DISSERTATION

KNOWLEDGE INTEGRATION IN TRANSDISCIPLINARY RESEARCH: A CASE STUDY

OF THE SOCIO-ECOLOGICAL COMPLEXITY PROJECT

Submitted by

Arren Mendezona Allegretti

Graduate Degree Program in Ecology

In partial fulfillment of the requirements

For the degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall 2015

Doctoral Committee Members:

    Advisor: Melinda Laituri
    Co-Advisor: Kathleen Pickering

    Jessica Thompson
    Maria Fernandez-Gimenez

ABSTRACT

KNOWLEDGE INTEGRATION IN TRANSDISCIPLINARY RESEARCH: A CASE STUDY

OF THE SOCIO-ECOLOGICAL COMPLEXITY PROJECT

Knowledge integration has been crucial for gaining a holistic picture of the inner

workings of socio-ecological systems. Integrating local and scientific knowledge sustains

biological and global cultural diversity, and may fill gaps in understanding that cannot be

elucidated by individual scientific disciplines. Interdisciplinary and transdisciplinary research

teams face the challenge of collaborating and integrating their varying disciplinary paradigms

and epistemologies along with stakeholders' local knowledge for understanding and adapting to

global and local environmental issues. Communication and knowledge integration across

funders, researchers, and research end-users in transdisciplinary research are critical for meeting

diverse stakeholder needs and genuinely engaging multiple knowledge systems. These

knowledge systems may include a combination of researcher and local ecological knowledge

embedded in institutions, disciplines, and cultures. The purpose of this dissertation is to

investigate and apply knowledge integration tools for examining socio-ecological systems and

transdisciplinary research communication. Specifically, I examine the Socio-ecological

Complexity (SEC) project as a case study. The SEC is a pseudonym for an actual project

examining the role of Community-Based Rangeland Management (CBRM) institutions in

influencing the resilience of Mongolian socio-ecological rangeland systems to climate change. I

apply two tools for the integration of knowledge within SEC: participatory reflection and

participatory mapping. I apply participatory reflection among the SEC research team and provide

stakeholder engagement indicators for reflecting, communicating, and incorporating the needs of funders, researchers, and research end users as major stakeholder groups in transdisciplinary research. These specific indicators allow transdisciplinary research teams to assess the current level of knowledge integration, communicate and target stakeholder needs that may influence project outcomes in communicating their research. To integrate the local ecological knowledge (LEK) of research end users, I apply participatory mapping to explore herders' knowledge of their rangelands and their perceptions of socio-ecological boundaries imbedded in their pastures. The process of participatory mapping revealed emic narratives on physical and human demarcated boundaries influencing landscapes, adaptive practices, and local governance arrangements for accessing pasture resources. Participatory mapping and participatory reflection serve as tools for integrating and communicating diverse knowledge systems in transdisciplinary research. To examine how knowledge and world views may be communicated among diverse actors in transdisciplinary research, I provide a reflexive account of the role of voice in transdisciplinary fieldwork. My reflexive account reveals the complex network of actors and how identity, language, financial structures and hierarchy within a multi-cultural and transdisciplinary project shape actors' voices and opinions. The application of knowledge integration tools (participatory reflection and participatory mapping) and the open dialogue about the role of voice in transdisciplinary research provide diverse views for evaluating transdisciplinary research outcomes and analyzing coupled human-environment relationships in socio-ecological systems.

ACKNOWLEDGEMENTS

I am thankful for my committee members, colleagues, family, and my husband for their support and love throughout my PhD experience. My committee members, including my Professors Melinda Laituri, Jessica Thompson, Kathy Pickering, and Maria Fernandez-Gimenez have been guiding forces for my dissertation and role models for achieving transdisciplinary work. Melinda, it truly was a privilege to watch you in the field as you worked with Batbuyan and lead the participatory mapping activities with herders in Mongolia. I will never forget the times we spent in Mongolia, especially in the 2012 field season where we attended the *Ovuu* festival in Arkhangai and drew systems maps over a cold Gem beer while it rained outside our ger. Thank you for allowing me to pursue a different outlook in my dissertation and supporting me in the direction that I took, even if it was different from yours. Jes, you have been the driving force for my dissertation and I am so fortunate to have been your student and experience your very organized guidance, constructive feedback, and support for shaping my dissertation. You have been a role model for me in many ways, particularly with prioritizing and taking organized action in personal life and academia. Words can't express how grateful I am for all your support and guidance. Kathy, the anthropology courses you taught truly changed my outlook for examining transdisciplinary research teams and questioning the socio-political structure of how research is conducted, particularly with the understanding of the colonial world views underpinning research methods. Thank you for your compassion, honesty, and guidance throughout all these years. Maria, I am grateful for your guidance and critical comments on my dissertation. While these comments were very humbling and frustrating at times, I knew that your comments and questions were carefully crafted to improve my work. I thank you for all of

these. Throughout significant events of my PhD work, I witnessed how incredibly important the SEC project was to you. Thank you for accepting me as part of the SEC team and your social-ecological systems lab.

I am indebted to friends and colleagues, especially the SEC team members who have made my graduate school experience memorable and fulfilling. Professors Steven Fassnacht, Robin Reid, and Jay Angerer- thank you for your support, inspiration and fun attitude especially as we travelled to Mongolia for the last few years. To my Mongolian friends and colleagues, Khishig, Tungaa, Chantsaa, Batkhishig, Batbuyan, Odko, Zulaa, Bolor, and Naransogt- thank you for your friendship, trust, and compassion. It was the relationships that I made with all of you that made me commit to the SEC project. I am also grateful to the herder groups we worked with during the participatory mapping sessions, including Ishghent, Bulag, Nogoon Khuv, Bayan nuuriinkhan, Chuluun Purev Amarsanaa. Thank you for sharing your stories and in-depth insight about your *nutag*.

I would not be finishing my PhD if not for the love and support that I have received from family, especially from my parents and my husband. Mom and Pop, thank you for deciding to move to the US and providing us with the opportunity to be educated in the States. If not for you, I would not have graduated from UC Santa Cruz and CSU with my BS, MS, and PhD degrees. Thank you for all of these life experiences. To my husband Paul, I am so grateful for your love, patience, and compassion throughout graduate school. Throughout those times when I was in the field and we were apart for several months, your support and love was what made me push through those hard times. Thank you for those little cards with flower petals from our garden and snacks that you would hide in my field pack. I read and reread these letters when I got lonely in the field. You have always been there throughout the seven years of my MS and PhD degrees.

Thank you for being my inspiration and motivation. I look forward to life after the PhD and our next round of adventures with our dog Myles and son Antonio.

TABLE OF CONTENTS

CHAPTER ONE

Introduction

Knowledge integration in transdisciplinary research involves the process of combining different forms of knowledge, including researcher and local knowledge, crucial for a synthesized and holistic representation of coupled human-environment interactions (Bohensky & Maru, 2011; Young et al., 2006). Transdisciplinary research involves more than just addressing disciplinary differences among researchers; it also includes incorporating the knowledge and cultures of multiple stakeholders (Cummings, Regeer, Ho, & Zweekhorst, 2013; Stokols, Hall, Taylor, & Moser, 2008). Integrating diverse forms of knowledge may support biological and global cultural diversity, bringing benefits to local stakeholders and scientists (Bohensky & Maru, 2011a; Edwards & Heinrich, 2006; Maffi & Woodley, 2012). Additionally, knowledge integration may also fill gaps in understanding that cannot be explained by individual scientific disciplines (Bohensky & Maru, 2011; Johannes, 1998). To investigate knowledge integration in transdisciplinary research, I examine the Socio-ecological Systems Complexity Project (SEC). The SEC project is a pseudonym for an actual research project investigating socio-ecological rangeland resilience to climate change in Mongolia. Transdisciplinary research teams such as SEC face the challenge of collaborating and integrating their varying disciplinary paradigms and epistemologies along with stakeholders' local knowledge in Mongolian rangeland systems. Applying SEC as a case study, my overall purpose is to examine and apply knowledge integration tools in socio-ecological systems and transdisciplinary research projects. Specifically, I apply Reflective Adaptive Processes (RAP) for integrating SEC researcher knowledge and world views in transdisciplinary projects. Secondly, I apply participatory mapping for integrating

researcher and herders' local knowledge on Mongolian rangeland socio-ecological systems (Figure 1.1). Finally, I explore the role of voice in transdisciplinary field research to examine how knowledge and world views may be communicated among actors in transdisciplinary research. I focus on researchers, Mongolian partners, and herders as main stakeholders in SEC. Throughout my dissertation chapters, I also acknowledge the role of cultural or knowledge brokers, such as Mongolian PhD students, SEC Mongolian Coordinators, and postdoctoral fellows who were critical in translating languages, world views, and knowledge among SEC team members.
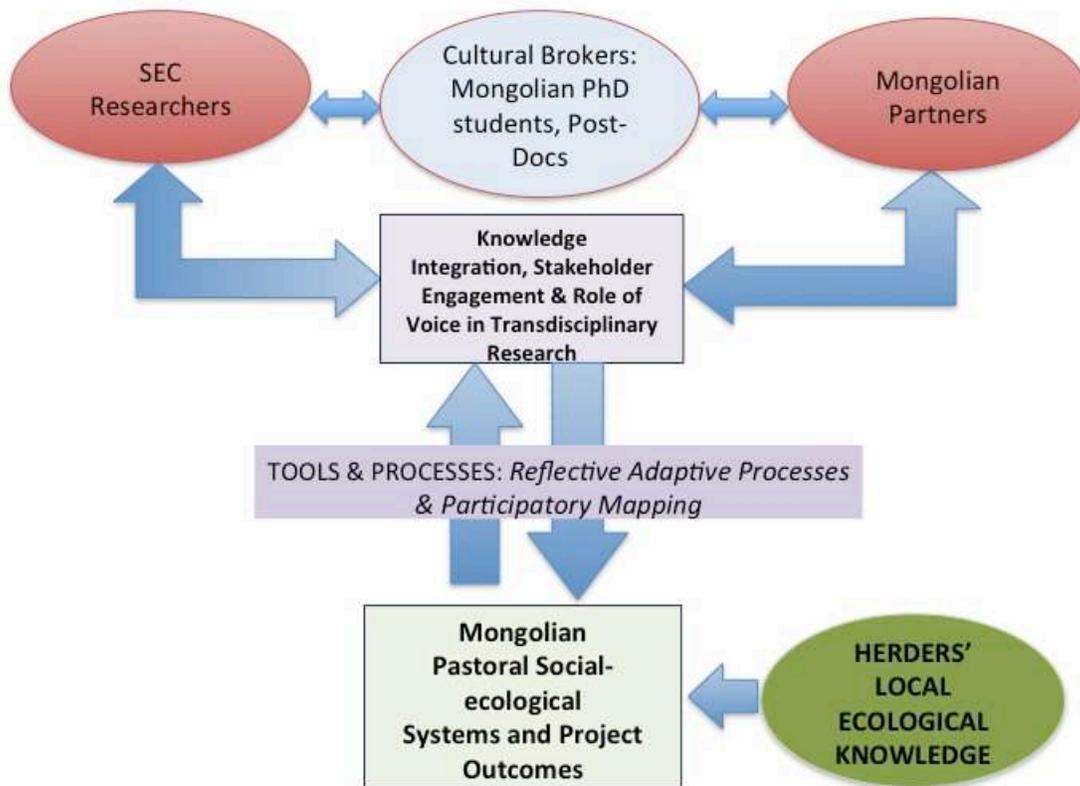
Figure 1.1. Knowledge is exchanged and integrated among the SEC research team and Mongolian collaborators. Tools and processes such as Reflective Adaptive Processes and participatory mapping may facilitate knowledge integration and the inclusion of different voices and local knowledge in transdisciplinary research.

Dissertation Framework

Knowledge integration and stakeholder engagement in transdisciplinary research teams require relationships and communication competencies transcending disciplinary, epistemological, and intercultural differences and challenges (Miller et al., 2008, Roux et al., 2012). Transdisciplinary research involves developing novel conceptual frameworks from multiple disciplines and engaging stakeholders throughout all stages of the research (Stokols et al., 2008). Integrating local and scientific knowledge includes research teams who initially set research agendas, questions, methods, and analyses with the intention of using and eventually integrating local knowledge with their project outcomes and products. Because scientific research teams are the in the position of power to integrate knowledge (Nadasdy, 1999, 2003), there is a need to understand knowledge integration within transdisciplinary research teams attempting to integrate their own knowledge and epistemologies within their research team and among local stakeholders. This study addresses this research gap by investigating the communication dynamics and experiences of the SEC team as researchers attempt to integrate and negotiate their knowledge within their team. In addition, this study engages with herders' local knowledge and narratives of their pastures boundaries for a diverse understanding of Mongolian socio-ecological systems.

Limitations

Nadasdy (1999) points out that integrating knowledge in socio-ecological systems research often involves making local knowledge fit within western conceptions of knowledge and scientific paradigms, ignoring power and colonial relations among knowledge holders within research teams and local stakeholders. This study does not ignore power relations within the SEC

3

research team nor does it claim that local knowledge is completely integrated with the SEC research outcomes. Rather, this study attempts to understand the dynamics of knowledge integration and power within the SEC research team and Mongolian partners. The role of voice in transdisciplinary research teams such as the SEC is also explored, particularly during the social and ecological field work where US-based SEC team members worked closely with Mongolian collaborators.

Rationale

Various rationales and arguments exist for integrating different forms of knowledge in socio-ecological research. Tengö et al. (2014) assert that cross-fertilization of diverse knowledge systems can enhance the capacity of stakeholders, including transdisciplinary researchers to collectively interpret complex natural resource conditions and relationships in socio-ecological systems. Knowledge systems may be composed of stakeholders, institutions and practices that produce, transfer, and apply knowledge in diverse contexts (Tengö, Brondizio, Elmqvist, Malmer, & Spierenburg, 2014). Bohensky and Maru (2011) emphasize the pressing need for integrating various forms of knowledge systems (e.g., local and researcher knowledge) in natural resource management and transdisciplinary research. The rationale for knowledge integration goes beyond scientific merits and entails the incorporation of social justice and the identity of indigenous peoples (Agrawal, 1995; Bohensky & Maru, 2011). Some scientists point out that a resilience framework of knowledge integration involves recognizing the importance of complexity, particularly when varying world views provide opportunity for researchers to revisit natural resource issues and co-build new transdisciplinary frameworks and models of socio-ecological systems (Bohensky & Maru, 2011; Houde, 2007). In the resilience framework, the

collective management of complexity and uncertainty in socio-ecological systems research can be beneficial when varied knowledge types are combined and recognized as distinct knowledge identities (Bohensky & Maru, 2011; Folke, Hahn, Olsson, & Norberg, 2005). This rationale for knowledge integration is especially applicable to transdisciplinary research teams attempting to communicate and integrate their diverse disciplines and epistemologies in understanding socio-ecological systems.

Socio-ecological researchers face the challenge of integrating knowledge as well as developing tools and management approaches whereby scientific knowledge is respected alongside local knowledge (Pullin and Knight, 2001; Reed et al., 2007; Reed 2008; Cowling et al., 2008). Raymond et al. (2010) point out that in response to these challenges,

> there has been the shift in views of research and management informed by reductionist ideas (e.g., the modeling of single species) to a post-normal science associated with the erosion of boundaries between different forms of knowledge and rationality (Scoones, 1999, Nowotny et al., 2001), and the coupling of social and ecological systems (Berkes, 2004, Folke et al., 2005) (p. 1766).

Many of these knowledge integration approaches, tools and frameworks include participatory monitoring and evaluation, interdisciplinary team communication and facilitation, co-management and community-based natural resource management (Berkes, 2009; Child & Lyman, 2005; Gobisaikhan & Menamkart, 2000; Thompson, 2007). These approaches not only recognize the significance of researcher and local knowledge integration, but also stress the need to draw on different knowledge types to collaboratively build shared frameworks for addressing socio-ecological issues (Raymond et al., 2010). In addition, these knowledge integration approaches recognize that knowledge creation stems from individual experiences that shape an individual's perceptions, thus providing opportunity for collective understanding and acceptance of varying worldviews (Ross, Sherman, Snodgrass, & Delcore, 2010). Finally, knowledge

integration involves ongoing and cyclical processes of co-creation of knowledge, reflection, social learning, and reflexive evaluation for understanding socio-ecological systems (Armitage, Marschke, & Plummer, 2008; Biggs, Breen, Slotow, Freitag, & Hockings, 2011; Roux, Stirzaker, Breen, Lefroy, & Cresswell, 2010). To apply and understand knowledge integration in socio-ecological systems research, this study examines knowledge integration within a transdisciplinary and multi-cultural research team, such as the SEC. To integrate and engage local knowledge, this study also employs participatory mapping approaches with a focus on herder narratives for examining their experiences and the boundaries imbedded in Mongolian rangelands.

SEC Background

The overall SEC project goal is to understand the role of formal community-based natural resource management (CBNRM) institutions or herder groups in influencing the resilience and vulnerability of Mongolian rangelands to climate change. SEC also aims to assess the effects of climate change on Mongolian socio-ecological rangeland systems. CBNRM is a process by which stakeholder groups or communities achieve access to natural resources and benefits, including financial benefits, from the collective stewardship and management of natural resources (Child & Lyman, 2005). An interdisciplinary and transdisciplinary approach is crucial for understanding the ecological, physical, and social processes of Mongolian rangeland systems and the role of CBNRM within them. As a result, a team of researchers at a large, land grant university in the Western U.S., hereby called the core SEC team, partnered with Mongolian researchers to acquire funding and to examine Mongolian rangeland systems. Note that most of SEC's Mongolian partnerships resulted from the Principal Investigator's (PI) 20-year

collaboration and relationship with key Mongolian colleagues and researchers. In addition, Mongolian postdoctoral and PhD students' relationships and contacts with Mongolian research and NGO institutions facilitated partnerships and commitments of Mongolian colleagues' participation within SEC.

Understanding relationships among individuals and Mongolian partners in SEC provide us with a context for evaluating SEC project events. The relationships among the SEC members reflect that knowledge integration does not function in isolation; rather, it is embedded in relationships, institutions, and local social norms (North, 1990). The complex SEC partnerships involve stakeholders, including researchers who share their knowledge and require certain resources significant for meeting their institutional needs. For example, the SEC team consists of US and Mongolian researchers from the disciplines of ecology, hydrology, geography, human ecology, soil sciences, and environmental communication. These disciplines represent different academic departments and institutions requiring varying resources and holding norms specific to their department and disciplinary cultures. These varying disciplines and norms have the capacity to influence communication dynamics, knowledge co-creation and integration within the SEC team.

Research Questions and Objectives

The overall study objective is to investigate and apply knowledge integration tools within the SEC project. This study is structured into three manuscripts with their respective purpose, objectives, research questions, and literature review.

Manuscript 1: Engagement and Accountability in Transdisciplinary Space: Principles for Facilitating a Reflective Adaptive Process in Complex Teams

This purpose of this manuscript is to explore how Reflective Adaptive Processes (RAP) or participatory reflection can serve as a tool for transdisciplinary teams to facilitate, apply, and collectively reflect on stakeholder engagement and knowledge integration in transdisciplinary research. Research objectives include the following:

1) Bridge education and communication theory to investigate how RAP may facilitate transdisciplinary work and research.

2) Explore RAP's potential to facilitate and assess stakeholder engagement in transdisciplinary research by examining the communication processes within the SEC research team.

3) Develop stakeholder engagement and accountability indicators for transdisciplinary research teams to reflect upon based on SEC team members' narratives and participant observation experiences. These indicators allow teams to collectively reflect, discuss, and examine the differential needs of stakeholders in transdisciplinary research.

4) Provide principles for applying RAP in transdisciplinary research teams based on SEC team experiences and literature.

5) Provide lessons learned from applying RAP and transdisciplinary research communication within the SEC research team.

The assumptions behind these objectives involves the understanding that SEC's experience in applying RAP may be helpful for other research teams, especially as they develop and negotiate shared meaning across disciplinary and cultural boundaries in transdisciplinary research. This

manuscript has been accepted for publication with the journal Knowledge Management for Development.

Manuscript II: Participatory Mapping and Herders' Local Knowledge of Mongolia's Landscapes and Boundaries

Socio-ecological boundaries delineate landscapes containing natural resources that are differentially accessed and managed by stakeholders. The purpose is to explore Mongolian herders' knowledge of their pasture and boundaries through participatory mapping processes. Research questions include:

1) What boundaries are depicted on herders' participatory maps?

2) How are boundaries discussed in herders' participatory mapping narratives?

Manuscript III. Reflections from the Field: Voice in Cross-Cultural and Transdisciplinary Research

The purpose of this manuscript is to explore the role of voice in transdisciplinary field research. Research objectives include the following:

1) Define the role and facets of voice in transdisciplinary field research.

