paleoecology that have a more expansive concept of time which can be challenging for people operating on shorter timescales to absorb. Especially in meeting of diverse disciplines that can spend an entire day or two just sorting out a common dictionary, let alone timescale.
4. Of course!
5. I think they are critical for developing an in-depth understanding of stakeholder's views, practices, beliefs etc. as they relate to the landscape.
6. I think anthropology/applied anthropology can contribute to better understandings about the role humans play in shaping the environment, in both contemporary and historic/prehistoric times. Knowing how societies and institutions impact the landscape enhances our understanding of that landscape.
7. Anthropology will tell you about people from a cultural systems perspective -- what they think and believe and what they do.
8. Social side of SES or meta-analysis such as SNA
9. I do… Though I am guessing the areas for advances would likely include a formalized system for linking trad knowledge and how knowledge is organized, retained and transmitted outside of and/or before the modern scientific construct/era
10. Not much experience, but a better understanding of cultural values and how people view their role in and influence on environments in the landscape they inhabit can surely impact the effectiveness of an SES approach.
11. Maybe. Depends on the individual and their ability to bridge the epistemological and methodological divide.

Some Executive and Leadership Team members interviewed for this study have worked with anthropologists on SES projects. Anthropologists with place-based expertise, a focus in ethnoecology and Native American culture, or employed by federal and state environmental agencies have all played important roles on previous research projects. There are also several anthropologists who have been associated with MtnSEON earlier in its award, and others who are currently involved with the network in various ways.

One Leadership Team member, trained as an applied anthropologist and planner, works closely with the Governance Working Group. A Working Group lead in another group is an environmental anthropologist who works with the United States Forest Service. Four respondents on the Working Group participant survey identified themselves as environmental or applied anthropologists, and it is likely there are more anthropologists engaged with Working Groups who I have not interacted with. Clearly anthropologists are already filling important roles in SES and SES-related research.

Navigating Barriers in SES Team Science

Teamwork and People

Generally, study participants felt that anthropologists have important perspectives and a variety of skills to bring to the SES table. Participants suggested that anthropologists might fill the important role of liaison with community partners and stakeholders. This is an important role, especially for projects that are best served by the development of transdisciplinary teams. While it might be seen as exclusively a support role, it has the potential to be an important research position through co-generating knowledge with community partners. Anthropologists are especially suited to this, as they have a history of working with specific communities or groups for extended periods of time and applied anthropologists often work in very similar positions, as discussed in Chapter 1. An important component that anthropology might be able to provide in this role is reflexivity. Using reflexivity to explore and understand the positioning of each of the team members might assist in developing strong team communication and relationships.

Project co-development was a common suggestion for how anthropologists can contribute to SES research. An important aspect of this is shaping project governance in a way that is equitable and inclusive of all team members, especially those who are not part of an academic institution. Because of anthropology's history of practitioners working closely with individuals and communities, anthropologists often have to navigate the needs and wishes of their participants with their own research agenda and expectations. This makes them a good fit for helping teams navigate each member's needs. In this way, the engagement of anthropologists in SES teams might assist in developing strong teams and help mitigate the challenges to conducting this kind of research that are related to weak team relations.

Anthropological approaches to understanding human and cultural diversity were seen as very important to SES efforts, especially in terms of understanding ontology and epistemology – both from a cultural standpoint, and a more reflexive, disciplinary standpoint. Anthropologists understand that humans conceptualize and relate to the natural world differently, and have different types of knowledge associated with it. Thus, anthropologists aim to work with these knowledge sets in their own context. This perspective is important to developing applied projects that are going to be effective and sustainable. Working within these differences requires skills that many applied and environmental anthropologists can provide, such as communicating and collaborating with people whose understandings of the world might be fundamentally different from their own. Likewise, these skills might be utilized in working with team members who come to the table with different ontological and epistemological backgrounds.

Integration of Perspectives and Approaches

More broadly, an understanding of human difference, especially with how various groups relate to, place themselves in, conceive of, interact with, and utilize natural systems is very important for describing and understanding human-nature relations in context. This grounded knowledge about places, people, and issues provides a natural starting point for informing research design. Anthropology tends to take a holistic, systemic approach to the

study of culture and its various components. Taking a perspective that does not focus specifically on individuals, understanding them as agents but also as integral parts of a larger whole, was seen by participants to fit well into the systemic perspective of SES.

Participants also suggested that some methods used by anthropologists might be useful to include in research design for SES projects. These are listed in Appendix C, along with other social science methods. Anthropological methods range from very qualitative and descriptive to very quantitative and measurement-oriented. Quantitative methods, including modeling, social network analysis, or surveys, might be easiest to integrate with ecological methods. Qualitative, descriptive methods, such as interviews and participant observation can still provide important data about the specific SES in question. One participant suggested, "What we need more of, I think, is some of the theoretical and the descriptive, objective-based qualitative work before we can get to some of the hypothesis-testing. And I think right now we're missing the skill set for that. And that's, I think, where anthropologists could be very useful."

Anthropologists draw on a broad set of skills and research methods, offering something to most research situations. Of course, not every anthropologist does both quantitative and qualitative research. Most probably lean more toward a preferred set of methods, but many anthropologists also use mixed methods, an approach that some interview and survey respondents felt fits SES quite well. As Kopnina and Shoreman-Ouimet (2011, 14) said, mixed methodologies "may aid both anthropologists in their daily practice and…instruct policy maker, urban planners or environmental educationalists." Perhaps we can add to this that it might help bridge divides between disciplinary researchers. One participant survey respondent stated that anthropologists "can provide…approaches that cut across the biophysical – social 'divide.'" Perhaps utilizing the wide array of methods anthropologists are familiar with, especially mixed methods, is one way they can assist with dealing with the challenge of integration of data, among other things. Nazarea et al. (1998), for example, utilize a qualitative approach to developing culturally relevant and contextually sensitive indicators of socioeconomic and ecological sustainability in the Manupali

watershed in the Philippines. Using a modified method of gathering local narratives and perspectives, then creating a scoring system based on dominant themes within them, these researchers were able to create a set of quantitatively useful and culturally situated indicators.

Disciplinary Boundaries

Some study participants suggested anthropologists might utilize their experience working with people with different types of knowledge to be effective collaborators and facilitators in SES projects. As discussed above, because of the effort many anthropologists put into understanding the ontology and epistemology of the people they work with, they are often adept at working with and understanding other ways of knowing from their own. With this skill set, anthropologists can be valuable members of SES teams, and contribute to overcoming challenges faced by these research teams, such as communicating across disciplinary boundaries.

One important response to the question of what anthropologists might contribute was that social scientists or anthropologists do not necessarily need to fill one role, or contribute in a specific way. Rather, they should work with ecologists and other team members to co-develop research questions and approaches, through a system of feedback among the team members, and their role should be specific to their expertise in relation to the context of the project. This was an important perspective for me to hear, as I had been thinking of compartmentalized roles for ecologists, social scientists, etc., on SES teams, without even realizing I was doing it, when there is much potential for those roles to blend.

Shaping the Future of SES

Taking the Lead

Several study participants said they would like to see social scientists initiating and taking the lead on SES projects. This echoes Strang (2009), who argues that social scientists should start their own projects and invite relevant collaborators on, rather than waiting to be invited as a collaborator. This would be a good opportunity to develop anthropologically

informed integration of perspectives and methods, and might also be an important avenue for shaping the future of SES research. It would also help avoid the situation of anthropologists and other social scientists being invited into a project after the research questions and design have been developed and asked to fill a consultant-type role.

Making and Responding to Critiques of SES

Perhaps more importantly, if anthropologists lead some SES projects, it provides avenues for developing questions and projects with more critical perspectives. To address the way anthropologists might shape future directions of SES, it seems prudent to discuss the various critiques people have made of SES and its reliance on resilience theory, and to consider how anthropologists' role in future SES projects might also address the lack of critical approaches within them. This particular aspect was not a part of my data collection, but sometimes what is not discussed is just as important as what is.

There are important critiques coming out of current discourse about SES and resilience scholarship, and anthropologists are engaged in some of this critical feedback and suggesting where to look for guidance on how to improve SES as an approach. Fabinyi, Evans, and Foales (2014) argue that SES struggles to capture the importance of social diversity and power within systems, and suggest that much can be learned from how these issues have been grappled with in social anthropology and political ecology.

Anthropologists are strongly positioned to respond to these critiques by helping fill in these gaps of SES which have been pointed out by its detractors. Some scholars take issue with the implicit assumption in a lot of SES research that social and ecological systems have similar dynamics (Cote and Nightingale 2012), and believe this obscures the need to consider the role of normative factors such as power relations and social values in governance of SESs. Anthropologists understand cultural systems as interconnected, all within a specific context, and influenced by those normative factors missing from many SES projects. Perhaps anthropologists can help identify which elements of human and natural systems are comparable and which are not analogous. Alternatively, perhaps they can help build a

framework that does not hold a human and a natural system side by side and compare them, but rather considers the unique human and non-human components of a single system.