2) Provide a reflexive ethnographic account of working with a cross-cultural and transdisciplinary field research team.

3) Bridging the literature and ethnographic analyses, examine how voice in fieldwork is shaped by identity, language, financial structures and hierarchy within a transdisciplinary research project.

4) Provide lessons learned and guidance for others practicing transdisciplinary field research and engaging in cross-cultural, team-based projects.

Manuscript Methods and Analyses

Table 1.1 summarizes the methods, data, analyses, and unit of analyses that explicitly states whether local or researcher knowledge is the main focus of investigation in each manuscript. In sum, the first manuscript applies RAP as a knowledge integration tool and examines how researcher knowledge is shared among the SEC core team and Mongolian colleagues. The second manuscript integrates herders' local knowledge through the process and tool of participatory mapping for exploring herders' knowledge of their pastures and associated socio-ecological boundaries. The third manuscript explores the role of voice in transdisciplinary fieldwork and focuses on research experience and knowledge within the SEC team. All three manuscripts apply the SEC project as a case study for examining and applying knowledge integration tools in transdisciplinary research projects. Since each manuscript is a dissertation chapter and has been submitted to separate journal and proceedings outlets, a description of the SEC team is repeated throughout this dissertation.

Table 1.1. Methods for understanding local and research knowledge integration in SEC

Manuscript	Objective	Methods	Data	Analysis	Unit of Analysis & Knowledge class
I. Engagement and Accountability in Transdisciplinary Space: Principles for Facilitating a Reflective Adaptive Process in Complex Teams	To examine how interdisciplinary research teams integrate and communicate their knowledge and epistemologies in transdisciplinary research	In-depth Interviews and Participant Observation	Interview transcripts, SEC team emails, participant observation of events including SEC Annual Meetings, Ecological Training Sessions, household surveys, and ecological surveys	Reflexive iteration of interview transcripts Grounded theory analysis	Researcher Knowledge
II. Participatory Mapping and Herders' Local Knowledge on Mongolia's Landscapes and Boundaries	To explore herder's knowledge of rangeland landscapes and boundaries through participatory mapping	Participatory Mapping with Herders	Field notes, herder narratives about participatory maps	Visual grounded theory of participatory maps and grounded theory of interviews	Local and Researcher Knowledge
III. Reflections from the Field: Voice in Cross-Cultural and Transdisciplinary Research	To explore what influences team member voice while conducting fieldwork in a transdisciplinary research project.	Participant Observation	Field notes and interviews with the SEC field teams	Ethnographic analyses and reflexive iteration	Mongolian Collaborator and Researcher Knowledge

Manuscript Results, Discussion and Conclusion

The results and discussions are expanded upon their respective manuscripts and chapters. The

concluding dissertation chapter involves a summary of findings and implications of each

manuscript.

REFERENCES

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, *26*(3), 413–439.

Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global Environmental Change*, *18*(1), 86–98. http://doi.org/10.1016/j.gloenvcha.2007.07.002

Berkes, 2004. Rethinking Community-Based Conservation. *Conservation Biology*. *18*(3), 621-630.

Berkes, F. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*, *90*(5), 1692–1702. http://doi.org/10.1016/j.jenvman.2008.12.001

Biggs, H. C., Breen, C., Slotow, R., Freitag, S., & Hockings, M. (2011). How assessment and reflection relate to more effective learning in adaptive management. *Koedoe*, *53*(2), 15–27.

Bohensky, E. L., & Maru, Y. (2011). Indigenous Knowledge, Science, and Resilience: What Have We Learned from a Decade of International Literature on Integration? *Ecology and Society*, *16*(4). http://doi.org/10.5751/ES-04342-160406

Child, B., & Lyman, M. W. (2005). Introduction. In *Natural Resources as Community Assets – Lessons from Two Continents*. Washington, D.C.: Sand County Foundation & Aspen Institute.

Creswell, J. W. (2008). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications, Incorporated.

Cummings, S., Regeer, B. J., Ho, W. W., & Zweekhorst, M. B. (2013). Proposing a fifth generation of knowledge management for development: investigating convergence between knowledge management for development and transdisciplinary research. *Knowledge Management for Development Journal*, *9*(2), 10–36.

Edwards, S. E., & Heinrich, M. (2006). Redressing cultural erosion and ecological decline in a far North Queensland aboriginal community (Australia): the Aurukun ethnobiology database project. *Environment, Development and Sustainability*, *8*(4), 569–583. http://doi.org/10.1007/s10668-006-9056-1

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473.

Gobisaikhan, D., & Menamkart, A. (2000). Participatory Monitoring and Evaluation: Lessons and Experiences from the National Poverty Alleviation Programme (NPAP) in Mongolia. In *Learning from Change Issues and experiences in participatory monitoring and evaluation* (p. 274). Intermediate Technology Publications.

Houde, N. (2007). The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. *Ecology and Society*, *12*(2), 34.

Johannes, R. E. (1998). The case for data-less marine resource management: examples from tropical nearshore finfisheries. *Trends in Ecology & Evolution*, *13*(6), 243–246.

Maffi, L., & Woodley, E. (2012). *Biocultural diversity conservation: a global sourcebook*. Routledge.

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin III, F. S., & Redman, C. L. (2008). Epistemological pluralism: reorganizing interdisciplinary research. *Ecology and Society*, *13*(2), 46.

Nadasdy, P. (1999). The politics of TEK: Power and the" integration" of knowledge. *Arctic Anthropology*, 1–18.

Nadasdy, P. (2003). Reevaluating the co-management success story. *Arctic*, 367–380.

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge university press.

Nowotny, H., Scott, P., & Gibbons, M. (2001). *Re-thinking science: knowledge and the public in an age of uncertainty* (p. 12). Cambridge: Polity.

Ross, Sherman, R., Snodgrass, J. G., & Delcore, H. D. (2010). *Indigenous peoples and the collaborative stewardship of nature: knowledge binds and institutional conflicts*. Left Coast Press.

Roux, D. J., Stirzaker, R. J., Breen, C. M., Lefroy, E. C., & Cresswell, H. P. (2010). Framework for participative reflection on the accomplishment of transdisciplinary research programs. *Environmental Science & Policy*, *13*(8), 733–741.

Scoones, I. (1999). New ecology and the social sciences: what prospects for a fruitful engagement? *Annual Review of Anthropology*, 479–507.

Stokols, D. (2008). *The science of team science: assessing the value of transdisciplinary research*. Elsevier.

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple

Evidence Base Approach. *AMBIO*, *43*(5), 579–591. http://doi.org/10.1007/s13280-014-0501-3

Thompson, J. L. (2007). *Interdisciplinary research team dynamics: A systems approach to understanding communication and collaboration in complex teams*. VDM Publishing.

Young, O. R., Berkhout, F., Gallopin, G. C., Janssen, M. A., Ostrom, E., & van der Leeuw, S. (2006). The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change*, *16*(3), 304–316. http://doi.org/10.1016/j.gloenvcha.2006.03.004

CHAPTER TWO

Engagement and Accountability in Transdisciplinary Space: Principles for Facilitating a Reflective Adaptive Process in Complex Teams

Summary

This paper explores how Reflective Adaptive Processes (RAP) may facilitate communication in transdisciplinary research and examine stakeholder engagement across funders, researchers, and research end users. RAP is a change process wherein participants collectively question, reflect, and address challenges facing research and teamwork. I examine RAP through frameworks of reflective inquiry, systems thinking, social and transformative learning, and participative reflection. I introduce the Socio-ecological Complexity (SEC) project to highlight stakeholder complexity, knowledge integration, and potential tensions in transdisciplinary research. Bridging theory and lessons from SEC, I provide stakeholder engagement and accountability indicators for research teams and organizations to reflect and take action. Based on literature and SEC experiences, I provide lessons learned and principles for facilitating RAP across transdisciplinary research teams. These principles may facilitate the communication of transdisciplinary research needs, transformative learning, and the development of outreach action plans for bridging science-management gaps.

Key words: Reflective Adaptive Process, transdisciplinary research, stakeholder engagement

Introduction

Natural resource management problems are experienced, understood, and evaluated differently by diverse stakeholders. Transdisciplinary research may be critical for a comprehensive approach in addressing these problems and engaging diverse interest groups or stakeholders (Klein, 2008; Lang et al., 2012; Stokols, 2006). Transdisciplinary research teams involve researchers from multiple disciplines with the goal of integrating knowledge, language, and methods for developing novel conceptual frameworks (Miller et al., 2008; Roux, Stirzaker, Breen, Lefroy, & Cresswell, 2010; Stokols, 2008). These frameworks have the potential to address societies' complex socio-ecological issues and contribute to greater theoretical and applied knowledge useful across disciplines and various stakeholders (Roux et al., 2010). Transdisciplinary research goes beyond emphasizing researchers as the producers of information and involves collectively managing challenges through the processes of social learning and stakeholder engagement (Miller et al., 2008; Mollinga, 2010; Stokols, 2008). As a result of these processes, disciplinary knowledge may become a shared understanding among different stakeholders with potential to bridge the science-management gap (Pohl, 2005; Roux et al., 2010). The gap involves the separation of managerial applications from the growth of scientific knowledge production, where stakeholders are typically disengaged from the scientific research process (Roux et al., 2010). While transdisciplinary research is not a panacea for engaging stakeholders in the scientific research process, the potential for bridging the science-management gap has attracted funders, researchers, and research end users to transdisciplinary research. Funders such as the National Science Foundation (NSF) attracted inter and transdisciplinary research projects with the capacity for linking the science-management gap and cultivating accountability for engaging diverse stakeholders.

There remains considerable work to be done on applying and evaluating transdisciplinary approaches, particularly engaging stakeholders and integrating the knowledge and needs of funders, researchers, and research end users. Roux et al.'s (2010) framework for participative reflection outlines an application of a reflective adaptive process (RAP); where accountability indicators for bridging the science-management gap are collectively evaluated by research funders, providers, and end users (e.g., policy makers, NGOs, local citizens). Roux et al. emphasizes knowledge integration and communication of stakeholder needs in transdisciplinary research. Building on Roux et al.'s framework, this paper explores how RAP can serve as a tool for transdisciplinary teams to facilitate, apply, and collectively reflect upon or examine stakeholder engagement in transdisciplinary research. First, I bridge education and communication theory to understand how RAP may facilitate transdisciplinary work and research (Figure 2.1). I introduce a research team investigating Mongolian rangeland socio-ecological systems to explore RAP's potential to facilitate and examine stakeholder engagement in transdisciplinary research (Figure 2.2). Then, I provide stakeholder engagement and accountability indicators for transdisciplinary research teams to reflect upon (Table 2.1). These indicators allow teams to collectively reflect, discuss, and examine the differential needs of stakeholders in transdisciplinary research. Our SEC example is a singular narrative of a RAP application and presents stakeholder engagement indicators potentially useful for other transdisciplinary teams. Integrating our SEC experiences and literature, I provide principles for applying RAP in transdisciplinary research teams (Table 2). While these principles do not serve as the blue print for all transdisciplinary teams, they may facilitate transdisciplinary communication and transformative learning. I conclude with lessons learned from applying RAP and transdisciplinary research communication. I anticipate that my findings are helpful for other

transdisciplinary teams as they develop and negotiate shared understandings across disciplinary and cultural boundaries.

RAP Theory and Transdisciplinary Research

RAP is a change process where stakeholders collectively and iteratively question, reflect, and take action on issues and challenges facing their work (Balasubramanian et al., 2010; Stroebel et al., 2005). RAP's core concepts and processes include systems thinking, social and transformative learning, reflective inquiry, and participative reflection (Figure 1). These processes may facilitate the transformation from disciplinary to transdisciplinary research, especially when teams collectively reflect about their study system, roles, and relationships with team members and project stakeholders.

Stokols et al. 2008 discuss the differences among disciplinary, multi-disciplinary, interdisciplinary, and transdisciplinary research. In contrast to interdisciplinary research, transdisciplinary work involves an integrative process where researchers develop novel conceptual frameworks, methods, and languages spanning beyond discipline specific theories and involving practitioners or non-academics, end users, and policy makers at *all* stages of the research (Cummings et al., 2013; Stokols, Hall, et al., 2008). It is possible for researchers to perform transdisciplinary work and yet return to disciplinary research, hence the cyclical process illustrated in Figure 2.1. I bridge Stokol's conceptual framework of transdisciplinarity with RAP tools of participatory reflection and processes of systems thinking, social and transformative learning, and reflective inquiry.
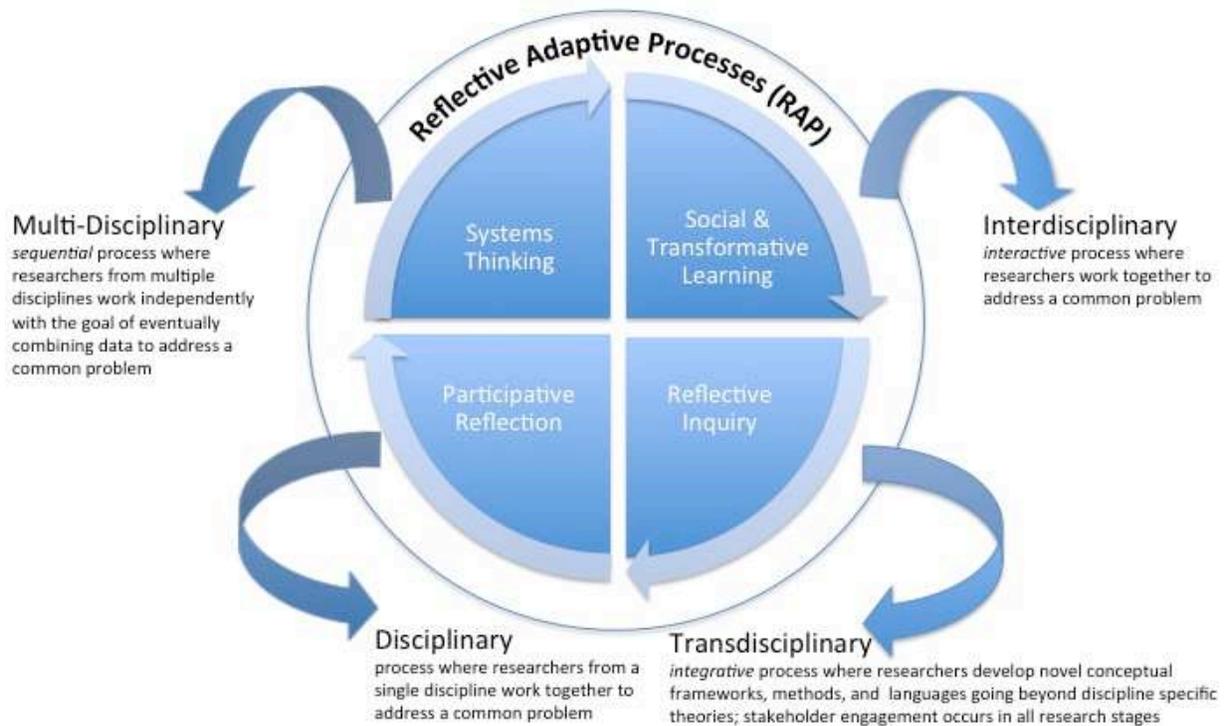
Figure 2.1. Reflective Adaptive Processes is based on social and transformative learning, systems thinking and reflective inquiry that facilitate the transformation from disciplinary to transdisciplinary research and stakeholder engagement (adopted from Stokols, 2008).

Systems thinking is a process for examining the interconnectedness and consequences of change within a system (Cundill, Cumming, Biggs, & Fabricius, 2012; Senge, 1997). RAP involves systems thinking by exploring relationships among research system constructs and facilitating collective thinking. RAP frames teams as complex adaptive systems (CAS) where members relate to one another in dynamic ways influencing team relationships, communication, and research outcomes (Daniels & Walker, 2001; Lissack, 1999; Stroebel et al., 2005).

Social learning builds off systems thinking where teams collectively examine consequences of changing knowledge and management within a system (Keen, Brown, & Dyball, 2005). For transdisciplinary research teams, changing management refers to the

management of teams and study systems (e.g., socio-ecological system). Social learning is a

process of collective reflection through facilitated interaction and dialog among stakeholders

(Keen, Brown, & Dyball, 2005). Through social learning, research team members reflect and

relate their own and others' interests through collaborative deliberation (Daniels & Walker,

2001). Social learning has also been found to foundational in forming communities of practice

and networks, especially as actors adapt and tune their work in achieving their goals (Cummings

& van Zee, 2005).

Muro and Jeffrey (2008) describe transformative learning as a process where individuals

gradually change their perspectives of the world and themselves. This transformation may occur

when individuals are faced with perplexing and uncomfortable dilemmas unexplainable by

current ways of knowing (Muro & Jeffrey, 2008). RAP may facilitate transformative learning,

specifically when the facilitator presents these dilemmas by encouraging group reflection. In this

manner, the facilitator "holds up the mirror" to a research team, reflecting these complex issues

and facilitating group experiential learning (Thompson, 2007). Tangible group experiences lead

to introspection and eventually concerted action and transformation (Kolb, 2005).

Reflective inquiry is also fundamental to the RAP framework. Lyons (2010) describes

reflective inquiry as examining how we think, practice, and engage the socio-political contexts of

our learning to achieve reflective consciousness. I emphasize Freire's (1970) work on the

necessity to actively reflect on the contexts of learning and communicating within a research

team.

Participative reflection is a component of the RAP process where team members are

asked to reflect on their individual and project needs, and take action on issues collectively

evaluated by the team (Roux et al., 2010). The participative reflection process is similar to the

reflection-plan-action cycle that may take place in a meeting or retreat, where collective reflections are shared on what and how team members are currently doing (outcomes and processes) and lessons learned to improve future work (Cummings et al., 2013). While program evaluation often occurs during mid-term or completion of the project, Roux et al. stress that participative reflection involves a combined intent of evaluation and reflection throughout the project to enhance collective understanding, clear purpose, and integrated action among research team members.

Roux et al. develop a framework for integrating participative reflection in the accomplishment and evaluation of transdisciplinary research. The framework includes differing emphases of success and needs of funders, research providers, and research end users as stakeholders in transdisciplinary research. The framework allows these stakeholders or parties to purposefully co-reflect about the progress of transdisciplinary research in a manner that is structured, continuous, and adaptive throughout their research program. In our project I have adopted Roux et al.'s framework to facilitate a participative reflection process, and I contribute stakeholder engagement discussion points and indicators as one of the key components of reflection. Specifically, I highlight the Socio-ecological Complexity (SEC) research team, which includes stakeholder roles crucial for fully examining the impact of transdisciplinary research communication and stakeholder engagement.

SEC Setting, Research Landscape, and Stakeholders

The SEC project is a pseudonym for an actual research project located in a large university in the Western U.S. SEC's research landscape includes the project goal and stakeholders, which includes the funders, researchers and research end users (Figure 2.2). SEC's

goals include examining how climate change influences Mongolian rangeland socio-ecological systems and the role of community-based rangeland management (CBRM) herder groups in Mongolian rangelands' resilience. SEC's main funder is the NSF through a coupled natural-human systems grant. A team of U.S. researchers partnered with Mongolian researchers, herders, and Mongolian policy institutions to examine Mongolian rangeland systems. Research hypotheses and proposal ideas were developed with Mongolian partners and herders in workshops prior to acquiring a NSF grant. Funding from the United States Agency for International Development (USAID) Collaborative Research Support Program and the World Bank helped to develop and deliver ecological training workshops with our Mongolian partners. In SEC, herders, natural resource practitioners, and Mongolian ministries are considered research end users who may apply SEC's research results into rangeland policy and decision-making (depicted as grey polygons in Figure 2.2).
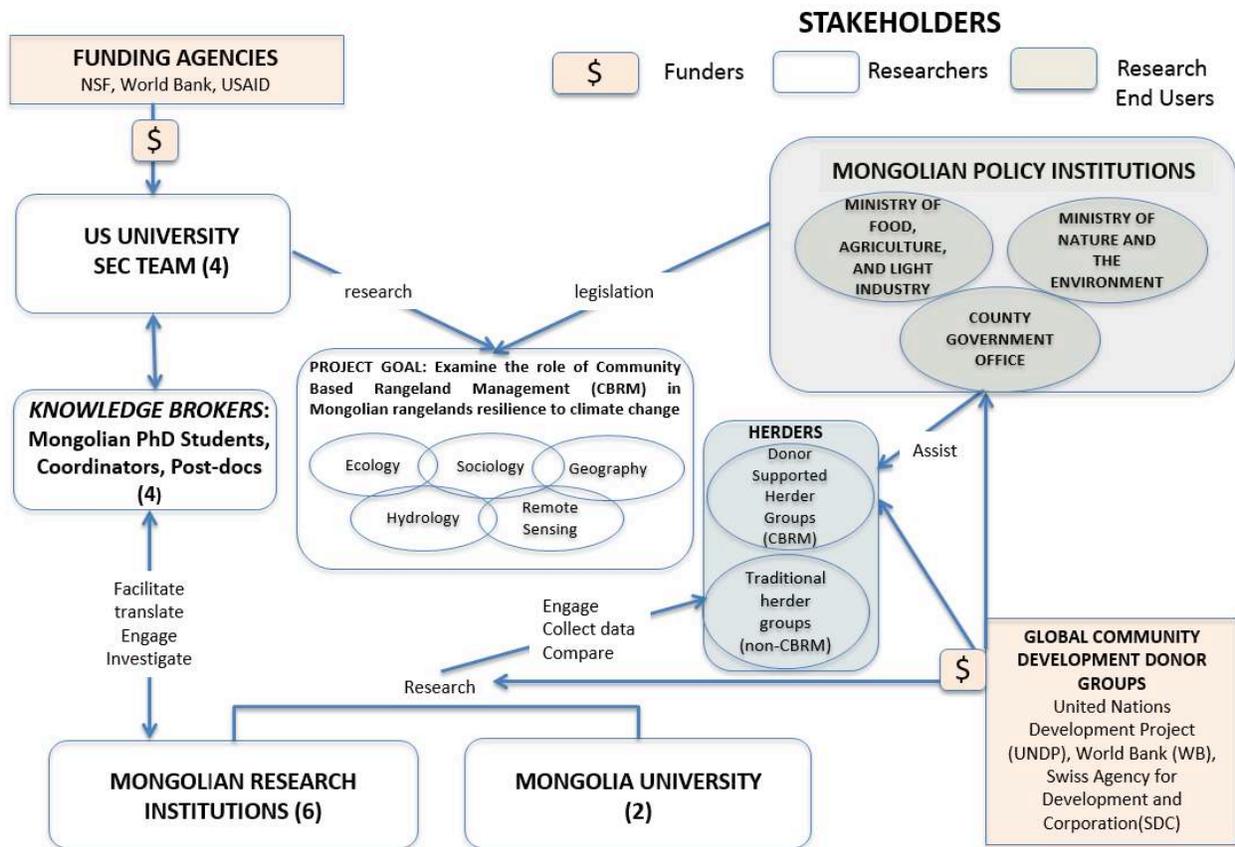
Figure 2.2. Complex socio-cultural research landscape where multiple actors and networks of funders, researchers, and research end users are stakeholders in the knowledge integration processes and outcomes of transdisciplinary research. Peach colors refer to funders, white for researchers, and grey for research-end users. Arrows indicate roles and numbers indicate number of institutions in partnership with SEC.

Researchers in SEC specialize in rangeland ecology, hydrology, geography, anthropology, remote sensing, and environmental communication. These researchers are at various points in their careers, including senior and junior faculty. The SEC team also includes Mongolian postdoctoral and PhD students serving as *knowledge/cultural brokers* and *boundary spanners* who facilitate team communication with Mongolian partners and US researchers

(Figure 2.2). Knowledge brokers and boundary spanners are those who bridge knowledge across disciplinary and cultural boundaries essential for adaptive-capacity building and collaboration (Cheruvelil et al., 2014; Meyer, 2010; Pennington, 2008; Williams, 2002). In SEC, some challenges include integrating knowledge, engaging stakeholders, facilitating accountability in project roles and duties, and sustaining commitment among US and Mongolian researchers. SEC's knowledge brokers address these tensions by translating languages, ideas, and knowledge crucial for project logistics and stakeholder engagement.

SEC's complexity reminds us that knowledge integration does not function in isolation; rather it is embedded in the management of relationships, institutions, and norms. Researchers and practitioners represent different departments and institutions, each with varying resources and norms specific to their department cultures and disciplinary paradigms. For example, many of our Mongolian partners were educated and trained under the Soviet research model, which is much different from the scientific method used in Western research institutions. It is not our purpose to analyze all these stakeholder relationships, but to recognize the role that disciplinary and institutional distinctions play when reflecting on knowledge integration and stakeholder engagement within transdisciplinary and multi-cultural endeavors in research and development.

Methods

This project is part of a larger ethnographic case study, in which I am using qualitative methods to explore, explain and better understand knowledge integration and communication processes within coupled natural-human systems research teams. In this paper, I focus on transdisciplinary team communication, accountability, and stakeholder engagement processes. As a participant observer and researcher with the SEC team, I take part in all team events, such

as writing sessions, monthly meetings, workshops in Mongolia, and social events since the inception of SEC in 2010. The relationships developed during the last four years cultivated camaraderie and trust crucial for gaining emic perspectives of transdisciplinary team communication.

I provided a "Consent to Participate" letter to team members, where I clarified my research intentions, potential products (e.g., publications), and confidentiality limitations, including the possibility of identities being indirectly recognized due to the size and closeness of the team. The PI and all Co-PIs, Mongolian graduate students, and postdoctoral fellows signed this consent to participate form. The team was also aware of my role as a participant observer and my research goals of examining communication and knowledge integration within transdisciplinary research teams. This awareness, I believe, created a communication climate in which team members were encouraged to express their thoughts about the team in personal interviews, emails, and team events. As a participant observer, I am aware of social desirability biases where respondents provide comments believed to be desirable by the researchers. To avoid these biases, I triangulated respondents' comments at team events with follow-up personal interviews and participant observation notes.

Data Collection and Analyses

I conducted four years of participant observation at SEC events including monthly meetings, annual meetings, two summer field seasons in Mongolia, conferences, informal social gatherings, and annual team retreats. SEC team retreats were mostly modeled after Roux et al.'s framework, where facilitators crafted participative reflection sessions that encouraged team

members to reflect and share about their research needs, concerns, and concepts that overlap and relate to multiple disciplines within the team. The SEC Co-PI facilitated the team retreat.

I systematically collected detailed field notes during team events and stored team documents including annual meeting reports, meeting minutes, presentations, and website information in a team database. I also recorded and stored emails and interviews with team members (*n*= 27) in a separate database for maintaining confidentiality and Institutional Review Board standards. Finally, I recorded and transcribed team conversations and field reflections into 584 pages of ethnographic notes.

I have open-coded and re-coded my field notes and transcriptions of meeting minutes and interviews. My analyses involved reflexive iterative processes for examining recurring codes and themes describing SEC communication processes. Reflexive iteration involves revisiting and connecting my data with emerging insights, leading to more polished and refined themes (Srivastava & Hopwood, 2009). Consistent with this paper's purpose, I weave in a selection of themes to illustrate SEC's experiences in participative reflection and engaging stakeholders.

Insights and Discussion

Participative Reflection in Transdisciplinary Research Teams

The interviews revealed participative reflection to be an applicable tool for the SEC research team in integrating knowledge and gaining trust crucial for transdisciplinary research communication. A Co-PI shares his thoughts about participative reflection during the team retreat:

> *It made things come full circle with the social, ecological, and physical data [integration] and started the whole round about of ideas… wow, we could bring this together!… it helped me see other places on the data that I'm working on and what could be helpful as well as how we could answer some questions not placed proposal in the beginning…[The*

team reflections] kept "egos in check" and focused on us working together rather than promoting own ideas…

After coding retreat interviews, I discovered that the PI, Co-PIs and doctoral students shared specific expectations and tensions concerning themes of (1) time commitment to the project, (2) roles and accountability, (3) expertise, (4) translation and cross-cultural communication, and (5) funding concerns. These themes were evident in the reflections of SEC colleagues:

> *I do feel that that there is no recognition of the time commitment demanded and the competition with other activities.*
>
> *Translation is the most challenging and time-consuming business that we need to acknowledge. We might need to be less demanding in requiring things in two languages. At times feel like I've become the default 'expert' on things I know little about. It has pushed me--which is fine--and I've learned quite a lot, but my role is still a little odd*
>
> *It [project] is my major priority and I hoped it would be the opportunity of a career for many of us, but not everyone has the same level of stake in it and this shows in their level of commitment.*

Based on follow-up interviews and participant observation experiences, I found that presenting these themes and tensions in team retreats facilitated deeper reflection on researcher needs, and allowed for transparency and candor among team members. For example, one of the early career Co-PIs publicly shared her challenge on being accountable for project management duties while managing another large NSF project, and her desire to move forward with new and evolving research directions outside of SEC. Instead of being critical to this Co-PI's challenge and conflict, a senior Co-PI empathized with her and mentioned that the early career researcher's candor made her reflect about research directions and juggling her own priorities. The candid sharing of Co-PIs' perspectives during the team retreat provoked other team members to reflect

on their roles. In post-retreat interviews, several team members mentioned similar challenges related to the themes of commitment and individual accountability.

Accountability and Stakeholder Engagement Indicators for Transdisciplinary Teams

Accountability and stakeholder engagement in transdisciplinary research is critical, particularly for addressing societal needs and bridging the science-management gap (Mathur, Price, & Austin, 2008; Pade-Khene et al., 2013; Pahl-Wostl, 2002). Accountability involves not only being responsible for project duties, but also taking ownership over agreed upon initiatives within a transdisciplinary team. Roux et al. (2010) framework for participative reflection includes accountability indicators for transdisciplinary teams to reflect upon and apply in their research project evaluation. However, accountability indicators alone are not sufficient for applying transdisciplinary research that engages and targets diverse stakeholders. Hence, we have developed stakeholder engagement discussion points or indicators for research teams to reflect upon, discuss in participatory reflection sessions, and apply to the evaluation of transdisciplinary research (Table 2.1). These include 1) emic or insider perspectives for engaging stakeholders, 2) stakeholder identification processes, 3) transparency on research interests, 4) time and budget for stakeholder engagement, and 5) outreach and communication efforts for diverse audiences. In my SEC experience, I feature stakeholder choice and identification indicators crucial for being sensitive to "consultation fatigue," where over engaged stakeholders may be consistently interviewed with similar questions by several local and international research groups (Reed, 2008).

Table 2.1. Stakeholder Engagement and Accountability Indicators in Transdisciplinary Research (Adopted from Roux et al., 2010).

Stakeholder Group	Stakeholder Engagement Indicators	Accountability Indicators
Research Funders/ Donors	*Broader Impacts:* Research focuses on societal needs identified by stakeholders *Methods and Stages of Engagement:* Involves stakeholders at initial research stages and informs stakeholders of researcher intentions.	*Sustainability of research programs* includes inter-project learning and student mentoring. Encouraging *discourse* for strengthening relationships Research teams have *flexibility* to change methods within scientific and financial limits. Inputs from research are used to *improve organizational practices.*
Research Providers	*Researchers apply emic perspectives* that are culturally meaningful and relevant to stakeholders (Albrecht, Freeman, & Higginbotham, 1998). *Stakeholders Choice and Identification Process:* Researchers are sensitive to consultation fatigue (Reed, 2008). *Transparency on Research Interests:* Researchers clarify intentions and outcomes. *Appropriate Time and Budget:* Partners and researchers feel that sufficient time and budget is set aside for stakeholder engagement. *Overall Outreach Efforts*: The research team provides sufficient	*Authorship Inclusivity*: Researchers develop transparent guidelines or a protocol for authorship. *Data Sharing*: Protocols for data-sharing are developed, accepted and complied with by *all* research team members. *Capacity building*: Students and researchers are mentored throughout the entire project. *Leadership and facilitation* of time and space to go beyond individual tasks and discuss team experiences in a safe and open environment. *Budgeting contracts and Compensation of Research Partners:* Appropriate budgets and compensation are openly discussed *Commitment: Researchers are committed to the project* during the entire course of the

	time to communicate research to different audiences in appropriate multi-cultural contexts.	research program.
Research end users (e.g., Policy makers, NGOs, citizens)	*Beneficiaries:* Identifying which stakeholders will benefit the most from the research. Trade-offs inevitably exist in identifying beneficiaries. Being transparent about these trade-offs may enable research end users to reflect on and target non-participants appearing to be excluded from the research project. *Bridging the stakeholder-researcher divide:* The presentation of research findings involve culturally appropriate stakeholder engagement strategies. *Integrating Stakeholder Feedback:* Stakeholder perspectives are communicated to researchers for matching research direction with societal needs.	*Adoption and organizational capacity*: Partners have the funding and technical capacity to sustain and conduct research. *Adaptive decision-making and policy revision*: Research end users can incorporate findings into their management plans and policies. *Co-location*: Research partners can host research staff and students for conducting field research.

Our main Mongolian colleague and cultural broker for communicating SEC project logistics shared her thoughts on consultation fatigue:

> *We have to consider one fact that herders and soum [county] officials are not getting happy with so much of data collection, because they are almost getting tired of different kinds of people [other researchers] and projects who come almost every month to collect the same information again and again without sharing the results back and with no benefits to them.*

The team's sensitivity to the tension of consultation fatigue and the willingness to engage stakeholders inspired the discussion of outreach plans and funding. These included a Mongolian nationwide radio talk show and a *soum* book funded by the Center for Collaborative Conservation. The radio show involved dialogue about project intentions and preliminary results on the social outcomes of community-based herder groups in Mongolia. The soum book was written in Mongolian and co-created by SEC Mongolian colleagues, local Mongolian teachers, and herders who partook in SEC ecological training workshops and field data collection. This book showcased local herder observations of rangeland health and hydroclimatic events for each soum, SEC preliminary data, and participatory maps created by local herder groups. The soum book and radio show are the result of SEC's team reflection on engaging our Mongolian research partners and herders as stakeholders within SEC. The stakeholder engagement indicators that I provide may enable other researchers to be sensitive to diverse stakeholder needs and the interrelationships of their research within the larger societal context. Note that SEC's knowledge and cultural brokers such as Mongolian PhD students, postdoctoral fellow, and coordinators facilitate the SEC team to take action on stakeholder engagement and accountability needs within SEC. SEC's knowledge brokers may also facilitate transdisciplinarity and RAP by engaging funder and research-ender users as stakeholders in SEC (Figure 2.1, Table 2.1).

Accountability indicators and discussion points for research providers include challenges of (1) authorship inclusivity, (2) data sharing, (3) capacity-building, (4) leadership and facilitation, (5) budgeting contracts and compensation of research partners, and (6) commitment. I feature these as challenges because I have witnessed tension and the need to co-reflect on these issues as a participant observer in the SEC team. These challenges are evident in the PI's thoughts on authorship:

The other part is authorship and I said that we have to be careful when you are writing … people feel ownership over it…We are going to have some hard conversations on this…that is the reality and we have to be transparent about it…

Underlying these communication challenges are group research norms and trust. I found that the more candid or transparent team communication is, the more individuals are able to openly discuss related issues, such as cultural sensitivity, group acceptability, and consensus for these norms. For example, the SEC team decided to create a formal guideline or "protocol" for authorship and data sharing. In interviews and at team meetings, team members cite the creation of this document and the related discussion as key events that facilitated greater transparency among the team. The discussion at times included direct disagreement about the protocol, particularly when all team members do not agree upon approaches to data sharing. The SEC members share their thoughts on data sharing in a retreat:

We need to be careful about how we behave in terms of gatekeepers to the data…. And that is what we are setting up here… maybe that is the thing we communicate effectively to say yeah, we do have a gate-keeping situation set up here.

We just need to be transparent about our fears and concerns instead of trying to hide it or mask it.

I feel a bit like I am becoming the "bad guy" on some issues—like the data sharing protocol. I sometimes feel that I am being cast as rigid and overbearingly "western" in my approach. This is uncomfortable for me. I agree there is an element of truth. But I also feel that sometimes the "culture card" is played when it is convenient and that no real/genuine effort is made to explore how we could tackle the alternative.

Despite the challenges in these conversations, it was through this conflict, tension and participative reflection that the team members were able to reflect on the social norms reinforced in the team and from external experiences. These collective reflections have lead the team, along with the full support and leadership of the PI to encourage and actively guide our Mongolian colleagues to submit proposals and dedicate a significant portion of our annual workshop in Mongolia for writing scientific proposals. Once proposals were submitted, the SEC PI travelled

to Mongolia and designed a four-day workshop in scientific writing for our colleagues and Mongolian students who participated in our field work. SEC also organized a conference in Mongolia open to international scholars, where SEC team members and local Mongolian students built their capacity in sharing their scientific work and learning about rangeland socio-ecological systems. Budget contracts have been carefully crafted to waive Mongolian student registration fees, obtain local sponsorships, and hire Mongolian firms for conference organization. These actions may reduce cross-cultural communication challenges and instill commitment among the SEC team and our Mongolian colleagues.

Another example of transdisciplinary and cross-cultural communication challenge in SEC is that many team members outside the United States have difficulty accessing the data collected and writing joint publications in the U.S. and Mongolia. These cross-cultural challenges are manifested when interacting with our Mongolian partners who are not fluent in English and were trained within a traditional Soviet scientific framework. Open discussions about data collection processes and methods for analysis sharply differ and fuel productive debate and reflection. This complex cultural scenario poses challenges for the team, especially the PI and our Mongolian project coordinator as knowledge brokers who continually strive to facilitate accountability and commitment among Mongolian partners while maintaining differential U.S. and Mongolian project norms in scientific writing. I highlight these scenarios to acknowledge the diverse ways in which science is approached and negotiated within the team. Examining intra-group differences within a transdisciplinary team sheds light on conflicting norms manifested through data sharing guidelines and communication styles differentially expressed and validated by academic disciplines and cultures. While conflict, tension, and issues of power may be inherent in transdisciplinary research teams, I have found that collectively and openly reflecting on group

research norms such as authorship and data sharing guidelines is essential for achieving sustained commitment, transparency, and trust. These findings corroborate with Turner et al.'s (2015) work highlighting the roles of transdisciplinary tensions and team leaders as they address these tensions through process-oriented and self-reflective management of complex teams.

Principles for Facilitating RAP

Strong transdisciplinary teams require regularly scheduled face-to-face meetings, a facilitator and team leader to initiate open dialogue and reflection (Cheruvelil et al., 2014; Max-Neef, 2005). In complex teams, transformative learning is necessary for creating a shared understanding of the dynamic issues at play (Roux et al., 2010, Lyons, 2010). Facilitating RAP throughout research stages, especially at the initial stage is important for establishing teamwork norms and fostering a shared level of collaboration and commitment among diverse stakeholders. A key principle for facilitating RAP involves encouraging and accepting multiple ways of framing problems in transdisciplinary research. The latter is fundamental for co-creating knowledge and social learning. As Roux et al. posit, "transdisciplinary learning involves the process of participative reflection through the sharing of experiences and ideas with others, leading to co-creation of new understanding and adaptation" (p. 737).

Lessons learned from Roux et al.'s framework for participative reflection and this case study involve the following:

1. Time and emotional energy is essential for gaining consensus among funders, researchers, and research end users.

2. Leaders must be skilled at encouraging team members to share their diverse ways of knowing and viewing the world.

3. Facilitators may apply social learning theories to enhance collective understanding among research teams.

4. Sub-teams are good only if frequent meetings and exchanges among the entire team occur. An integrative framework among sub-teams must be developed and continually communicated in the entire research team to understand how new knowledge relates to complex issues framed by various disciplines.

5. Learning in transdisciplinary teams has costs and is not efficient in an academic sense, particularly when researchers potentially change their ways of doing research to integrate other world views, cultures, and languages within the diverse research team (Goring et al., 2014; Roux et al., 2010). Despite this inefficiency, researchers commit and make the choice to invest in transdisciplinary research because they acknowledge their interdependencies among researchers for developing a holistic view of complex issues. Without this commitment, researchers may come to the realization that new paradigms will not be collectively developed. Researchers may recognize that transdisciplinary research may lessen the science-management gap as stakeholder relationships and research frameworks are collectively developed.

6. Discomfort, tension, and resistance may occur when researchers are faced with changing their mode of thinking, sharing data with individuals from different disciplines, and doing research (Turner, Benessaiah, Warren, & Iwaniec, 2015; Rüegg et al., 2014). However, discomfort may often be an indicator as a team shifts from being multi-disciplinary to being transdisciplinary (Roux et al., 2010). Change, discomfort, and reflection are inherent aspects of learning (Daniels & Walker, 2001; Lyons, 2010) and transdisciplinarity (Turner et al. 2015). Despite this discomfort, researchers thrive on

learning and may recognize that commitment to learning may entail change, critical

discourse, and sharing of diverse experiences and perspectives.

7. Personal team relationships cultivate trust and develop a sense of community moving

   beyond the research effort. These relationships foster candor within a team to bring up

   conflict and project issues, reflect on team accountabilities and collectively come up with

   options for engaging research end users and funders as stakeholders of transdisciplinary

   research.