As I pointed out in Chapter 1, some researchers have noted that resilience scholarship and application, so foundational to SES science, has taken little note of issues of power, agency, or inequality (Castree et al. 2014, Cretney 2014, MacKinnon and Derickson 2012). The consideration of issues of power both in the SES itself and how researchers approach the study of that SES is essential to ensuring that applications or interventions suggested by or developed through research do not ignore or harm already vulnerable populations. We must take a critical eye to the effort. Environmental research and policy informed by it often does not account for issues of power and externality (Larsen 2011). This is a perspective anthropologists can help provide, especially through the contributions laid out above, such as acting as liaisons, etc.

Theory Development

Some scholars argue that, to date, there has been only a weak theorization of the social side of SES science (Fabinyi, Evans, and Foale 2014). While the development of SES theory was not treated in depth by survey or interview participants, it was spoken of by some as an important potential contribution. One interviewee, when asked what role he thought social scientists might fill in SES, brought up theory development in a way that left me with the impression that he did not think ecologists have the best perspective are strongly suited to develop SES theory and that social scientists are better for the task. I asked if he had used any sort of theoretical framework when developing previous SES projects and proposals, and he replied, "Well, I didn't, because I'm not a social scientist. So, the approach was, bring in the social scientists that know what the theoretical approach could be."

Environmental anthropology has a trove of theory that informs how we approach studying human-nature relations; it is very possible that there are elements of this body of theory which would meld well with SES theory to date. The concept of resilience is incomplete or flawed from some perspectives but it is only one part of SES. Another part is systems theory. How does anthropological understanding of human theories compare to

systems theory? Can they work together? Are there anthropological theories that might complement or counter those foundational perspectives of resilience, vulnerability, and complex systems? These and other questions considering the place of theory in SES, what kind of theory has been utilized to date, and how anthropologists might help shape it moving forward would be well worth exploring in future research and discourse.

Conclusion

Anthropology is a broad discipline that often straddles the line between science and the humanities. While this might be confusing for researchers who come from disciplines which have narrower sets of methods and are firmly rooted in specific paradigms, this is one of the things about anthropology that most lends it to engaging with SES science. Because of the various ways the concept of an SES is implemented in research and application, the diversity of methods and theoretical frameworks within anthropology lend themselves to this approach. Depending on the research questions of the project and the components of the SES being focused on, some projects require more qualitative, descriptive approaches. Others are more suited to quantitative, measurement-oriented research, and some would benefit from the utilizing of mixed methods. Anthropology also has the advantage of its holistic, systemic scope, as well its many different scales of interest, from the individual to culture-wide, making it flexible to the size and focus of whatever SES is being studied.

Anthropology is relatively unique in that it can be quite messy. There are many diverging theories, various conceptual frameworks and methodologies with which to approach actual research, and theoretical and applied aspects, not to mention the number of subdisciplines, sub-subdisciplines, and cross-pollination with other social sciences in areas of inquiry like political ecology. There has been a lot of debate throughout the history of the discipline about theory and whether grand theory or more localized theory is better or whether we should be aiming to understand universal human nature or studying localized differences. This might be intimidating for some because of how important it often is to find the "right answer," and in anthropology there is very rarely one right answer. Maybe this

diversity of thought and perspective, under the unifying umbrella of people and culture, is one of the most important things anthropology can bring to SES.

Conclusion

In this thesis, I ask and explore several questions related to Social Ecological Systems team science. First, what challenges has MtnSEON faced in its efforts to facilitate SES team science? How do these challenges compare to those faced in interdisciplinary environmental research more generally, and through that comparison can we consider MtnSEON as a case study for collaborative SES research? And how can anthropologists contribute to navigating these challenges in SES team science?

In my efforts to answer these questions, I have utilized a mixed-methods approach. I have engaged in participant observation over the last year of my assistantship, and conducted interviews with MtnSEON leadership. I also distributed two surveys, one to the Executive and Leadership Team and the other to working group leads and participants. The results from this process gave important insights into how my research questions might be answered, and provided several avenues for future inquiry.

MtnSEON has faced a number of barriers and challenges over the course of its life as a network, from issues with communication and integration to institutional challenges. These are not unique to MtnSEON but are widely acknowledged by science of team science scholars, as demonstrated by the survey conducted by Roy et. al (2013), and can be attributed at least partly to the demarcation and reinforcement of disciplinary boundaries and epistemologies as discussed by Gieryn (1983) and Miller et al. (2008). MtnSEON is an effective case study for considering what difficulties might be faced by SES research teams.

Anthropologists are well placed to contribute to the navigation of these challenges of difficulties in SES work. From facilitating stronger team relationships and communication through the explicit recognition and discussion of different types of disciplinary knowledge, to collaboratively developing theoretical frameworks that bring human and non-human system components together in fresh ways, anthropologists have a lot to offer in the development of SES research and application. There are also gaps in SES frameworks and approaches that anthropologists can help fill, by providing critical and reflexive perspectives in team settings.

The results from my thesis also point to how researchers might move forward in developing inquiry about SES and its general assumptions. A discussion I would like to see evolve in the SES literature is one centered around dichotomy. Social scientists have given much time and thought to the conceptual "human-nature dichotomy" that grew out of the Enlightenment and is deeply engrained in Western thought, initially assuming that it is a universally understood conception (Hollingshead 1940). In contemporary scholarship, it has been strongly questioned and resisted, with a growing recognition that it is too simplistic an explanation; nature and society are not actually two sides of a strict binary (Descola and Palsson 1996). In future discussions about SES approaches, it would be worth considering whether specific SES frameworks resist or reinforce this nature-society divide, as well as other conceptual dichotomies that are based in it. The concept of an integrated social ecological system seems at surface level to push back against an essentialist division between human and non-human components but do all SES frameworks truly break down that dichotomous barrier? This question might provide important perspectives for developing future SES application and theory.

SES has the potential to be an extremely useful tool and framework for developing integrated, interdisciplinary, applied research. MtnSEON has brought together a wide variety of people from different disciplines and vocations to explore this potential. The working groups will go their own directions after the end of the award; some will continue their efforts at developing research and some will probably move on to different projects. Whatever level of engagement they maintain, connections have been developed and many working group members have developed a committed interest in continuing SES work. In this way, despite the various changes MtnSEON has dealt with over its award, it has networked people with different types of knowledge to take SES perspectives on issues of resilience and vulnerability in mountain landscapes. This was the main point of submitting the proposal for the RCN back in 2011, and although it has manifested differently than originally envisioned, this is an important outcome. From here, these groups and individuals will take what they have learned and continue to apply it. These future efforts will likely turn out differently from any predictions we might make right now. Uncertainty in SES is

reflected in the uncertainty of where this relatively small network and its various components will end up.

I personally will also take away important lessons from working with MtnSEON and focusing my thesis research on the network. Perhaps the most significant of these is recognizing how vital relationships are in conducting interdisciplinary, collaborative environmental research like SES science. This is fitting, considering how relational social ecological systems are. Along with this, I am learning the importance of process, that interdisciplinary collaboration takes time and effort to conduct effectively. Change is inevitable in networks and systems, and thinking about success as what happens along the way, rather than at the end, provides room for flexibility and adaptation. Just as these characteristics are essential for SESs to be resilient, they are also essential for interdisciplinary environmental team science to be successful, however that is defined.

References

Adams, Vincanne, Taslim Van Hattum, and Diana English. 2009. "Chronic Disaster Syndrome: Displacement, Disaster Capitalism, and the Eviction of the Poor from New Orleans." *American Ethnologist* 36 (4): 615-636.

Alessa, Lilian, James Gosz, David Griffith, Andrew Kliskey, and Amber Ziegler. In Press. "MtnSEON and Social-Ecological Systems (SES) Science in Complex Mountain Landscapes." Invited manuscript for *Frontiers in Ecology and the Environment*.

Alessa, Lilian, Andrew Kliskey, and Mark Altaweel. 2009. "Toward a Typology for Social-Ecological Systems." *Sustainability: Science, Practice, & Policy* 5 (1): 31-41.

Alessa, Lilian, Andrew Kliskey, Mark Altaweel, Michael Barton, Steve Bankes, Eduardo Bondizio, Dan Brown, Johannes Feddema, Colin Grier, Jiaguo Liu, Emilio Moran, Jonathan Ozik, Thomas Park, William Rand, Daniel Rogers, and Shaowen Wang. 2015. *Best Practices for Integrating Social Sciences into Social Ecological Systems Science: Future Directions for Building a More Resilient America*. Moscow, Idaho: Center for Resilient Communities, University of Idaho.