Applying the lessons learned from my SEC experience, I now summarize guiding

principles for applying RAP (Table 2.2) for other transdisciplinary teams to adopt and adapt.

These principles are also based on theoretical frameworks of social learning, systems thinking,

and reflective inquiry with applications in adaptive co-management and transdisciplinary

research (Biggs et al., 2011). While time and budget limitations make it challenging for funders

and research-end users to develop and attend RAP sessions, discussing stakeholder engagement

during RAP sessions enables transdisciplinary teams to openly acknowledge the role of power

and the research project's influence on diverse stakeholders. Committing time to understand

differing views bridges multiple knowledge systems and promotes a shared understanding of

complex issues and appropriate management options (Armitage et al., 2009; Berkes, 2009; Biggs

et al., 2011).

Table 2.2. Principles for facilitating Reflective Adaptive Processes.

Principles and Strategies	Description and Rationale
Collectively developing a **mission-vision** for a clear **identifiable set of norms, goals, and social interests**	An agreed-upon mission capacitates individuals to efficiently work toward goals shared by the research team and/or organization (Armitage et al., 2009; Stroebel et al., 2005).
Creating and incentivizing **time and space for participatory reflection**	Fostering safe environments and time for reflection allows diverse worldviews to be openly shared within teams and organizations (Biggs et al., 2011; Stroebel et al., 2005). Projects that have little or no in-built space for reflection will not have the capacity to effectively engage in a trandisciplinary learning network (Cummings & van Zee, 2005).
Establishing norms for **conflict management and flexibility**	Standards for conflict management acknowledge that conflict and power differentials inevitably occur in research teams and organizations. Shared standards for conflict management will clarify individual interests, instead of positions that may divide the research team. Flexibility in these standards provides opportunities for individuals to express specific experiences that influence positions and interests (Berkes, 2009; Cheruvelil et al., 2014; Daniels & Walker, 2001).
Bridging and co-producing multiple **knowledge** systems	Integrating different ways of knowing levels enhances holistic views of complex issues. (D. R. Armitage et al., 2009; Berkes, 2009)
Supportive **leadership** and **facilitation**	Supportive leadership facilitates the open discussion of diverse perspectives (Berkes, 2009; Lang et al., 2012; Stroebel et al., 2005).

Democratizing the **distribution of power**	The facilitator redirects control and power among stakeholders to foster the communication of varying interests (Berkes, 2009).
Collective experimentation	Individuals within an organization collectively experiment with methods for understanding complex issues. Collective experimentation engenders group experiences crucial for transformational learning (Berkes, 2009).
Creating **collective cognitive agency, responsibility, and accountability**	Collective cognitive agency involves the capacity of individuals to unify interests and collectively act in sync based on shared experiential learning (Roling & Jiggins, 2001). Individuals are accountable for communicating their interests essential for holistic views of study systems (Berkes, 2009).

Conclusion

The guidelines for facilitating RAP are the result of participative reflection within the SEC team and literature combining theory on RAP and adaptive management (Figure 2.1). These guidelines are presented as principles for facilitating transformative learning and engaging stakeholders crucial in complex teams. Our SEC project probed into how RAP can serve as a tool for transdisciplinary teams to facilitate, apply, and collectively examine stakeholder engagement across funder, researchers and research end users in transdisciplinary research.

Roux et al. (2010) stress that program evaluation should consider reflection on research team achievements in the context of society's needs and goals. The role of participative reflection in transdisciplinary research is critical in fostering social and transformative learning, reflective inquiry, and acquiring a shared understanding of complex issues framed by varied disciplines, stakeholders, and worldviews. Participative reflection as part of RAP allows for adaptive management among stakeholders in transdisciplinary research (Biggs et al., 2011)

Future work could investigate the role of participative reflection on team perceptions of transdisciplinarity, and how these perceptions influence behavior and actual outcomes of transdisciplinary work and stakeholder engagement. Project views, leadership, and team relationships shift as research teams metamorphose from multi-disciplinary to transdisciplinary teams. Further research on the stages of transdisciplinarity is also warranted. What are the engagement strategies that facilitate transdisciplinary research teams to move beyond academic accomplishments (e.g., publishing in high impact journals) and foster practical action that directly changes the way socio-ecological systems are being managed? How can individuals and teams work within their institutional boundaries, and move forward with others to create environments that foster social and transformative learning? Reflecting on these questions allows scholars and practitioners to polish existing methods to match stakeholder needs as teams of funders/donors, researchers, practitioners, and research end users collectively address complex societal and natural resource challenges.

REFERENCES

Albrecht, G., Freeman, S., & Higginbotham, N. (1998). Complexity and human health: the case for a transdisciplinary paradigm. Culture, Medicine and Psychiatry, 22(1), 55–92.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., Diduck, A., Doubleday, N., Johnson, D., Marschke, M., McConney, P., Pinkerton, E., Wollenberg, E. K. (2009). Adaptive co-management for social–ecological complexity. Frontiers in Ecology and the Environment, 7(2), 95–102. doi:10.1890/070089

Balasubramanian, B. A., Chase, S. M., Nutting, P. A., Cohen, D. J., Strickland, P. A. O., Crosson, J. C., Miller, W. L., Crabtree, B. F. (2010). Using learning teams for reflective adaptation (ULTRA): insights from a team-based change management strategy in primary care. The Annals of Family Medicine, 8(5), 425–432.

Berkes, F. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. Journal of Environmental Management, 90(5), 1692–1702. doi:10.1016/j.jenvman.2008.12.001

Biggs, H. C., Breen, C., Slotow, R., Freitag, S., & Hockings, M. (2011). How assessment and reflection relate to more effective learning in adaptive management. Koedoe, 53(2), 15–27.

Cheruvelil, K. S., Soranno, P. A., Weathers, K. C., Hanson, P. C., Goring, S. J., Filstrup, C. T., & Read, E. K. (2014). Creating and maintaining high-performing collaborative research teams: the importance of diversity and interpersonal skills. Frontiers in Ecology and the Environment, 12(1), 31–38. doi:10.1890/130001

Cummings, S., & van Zee, A. (2005). Communities of practice and networks: reviewing two

    perspectives on social learning. Knowledge Management for Development Journal, 1(1),

    8–22.

Cummings, S., Regeer, B. J., Ho, W. W., & Zweekhorst, M. B. (2013). Proposing a fifth

    generation of knowledge management for development: investigating convergence

    between knowledge management for development and transdisciplinary research.

    Knowledge Management for Development Journal, 9(2), 10–36.

Cundill, G., Cumming, G. S., Biggs, D., & Fabricius, C. (2012). Soft Systems Thinking and

    Social Learning for Adaptive Management. Conservation Biology, 26(1), 13–20.

    doi:10.1111/j.1523-1739.2011.01755.x

Daniels, & Walker. (2001). Working through environmental conflict the collaborative learning

    approach. Westport, Conn.: Praeger.

Freire, P. (1970). Pedagogy of the oppressed. Continuum International Publishing Group.

Goring, S. J., Weathers, K. C., Dodds, W. K., Soranno, P. A., Sweet, L. C., Cheruvelil, K. S.,

    Kominoski, J.S., Rüegg, J., Thorn, A.M., Utz, R. M. (2014). Improving the culture of

    interdisciplinary collaboration in ecology by expanding measures of success.

    Frontiers in Ecology and the Environment, 12(1), 39–47. doi:10.1890/120370

Keen, M., Brown, V. A., & Dyball, R. (2005). Social learning in environmental management:

    towards a sustainable future. Routledge.

Klein, J. T. (2008). Evaluation of Interdisciplinary and Transdisciplinary Research. American

    Journal of Preventive Medicine, 35(2), S116–S123.

    doi:10.1016/j.amepre.2008.05.010

Kolb, A. Y., & Kolb, D. A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. Academy of Management Learning & Education, 4(2), 193–212. doi:10.2307/40214287

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M. & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainability Science, 7(1), 25–43.

Lissack, M. R. (1999). Complexity: the science, its vocabulary, and its relation to organizations. Emergence, 1(1), 110–126.

Lyons, N. (2010). Handbook of reflection and reflective inquiry: Mapping a way of knowing for professional reflective inquiry. Springer. Retrieved from http://www.springerlink.com/index/10.1007/978-0-387-85744-2_2

Mathur, V. N., Price, A. D., & Austin, S. (2008). Conceptualizing stakeholder engagement in the context of sustainability and its assessment. Construction Management and Economics, 26(6), 601–609.

Max-Neef, M. A. (2005). Foundations of transdisciplinarity. Ecological Economics, 53(1), 5–16. doi:10.1016/j.ecolecon.2005.01.014

Meyer, M. (2010). The Rise of the Knowledge Broker. Science Communication, 32(1), 118–127. doi:10.1177/1075547009359797

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin III, F. S., & Redman, C. L. (2008). Epistemological pluralism: reorganizing interdisciplinary research. Ecology and Society, 13(2), 46.

Mollinga, P. P. (2010). Boundary Work and the Complexity of Natural Resources Management. Crop Science, 50 (Supplement 1), S–1–S–9. doi:10.2135/cropsci2009.10.0570

Muro, M. (2008). The role of social learning in participatory planning & management of water resources. Retrieved from http://dspace.lib.cranfield.ac.uk/handle/1826/3513

Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. Journal of Environmental Planning and Management, 51(3), 325–344. doi:10.1080/09640560801977190

Pade-Khene, C., Luton, R., Jordaan, T., Hildbrand, S., Gerwel Proches, C., Sitshaluza, A., Dominy, J., Ntshinga, W., & Moloto, N. (2013). Complexity of Stakeholder Interaction in Applied Research. Ecology and Society, 18(2). doi:10.5751/ES-05405-180213

Pahl-Wostl, C. (2002). Participative and stakeholder-based policy design, evaluation and modeling processes. Integrated Assessment, 3(1), 3–14.

Pennington, D. D. (2008). Cross-disciplinary collaboration and learning. Ecology and Society, 13(2), 8.

Pohl, C. (2005). Transdisciplinary collaboration in environmental research. Futures, 37(10), 1159–1178. doi:10.1016/j.futures.2005.02.009

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. Biological Conservation, 141(10), 2417–2431. doi:10.1016/j.biocon.2008.07.014

Roling, N., & Jiggins, J. (2001). Agents in Adaptive Collaborative Management: The Logic of Collective Cognition. In Biological diversity balancing interests through adaptive collaborative management (p. 145).

Roux, D. J., Stirzaker, R. J., Breen, C. M., Lefroy, E. C., & Cresswell, H. P. (2010). Framework for participative reflection on the accomplishment of transdisciplinary research programs. Environmental Science & Policy, 13(8), 733–741.

Rüegg, J., Gries, C., Bond-Lamberty, B., Bowen, G. J., Felzer, B. S., McIntyre, N. E., … Weathers, K. C. (2014). Completing the data life cycle: using information management in macrosystems ecology research. Frontiers in Ecology and the Environment, 12(1), 24–30. doi:10.1890/120375

Senge, P. M. (1997). The fifth discipline. Measuring Business Excellence, 1(3), 46–51.

Stokols, D. (2006). Toward a science of transdisciplinary action research. American Journal of Community Psychology, 38(1), 63–77.

Stokols, D. (2008). The science of team science: assessing the value of transdisciplinary research. Elsevier.

Stroebel, C. K., McDaniel, R. R., Crabtree, B. F., Miller, W. L., Nutting, P. A., & Stange, K. C. (2005). How complexity science can inform a reflective process for improvement in primary care practices. Joint Commission Journal on Quality and Patient Safety, 31(8), 438–446.

Thompson, J. L. (2007). Interdisciplinary research team dynamics: A systems approach to understanding communication and collaboration in complex teams. VDM Publishing.

Turner, V. K., Benessaiah, K., Warren, S., & Iwaniec, D. (2015). Essential tensions in interdisciplinary scholarship: navigating challenges in affect, epistemologies, and structure in environment–society research centers. *Higher Education*. doi:10.1007/s10734-015-9859-9

Van Asselt Marjolein, B. A., & Rijkens-Klomp, N. (2002). A look in the mirror: reflection on participation in Integrated Assessment from a methodological perspective. Global Environmental Change, 12(3), 167–184.

Williams, P. (2002). The competent boundary spanner. Public Administration, 80(1), 103–124.

CHAPTER THREE

Participatory Mapping and Herders' Local Knowledge on Mongolia's Landscapes and Socio-ecological Boundaries

Summary

Socio-ecological boundaries delineate cultural landscapes containing natural resources that are differentially accessed and managed by different stakeholders. These socio-ecological boundaries may be human-demarcated and biophysical serving as material and non-material features delineating landscapes. . Our purpose is to explore Mongolian herders' knowledge of their home pasture and socio-ecological boundaries. Our research questions are: 1) what boundaries are depicted on herders' participatory *maps*? and 2) how are boundaries discussed through herders' participatory mapping *narratives*? We conducted participatory mapping and informal interviews (n= 35) with herder groups and local government officials across four ecological zones in Mongolia: desert steppe, mountain steppe, forest steppe, and steppe. Narratives during the participatory mapping process and interviews were qualitatively coded applying visual grounded theory. Biophysical boundaries drawn on participatory maps included economic, hydroclimatic, geomorphological, and ecological boundaries portrayed as springs, landforms, and vegetation types. Non-physical boundaries such as governance arrangements were evident in participatory mapping narratives and served as human-demarcated boundaries for accessing seasonal camps, livestock markets, government assistance, resources for inter- and intra-county migration. Herder mobility and governance were the most common themes discussed during participatory mapping narratives and informal interviews with local government (soum) officials. Herder mobility involves adaptive practices influenced and

facilitated by governance, hydroclimatic, geomorphological, and ecological boundaries. The relationships among herder mobility, adaptive practices, governance boundaries, and biophysical pasture boundaries are coupled and dynamic, resulting in multi-dimensional outcomes of herder livelihood sustainability and pasture condition. Different pasture boundaries play diverse and integrated roles in influencing herder movement and sustaining herding livelihoods. The dynamics among these boundaries highlight the local meanings of Mongolian rangelands and recognize the significance of local worldviews crucial for knowledge integration in socio-ecological research.

Introduction

Livelihoods and adaptive practices are shaped by the intersection of ecological and socio-political boundaries, institutions, and access to natural resources (Buzinde & Manuel-Navarrete, 2013; Carlile, 2004; Ostrom, 2009; Strayer, Power, Fagan, Pickett, & Belnap, 2003). The efficacy and outcomes of conservation and natural resource management are shaped by socio-political and ecological boundaries that characterize landscapes and determine ownership, territory, and governance (Dallimer & Strange, 2015). These boundaries, hereby called socio-ecological boundaries, delineate landscapes containing natural resources that are differentially accessed and managed by diverse stakeholders.

Examining socio-ecological boundaries integrates local ecological knowledge and practices, and enables researchers to acquire a systems view for investigating complex socio-ecological research questions useful for effective decision-making and policy (Barham, 2001). Paasi (2009) emphasizes that socio-ecological boundaries do not only consist of mere physical lines representing "calculative territory" and ecosystems, but rather social practices created by

cultural, political, and economic institutions. Investigating how socio-ecological boundaries are perceived, managed, and transformed by stakeholders and institutions is crucial to achieving conservation and adaptive management goals (Buzinde & Manuel-Navarrete, 2013; Dallimer & Strange, 2015; Fernández-Giménez, Batkhishig, Batbuyan, & Ulambayar, 2015). This paper explores Mongolian herders' perceptions and world views of their pastures and socio-ecological boundaries.

Mongolia's vast landscape and diverse ecosystems have been dynamically influenced by wildlife and livestock grazing for over 2,000 years, creating a mosaic of social and ecological boundaries (Endicott, 2014). These boundaries are tightly coupled with livelihoods and adaptive practices embedded in pastoral sense of places, changing political regimes, markets, and access to natural resources (Armitage et al., 2009; Batkhishig Baival & Fernández-Giménez, 2012; Fernández-Giménez et al., 2015; Murphy, 2014). Local Ecological Knowledge (LEK) influences pastoral perceptions of their pastures and consequently adaptive practices or behaviors that reproduce these rangeland boundaries. Combining the concepts of LEK and socio-ecological boundaries, we apply participatory mapping methods (Laituri, 2011) to explore Mongolian herders' LEK of their pastures and views of landscape features and boundaries deemed important to herders. Specifically, we examine the following research questions: 1) what boundaries are depicted on herders' participatory maps? 2) how are boundaries discussed through herders' participatory mapping narratives?

Our research questions are embedded within the Socio-ecological Complexity project (SEC), which investigates the role of community-based rangeland management and climate change in Mongolian rangelands. SEC is a pseudonym for an actual research project based at a large university in the Western United States. SEC applies socio-ecological methods including

household surveys, focus groups, interviews, ecological sampling, remote sensing, and hydroclimatic modeling. Our study applies participatory mapping methods to incorporate herders' local knowledge and emic views of the pastures. Herders' views of their pastures reveal how socio-ecological boundaries influence adaptive practices and community-based rangeland efforts in Mongolia.

We focus this paper on donor funded formally organized community-based rangeland management (CBRM) herder groups and non-donor funded traditional herder groups in Mongolia examined by the SEC project. We first describe socio-ecological boundaries and then provide the CBRM context in Mongolia. We also highlight the integration of local knowledge as a crucial aspect of examining adaptive practices that produce socio-ecological boundaries in Mongolian rangelands. In our results and discussion section, we describe the boundaries conveyed on participatory maps and narrated by herder families and local government officials. We conclude with the applications and significance of socio-ecological boundaries in CBRM research and donors supporting herder groups and their livelihoods.

Socio-ecological Boundaries

Socio-ecological boundaries may be comprised of human-demarcated and biophysical boundaries. Human-demarcated boundaries involve patterns of human behavior that characterize socio-ecological systems (Zastrow & Kirst-Ashman, 2006) . These human-demarcated boundaries may establish the separation among ecological, socio-economic, and political spaces (Newman, 2003; Sternlieb, Bixler, Huber-Stearns, & Huayhuaca, 2013). For example, human-demarcated boundaries such as fences and political borders may demarcate specific areas with ecological and socio-economic resources managed by distinct individuals and institutions. These

boundaries may also influence behavior of individuals and arrangements for accessing natural resources (Dallimer & Strange, 2015).

Human-demarcated and biophysical boundaries may be both material and non-material influencing the ability of individuals to visualize and map certain boundaries as well as comprehend the meaning behind these boundaries. Examples of material biophysical boundaries include visible rangeland vegetation communities (Stayer et al., 2003). Material or physical boundaries that are human-demarcated include those than can be visualized and clearly delineate certain areas in a landscape. Non-material human-demarcated boundaries such as cultural norms or unwritten rules that dictate herder group membership and access to resources are less visible and are potentially less tangible to individuals. These non-material human-demarcated boundaries may be considered fuzzy, particularly when spatial boundaries around resources are permeable and rules for accessing resources are negotiable among community-based herder groups (Fernández-Giménez et al., 2015). These boundaries involve governance arrangements and institutions that set the context for CBRM in Mongolia. We define governance as the processes and structures by which stakeholders make decisions and share power (Folke, Hahn, Olsson, & Norberg, 2005; Juda, 1999; Ostrom, 2007). Institutions are the formal and informal rules among herder groups that dictate grazing practices and reproduce a mosaic of rangeland boundaries in the landscape.

Boundaries and Community- based rangeland management context in Mongolia

Community- based rangeland management (CBRM) institutions include herder groups employing formal community-based activities facilitated by local non-governmental organizations (NGOs) or development agencies and funded by global donors. Some of these

activities involve collectively sharing pasture resources through formal agreed-upon rules as well as informal rules for grazing. Mongolia transitioned from a socialist to a market-based economy in 1992, where all collective assets were privatized and state herding collectives were dismantled (Fernandez-Gimenez, 1999). Since 1999, donors have established over 2000 formal CBRM herder groups to address pasture degradation and livelihood challenges in Mongolia (Mau & Chantsallkham, 2006). Capacity-building and community-based activities for operating in a market-based economy, such as livelihood assistance programs, are provided to herders by global community development donors.

A common approach to applying CBRM is developing and facilitating the formation of herder groups implemented by various donors and development agencies (Addison et al., 2013). Within the SEC project, we distinguish formal CBRM herder groups from traditional non-CBRM herder groups as those that receive that receive support (e.g., facilitated training workshops) from donors. Development agencies apply various terms for these herder groups and distinguish these donor- funded herder groups from traditional herding groups that cooperate in livelihood strategies without the involvement of donors or other external agents (Addison et al., 2013). For example, some donors such as the Swiss Development Corporation (SDC) facilitate the formation of herder groups called Pasture User Groups (PUG). SDC apply territory-based approaches where all herders within a territory are organized as a PUG.

In this case, herders' PUG participation is not 100% voluntary, but rather determined by funders and project approaches that designate a territory with specific boundaries allocated for grazing. This territory-based approach involves spatial socialization where individual actors and collectives are socialized or grouped as members of specific territorially bounded entities such as designated areas for grazing (Paasi, 2009). Some donors such as SDC and World Bank apply

participatory mapping approaches in determining grazing territories (Mau & Chantsallkham, 2006). The preparation of pasture management plans (PMP) is required from the PUG. PMPs regulate pasture resting, well management, seasonal rotations and the fencing of haymaking areas (Dorligsuren, Batbuyan, Densambu, & Fassnacht, 2012). Associations of PUGs (APUGs) are NGOs trained and initiated by donors. APUGs and PUG leaders negotiate and facilitate pastoral movements of non-PUG members in and out of their designated pasture boundaries (Olonbayar, 2010). PUGs form and agree on land-use contracts with *soum* (county) and *bag* (smallest administrative unit) governors requiring herders to rest spring and winter pastures (Dorligsuren et al., 2012). Winter pastures are crucial for livestock to survive harsh winters, particularly with the provision of sufficient warmth and protection from wind (Murphy, 2011). Spring campsites are important for serving as birthing centers providing warmth for newborn livestock (Murphy, 2011). The resting of spring and winter camps formally stated in land use contracts has helped alleviate conflicts and social boundaries between PUG and non-PUG members (Dorligsuren et al., 2012). The creation of new territorial boundaries based on PUG land use contracts inevitably influences the existing human relationships, norms, and boundaries on pastures (Fernandez-Gimenez, 2002). For example, violations of an informal agreement (e.g., conversations) between herder groups to rest a winter pasture may result in conflict with negotiable sanctions on the herder who violated the agreement. However, formalizing agreements through land use contracts with the support and oversight of local governments legitimizes rules that set and delineate boundaries and territories within pastures (Dorligsuren et al., 2012).

PUGs, APUGs, Pasture Management Plans (PMPs), and land use contracts formalize rules and agreements within community-based herder groups. The formalization process within

community-based herder groups involves elements of governance and institutions that produce boundaries at specific or finer spatial scales of herders' pastures. For example, pasture management plans co-developed by herder groups and local governments stipulate rules specific to certain PUG territories, reflecting the finer spatial scales at which pastures are managed. These arrangements and institutions in turn shape adaptive practices and grazing in cultural landscapes.

Local Knowledge, Sense of Place and Adaptive Practices

Mongolia's cultural landscape involves adaptive practices shaped over changing environments as well as institutional and political regimes. Adaptive practices also involve strategies, sense of places, and decisions that enable individuals to persist and sustain their livelihoods during current change or shocks (Fernández-Giménez et al., 2015; Mearns & Norton, 2010). Herders' senses of places such as *nutag* and *otor* highlight relationships with land, practices, kinship, cultural beliefs, and identity (Cross, 2001). *Nutag* is a term that encompasses herder worldviews and mindsets about home pastures, customary migratory territories, indigenous knowledge and herders' ties to nature (Baival, 2012; Murphy, 2011). *Otor* refers to long-distance movements of herders with their livestock to specific pastures reserved for animal fattening (Dorligsuren et al., 2012). Otor is also an adaptive strategy for escaping drought and severe winter storms called *dzud*. *Otor* and *nutag* are interlinked with herders' local ecological knowledge and experiences shaped by herders' pasture access rights and land tenure (Fernandez-Gimenez, 1999).

Socio-ecological boundaries are interlinked with *otor* and *nutag*, especially when herders respect the boundaries of grazing areas and winter camps registered to a specific herding family. Emotional meanings to one's *nutag* provide the basis for herders and their families'

understanding and relation to their pastures. Thus, *nutag* may be a shared understanding and commitment to stewarding rangeland systems with intersecting human-demarcated and biophysical boundaries. Baival (2012) recommends a *nutag* framework to donors and NGOs, where local ecological knowledge and indigenous adaptive practices are incorporated into pasture management plans and land use contracts. The *nutag* framework is about a process and language that may bridge the external donor knowledge with the local knowledge. This framework and approach uses local herders' world views as the starting point for discussions in sustaining rangelands. This framework may also guide participatory research tools, such as participatory mapping for examining the role of socio-ecological boundaries in herders' adaptive practices and livelihoods.

Methods

Study Site Description

Study sites were selected within SEC research locations and represented diverse ecological zones (Figure 3.1). These sites were located in six counties or *soums*: Ikh Tamir in Arkhangai province or *aimag*, Undurshireet in Tuv *aimag*, Tsagaan Ovoo and Sergelen in Dornod *aimag*, and Saikhandulan and Altanshiree in Dornogovi *aimag*. These *aimags* occurred in the forest steppe, steppe, and desert steppe ecological zones respectively. The ecological and physical landscapes in our study sites represented a diversity of pasture resources that are differentially accessed, negotiated and shared among herder families, community-based herder groups, and local governments. Understanding these complexities from varying ecological and social perspectives influenced the research team approach to applying the participatory mapping process. Our research team was composed of two Mongolian researchers, one American

professor, and a Filipina-Spanish PhD Candidate. Our senior Mongolian researcher has had over 10 years of experience working with the herder groups involved in our study.
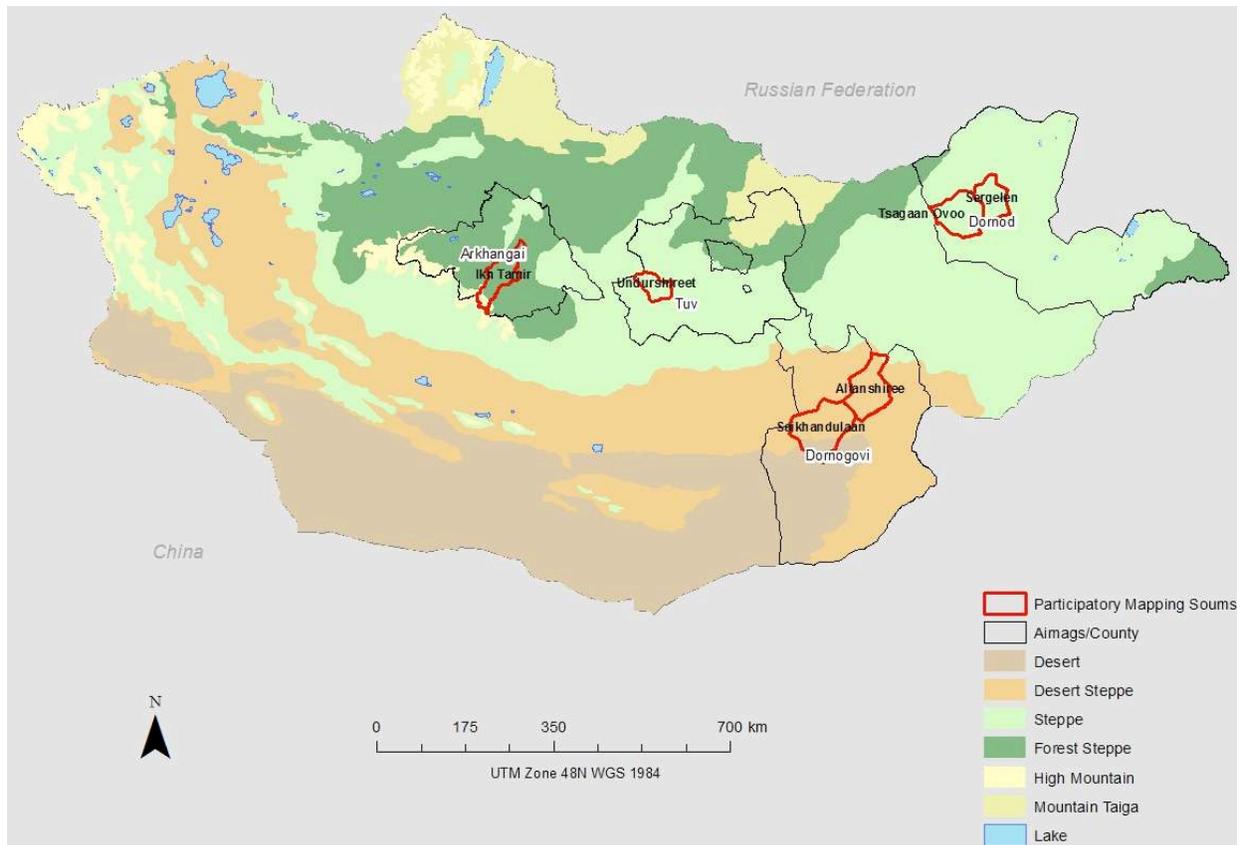
Figure 3.1. Participatory mapping study sites.

Qualitative Participatory Mapping Process

Qualitative participatory mapping focuses on stakeholders' narratives as they draw and discuss their places of significance (Gadamus & Raymond-Yakoubian, 2015). The focus of participatory mapping narratives over the ultimate production of Geographic Information System (GIS) maps involves the prevention of map misuse, and avoidance of maps with rigid boundaries, static features, and poor representation of indigenous territories (Fox, Suryanata, Hershock, & Pramono, 2008; Laituri, 2011; Wainwright & Bryan, 2009). Gadamus and

Raymond-Yakoubian (2015) found that it was more efficient to examine participatory map context by focusing on participant narratives than to try to represent all knowledge (e.g., indigenous and researcher knowledge) through maps. Because our research questions concerned participatory map content and how herders discussed their pastures and boundaries, it was appropriate to focus on herders' participatory mapping narratives to reveal the socio-ecological boundaries and local knowledge (Figure 3.2). Mapping and narratives are a recursive process that encourages reflection necessary for empowerment and adaptive management (Gadamus & Raymond-Yakoubian, 2015). Narratives occur at two critical junctures in the participatory process: 1) while maps are drawn and 2) when maps are shared. These narratives are often not explicitly included in analyses of maps, yet provide the context for what is mapped and why certain features mapped.
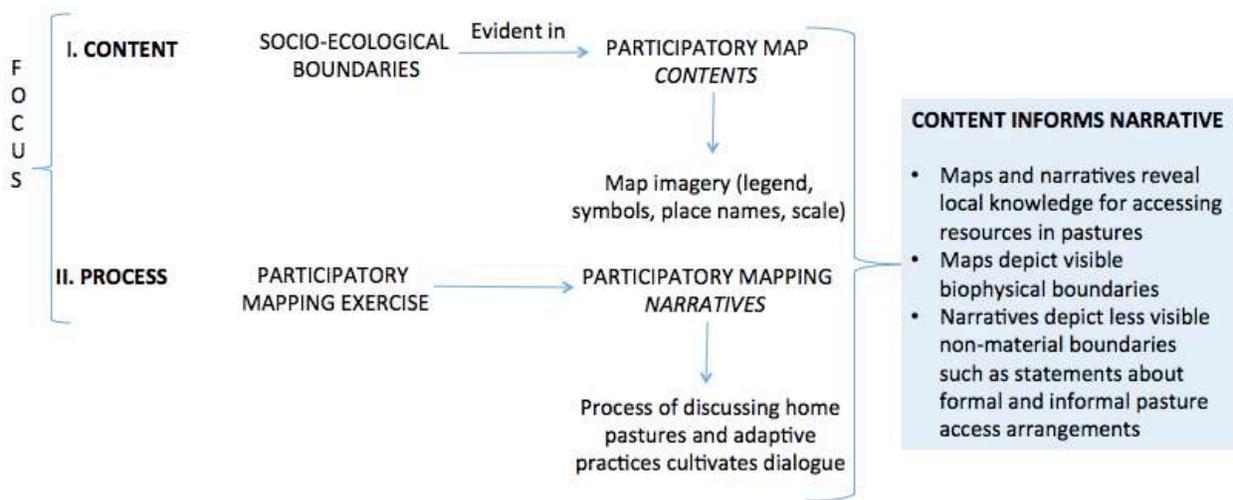
Figure 3.2. Methods focused on analyzing participatory map content and narratives to reveal the socio-ecological pasture boundaries and adaptive practices maintaining landscapes and territories.

Mapping territories and herder group boundaries were not new processes for herder groups visited in our June 2012 and 2013 field seasons. This was evident when our research team observed the numerous Geographic Information System (GIS) maps of herder group boundaries or territories displayed in the Pasture User Group (PUG) center of each *soum*. Our research team's purpose was to not map the PUG or herder group boundaries per se, but to explore herder world views about their pastures and boundaries important to herder families. After the Institutional Review Board approval to conduct our study, we first requested permission from herder leaders to participate in our mapping activities while being transparent about research intentions and aims. Once we were granted permission, we visited the herder group leader's home yurt or *ger* and introduced ourselves through our senior Mongolian research team member.

After personal introductions with herders' families, we requested the herders and their families to draw the pastures and places of significance for them. We handed them a blank piece of white butcher paper and colored pens, on which family members and neighbors drew their pastures and determined their legend, extent and scale of their map. We also emphasized that there was no right or wrong way of making the map and that we were grateful for their insight and stories about their maps. The creation of the maps took between 20-30 minutes as herder participants shared and negotiated the representation and visualization of their pastures. After participants created their maps, stories and views about their pastures were shared. Participants and researchers engaged in conversations about their pastures, especially as we asked questions of why certain places were important to participants. Likewise, participants asked us about our intentions and even personal lives. As participant observers, we considered these conversations important for developing relationships and simultaneously learning about herder world views about their pastures and boundaries imbedded in their landscapes and herding practices.

Data Sources and Analyses

Data sources included the content of the participatory (PAR) maps, herder narratives and informal interviews with herder group leaders, environmental officers, and Association of Pasture User Group (APUG) representatives (n= 35). We had six herder groups take part in our participatory mapping sessions, with four herder groups funded by donors (CBRM) and the remaining two not funded by donors (non-CBRM) (Table 3.1). While it is not our purpose to compare CBRM and non-CBRM herder groups, we recognize that donor approaches differ in facilitating community-based activities practiced by herder groups.

Table 3.1. Herder group participants in PAR mapping.

Herding Group*	Donor Funded?**	Location	
		Aimag	*Soum*
1	Yes (CBRM)	Arkhangai	Ikh Tamir
2	No (CBRM)	Tov	Undurshireet
3	No (non-CBRM)	Dornod	Tsagaan ovoo
4	Yes (CBRM)	Dornod	Sergelen
5	No (non-CBRM)	Dornogovi	Saikhandulaan
6	Yes (CBRM)	Dornogovi	Altanshireet

* Herding group names are replaced with numbers to honor their anonymity
** CBRM refer to community-based groups funded by donors or development agencies. Non-CBRM groups refer to traditional herding groups that cooperate in livelihoods without the help of donors.

Herders' narratives during the participatory mapping process enabled the researchers to move beyond the content of the map, and delve into "social processes of visualization" underlying the content of the map (Konecki, 2011, p.159). Konecki (2011) emphasizes these social processes of visualization as significant data slices comprising multi-layered visual data. For example, the PAR map is a visual product depicting content useful for examining our

research question. However, herders' narratives during the PAR map-making process reveal emic perspectives that provide significance to the visual objects and symbols conveyed on their maps. Herders' narratives are supplemented by informal conversations/interviews with herder families and APUG representatives about their pastures and herding practices. Field notes captured translated narratives, informal interviews, and personal observations of the participatory mapping process. These field notes were triangulated among research team members, including our Mongolian researchers who wrote their field notes in Mongolian and translated these to English.

Participatory maps and herder narratives were qualitatively coded using grounded theory and visual grounded theory respectively (Konecki, 2011; Strauss & Corbin, 2007). Grounded theory includes the process of generating codes from qualitative data where recurring patterns, themes, codes, and a general theory emerge. Visual grounded theory concentrates on slices of visual data (i.e., maps) and involves multi-slice imagining with the assumption that visual data are multi-layered (Konecki, 2011). Similar to grounded theory, visual grounded theory involves constructing categories (open coding), memo writing, selective coding, theoretical memo writing, comparative analyses of images for validating relationships among codes, and theoretical sampling for answering research questions (Konecki, 2011).

The combination of visual grounded theory for participatory maps and grounded theory for herder narratives and informal interviews allowed for a greater examination of the context and content behind the participatory mapping process with Mongolian herders. These combined analyses provided the opportunity to consider participatory mapping as a tool and process of integrating local knowledge into the SEC project.

Methodological Limitations

Limitations include language differences and translation of narratives and informal interviews. Since two out of the four researchers in our team were not fluent in Mongolian, all conversations were translated through our Mongolian team members. Framing and interpreting questions about pasture boundaries inevitably has its limits. For example, our Mongolian colleague mentioned that there are five Mongolian words referring to boundary: *xil* (border)*, zaag* (line between two or three people's territory; line; boundary)*, hitzgar* (boundary limit)*,* and *xuree* (enclosed area within a boundary). This highlights the importance of using culturally appropriate words for framing questions associated with boundaries. To address these limitations, the research team discussed interpretations of herder narratives and informal interviews on a daily basis. We verified the content of herders' maps with several SEC Mongolian researchers with extensive work experience in our study sites. Finally, we triangulated generated codes from field notes and maps with literature on CBRM and pastoral mobility in Mongolia.

Results and Discussion

Participatory Maps and Views of Boundaries

Boundaries depicted in herders' maps included biophysical and human-demarcated boundaries of their *nutag* and their pasture resources. We consider these as material boundaries since these physically delineate areas or territories belonging to their kin and/or herder group. These boundaries can be further categorized into economic, ecological, hydro-climatic, geomorphological, and spiritual (Box 3.1).

Box 3.1. Material/Physical Boundaries Depicted on Participatory Maps

Economic: seasonal shelters & camps, roads (paved, unpaved, mining), wells

Ecological: vegetation communities, grass species (palatable and unpalatable species)

Hydro-climatic: rivers (ephemeral and permanent), springs, lakes

Geomorphological: valleys, peaks, ridges, hills, slope, aspect.

Spiritual/Cultural : ovuu (sacred cairns often on mountain peaks marking religious sites)

Economic boundaries included seasonal camps, hand and mechanized wells, and roads While these are points and lines depicted on herders' maps, we consider these as economic boundaries since they delimit specific areas that influence herder movement to ensure the sustainability of their livestock and livelihoods. These economic boundaries may be visible and tangible to herders since these depict and separate assets or pasture resources observable on the landscapes. For example, winter shelters are visible on a landscape and symbolize ownership and possession or exclusive rights of resources in the surrounding winter camp. Herders return every year to their winter shelters and camps essential for the survival of their livestock. Tightly coupled with economic boundaries are plant communities, which mark ecological boundaries that delineate suitable pastures for certain types of livestock. Specific vegetation such as palatable grass species for certain livestock distinguishes pastures and influences forage quality significant for sustaining livestock types. For example, a herder whose livestock is mainly comprised of sheep will graze in pasture with grass and forb species palatable for sheep. This herder will generally not mind if other herders graze their camels with preferences of shrubs that are unpalatable to sheep. Palatability and functional groups of vegetation (grasses, sedges, forbs, & shrubs) were depicted on herders' maps and served as ecological boundaries for influencing

access to pastures. Herders' local knowledge on locations of palatable grass species for livestock was consistently conveyed in herder's maps and was noteworthy in determining pastures deemed suitable to herders with a certain livestock composition.

Geomorphological, hydro-climatic, and economic boundaries are interlinked, mainly since these influence placement of and access to seasonal camps and shelters crucial for livestock and herder movement. For instance, the placement of winter camps and shelters is partially influenced by geomorphological and hydro-climatic boundaries in rangelands. Geomorphological boundaries such as leeward areas of valleys are ideal sites for winter camps because they shelter livestock, and therefore are valued economic assets for herding families. Mountain peaks or passes are marked by sacred cairns called *ovoos* and signify the crossing of geomorphological and spiritual boundaries where pastoral migrations and Buddhist celebrations occur. Natural springs serve as hydro-climatic boundaries because they delineate water access points for livestock and drive the seasonal movement and placement of winter camps and shelters. Acquiring winter shelters is mainly driven by inheritance, usually by the senior herder (Fernandez-Gimenez, 2002). Winter shelters serve as economic boundaries and are assets that can be owned, bought, and sold by families (Fernandez-Gimenez, 2002). Access to winter shelters and reserve pastures especially in times of natural disasters such as *dzuds* involve herders from other *soums* and PUGs crossing political or administrative boundaries to access resources (Fernandez-Gimenez, Batkhishig, & Batbuyan, 2012).

Accessing reserve pastures and other pasture resources requires formal and informal/ traditional arrangements for crossing political boundaries. These arrangements serve as non-material human-demarcated boundaries evident in participatory maps and narratives (Box 3.2). Non-material human-demarcated boundaries are those without material structures that separate

grazing territories and dictate access to pasture resources and markets. These boundaries are often in the form of agreed upon arrangements or contracts such as pasture management plans. Narratives of *otor* and *nutag* were classified adaptive/sense-of-place boundaries since these were embedded in traditional practices that create and reproduce human-demarcated boundaries. The following section further dissects herders' narratives of boundaries, traditional practices, and agreed upon arrangements for accessing pasture resources.