Anderies, John, Marco A. Janssen, and Elinor Ostrom. 2004. "A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective." *Ecology and Society* 9 (1):18. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/art18

Anderson, Eugene N. 2011. "Drawing from Traditional and 'Indigenous' Socioecological Theories." In *Environmental Anthropology Today*, edited by Helen Kopnina and Eleanor Shoreman-Ouimet, 56-74. New York: Routledge.

Atran, Scott, Norbert Ross, and Douglas Medin. 2005. "The Cultural Mind: Environmental Decision Making and Cultural Modeling Within and Across Populations." *Psychological Review* 112 (4): 744-776.

Austin, Diane E. 2004. "Partnerships, Not Projects! Improving the Environment Through Collaborative Research and Action." *Human Organization* 63 (4): 419-430.

Barton, C. Michael, Isaact I.T. Ullah, Sean M. Bergin, Helena Mitasova, Hessam Sarjoughian. 2012. "Looking for the Future in the Past: Long-term Change in Socioecological Systems." *Ecological Modeling* 241: 42-53.

Bennett, L. Michelle, and Howard Gadlin. 2012. "Collaboration and Team Science: From Theory to Practice." *Journal of Investigative Medicine* 60 (5): 768-775. doi: 0.231/JIM.0b013e318250871d.

Berkes, Fikret, J. Colding, and Carl Folke, ed. 2003. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. New York: Cambridge University Press.

Binder, Claudia R., Jochen Hinkel, Pieter W.G. Bots, and Claudia Pahl-Wostl. 2013. "Comparison of Frameworks for Analyzing Social-ecological Systems." *Ecology and Society* 18 (4): article 26. [online] doi: 10.5751/ES-05551-180426

Blount, Ben G., and Ariana Pitchon. 2007. "An Anthropological Research Protocol for Marine Protected Areas: Creating a Niche in a Multidisciplinary Cultural Hierarchy." *Human Organization* 66 (2): 103-111.

Brondizio, Eduardo S. 2004. "Agriculture Intensification, Economic Identity, and Shared Invisibility in Amazonian Peasantry: Caboclos and Colonists in Comparative Perspective." *Culture and Agriculture* 26 (1-2): 1-24.

Casagrande, David G., Diane Hope, Elizabeth Farley-Metzger, William Cook, Scott Yabiku, and Charles Redman. 2007. "Problem and Opportunity: Integrating Anthropology, Ecology, and Policy through Adaptive Experimentation in the Urban U.S. Southwest." *Human Organization* 66 (2): 125-139.

Castree, Noel, William M. Adams, John Barry, Daniel Brockington, Bram Büscher, Esteve Corbera, David Demeritt, Rosaleen Duffy, Urike Felt, Katja Neves, Peter Newell, Luigi Pellizzoni, Kate Rigby, Paul Robbins, Libby Robin, Deborah Bird Rose, Andrew Ross, David Schlosberg, Sverker Sörlin, Paige West, Mark Whitehead, and Brian Wynne. 2014. "Changing the Intellectual Climate." *Nature Climate Change* 4: 763-768.

CFIR (Committee on Facilitating Interdisciplinary Research). 2004. *Facilitating Interdisciplinary Research*. Washington DC: National Academies Press.

Charnley, Susan, and William H. Durham. 2010. "Anthropology and Environmental Policy: What Counts?" *American Anthropologist* 112 (3):397-415.

Checker, Melissa. 2007. "'But I Know It's True': Environmental Risk Assessment, Justice, and Anthropology." *Human Organization* 66 (2): 112-124.

Collins, Randall. 1979. *The Credential Society: An Historical Sociology of Education and Stratification.* New York: Academic Press.

Collins, Scott L., Stephen R. Carpenter, Scott M. Swinton, Daniel E. Orenstein, Daniel L. Childers, Ted L. Gragson, Nancy B. Grimm, J. Morgan Grove, Sharon L. Harlan, Jason P. Kaye, Alan K. Knapp, Gary P. Kofinas, John J. Magnuson, William H. McDowell, John M. Melack, Laura A. Ogden, G. Philp Robertson, Melinda D. Smith, and Ali C.

Whitmer. 2011. "An Integrated Conceptual Framework for Long-Term Social-Ecological Research." *Frontiers in Ecology and the Environment* 9 (6): 351-357.

Cote, Muriel, and Andrea J. Nightingale. 2014. "Resilience Thinking Meets Social Theory: Situating Social Change in Socio-Ecological Systems." *Progress in Human Geography* 36 (4): 475-489.

Cretney, Raven. 2014. "Resilience for Whom? Emerging Critical Geographies of Socio-ecological Resilience." *Geography Compass* 8 (9): 627-640.

Descola, Philippe, and Gísli Pálsson. 1996. *Nature and Society: Anthropological Perspectives.* New York: Routledge.

Ervin, Alexander M. *Applied Anthropology: Tools and Perspectives for Contemporary Practice*. Boston: Allyn and Bacon.

Fabinyi, Michael, Louisa Evans, and Simon J. Foale. 2014. "Social-Ecological Systems, Social Diversity, and Power: Insights from Anthropology and Political Ecology." *Ecology and Society* 19 (4): article 28. doi: 10.5751/ES-07029-190428

Fernandez-Gimenez, Maria E., John U. Hays, Jr., Henry P. Huntington, Regis Andrew, and Willie Goodwin. 2008. "Ambivalence Toward Formalizing Customary Resource Management Norms Among Alaska Native Beluga Whale Hunters and Tohono O'odham Livestock Owners." *Human Organization* 67 (2): 137-150.

Gieryn, Thomas F. 1983. "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists." *American Sociological Review* 48 (6): 781-795.

Gunderson, Lance H. 2003. "Adaptive Dancing: Interactions Between Social Resilience and Ecological Crises." In *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, edited by Fikret Berkes, Johan Colding, and Carl Folke, 33-52. New York: Cambridge University Press.

Haenn, Nora, and David G. Casagrande. 2007. "Citizens, Experts, and Anthropologists: Finding Paths in Environmental Anthropology." *Human Organization* 66 (2): 99-102.

Haenn, Nora, Birgit Schmook, Yol Reyes, and Sophie Calmé. 2014. "Improving Conservation Outcomes with Insights from Local Experts and Bureaucracies." *Conservation Biology* 28 (4): 951-958.

Holling, C.S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 14 (1): 1-23.

Hollingshead, A.B. 1940. "Human Ecology and Human Society." *Ecological Monographs* 10 (3): 354-366.

Klenk, Nicole L., Katie Meehan, Sandra Lee Pinel, Fabian Mendez, Pablo Torres Lima, and Daniel M. Kammen. "Stakeholders in Climate Science: Beyond Lip Service?" *Science* 350 (2015): 743-744.

Kopnina, Helen and Eleanor Shoreman-Ouimet, eds. 2011. *Environmental Anthropology Today*. New York: Routledge.

Lamont, Michèle, and Virág Molnár. 2002. "The Study of Boundaries in the Social Sciences." Annual Review of Sociology 28: 167-95. doi: 10.1146/annurev.soc.28.110601.141107.

Lansing, J. Stephen, Siew Ann Cheong, Lock Yue Chew, Murray P. Cox, Moon-ho Ringo Ho, and Wayan Alit Arthawiguna. 2014. "Regime Shifts in Balinese *Subaks*." *Current Anthropology* 55 (2): 232-239.

Larsen, Peter Bille. 2011. "Environmental Politics and Policy Ambiguities in Environmental Anthropology." In *Environmental Anthropology Today*, edited by Helen Kopnina and Eleanor Shoreman-Ouimet, 75-93. New York: Routledge.

MacKinnon, Danny, and Kate Driscoll Derickson. 2012. "From resilience to resourcefulness: A critique of resilience policy and activism." *Progress in Human Geography* 37 (2):253-270.

MacMynowski, Dena P. 2007. "Pausing at the Brink of Interdisciplinarity: Power and Knowledge at the Meeting of Social and Biophysical Science." *Ecology and Society* 12 (1): 20. [online.] URL: http://www.ecologyandsociety.org/vol12/iss1/art20/.

Martin, Patricia Yancey, and Barry Turner. 1986. "Grounded Theory and Organizational Research." *The Journal of Applied Behavioral Science* 22 (2):141-157.

Miller, Thaddeus R., Timothy D. Baird, Caitlin M. Littlefirled, Gary Kofinas, F. Stuart Chapin III, and Charles R. Redman. 2008. "Epistemological Pluralism: Reorganizing Interdisciplinary Research." *Ecology and Society* 13 (2): 46 [online]. URL: http://www.ecologyandsociety.org/vol13 /iss2/art46/

Nazarea, Virginia, Robert Rhoades, Erla Bontoyan, and Gabriela Flora. 1998. "Defining Indicators Which Make Sense to Local People: Intra-Cultural Variation in Percetions of Natural Resources." *Human Organization* 57 (2): 159-170.