Box 3.2. Non-material Human-demarcated Boundaries

<u>Political/administrative</u>- *bagh* (subdistrict)*, soum*, and *aimag* boundaries, PUG territories

<u>Formal Agreements</u>- winter camp access, pasture management plans

<u>Migratory</u>- seasonal movement, inter-*soum* migration

<u>Adaptive/Sense of Place</u> - *nutag, otor*

Narratives of Human-demarcated Boundaries

Herders refer to non-material human-demarcated boundaries when they discuss arrangements and contracts for mobility and grazing. These formal and informal arrangements include processes and contracts that influence how pasture resources are accessed, allocated, and used (Juda, 1999; Folke et al. 2005; Murphy, 2014; Ostrom 2007), and therefore serve as *governance boundaries*. Moreover, these arrangements involve rules and norms that guide herder behavior, movement, and decision-making for accessing pasture resources.

Narratives of governance boundaries included accessing winter camps, markets, government assistance, and inter- and within-*soum* migration (Figure 3.3). The process of accessing winter camps involves traditional arrangements among kin and bureaucratic arrangements among PUGs, APUGs, and *soum* land officers responsible for developing their

pasture management plans and providing land use certificates. These bureaucratic arrangements

and processes were evident in herder and *soum* official narratives:

> *In this area, [a herder] who wants to possess a winter camp first needs to make application to soum land officer. Then, this application is delivered to officer of government who makes the order and the citizen will possess 1 ha of land during 15 years.*
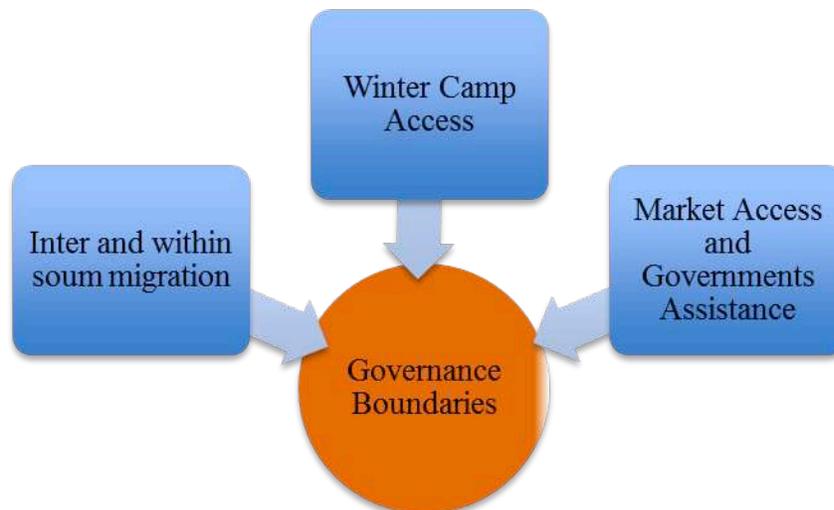
Figure 3.3. Inter and within *soum* migration, access to winter camps, markets, and government

assistance were common field codes evident in herder narratives and participatory maps.

Seasonal camps are those that generally include a livestock shelter (e.g., winter shelter)

and the surrounding pasture area. Winter shelters are accessed and secured through long-term

leases registered with the *soum* local government (Reid et al., 2014). Herding families may have

exclusive possession and secure access to their winter shelters, but do not have legal ownership

or possession over the winter pastures surrounding their winter shelters. Despite the lack of legal

ownerships, it is customary for herders to respect these winter pasture boundaries. These

intangible human-demarcated boundaries are determined by cultural norms, local knowledge,

and herder conceptions of their home pastures or *nutag*. These non-material boundaries are reflected in an elder's sense of place and world views of nutag: "*Nutag means relatives, moving from pastures, common property, and land belonging to everyone*."

Differing views of common property tied with kinship and mobility reflect the need for flexibility and security to pasture resources (Fernandez-Gimenez, 2002). Flexibility and security are also necessary for market access and government assistance, especially times of *dzud* (Fernandez-Gimenez and Le Febre, 2006). We apply the term market to refer to processes for the distribution of goods, services, and financial resources influenced by supply and demand (Luvsandorzh, Khashchuluun, & Batnasan, 2012). Common goods and services discussed by herders included livestock number and type, cashmere prices, government loans and donor aid for cashmere processing, haymaking, well maintenance, and transportation services. Accessing markets and government assistance are significant for PUGs and herding families who have formal agreements with local *soum* government. Below is an account of a herding family and the necessity to form PUGs or cooperatives for accessing government subsidies.

> *We are five families that herd animals together, so there is government demand to become a cooperative. If we refuse this condition [becoming a cooperative], we won't take the wool and cashmere cash giveaway. The government gives money to herders for their animal wool and cashmere.*

Herder strategies for accessing government assistance and pasture resources may include gaining and sustaining membership to PUGs. Donors provide aid (e.g., finances for installing or improving well infrastructure) to local governments and PUGs vital for herding families and their livelihoods. Access to aid and government subsidies serve as an incentive for herding families to form PUGs. As mentioned in our informal conversations with community development researchers, there are several accounts of non-PUG members that intermarry with PUG members and distinct relatives to gain access to subsidies, pasture resources, and markets.

This scenario depicts the role of kinship networks in creating and sustaining arrangements or governance boundaries for accessing pasture resources.

Kinship networks are key for developing formal and informal arrangements for accessing pasture resources and inter and within *soum* migration (Addison & Brown, 2014; Murphy, 2014; Sneath, 1999). Formal arrangements facilitated by herding families, *soum* government officials, and Association of PUGs (APUGs) are important for long-distance migration to greener or snowless pastures within their *soums* and/or other *soums* in times of natural disasters. To regulate migration, herding families belonging to specific PUGs are formally registered within the *soum* and the APUG's pasture management plan. Conflict may occur when non-PUG members and unregistered herding families graze their herds in pastures regulated by other *soums* and APUGs. These were evident in these herder and *soum* officials' narratives:

> *When pasture is bad, local herders moving "Saviin ar'' [place name]. They can't reject another [outsider] soum herder arriving in their pasture. A lot of herders coming in this area are from another aimag and Ulaanbaatar… A herding family may come from another aimag and their family members (husband, wife) have registration with a different soum. Therefore, it is possible for this herding family to move anywhere…*

> *We have pasture resource area when we use it wintertime. Another soum herders come in our pasture area and we didn't possess our pasture [no pasture certificate] so we couldn't chase them.*

These conflicts also represent the social or membership boundaries that exist between PUG and non-PUG members, where PUG members may have pasture certificates and formal rules stated in pasture management plans for excluding access and regulating mobility within their grazing area or territory.

Mobility is the preferred risk strategy for adapting to natural disasters, accessing pasture resources and markets, and consequently sustaining livelihoods (Addison & Brown, 2014; Doss, McPeak, & Barrett, 2008; Sneath & Humphrey, 1999). Herder mobility involves adaptive

practices influenced by local ecological knowledge and governance arrangements. Adaptive

practices discussed in participatory mapping narratives mainly include *otor* or inter-*soum*

migration (Fernandez-Gimenez, 1999; Fernández-Giménez et al., 2015; Murphy, 2011). The

relationships among adaptive practices, herder mobility, and both biophysical and human-

demarcated boundaries evident in herders' participatory maps and narratives are coupled and

dynamic, resulting in complex and multi-dimensional outcomes of herder livelihood

sustainability (Lee, Kakinuma, Okuro, & Iwasa, 2015) (Figure 3.4). For example, herders' maps

and narratives about *otor* involve crossing biophysical and human-demarcated boundaries for

accessing in snowless or greener pastures. Adaptive practices such as *otor* are boundary creating

or producing practices that may exclude or include herder groups from accessing key pasture

resources critical for livestock and livelihood sustainability.
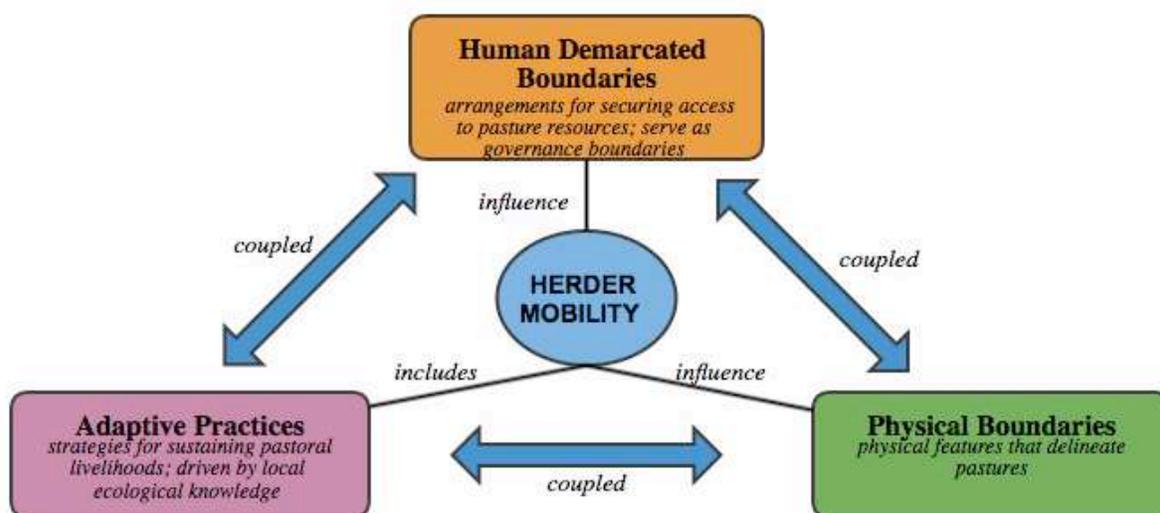
Figure 3.4. Herder mobility involves adaptive practices that are coupled with human demarcated

and biophysical boundaries in rangelands.

Conclusions

Biophysical and human-demarcated boundaries were evident in herders' participatory maps and narratives. These boundaries could be further dissected into material and non-material, which may vary in their visibility in the landscape (Figure 3.5). For example, biogeochemical processes in rangeland soils are less visible to pastoralists and yet create distinct boundaries in vegetation communities that are observable on the landscapes. Roads are visible human-demarcated material boundaries while grazing contracts are less visible boundaries. Grazing contracts are less visible since they only exist on paper and are not clearly or physically inscribed in the landscape. Grazing contracts, pasture management plans, herder group territories, migration routes and political boundaries are considered fuzzy boundaries since they are not abruptly marked by material or physical features that visibly demarcate specific areas in rangelands.
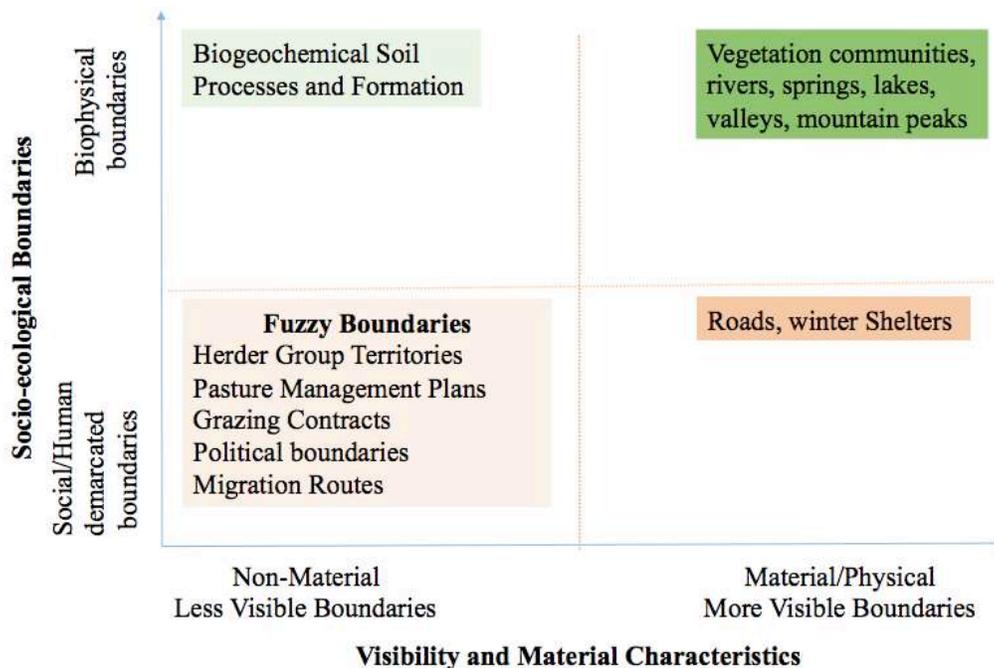
Figure 3.5. A typology of socio-ecological boundaries varying in their physical/material and visibility features on rangelands.

Human-demarcated boundaries such as winter camps and PUG territories were clearly depicted in herders' maps and accompanied with narratives involving arrangements for mobility and grazing. We have referred to these arrangements as governance boundaries that include seasonal camp access, migration among and within *soums*, and accessing markets and government assistance. These governance boundaries involve rules and norms that guide herder's adaptive practices, movement and decision-making for accessing pasture resources.

Herder mobility and governance were the most common themes discussed during participatory mapping narratives. Herder mobility is an adaptive strategy essential for accessing pasture resources and crossing physical and human-demarcated boundaries. Herders' adaptive practices include *otor* influenced by governance and physical boundaries within a rangeland ecosystem. Hydroclimatic, geomorphological, ecological, political, and economic boundaries in turn influence herder mobility. Examining these coupled relationships reveals the roles of different types of boundaries in influencing herder movement. Herders' narratives depicted governance and physical boundaries that dictate movement to specific grazing locations and market or *soum* centers for selling livestock products.

Donors and development agencies providing assistance to community-based herder groups may focus on the diverse facets of human-demarcated boundaries tied to accessing pasture resources. International donors' emphases on baseline biophysical boundaries coupled with pastoral livelihood concerns are common approaches for sustaining rangelands and livelihoods. However, donors' sole focus on biophysical boundaries and livelihood interventions overlooks the less visible and fuzzy human-demarcated boundaries influenced by herders' adaptive practices. Addison et al. (2013) assert that to improve Mongolian rangeland condition and livelihoods, donors must focus on the physical link between herder groups' adaptive

practices /activities and pasture condition. The integration of human-demarcated boundaries, local ecological knowledge, and herder views of *nutag* allows donors to be more cognizant of herders' adaptive practices and arrangements for accessing pasture assets, markets, and facilitating herders' mobility critical for improving rangeland condition. These arrangements norms also serve as governance boundaries pertinent to the acceptance and compliance of pasture management plans.

Herders' local ecological knowledge drives mobility as an adaptive strategy for coping with socio-ecological rangeland changes. Examining socio-ecological boundaries integrates herders' local ecological knowledge, sense of place, and emic perspectives of their rangeland systems and pasture resources. Donors wishing to support pastoral livelihoods may integrate these herder perspectives of human-demarcated boundaries for facilitating mobility and sustaining buy-in of decisions made within community-based herder groups.

Participatory mapping is a common donor strategy for integrating herders' local ecological knowledge and perceptions of territories within rangelands. However, donor's emphasis on the content of participatory maps may only highlight the tangible physical boundaries and neglect the non-visible human-demarcated boundaries influential in herders' livelihoods. The work presented in this paper highlights the significance of participatory mapping narratives in revealing less visible human-demarcated boundaries critical for examining herders' adaptive practices. Participatory mapping processes may incorporate the *nutag* approach/framework crucial for co-learning about socio-ecological boundaries in Mongolian rangeland management. Participatory mapping with the focus on herders' narratives is a recommended process for local governments to use as a meaningful tool for knowledge integration and adaptive capacity building (Baival and Fernández-Giménez, 2012).

REFERENCES

Addison, J., & Brown, C. (2014). A multi-scaled analysis of the effect of climate, commodity

    prices and risk on the livelihoods of Mongolian pastoralists. *Journal of Arid*

    Environments, *109*, 54–64. http://doi.org/10.1016/j.jaridenv.2014.05.010

Addison, J., Davies, J., Friedel, M., & Brown, C. (2013). Do pasture user groups lead to

    improved rangeland condition in the Mongolian Gobi Desert? *Journal of Arid*

    Environments, *94*, 37–46. http://doi.org/10.1016/j.jaridenv.2013.02.009

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., …

    Wollenberg, E. K. (2009). Adaptive co-management for social–ecological complexity.

    Frontiers in Ecology and the Environment, *7*(2), 95–102. http://doi.org/10.1890/070089

Baival, B. (2012). *Community-based natural resource management and social-ecological*

    resilience of rural communities. Colorado State University, Colorado, United States.

Baival, B., & Fernández-Giménez, M. E. (2012). Meaningful learning for resilience-building

    among Mongolian pastoralists. *Nomadic Peoples*, *16*(2), 53–77.

Buzinde, C. N., & Manuel-Navarrete, D. (2013). The social production of space in tourism

    enclaves: Mayan children's perceptions of tourism boundaries. *Annals of Tourism*

    Research, *43*, 482–505.

Cross, J. E. (2001). What is "sense of place." In *Archives of the Twelfth Headwaters Conference*

    (pp. 2–4). Retrieved from https://western.edu/academics/headwaters/headwaters-

    conference/archives/cross_headwatersXII.pdf

Dallimer, M., & Strange, N. (2015). Why socio-political borders and boundaries matter in

    conservation. *Trends in Ecology & Evolution*, *30*(3), 132–139.

    http://doi.org/10.1016/j.tree.2014.12.004

Dorligsuren, D., Batbuyan, B., Densambu, B., & Fassnacht, S. (2012). Lessons from A Territory-

    Based Community Development Approach in Mongolia: Ikhtamir Pasture User Groups.

    In Fernandez-Gimenez, Maria, Xiaoyi Wang, B. Batkhishig, & Robin S. Reid (Eds.),

    Restoring Community Connections to the Land: Bulding resilience through community-

    based rangelands management in China and Mongolia.

Doss, C., McPeak, J., & Barrett, C. B. (2008). Interpersonal, intertemporal and spatial variation

    in risk perceptions: Evidence from East Africa. *World Development*, *36*(8), 1453–1468.

Endicott, E. (2012). *A history of land use in Mongolia the thirteenth century to the present*. New

    York: Palgrave Macmillan. Retrieved from

    http://www.palgraveconnect.com/doifinder/10.1057/9781137269669

Fernandez-Gimenez, M. (1999). Sustaining the Steppes: A Geographical History of Pastoral

    Land Use in Mongolia. *Geographical Review*, *89*(3), 315–342.

Fernandez-Gimenez, M. E. (2002). Spatial and social boundaries and the paradox of pastoral

    land tenure: a case study from postsocialist Mongolia. *Human Ecology*, *30*(1), 49–78.

Fernandez-Gimenez, M. E., Batkhishig, B., & Batbuyan, B. (2012). Cross-boundary and cross-

    level dynamics increase vulnerability to severe winter disasters (dzud) in Mongolia.

    Global Environmental Change, *22*(4), 836–851.

Fernández-Giménez, M. E., Batkhishig, B., Batbuyan, B., & Ulambayar, T. (2015). Lessons

    from the Dzud: Community-Based Rangeland Management Increases the Adaptive

Capacity of Mongolian Herders to Winter Disasters. *World Development*, *68*, 48–65. http://doi.org/10.1016/j.worlddev.2014.11.015

Fernandez-Gimenez, M., & Le Febre, S. (2006). Mobility in pastoral systems: Dynamic flux or downward trend? *The International Journal of Sustainable Development and World Ecology*, *13*(5), 341–362.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473.

Fox, J., Suryanata, K., Hershock, P., & Pramono, A. H. (2008). Mapping Boundaries, Shifting Power: The Socio-Ethical dimensions of Participatory Mapping. *GOODMAN, M., BOYKOFF, M. & K. EVERED (Eds.), Contentious Geographies: Environmental Knowledge, Meaning, Scale, MPG Books Ltd, Bodmin, Cornwall*, 203–217.

Gadamus, L., & Raymond-Yakoubian, J. (2015). Qualitative Participatory Mapping of Seal and Walrus Harvest and Habitat Areas:: Documenting Indigenous Knowledge, Preserving Local Values, and Discouraging Map Misuse. *International Journal of Applied Geospatial Research*, *6*(1), 76–93. http://doi.org/10.4018/ijagr.2015010105

Juda, L. (1999). Considerations in developing a functional approach to the governance of large marine ecosystems. *Ocean Development & International Law*, *30*(2), 89–125.

Konecki, K. T. (2011). Visual Grounded Theory: A Methodological Outline and Examples from Empirical Work. *Revija Za Sociologiju*, 131–160. http://doi.org/10.5613/rzs.41.2.1

Laituri, M. (2011). GIS and Indigneous Knowledge. In *The Sage Handbook of GIS and Society*. Sage Publications, Ltd.

Lee, J. H., Kakinuma, K., Okuro, T., & Iwasa, Y. (2015). Coupled social and ecological dynamics of herders in Mongolian rangelands. *Ecological Economics*, *114*, 208–217.

Luvsandorzh, P., Khashchuluun, C., & Batnasan, N. (2012). *Mongolia at the Market: Dedicated to the 60th Anniversary of the School of Economic Studies*. Lit. Retrieved from http://books.google.com/books?id=gIsGCRQNYtAC

Mau, G., & Chantsallkham, J. (2006). Herder Group Evaluation: A study of herder groups, their present status, and future potential. UNDP, Mongolia.

Mearns, R., & Norton, A. (2010). *Social dimensions of climate change: equity and vulnerability in a warming world*. World Bank-free PDF. Retrieved from http://books.google.com/books

Murphy, D. J. (2011). Going on Otor: Disaster, Mobility, and the Political Ecology of Vulnerability in Uguumur, Mongolia. Retrieved from http://uknowledge.uky.edu/gradschool_diss/168/

Murphy, D. J. (2014). Booms and Busts: Asset Dynamics, Disaster, and the Politics of Wealth in Rural Mongolia. *Economic Anthropology*, *1*(1), 104–123.

Newman, D. (2003). Boundaries. In J. Agnew, K. Mitchell, & G. Toal (Eds.), *A companion to Political Geography* (pp. 123–137.). Malden: Blackwell Publishing.

Ostrom, E. (2007). A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences*, *104*(39), 15181–15187.

Ostrom, E. (2009). A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science*, *325*(5939), 419–422. http://doi.org/10.1126/science.1172133

Paasi, A. (2009). Bounded spaces in a "borderless world": border studies, power and the anatomy of territory. *Journal of Power*, *2*(2), 213–234.

Reid, R. S., Fernández-Giménez, M. E., & Galvin, K. A. (2014). Dynamics and Resilience of

    Rangelands and Pastoral Peoples Around the Globe. *Annual Review of Environment and*

    Resources, *39*(1), 217–242. http://doi.org/10.1146/annurev-environ-020713-163329

Sneath, D. (1999). *The end of Nomadism?: society, state, and the environment in Inner Asia*.

    Duke University Press.

Sternlieb, F., Bixler, R. P., Huber-Stearns, H., & Huayhuaca, C. 'aska. (2013). A question of fit:

    Reflections on boundaries, organizations and social–ecological systems. *Journal of*

    Environmental Management, *130*, 117–125.

Strauss, A., & Corbin, J. (2007). *Basics of qualitative research: Techniques and procedures for*

    developing grounded theory. Sage Publications, Incorporated.

Strayer, D. L., Power, M. E., Fagan, W. F., Pickett, & Belnap, J. (2003). A Classification of

    Ecological Boundaries. *BioScience*, *53*(8), 723–729. http://doi.org/10.1641/0006-

    3568(2003)053[0723:ACOEB]2.0.CO;2

Wainwright, J., & Bryan, J. (2009). Cartography, territory, property: postcolonial reflections on

    indigenous counter-mapping in Nicaragua and Belize. *Cultural Geographies*, *16*(2), 153–

    178.

Zastrow, C., & Kirst-Ashman, K. (2006). *Understanding human behavior and the social*

    environment. Cengage Learning.

CHAPTER FOUR

Reflections from the Field: Voice in Cross-Cultural and Transdisciplinary Research

Summary

Sustaining multicultural collaboration, commitment and accountability in cross-cultural transdisciplinary field research requires engaging and creating space for diverse voices. Despite the urgent need to examine transdisciplinary research processes, narratives concerning the role and influence of voice in transdisciplinary research (TDR) are often buried beneath the well-organized and distilled scientific products typically showcased to academic audiences. In this manuscript, I explore the role of voice in transdisciplinary field research. First, I begin by defining and exploring the role of voice in this context. Second, I offer a reflexive account of my experience working on a cross-cultural transdisciplinary research project. Third, I provide an ethnographic analysis to offer guidance for others practicing transdisciplinary field research, particularly for those engaged in cross-cultural, team-based projects. My reflexive account of transdisciplinary fieldwork reveals the complex network of actors and how those voices and opinions are shaped by identity, language, financial structures and hierarchy within TDR projects. Researcher *identity* influences how team members perceive their discipline, epistemologies, and shifting roles within transdisciplinary projects. *Language* in multicultural fieldwork involves the translation of interlingual and semantic knowledge differences, where team members voice their concerns and develop common meanings about the project. *Hierarchy* and *financial structures* of TDR projects are reflected in the ways in which the research language is applied and communicated. Ignoring these influences on voice, and solely focusing on transdisciplinary research products may result in the oversimplification of communication

conflicts. The goal of this manuscript is to unravel a few indispensible insights for enhancing team dynamics, fieldwork, and consequently the caliber of scientific research conducted in transdisciplinary teams.

Introduction

It was July 15, 2012, I had just finished describing the soils in our plot and I joined my team members resting on the windswept mountain steppe in Arkhangai, Mongolia. My cell phone rang and I could see that it was the co-principal investigator (Co-PI) of our project calling me again to check-in. With my field team leader's eyes on me as the only non-Mongolian team member, I calmly left the group so that I could have more privacy. I was tired and frustrated about constantly not knowing project logistics and feeling like my voice did not matter. When I got the call from the Co-PI, I calmly told her to call the team leader directly. I did not want my phone call with the Co-PI to create tensions between the team lead and me, particularly since I could communicate project details to the Co-PI in English. I was aware of the implications of my position as the PhD student in my team representing the US University that was directing and funding this research project. I was also conscious of the importance of hierarchy in conducting fieldwork with our Mongolian partners, and the Co-PI's direct phone calls to her PhD student instead of the team leader contributed to these communication tensions in fieldwork. The Co-PI and I understood that there were many cultural, organizational and interpersonal aspects that influenced our fieldwork and team dynamics.

After in-depth analysis and reflection on my fieldwork experience, four major themes highlighted the importance of voice in fieldwork: researcher identity, language, hierarchy, and financial structures. These four themes continued to re-appear and soon I had strong evidence

that these were important forces that influenced how individuals in our team voiced their

opinions and reactions while in the field, conducting transdisciplinary team research. Engaging

diverse voices of team members in field research is complex and critical for sustaining cross-

cultural collaboration, commitment, and accountability in transdisciplinary research (Gray, 2008;

Mezias, Chen, & Murphy, 1999; Mountz, Miyares, Wright, & Bailey, 2003; Thomas, Tienari,

Davies, & Merilainen, 2009; Thompson, 2009). In this manuscript, I explore what influences

team member *voice* while conducting fieldwork in a transdisciplinary cross-cultural research

project. The aim of this manuscript is threefold. First, I begin by defining and exploring the role

of voice in transdisciplinary and cross-cultural field research. Second, I offer a reflexive account

of my experience of working on a cross-cultural transdisciplinary research project. I focus on my

role and identity within the fieldwork process and interactions within the larger research team.

Third, I analyze my experiences to offer insights for others practicing transdisciplinary

fieldwork, particularly for those engaged in cross-cultural, team-based projects. Similar to the

work of Mountz et al. (2003), who focused on the role of power and team dynamics in field

research, I immersed myself in my own field research struggles in an attempt to analyze and

further understand the nuances of conducting socio-ecological field work and transdisciplinary

science within a multi-cultural research team.

Voice and Transdisciplinary Research

Peoples and Depoe (2014) link the concept of *voice* with the expression of an opinion or

the articulations of worldviews. Voice is the process of sharing details about oneself, including

one's identity and how one comes to know the world (Couldry, 2010). In transdisciplinary

research teams, the voices of researchers and stakeholders are shared with the collective goals of

integrating knowledge, language and methods to develop novel conceptual frameworks (Miller et al., 2008; Roux, Stirzaker, Breen, Lefroy, & Cresswell, 2010). Transdisciplinary research involves more than just addressing disciplinary differences among researchers, but rather engaging the knowledge, voices and cultures of multiple stakeholders at *all* stages of the research (Cummings, Regeer, Ho, & Zweekhorst, 2013; Stokols, Hall, Taylor, & Moser, 2008).

I apply Mezia's (1999) definition of culture as the processes defining the identity of actors or stakeholders and providing the "behavioral scripts" for managing relations between actors (p.326). I also acknowledge Eric Wolf's (2010) view of cultures as perpetually changing and unbounding traits expressed through social relations of power, politics, and communication. These definitions shed light in how culture is played out in a dynamic mix of power relations in transdisciplinary research, where researchers' cultural world views are formed by his or her position within the structure and hierarchy of a project (Wolf, 2010; Wolf, 2014). Consequently, a researcher's position within a project also influences how stakeholders are engaged within the TDR project and its outcomes (e.g., publication products). Stakeholders include those who have a stake in the processes and outcomes of TDR, including researchers, funders, and research end-users (e.g., policy makers, non-governmental organizations, and citizens) (Roux et al., 2010). Engaging stakeholders' voices in TDR projects may also reveal the process through which transdisciplinary research and science is produced and applied (Latour, 1998; Roux, Rogers, Biggs, Ashton, & Sergeant, 2006). Similar to Nadasdy (1999) and Latour's (1998) assertions on research and science, I emphasize the social context in transdisciplinary fieldwork and research, including the communication processes that produce science. Solutions to complex problems in natural resources may also be found in the processes of scientific research, including the

dialogue, deliberation, and power plays that occur when voices are shared (Daniels & Walker, 2001).

Many factors influence how voices are shared, engaged and represented in TDR. In this manuscript, I focus on identity, language, financial structure and hierarchy as the major factors that influenced voice in my fieldwork experience. Researcher *identity* includes how team members perceive themselves within their disciplines and roles within TDR projects (Collins, 1993; Lingard, Schryer, Spafford, & Campbell, 2007; Muhammad et al., 2014; Wall & Shankar, 2008). Related to identity, researchers use discipline-specific *language* to communicate their worldviews, research questions, methods and analyses. Examining language in multicultural TDR fieldwork involves the translation of interlingual differences and knowledge boundaries, through which team members voice their concerns, translate and develop common meanings about the project (Aneas & Sandín, 2009; Carlile, 2004; Kitson & Phil, 2009). The process of co-developing common concepts and research languages may be influenced by the *financial structures* (e.g., funding sources) of the project and the *hierarchy* of methods, disciplines and roles in TDR projects (Braun, 2012; Khagram et al., 2010; Lingard et al., 2007). Examining how language, hierarchy, financial structures and identity shape influence the expression of voices in TDR projects may reveal the communication processes that influence the production of scientific products and outcomes (Goring et al., 2014; Mountz et al., 2003; Thompson, 2007, 2009). In this manuscript, I share my fieldwork experiences as a member of the Socio-ecological Complexity (SEC) research team (I am using a pseudonym for the team to honor the team members' anonymity) and analyze the factors that influenced voice in my fieldwork experience.

Socio-ecological Complexity (SEC) Project

The SEC project is a pseudonym for an actual transdisciplinary research project investigating the resilience of rangeland social-ecological systems to climate change in Mongolia. The core SEC research team includes the principal investigator (PI) and Co-PIs who represent different academic departments, including Ecosystem Science and Sustainability, Forest and Rangeland Stewardship, Human Dimensions of Natural Resources, and Watershed Sciences at a large, land grant university in the Western US. These diverse departments reflect different approaches and disciplines crucial for acquiring holistic views of complex environmental issues.

SEC's main funder is the National Science Foundation (NSF), which awarded the team a $1.5 million coupled natural-human systems grant for a five-year project. The team of US researchers partnered with Mongolian researchers, herders and government agencies to examine Mongolian rangeland systems. Research hypotheses and proposal ideas were initially developed with Mongolian partners and herders in workshops prior to competing for the NSF grant. Funding from the United States Agency for International Development (USAID) Collaborative Research Support Program and the World Bank helped to develop and deliver ecological training workshops with the Mongolian partners.

The SEC research team also consisted of Mongolian, Philippine, and American postdoctoral trainees and PhD students in rangeland ecology, hydrology and human dimensions of natural resources. Together with the PI, Co-PIs, and the Mongolian project coordinator, the graduate students worked with our Mongolian partners to collect ecological, hydrological and socio-economic data and interview government officials, project officers and herders. To communicate and organize fieldwork, the SEC team conducted monthly face-to-face meetings

and calls in the US, annual meetings in Mongolia, and data collection training workshops for each of the three field seasons in Mongolia. Mongolian senior researchers, junior scholars, and secondary school teachers participated in these training workshops and in data collection. Senior Mongolian scholars led teams of Mongolian students and junior researchers in collecting socio-ecological data. The SEC team in the US depended on Mongolian collaborators' commitment for leading fieldwork, translating workshops, training and outreach materials, as well as coordinating with seven Mongolian research partners who provided the staff and capacity to collect data across Mongolia's ecological zones.

The SEC project involves multicultural and transdisciplinary endeavors that require the translation of languages and cultures among researchers representing US, Mongolian, and disciplinary institutions. This rich mix of cultures defines the identity of the SEC members and hence the "behavioral scripts" that researchers use to communicate and navigate through the structures and hierarchy embedded in research teams (Mezias et al., 1999). Each researcher within the team identifies with a disciplinary language serving as a "behavioral script" to communicate and navigate in TDR. SEC's complexity illustrates that knowledge integration does not function in isolation; rather it is embedded in the relationships, institutions and norms of diverse actors. I highlight SEC's relationships with our Mongolian partners and the challenges that our Mongolian coordinators and senior researchers face, specifically with accommodating SEC's socio-ecological methods that entailed new and unfamiliar approaches for integrating disciplinary expertise, knowledge, and languages. This challenge and complexity is heightened when our Mongolian partners lead entire field teams applying SEC's scientific protocols. SEC's PIs in the US and senior Mongolian partners face different sets of challenges and privileges in conducting TDR and socio-ecological fieldwork. For example, the PIs have the privilege of

participating in face-to-face monthly meetings with the SEC team, gaining funds for their graduate students, and developing socio-ecological field protocols to be led by our Mongolian partners. These privileges influence the expression of voice and opinion with SEC. Recognizing these privileges differentially experienced by US and Mongolian scholars set the context for examining my own fieldwork challenges in expressing my voice with an all-Mongolian research team, especially as the only representative from the US University directing and funding SEC field research.

Methods

Roles and Positionality

I have been part of the SEC team as a graduate student researcher for over four years. I was initially tasked to study transdisciplinary team dynamics and communication processes for my dissertation. In the first two years of the project, I was also tasked to organize virtual meetings and write meeting minutes, annual meeting reports and evaluations on ecological training workshops. I was responsible for reminding the PI and Co-PIs of their "to do" list mentioned in meeting minutes. As a PhD student, I adjusted to this new team hierarchy where emailing professors and researchers their "to dos" and obligations was an accepted and natural process for our team. This hierarchy differed substantially from the typical graduate student role in the U.S. as well as the typical hierarchy for research in Mongolia, where junior scholars and students would not be in the position to remind senior scholars about their obligations to the research team.

My training in the social and ecological sciences attracted me to participate and examine the different data collection and analysis components of SEC. I served as a participant observer

in the socio-ecological data collection and assisted in fieldwork where we interviewed herder groups and collected vegetation, soils and geomorphological data in the Mongolian rangelands. My assertions and emphases on the role of voice in TDR are based on my everyday, lived experiences working within the SEC team. Thus, I use a constructivist approach, as opposed to a positivist approach to examine SEC as a team of researchers voicing their different approaches and worldviews to integrating disciplinary data and knowledge systems (Ross et al., 2010). Positivist approaches base assertions on pure empirical data and objectivity that discounts self-reflexivity, emotion, and experience of the researcher (Clark, 1998; Creswell, 2008). A constructivist approach based on my field experience enables me to investigate context and content of communication processes expressed in the differing voices of researchers within the SEC team (Atkinson & Hammersley, 1994).

SEC Case Study

This manuscript is part of a larger ethnographic case study, in which I am using qualitative methods to explore, explain and better understand knowledge integration and communication processes within TDR teams. As a participant observer and researcher in SEC since 2011, I developed relationships with SEC team members. I believe that these relationships cultivated camaraderie and trust crucial for gaining emic perspectives of transdisciplinary team communication. I provided a "Consent to Participate" letter to team members in 2011, where I clarified my research intentions, potential products (e.g., publications), and confidentiality limitations, including the possibility of identities being indirectly recognized due to the size and closeness of the team. The PI and all Co-PIs, graduate students, postdoctoral fellows and senior Mongolian collaborators signed this consent form. The team was aware of my role as a

participant observer and my research goals of examining communication and knowledge

integration within TDR teams. This awareness, I believe, created a communication climate in

which team members were encouraged to express their thoughts about the team in personal

interviews, emails and team events. I was aware of social desirability biases where respondents

provide comments believed to be desirable by the researchers (Grimm, 2010). To avoid these

biases, I triangulated respondents' comments at team events with follow-up personal interviews

and participant observation notes.

Data Collection and Analyses

In the four years of participant observation, I gathered data while organizing and

attending monthly and annual meetings, conducting fieldwork in Mongolia, attending

conferences, informal social gatherings and annual team retreats. These interrelated activities

were key events within SEC and influenced my views in conducting fieldwork in Mongolia. In

this manuscript, I specifically highlight my 2011 and 2012 fieldwork experiences, which

included co-organizing training workshops and collecting social and ecological data in

Mongolia. In 2011, I helped interview herder groups and local government officials in the Gobi

Desert. With funding from a USAID grant, I also co-organized the 2011 ecological training

workshop with Mongolian researchers. My 2012 fieldwork included participatory mapping with

Mongolian herder families and collecting rangeland ecological data in the forest and mountain

steppes. During both years of fieldwork, I worked with Mongolian researchers in collecting

rangeland socio-ecological data. To gain different perspectives of team members' experiences

with SEC, I interviewed US and Mongolian partners ($n= 27$), transcribed these interviews and

stored these in a separate database for maintaining confidentiality and my university's Institutional Review Board standards.

A critical component of my data involved my field notes and daily journal entries detailing my reflections and fieldwork experiences with my US and Mongolian colleagues. I have open-coded and re-coded my field notes, journal entries, and interviews. Since joining the SEC team in 2011, it was my reflexive iteration of my own fieldwork experiences that led me to realize that voice matters in the fieldwork process and the production of transdisciplinary research. Reflexive iteration involves revisiting and connecting my field notes and experience with emerging insights, leading to more polished and refined stories, themes, and concepts (Srivastava & Hopwood, 2009). For example, I have reread approximately 234 pages of fieldwork journal entries over the last three years, re-highlighted specific entries with repeating patterns of themes and wrote about my interpretations of my fieldwork reflecting these common themes. Consistent with this manuscript's purpose, I weave in a selection of stories and themes serving as what I believe to be the four main influences on a team member's willingness and ability to express his or her *voice* in a transdisciplinary research team.

Analysis and Discussion

I have selected several examples from my field experience that illustrate identity, language, financial structure and hierarchy aspects of team member voice in a transdisciplinary context. While these aspects overlap, I have made choices as the narrator of this manuscript to select examples that best illustrate the nuances of voice and its influence in transdisciplinary research (TDR).

Researcher Identity

The identity of researchers within transdisciplinary teams may be expressed through their voices and roles as they collectively navigate the complex world of developing relationships and partnerships in TDR contexts (Hagoel & Kalekin-Fishman, 2002; Lingard et al., 2007; Manathunga, 2009; Wagner et al., 2011; Wall & Shankar, 2008b). Muhammad et al. (2014) assert that the identity and status of research team members become more important through dimensions of power and privilege within project partnerships. Within this research team, we had strong partnerships with Mongolian communities of researchers who were crucial for gathering socio-ecological field data. The Mongolian research partners were appropriately positioned to lead field teams based on their experience and relationship to the communities they work with.

Multiple positionalities and associated identities influence research validity, processes, and outcomes on collaborative insider-outsider teams (Collins, 1993; Muhammad et al., 2014). Insider teams may involve actors directly driving the research design and questions while outsider teams could involve actors who were brought in later, yet play important roles such as collecting research data and providing perspectives necessary for integrating knowledge. The existence of insider-outsider teams may occur in large TDR projects where team members are in multiple positions to communicate with different communities of practice and research. In the SEC project, communities of researchers consisted of PIs and Co-PIs from US universities and collaborator researchers from Mongolian natural resource institutes and universities. From a research and funding perspective, it is relatively easy to envision the PI and Co-PIs from US universities as the insider or core team, especially since they secured and controlled funding from US agencies and led the development of methods, analyses and database that housed

majority of the data. Our main Mongolian partner institution stored all of the hard copies of our social data.