Orlove, Benjamin S. 1980. "Ecological Anthropology." Annual Review of Anthropology 9: 235-273.

Orlove, Benjamin S., and Stephen B. Brush. 1996. "Anthropology and the Conservation of Biodiversity." *Annual Review of Anthropology* 25: 329-352.

Ostrom, Elinor. 2009. "A General Framework for Analyzing the Sustainability of Social-Ecological Systems." *Science* 325 (5939): 419-422.

Pellmar, Terry C., and Leon Eisenberg, eds. 2000. Bridging Disciplines in the Brain, Behavioral, and Clinical Sciences. Washington DC: National Academies Press.

Pooley, Simon P., Andrew Mendelsohn, and E.J. Milner-Gulland. 2013. "Hunting Down the Chimera of Multiple Disciplinarity in Conservation Science." *Conservation Biology* 28 (1): 22-32.

Ralph, Nicholas, Melanie Birks, and Ysanne Chapman. 2015."The Methodological Dynamism of Grounded Theory." *International Journal of Qualitative Methods* 14 (4): 1-6.

Redman, Charles L. 2014. "Should Sustainability and Resilience be Combined or Remain Distinct Pursuits?" *Ecology and Society* 19 (2): 37. doi: 10.5751/ES-06390-190237.

Roy, Eric D., Anita T. Morzillo, Francisco Seijo, Sheila W.M. Reddy, Jeanine M. Rhemtulla, Jeffrey C. Milder, Tobias Kuemmerle, and Sherry L. Martin. 2013. "The Elusive Pursuit of Interdisciplinarity at the Human-Environment Interface." *BioScience* 63 (9): 745-753.

Stokols, Daniel, Kara L. Hall, Brandie K. Taylor, and Richard P. Moser. 2008. "The Science of Team Science: Overview of the Field and Introduction to the Supplement." *American Journal of Preventative Medicine* 35 (2S): S77-S89.

Strang, Veronica. 2009. "Integrating the Social and Natural Sciences in Environmental Research: A Discussion Paper." *Environment, Development, and Sustainability* 11: 1-18.

Treitler, Inga, and Douglas Midgett. "It's About Water: Anthropological Perspectives on Water and Policy." *Human Organization* 66 (2007): 140-149.

Tschakert, P., and L.J. Shaffer. 2014. "Ingredients for Social-Ecological Resilience, Poverty Traps, and Adaptive Social Protection in Semi-Arid Africa." In *Social-Ecological Systems in Transition*, edited by Shoko Sakai and Chieko Umetsu, 139-156. Tokyo: Springer Japan.

Van Willigen, John. 2002. *Applied Anthropology: An Introduction*. 3rd edition. London: Bergin and Garvey.

Vogt, Jessica M., Graham B. Epstein, Sarah K. Mincey, Burnell C. Fischer, and Paul McCord. 2015. "Putting the E in SES." *Ecology and Society* 20 (1): 55. doi: 10.5751/ES-07239-200155.

West, Colin. 2010. "Household Extension and Fragmentation: Investigating the Socio-Environmental Dynamics of Mossi Domestic Transitions." *Human Ecology* 38 (3): 363-376.

Appendix A: Executive and Leadership Team Survey

1. What is your general disciplinary alignment?
    - Ecology
    - Social Science
    - Other (Please specify)
2. Please identify your specific disciplinary focus (e.g. landscape ecology, limnology, geography).
3. What is the highest degree or credential you have earned?
    - Bachelor's degree
    - Master's degree
    - Doctoral degree
    - Other:
4. Before working with MtnSEON, did you have experience with conducting Social-Ecological Systems science and research?
    - Yes, I have been involved in previous SES or related work
    - No, but I have read about SES and related approaches in the literature
    - No, MtnSEON was my first exposure to SES
5. (Open ended) Please give a brief description of how you define SES research.
6. Please indicate how strongly you DISAGREE or AGREE with the following statements on a scale of 1 to 7 (1. Strongly Disagree; 2. Moderately Disagree; 3. Slightly Disagree; 4. Not Sure; 5. Slightly Agree; 6. Moderately Agree; 7. Strongly Agree):

	1	2	3	4	5	6	7
MtnSEON working groups in general have successfully developed integrated SES research approaches.							

MtnSEON has been successful in facilitating, coordinating, integrating, and synthesizing existing programs and research, both regionally and internationally.							
MtnSEON has been successful in designing collaborative, interactive research, education, and governance projects.							
MtnSEON has been successful in creating partnerships which will use new approaches to produce linked, scalable models and methods to inform management decisions affecting the resilience of mountain landscapes.							

(Open ended) Please add any thoughts regarding the statements above.

7. Please indicate how strongly you DISAGREE or AGREE with the following statements on a scale of 1 to 7 (1. Strongly Disagree; 2. Moderately Disagree; 3. Slightly Disagree; 4. Not Sure; 5. Slightly Agree; 6. Moderately Agree; 7. Strongly Agree):

	1	2	3	4	5	6	7
MtnSEON working groups have developed successful interdisciplinary collaborations.							
MtnSEON working groups would benefit from using more quantitative methods.							
MtnSEON working groups would benefit from using more qualitative methods.							
MtnSEON would benefit from engaging more ecologists.							
MtnSEON would benefit from engaging more social scientists.							

(Open ended) Please add any thoughts regarding the statements above.

8. (Open ended) Based on experiences gathered from the evolution of MtnSEON, how would you structure future SES oriented research projects? Please be as specific and detailed as you would like.

Appendix B: Working Group Lead and Participant Survey

1. What is your role in MtnSEON?

   ___ Working Group lead ___ Working Group participant ___ Other (Please describe)

2. What is your position?

   ___ Academic researcher ___ Federal/state agency personnel ___ Tribal agency personnel ___ Graduate student ___ Other (Please describe):

3. Before working with MtnSEON, did you have experience with conducting Social Ecological Systems science and research?

   ___ Yes, I have been involved in previous SES or related work

   ___ No, but I have read about SES or related approaches in the literature

   ___ No, MtnSEON was my first exposure to SES

4. In your experience with MtnSEON, do you believe your Working Group has successfully developed an integrated SES approach?

   ___ Yes – we effectively integrated social science and ecological approaches

   ___ Somewhat – our research considered both social science and ecological approaches but is weighted heavily toward one or the other

   ___ No – we aimed to integrate social and ecological approaches but have only effectively included one area

5. Please indicate how strongly you DISAGREE or AGREE with the following statements on a scale of 1 to 7.

   My Working Group would benefit from…

	1. Strongly Disagree	2. Moderately Disagree	3. Slightly Disagree	4. Not Sure	5. Slightly Agree	6. Moderately Agree	7. Strongly Agree
Implement-ing more qualitative methods.							

Implement-ing more quantitative methods.							
Engaging more ecologists.							
Engaging more social scientists.							

Please add any thoughts regarding the statements above.

6. On a scale of 1 – 4, how familiar are you with the following disciplines and methodologies?

	1. Not at all familiar	2. Slightly familiar	3. Somewhat familiar	4. Very familiar
Anthropology (in general)				
Applied Anthropology				
Environmental Anthropology				
Ethnography				

If you are very or somewhat familiar with any of the disciplines or methodologies listed above, do you believe they might offer important perspectives to SES approaches? Please explain.

7. How old are you?

   ___ 18-24 ___ 25-40 ___ 41-55 ___ 56+

8. What is your gender?

   ___ Male ___ Female ___ Other:

9. What is the highest degree or credential you have earned?

   a. Bachelors:

   b. Masters:

   c. Doctoral:

d. Other:

10. What is your general disciplinary alignment?

___ Ecology ___ Social Science ___ Other (Please specify):

11. Please identify your specific disciplinary focus (e.g. landscape ecology, limnology, environmental anthropology).

12. On a scale of 1 to 4 (1. Not at all successful; 2. Slightly successful; 3. Somewhat successful; 4. Very successful), in your Working Group setting, how successful have you been in:

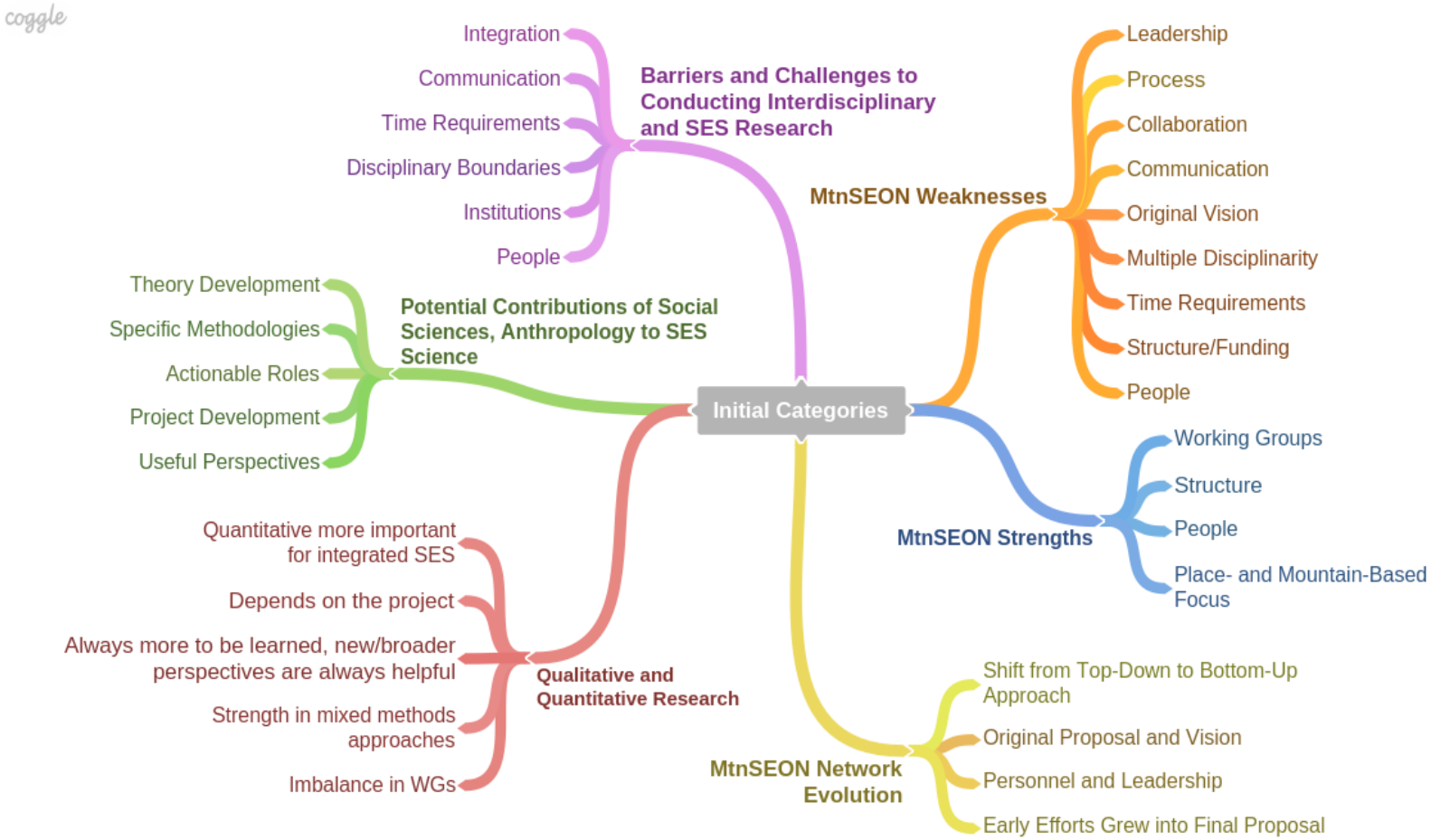
	1. Not at all successful	2. Slightly Successful	3. Somewhat Successful	4. Very Successful
Collaborating with people outside of academia (agency personnel, tribal personnel, policy makers, etc.)				
Working with researchers outside your own discipline				

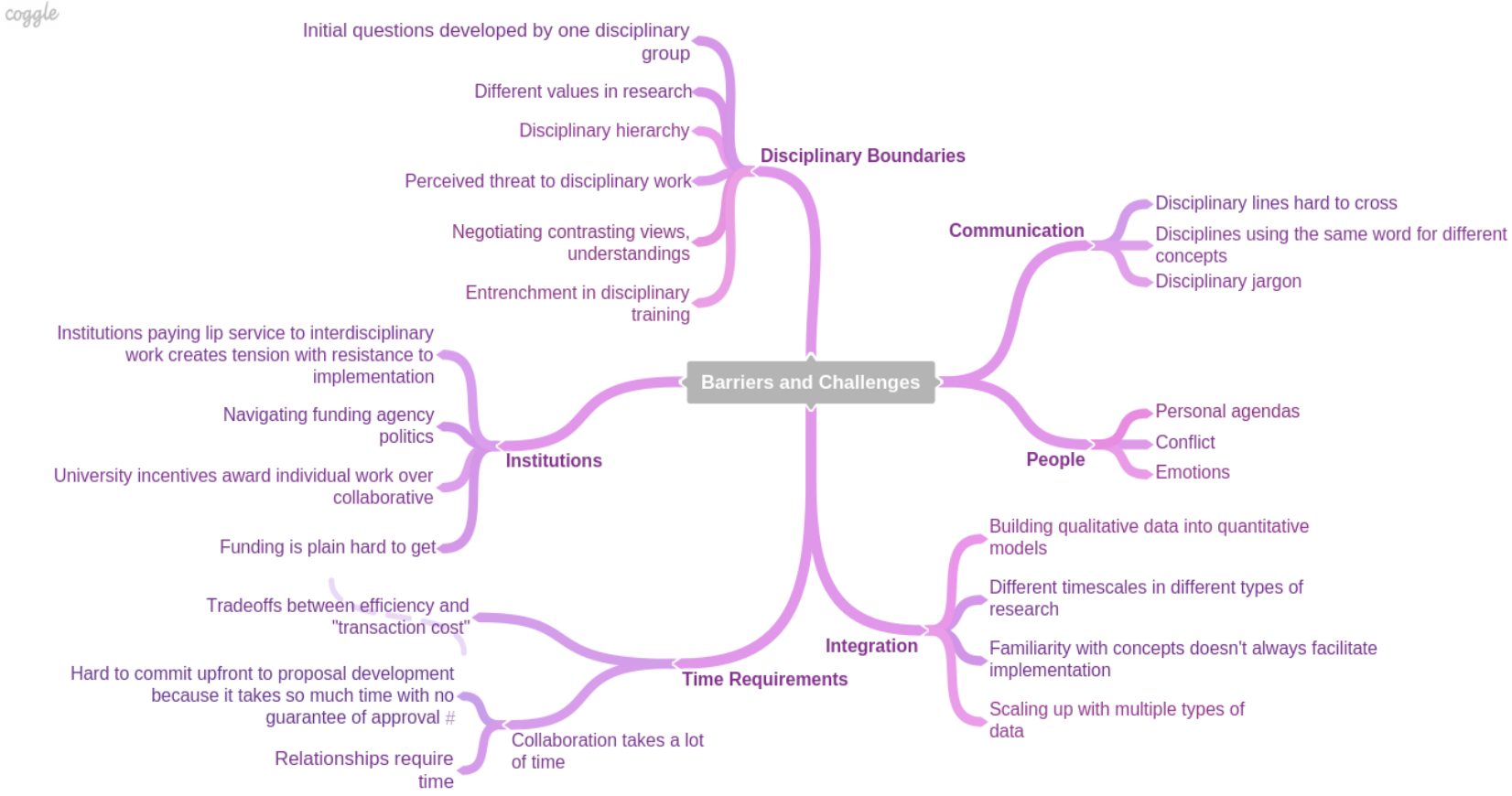
Please add any thoughts regarding the statements above.

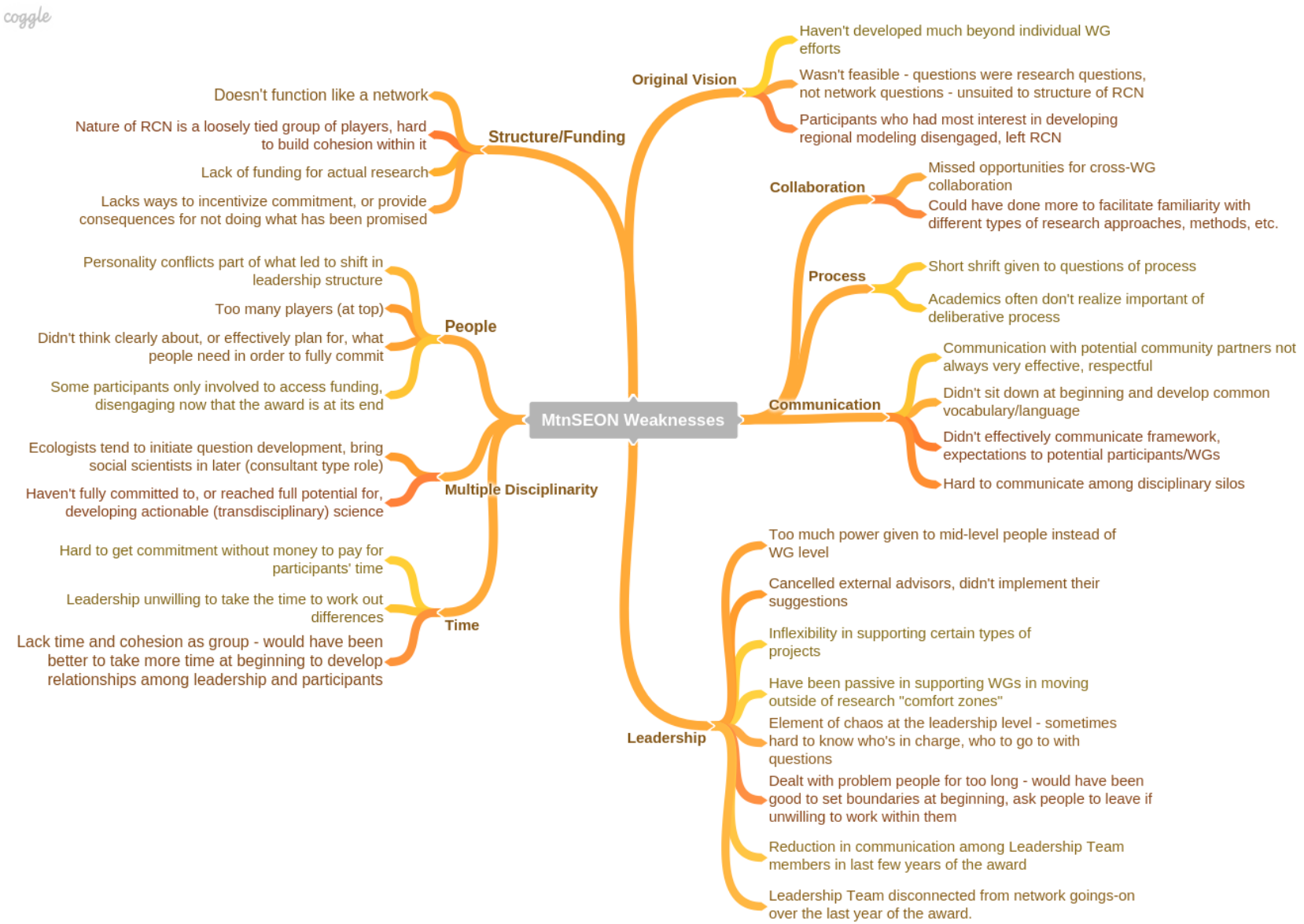
13. On a scale of 1-4 how important is it to you to engage in interdisciplinary research?

1. Not at all Important	2. Slightly Important	3. Somewhat Important	4. Very Important

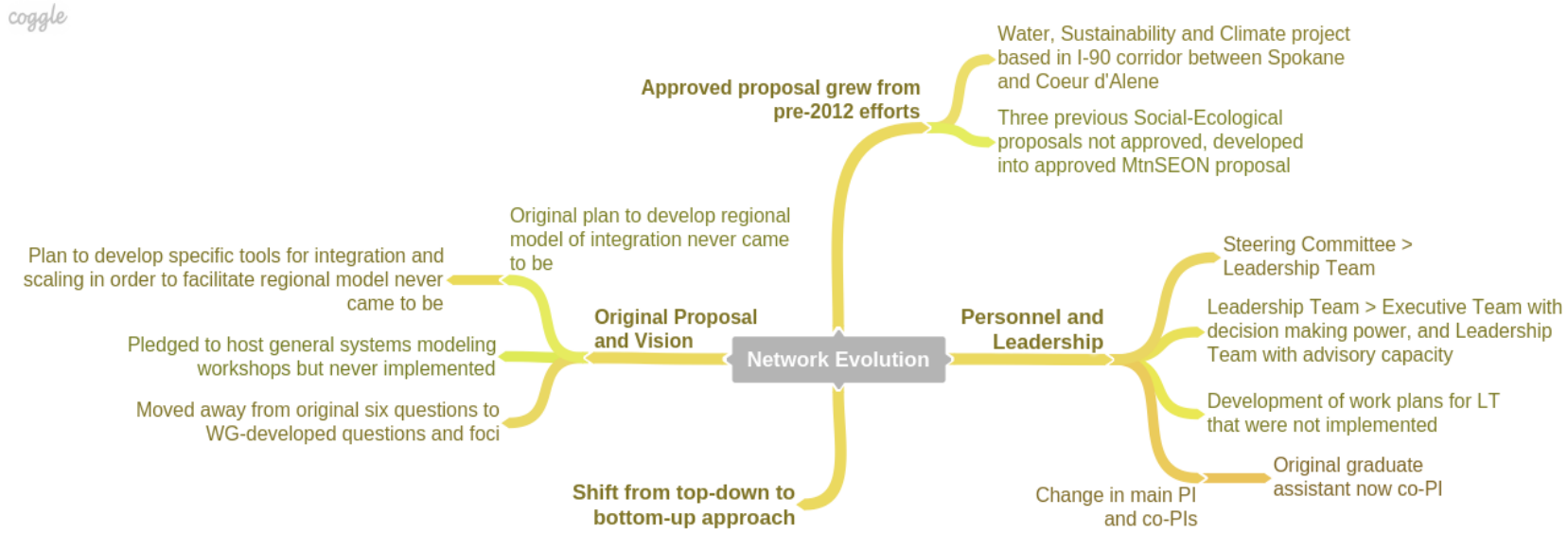
Appendix C: Expanded Initial Themes and Subcategories

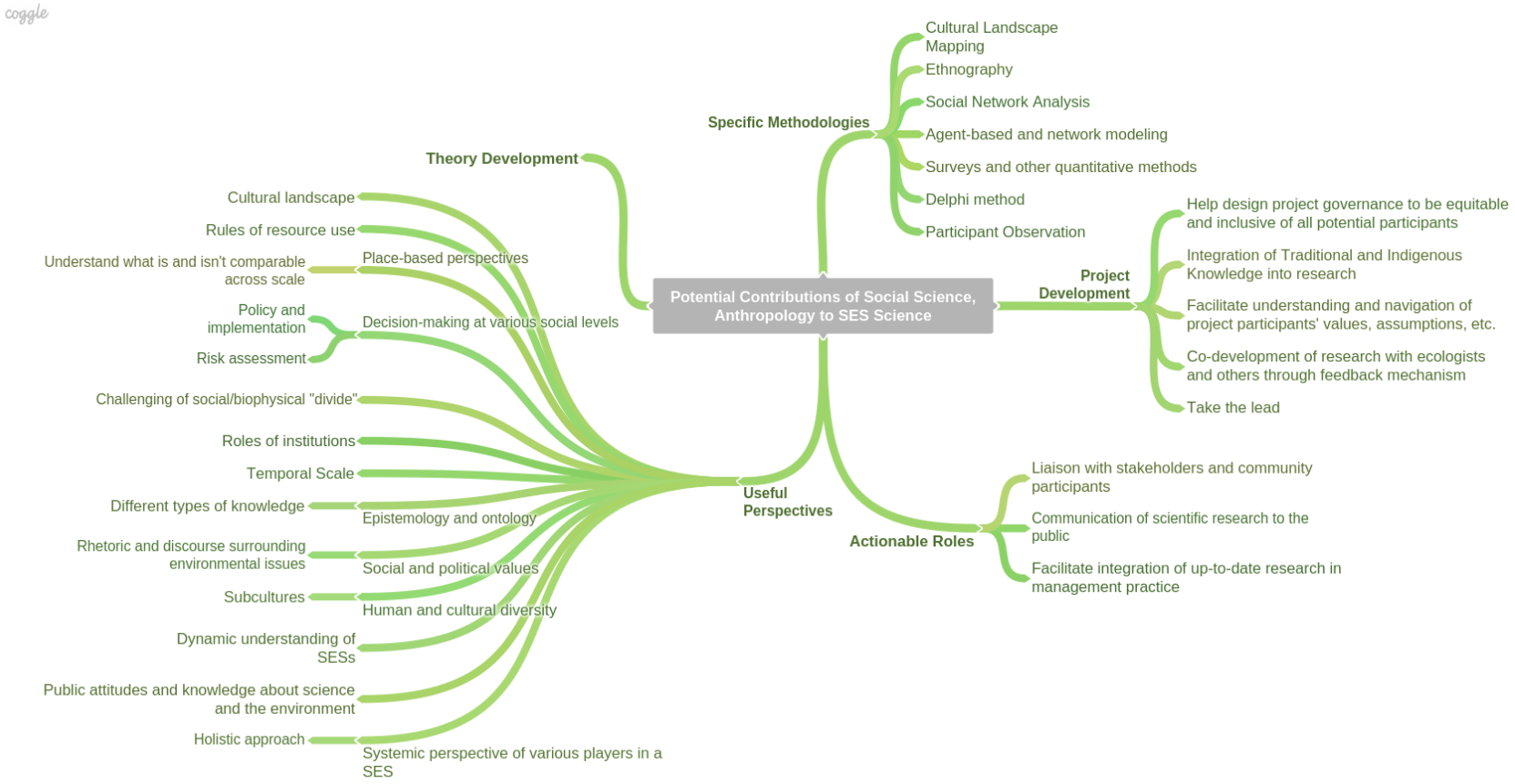


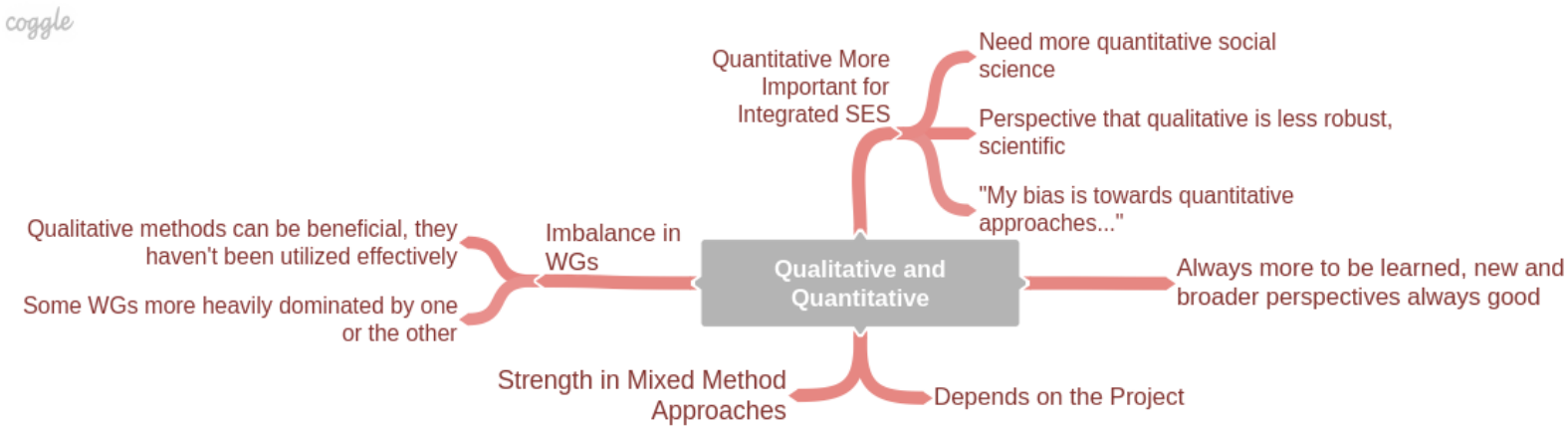

coggle
Barriers and Challenges
Disciplinary Boundaries
Initial questions developed by one disciplinary group
Different values in research
Disciplinary hierarchy
Perceived threat to disciplinary work
Negotiating contrasting views, understandings
Entrenchment in disciplinary training
Institutions
Institutions paying lip service to interdisciplinary work creates tension with resistance to implementation
Navigating funding agency politics
University incentives award individual work over collaborative
Funding is plain hard to get
Time Requirements
Tradeoffs between efficiency and "transaction cost"
Hard to commit upfront to proposal development because it takes so much time with no guarantee of approval #
Collaboration takes a lot of time
Relationships require time
Communication
Disciplinary lines hard to cross
Disciplines using the same word for different concepts
Disciplinary jargon
People
Personal agendas
Conflict
Emotions
Integration
Building qualitative data into quantitative models
Different timescales in different types of research
Familiarity with concepts doesn't always facilitate implementation
Scaling up with multiple types of data


coggle
MtnSEON Weaknesses
Original Vision
Haven't developed much beyond individual WG efforts
Wasn't feasible - questions were research questions, not network questions - unsuited to structure of RCN
Participants who had most interest in developing regional modeling disengaged, left RCN
Collaboration
Missed opportunities for cross-WG collaboration
Could have done more to facilitate familiarity with different types of research approaches, methods, etc.
Process
Short shrift given to questions of process
Academics often don't realize important of deliberative process
Communication
Communication with potential community partners not always very effective, respectful
Didn't sit down at beginning and develop common vocabulary/language
Didn't effectively communicate framework, expectations to potential participants/WGs
Hard to communicate among disciplinary silos
Leadership
Too much power given to mid-level people instead of WG level
Cancelled external advisors, didn't implement their suggestions
Inflexibility in supporting certain types of projects
Have been passive in supporting WGs in moving outside of research "comfort zones"
Element of chaos at the leadership level - sometimes hard to know who's in charge, who to go to with questions
Dealt with problem people for too long - would have been good to set boundaries at beginning, ask people to leave if unwilling to work within them
Reduction in communication among Leadership Team members in last few years of the award
Leadership Team disconnected from network goings-on over the last year of the award.
Structure/Funding
Doesn't function like a network
Nature of RCN is a loosely tied group of players, hard to build cohesion within it
Lack of funding for actual research
Lacks ways to incentivize commitment, or provide consequences for not doing what has been promised
People
Personality conflicts part of what led to shift in leadership structure
Too many players (at top)
Didn't think clearly about, or effectively plan for, what people need in order to fully commit
Some participants only involved to access funding, disengaging now that the award is at its end
Multiple Disciplinarity
Ecologists tend to initiate question development, bring social scientists in later (consultant type role)
Haven't fully committed to, or reached full potential for, developing actionable (transdisciplinary) science
Time
Hard to get commitment without money to pay for participants' time
Leadership unwilling to take the time to work out differences
Lack time and cohesion as group - would have been better to take more time at beginning to develop relationships among leadership and participants

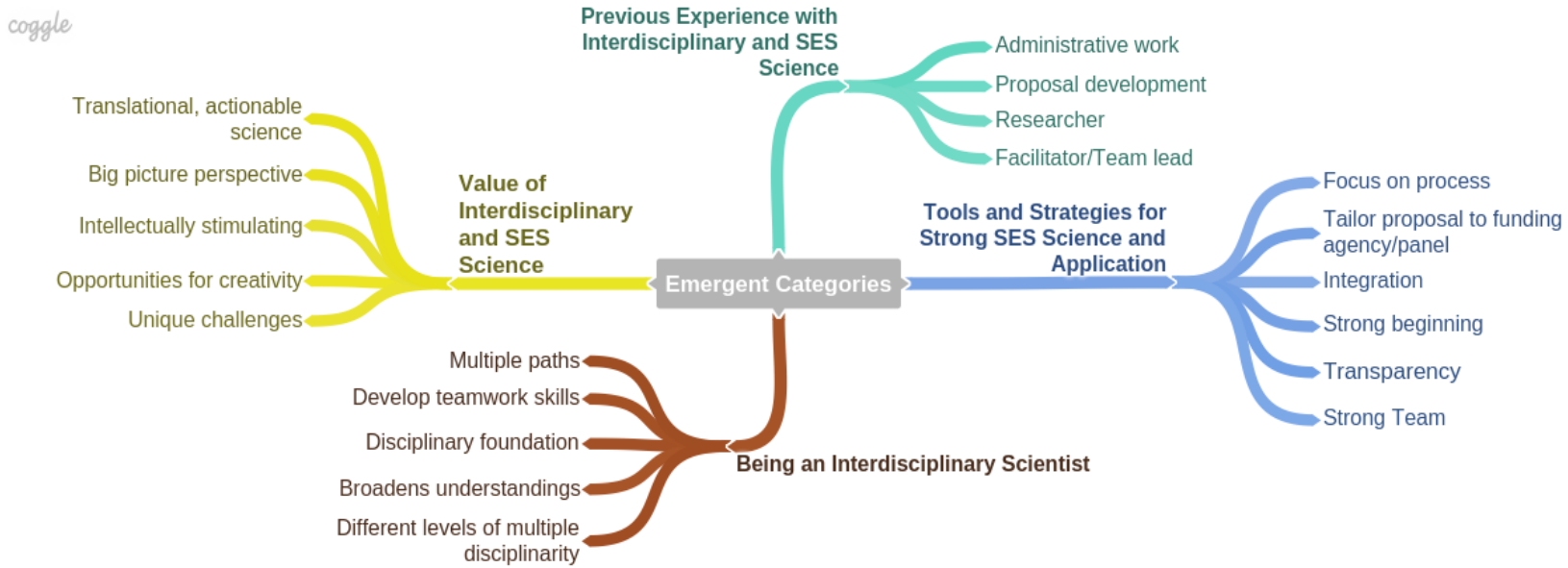

coggle
MtnSEON Strengths
Structure
Structure of individual working groups, research foci not imposed from the top
Working Group structure itself
Sharing of resources and expertise
Core group for administrative oversight, combined with bottom-up development of research efforts
Multiple universities and organizations involved
People
Involvement of non-academic personnel in WGs
Lead PI's consistent leadership and vision
Core group of strong, committed people at WG level
Place- and mountain-based focus
Working Groups
Momentum of current efforts likely to result in publications, proposals, and other products after award ends
Persistence through time, sustained effort and focus
Spin off initiatives
Development of strong SES approaches
Bottom-up networking function, bringing outside people into MtnSEOn
Breadth and diversity of research foci, group perspectives and approaches


coggle
Network Evolution
Approved proposal grew from pre-2012 efforts
Water, Sustainability and Climate project based in I-90 corridor between Spokane and Coeur d'Alene
Three previous Social-Ecological proposals not approved, developed into approved MtnSEON proposal
Original Proposal and Vision
Original plan to develop regional model of integration never came to be
Plan to develop specific tools for integration and scaling in order to facilitate regional model never came to be
Pledged to host general systems modeling workshops but never implemented
Moved away from original six questions to WG-developed questions and foci
Shift from top-down to bottom-up approach
Personnel and Leadership
Steering Committee > Leadership Team
Leadership Team > Executive Team with decision making power, and Leadership Team with advisory capacity
Development of work plans for LT that were not implemented
Change in main PI and co-PIs
Original graduate assistant now co-PI

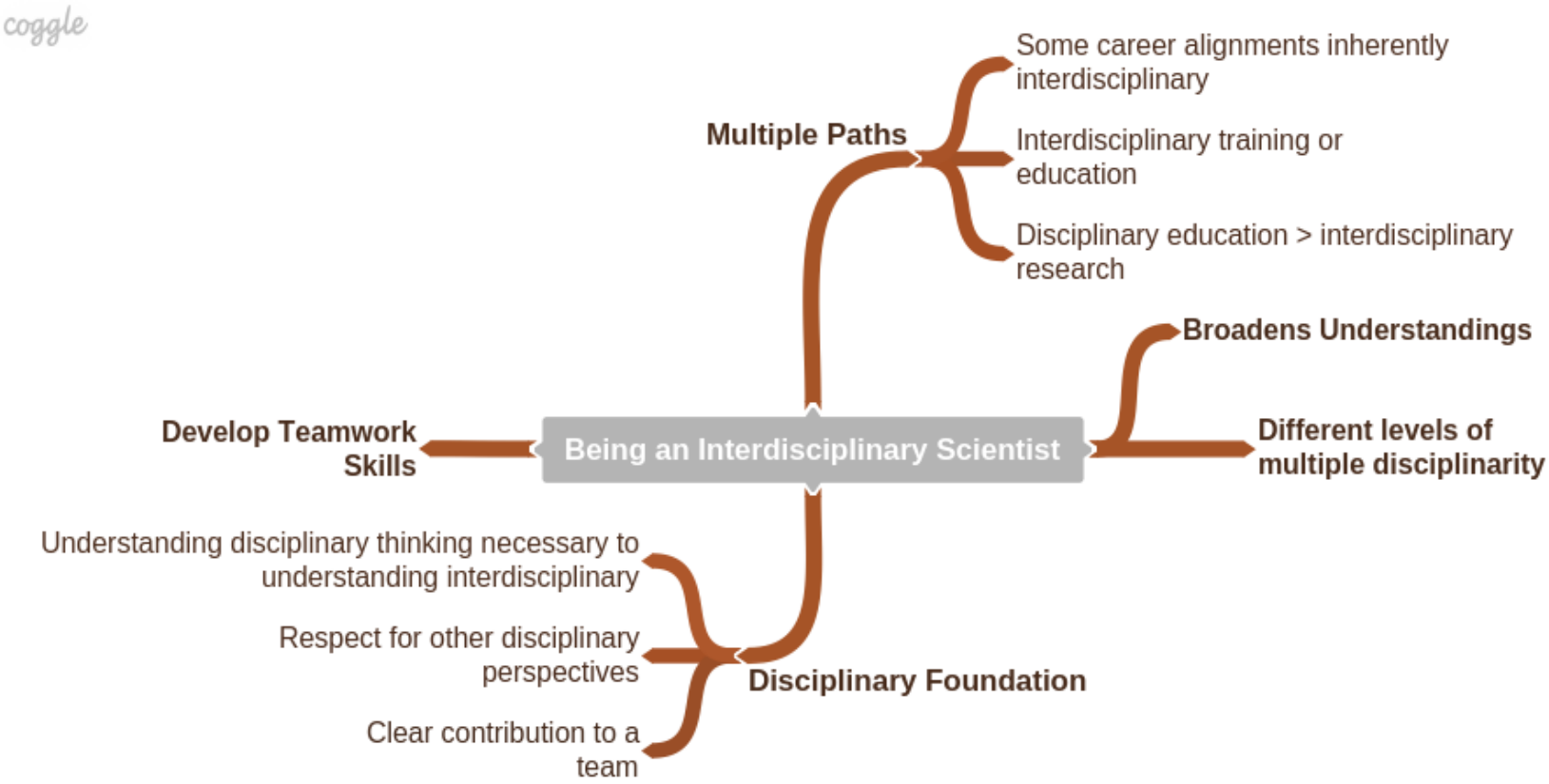

coggle
Potential Contributions of Social Science, Anthropology to SES Science
Theory Development
Cultural landscape
Rules of resource use
Understand what is and isn't comparable across scale
Place-based perspectives
Policy and implementation
Risk assessment
Decision-making at various social levels
Challenging of social/biophysical "divide"
Roles of institutions
Temporal Scale
Different types of knowledge
Epistemology and ontology
Rhetoric and discourse surrounding environmental issues
Social and political values
Subcultures
Human and cultural diversity
Dynamic understanding of SESs
Public attitudes and knowledge about science and the environment
Holistic approach
Systemic perspective of various players in a SES
Useful Perspectives
Specific Methodologies
Cultural Landscape Mapping
Ethnography
Social Network Analysis
Agent-based and network modeling
Surveys and other quantitative methods
Delphi method
Participant Observation
Actionable Roles
Liaison with stakeholders and community participants
Communication of scientific research to the public
Facilitate integration of up-to-date research in management practice
Project Development
Help design project governance to be equitable and inclusive of all potential participants
Integration of Traditional and Indigenous Knowledge into research
Facilitate understanding and navigation of project participants' values, assumptions, etc.
Co-development of research with ecologists and others through feedback mechanism
Take the lead


coggle
Qualitative and Quantitative
Quantitative More Important for Integrated SES
Need more quantitative social science
Perspective that qualitative is less robust, scientific
"My bias is towards quantitative approaches..."
Imbalance in WGs
Qualitative methods can be beneficial, they haven't been utilized effectively
Some WGs more heavily dominated by one or the other
Always more to be learned, new and broader perspectives always good
Strength in Mixed Method Approaches
Depends on the Project

Appendix D: Expanded Emergent Themes and Subcategories




coggle
Tools and Strategies for Effective Interdisciplinary and SES Science
Strong Beginning
Determine team members' needs and strengths as early possible
Determine data needs as early as possible
Develop common language/vocabulary
Invest in relationships early on
Bring community partners in as early as possible
Tailor Proposal to Funding Agency/Panel
Focus on Process
Give the necessary time to relationship building
Flexible, adaptable project design
Accept ambiguity, uncertainty
Integration
Framework in place from beginning
Systems Approach
Baby Steps
Spatial Approach
General Systems Modeling
Transparency
Develop Strong Team
Tailor team to project context
Conflict management
Determine team members' needs and strengths as early possible
Core group of SES scientists
Dialogue
Invest in relationships


coggle
Being an Interdisciplinary Scientist
Multiple Paths
Some career alignments inherently interdisciplinary
Interdisciplinary training or education
Disciplinary education > interdisciplinary research
Broadens Understandings
Different levels of multiple disciplinarity
Develop Teamwork Skills
Disciplinary Foundation
Understanding disciplinary thinking necessary to understanding interdisciplinary
Respect for other disciplinary perspectives
Clear contribution to a team

Appendix E: Bivariate Correlation Matrix

Working Group Lead and Participant Survey – Bivariate Correlation: Pearson's r									
	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Support more qualitative methods	1.000								
2. Support more quantitative methods	0.184	1.000							
3. Support more ecologists	-0.436	0.235	1.000						
4. Support more social scientists	0.028	0.723	-0.179	1.000					
5. Familiarity with anthropology	0.127	-0.281	0.271	-0.371	1.000				
6. Familiarity with ethnography	0.064	-0.243	-0.005	-0.260	0.728	1.000			
7. Agree that Working Group has successfully developed integrated SES approach	-0.193	0.242	-0.295	0.558	-0.141	0.109	1.000		
8. Agree that Working Group has developed successful collaborations with non-academic participants	0.108	0.179	0.160	-0.008	0.000	0.198	-0.057	1.000	
9. Agree that Working Group has developed successful collaborations with multi/interdisciplinary participants	0.259	0.243	0.441	-0.095	0.000	0.250	-0.553	0.081	1.000