Power may be concentrated with the insider team of researchers controlling funding and research data. As a PhD candidate within the SEC project in the US, I was considered part of the core insider team with one of the Co-PIs serving as my adviser and guiding me through the research questions stated in our NSF proposal. However, my field experience in Mongolia resulted in the reverse situation where I was considered part of the outsider team of US researchers. There were three field teams assigned to collect ecological data across Mongolia. I belonged to the third field team, where my researcher identity was challenged as the only US representative from the SEC project. I was assigned to collect soils data with the team and to ensure that research protocols were being followed. My Mongolian field team lead was a collaborator and not a Co-PI of the SEC project. She was a Mongolian researcher who had substantial experience with botanical surveys in the Gobi Desert, but was relatively new to the SEC protocol of collecting and integrating geomorphological, soils, vegetation and biomass data for assessing rangeland resilience. The complex nature of positionality, identity, power and representation of team members created a scenario ripe for conflict and communication challenges. For example, I asked a team member and translator about the team budget for camping and my concerns about not being able to stay in a hotel when the weather was bad. We were told by the Co-PI that we would mostly be camping and that budget was very limited for hotels. The team leader overheard my simple inquiry and reacted "You want to see budget, here I show budget and I have lots of paperwork to show you!" Surprised by her response, I simply stated that I trusted her and that I truly did not know what was going on. Reflecting on this conversation and discussing similar field experiences with the SEC's PI, I understood that my

lenses of planning fieldwork differed greatly from Mongolian cultural norms of flexibility to scheduling fieldwork. Fieldwork plans would change daily due to the complex contingencies and negotiations needed to facilitate ecological sampling and traveling to different field sites. In addition, my position and identity representing the supposedly insider or core SEC team may have created tension within my field team, especially with the field team leader. This tension was further fueled by the lead Co-PI calling my cell phone directly instead of calling the team leader first. As mentioned in the beginning of this manuscript, I had to tell the Co-PI to stop calling me and instead call the team leader directly. The Co-PI understood right away about this power dynamic and the importance of showing trust that our Mongolian team lead had the field work under control and was well versed in the protocols and role of leading her team.

Identity in multicultural and TDR projects like the SEC may consist of personal, epistemological and institutional layers embedded in researchers' voices, identities, and roles (Borg, Karlsson, Kim, & McCormack, 2012; Khagram et al., 2010). Personal and epistemological layers of identity involve our current and prior experiences with TDR projects, as well as relationships with team members, friends, and families that influence how we see and come to know to the world. Examining the role of identity in TDR research initially involves a reflexive understanding of one's own identity and its influence on the roles and outcomes within the project. For example, my identity is largely shaped by my experience of being raised in the Philippines for 18 years and having had the privilege of being educated in the US for my undergraduate and graduate degrees. My background has made me aware of my own privileges of conducting research in places where there is a colonial legacy. Because of my western-based education and background growing up in a developing country, my cultural world views have been formed by my experiences of working with diverse individuals in various research projects.

From an epistemological standpoint, I come to know the world and research based on my experiences as a socio-ecological scholar where I was originally trained to apply both constructivist and positivist research tools. My personal and epistemological identities have shaped my institutional role of working within the SEC project and representing the cross-departmental interdisciplinary degree program in Ecology within my university. My ecology program provided me with the space and flexibility to work with different disciplines and the departments represented within SEC. Thus, my personal, epistemological, and institutional role has driven my desire to understand the interplay among the diverse facets of knowledge, disciplines, and voices within SEC. This desire in turn has influenced my participation and role in both the social and ecological fieldwork in Mongolia as well as my aspiration to reach out and engage with our Mongolian partners and graduate students.

The role of knowledge brokers within SEC is pivotal to understanding identity and the expression of voice in TDR research (Aneas & Sandín, 2009; Borg et al., 2012; Mountz et al., 2003; Muhammad et al., 2014; Stokols, Misra, Moser, Hall, & Taylor, 2008). Lingard et al. (2007) assert researchers in interdisciplinary and TDR teams can have multiple identities and roles representing diverse disciplines. The multiplicity of roles and identities in TDR teams creates conditions for conflict and creativity, especially when team members serve as knowledge brokers who translate and transfer knowledge across different scholarly communities. Potentially all researchers in the team can be knowledge brokers based on their discipline and the scholarly communities they work with (Lingard et al., 2007; Mountz et al., 2003). However, researchers can also feel estrangement or seem to be a "stranger" when defending the legitimacy of their discipline and their voice and associated experiences (Lingard et al., 2007). Providing the space for expressing one's voice in TDR fieldwork entails more than an understanding of project roles,

but also providing the opportunities for researchers' identities to be flexible and shift among different communities of practice and the so-called insider/outsider communities present in TDR projects (Lingard et al., 2007; Manathunga, 2009; Muhammad et al., 2014). Acknowledging the need for researcher identities to be flexible is crucial for researchers to feel that their voices are genuinely heard, and considered legitimate. There is also the possibility of voices being initially heard, but ultimately not considered in the decision-making process, resulting in consultation fatigue (Reed, 2008).

The inclusion of voices at different research stages its influenced by power relations underlying research languages that legitimize knowledge, concepts and methods in TDR (Nadasdy, 2003). For example, our Mongolian partners were engaged in the development of SEC research questions prior to acquiring NSF funding. This ensured that the research interests, knowledge, and world views of our Mongolian partners were integrated into our research proposal directing the overall methods, field work, and analyses in SEC. To integrate these diverse interests and knowledge in SEC's research proposal, various translation processes needed to occur among different languages that were voiced by SEC members. The following section discusses the role of language and voice in TDR fieldwork and communication.

Language and Knowledge Boundaries

The role of language is essential in cross-cultural and transdisciplinary field experiences (Aneas & Sandín, 2009; Bracken & Oughton, 2006; Hennink, 2008; Mountz et al., 2003; Ranganathan, 2007). Addressing language boundaries in multicultural and transdisciplinary field settings goes beyond translating interlingual differences (e.g., English vs. Mongolian) and involves recognizing the complexity and impact of different research languages that all team

members must communicate, transfer, and transform (Carlile, 2004; Kitson & Phil, 2009). Research languages involve the manner in which researchers within specific disciplines express their research questions, concepts, methods, and analyses for studying a particular system. Transdisciplinary research languages not only entail different disciplines, but also include exposure and acknowledgement of different ways of doing and envisioning research conduct in multicultural teams. For example, many of our Mongolian junior researchers mentioned that they were accustomed to having their professors develop their research questions, analyses, and presentation of data in one particular manner. The typical research conduct is to obey and follow what is told of their superiors. In contrast, SEC norms required all Mongolian researchers, including students and junior scholars to develop a short research proposal in Mongolian that stated their research questions, methods, and proposed analyses prior to obtaining data stored in the US university database. As our Mongolian coordinator mentioned, "we are not used to this kind of democracy" referring to our Mongolian junior researchers' exposure to developing their own research questions and analyses. To build capacity and exposure to new ways and norms of approaching research, our PI travelled to Mongolia on several occasions to train our Mongolian junior scholars and students in proposal writing and socio-ecological analyses. We also allotted significant time in our second annual meeting to proposal writing workshops. Our Mongolian postdocs, coordinators, and PhD students were pivotal to communicating with our Mongolian colleagues and appropriately translating research proposals.

Translating research languages involves the complex task of accepting how researchers come to know and understand a process while conducting transdisciplinary science and fieldwork. Attributing interlingual differences as the sole cause for misunderstandings in TDR communication and multicultural fieldwork is myopic. Based on my field experiences and

interviews with team members from the U.S. and Mongolia, I have come understand that it is the

research language(s) intertwined with our epistemologies and interlingual language boundaries

that influence and enrich our team dynamics of conducting fieldwork, voicing our opinions and

translating our knowledge systems in TDR field settings. For example, I recall a conversation

that I had with the team leader, where I asked about the Ibex population in one of our field sites.

She mentioned that the population was 100. I followed-up with inquiring whether the projected

population differed from the number of recent observed sightings. The team leader appeared to

be frustrated and mentioned, "I told you 100 Ibexes, you don't listen!" I tried to explain myself

further providing an example that a researcher could have an projected population of 400, but

could only observe 100 in a particular area. It just depends." The team leader explains, "I didn't

say 400 Ibexes, You don't listen to me. I don't translate!" While neither of us were wildlife

biologists, I assumed that our team leader would understand the difference between projected

population and the number of observed sightings. The complexity of translating different

semantic and research languages (e.g., difference between projected population and number of

observed Ibex sightings for a particular area) often results in the misinterpretation of voices and

consequently the intentions and knowledge associated with those voices.

Kitson and Phil (2009) provide an integrative framework for managing knowledge and

language across syntactic, semantic, and pragmatic boundaries in diverse teams and settings.

Syntactic knowledge boundaries involve basic knowledge transfers with common lexicons and

languages (Carlile, 2004; Kitson & Phil, 2009). Semantic knowledge boundaries include

*translating knowledg*e and thus languages where common meanings need to develop and

different interpretations exist. Kitson and Phil assert that addressing semantic knowledge

boundaries and languages works well when groups recognize their need to understand and communicate differences and dependencies more effectively.

Semantic knowledge boundaries thrive in TDR fieldwork, and the development of common meanings and languages become even more complex in multicultural teams where acknowledging the need to communicate needs or dependencies are differentially interpreted, expressed, and suppressed by social norms. Communicating dependencies involves team members expressing their voices and opinions for certain actions, decisions, and products needed for the team to move forward with their project. Expressing these dependencies involves many layers of research and semantic language boundaries that require complex translation, adaptation, and careful attention of how these languages are differentially interpreted and expressed (Becher & Trowler, 2001). For example, I recall my field experience with the SEC field team and having one of the Mongolian members telling me "Your problem is team problem!" when I asked if they had seen my misplaced sunglasses, toilet paper and voice recorder. I was surprised that my mindless mistakes (i.e., misplacing my personal items) bothered the entire field team. I also realized that in this team, no one would mention misplaced items for which they were personally accountable. This simple example illustrates how different social norms influence the expression and communication of issues and dependencies as a team. There is also the notion of individualistic versus collectivist principles exercised within the team (Mezias, 1999). My western-based lenses of being individualistic influenced my perception of accountability in team-based settings. Within the field team, misplacing any item deemed important by an individual team member, whether they were personal or team property, appeared to be perceived as an issue for which the entire team was accountable. The team language for expressing accountability and having the agency to voice issues require special attention to the role of power in TDR.

The role of politics and power are most visible when teams openly address pragmatic knowledge boundaries (Carlile, 2004; Kitson & Phil, 2009). These pragmatic boundaries involve conflicting interests, problems in sharing and accessing knowledge, and establishing a common interest for developing a shared meaning and language. Applying a Foucauldian approach to relating knowledge and power at certain boundaries, Carlile (2004) warns us that power is still expressed even when actors have equal ability to share and assess each other's language and associated voices. However, when the capacity and privilege to use the common language (e.g., English spoken by U.S. scientists) are not equal or represent one of many actors' knowledge (e.g., research language and protocols), mismatches in translation and misrepresentation of voices occur (Carlile, 2004). In this team, we were very aware of the power differences within the larger project, especially with the U.S. researchers serving as principal investigators while Mongolian researchers served as collaborators for collecting socio-ecological field data. It is important to note that overall SEC research objectives were co-defined by the US and Mongolian researchers prior to receiving NSF funding. Instruments and methods for collecting field data were created by U.S. researchers and communicated through training workshops conducted in Mongolia. Mongolian researchers and graduate students served as knowledge brokers and were indispensable at transferring and translating research languages during these training workshops. SEC's knowledge brokers were pivotal for integrating our Mongolian partners' voices in our research protocols, especially our ecological protocols that were modified for data compatibility and sharing purposes. These knowledge brokers helped bridge semantic and pragmatic knowledge boundaries that represent diverse voices and languages in TDR field research. This situation depicts power differences between US and Mongolian researchers and the importance of matching translation processes to specific interlingual, semantic and pragmatic knowledge

boundaries. The emphases on sharing knowledge across boundaries extends beyond concern for the structure and meaning of language to pragmatic concerns of what processes and methods are required for effective communication across disciplines and cultures (Carlile, 2004; Cruse, 2000). The following excerpt dissects my personal experience with research language incompatibilities and its influence on TDR fieldwork.

Research Language Incompatibilities in Team Fieldwork

I realize that it was not only me who was just struggling with language issues within my team. The team leader and members were learning the research language and were required to collect data in a new and complex research language stated in the ecological protocols or what we called the "cookbook." Most of the team members had four days to learn the research language in our ecological training workshops while I had a few years since I started working with SEC. To complicate matters, teams had to learn to live and work with their team for three consecutive weeks in remote Mongolian steppes. While I also had challenges with the interlingual differences and research language, I had the privilege of having almost a decade of experience of conducting ecological fieldwork applying many of the scientific methods stated in the protocol. In addition, most of my formal education and work experience involved western scientific approaches to viewing and examining socio-ecological systems. It was relatively easy for me to comprehend and apply the SEC research language, considering my training, education, and that I was representing the U.S. university where the research protocols were developed. I struggled with the Mongolian language while my team members struggled with the research language and consequently did not understand the reasoning behind why we collected data in a specific manner. This complex situation would be ripe for exchanging knowledge and experience

with the diverse languages. Yet, I felt like the dialogue and exchange I was exposed to in other international fieldwork scenarios did not quite occur as I had envisioned. I wanted to consult with team members and I wanted team members to consult with me, especially in selecting plots in our different field sites. My role of examining soils and ensuring that soils were homogeneous across field sites was critical, yet I was rarely consulted. I felt my voice and the research language were not heard and that they did not matter to the team. The reality was that the miscommunications in the field were not just rooted in the notion of the team not taking my voice and expertise into account. These miscommunications were embodied in power and the hierarchy and financial structure in the SEC project.

Hierarchy and Financial Structure

Financial structures and associated hierarchy may also influence the potential for sharing collaborative voices in TDR projects (Becher & Trowler, 2001; Braun, 2012; Lingard et al., 2007; Manathunga, 2009). Financial structures and hierarchy create incentives or disincentives for scientists to collaborate and may reinforce the team members' reticence or insistence on voicing preferred research directions and decisions in TDR fieldwork (Braun, 2012). Financial structures such as funding sources and grant proposals stipulations may also define research methods and consequently field methods deemed valid to funding agencies (Lingard et al., 2007; Mountz et al., 2003; Muhammad et al., 2014). Additional work not included in the conceptual framework stated in the funded grant proposal may result in the hierarchy or prioritization of research methods and analyses (Lingard et al, 2007). This hierarchy of methods and analyses impacts TDR fieldwork, where team members allot most of their resources, time, and communication efforts.

Lingard et al. (2007) narrate their team experiences of structural constraints originating in the value system of their research funder and the hierarchy embodied in their research field methods and analyses. In the case of the SEC project, financial structure and hierarchy influenced fieldwork and consequently diverse perceptions of team members and prioritization of project components. The priority of methods, analyses, and allocation of resources associated with specific disciplines also influence team members' perceptions of hierarchy. For example, my interviews and fieldwork participant observation experiences revealed different perceptions of how the SEC project had prioritized the separate ecological and social fieldwork. Both fieldwork efforts were led by different field leaders and occurred in different field seasons requiring a unique set of resources. For example, we conducted the social fieldwork mostly in the winter as opposed to the ecological field work that occurred in the summer. Consequently, the financial resources allotted for each type of fieldwork differed. The social fieldwork included interviews, surveys, and focus groups with herder groups and county governments requiring field members to stay in county centers and local hotels. In contrast, the ecological fieldwork involved sampling the rangelands surrounding herders' winter camps (*uvuljaa*) requiring ecological field teams to camp near *uvuljaas* instead of staying in hotels. As a result, more financial resources were allocated for the ecological team's gear (e.g., U.S. branded three-season tents, soils equipment, cameras) than for the social team. The difference in financial resources for each type of team appeared to create different sentiments among ecological and social team members. In our team, many of the members felt that it was unfair that they had to camp and stay in tents perceived as cheap and not sturdy enough to withstand the Mongolian winds. These sentiments perhaps revealed the resistance of our Mongolian partners to reproduce the power relations and hierarchy associated with individuals' sleeping in tents instead of hotels. While the reasons

underlying these sentiments may be interpreted in various ways, the financial structure and SEC's decision-making processes for resources and budgets influenced some of our colleagues' sentiments.

During the 2011-2012 fieldwork, Mongolia's economy was booming with numerous well-paid jobs in natural resource projects with NGOs and mining companies. Much of the contract work with NGOs and donor agencies had larger budgets that far surpassed SEC's limited funds to do similar fieldwork. Since SEC was funded by U.S. agencies (e.g., National Science Foundation) that had also financed other existing research in Mongolia, there was the expectation from some of our Mongolian collaborators that the SEC budgets for doing fieldwork would be similar. The discrepancy in budgets and financial structures for delivering funds to Mongolian collaborators (essentially through contracts and cash) created challenges for the SEC PIs and Co-PIs in cultivating commitment and motivation among our partners. Additionally, this discrepancy in budgets initially fostered the sentiment (as shared among several team members) that SEC did not budget sufficient resources for their Mongolian collaborators who collected all the socio-ecological data across the entire country of Mongolia. Despite these budgetary constraints, the sustained commitment from our Mongolian partners enabled the SEM team to continue the collaboration needed for collecting the immense socio-ecological data across Mongolia.

Giddens (1984) structuration theory depicts the tensions on how financial structures can support and thwart the existence and collaboration in research teams. While there are challenges associated with financial structures in transdisciplinary fieldwork, there are also a myriad of opportunities that cultivate agency in TDR (Lingard et al., 2007). In SEC, these opportunities involved our Mongolian collaborators to lead their own research field team and take complete

control of their team field research budget based on signed sub-contracts. Other opportunities involved the mentoring and training of Mongolian students and junior researchers to apply new socio-ecological field methods while earning a stipend. One of the young Mongolian scholars who participated in both the social and ecological fieldwork explained "*So much of my career and my life were linked with this project…[As a scholar who obtained funding from SEC to complete my masters degree], I was like an ambassador of SEC in my institute.*"

Concluding Thoughts

Conceptualizing the role of voice in TDR fieldwork involves examining the impact of researcher identity, language, financial structure and hierarchy on research team communication processes and outcomes. In the SEC project, I explored the role of voice in TDR through participant observation, team conversations, and interviews experienced throughout my fieldwork in the US and Mongolia. Reflecting on my fieldwork experience, I offer some observations that may help foster greater collaboration with improved attention to the role of voice and how voice may affect the collaborative scientific process in a multicultural TDR project.

Identity influences how team members perceive their discipline, epistemologies and their roles within TDR projects. For researchers to vocalize their evolving roles and priorities within TDR fieldwork, they must consider how they are crossing knowledge boundaries and translating languages across disciplines and cultures. Space and flexibility for team members' identities and roles to shift is crucial for easing the process of translation and knowledge boundary crossing (Manathunga, 2009). Cultivating this space and flexibility involves openly acknowledging that all team members' roles may slightly shift, especially as they can serve as knowledge brokers for

translating and transforming the research language. Team retreats and other opportunities for face-to-face group reflections may provide the space for team members to be candid and vocalize their shifting identities and roles as they collectively navigate TDR (Roux et al., 2010). In TDR fieldwork, it is recommended that budget and time is allocated for a facilitated team retreat soon after the fieldwork is completed. This retreat is crucial for sharing current concerns and lessons learned from the field, which are influential in how team members view their shifting roles, identity, and research analyses.

Language in multicultural fieldwork does not only involve the translation of interlingual differences, but the translation of semantic boundaries where team members voice their concerns and develop common meanings about the project. One must go beyond attributing miscommunication in TDR fieldwork solely to interlingual differences and be aware of the research languages that are differentially interpreted and translated among team members. Reflecting on the role of research language allows TDR leaders and team members to genuinely listen and be more sensitive to the roles and representation of team members, particularly with how they accept, translate and adapt to a projects' research language.

Hierarchy and financial structures of TDR projects are reflected in the ways in which the research language is applied and communicated. Funding institutions typically value and prioritize specific frameworks and methods, which then shape the financial structures in TDR projects. This prioritization of conceptual frameworks may also form a hierarchy of associated field methods, where resources are allotted to different methods, tools, and disciplines in TDR. Team members with certain levels of agency and hierarchy have the liberty to express and reinforce their social norms in regards to fieldwork behaviors and voicing opinions about the TDR funding and processes.

The process and outcomes of transdisciplinary science are influenced by the complex network of actors who vocalize their opinions, which are shaped by their identity, language, financial structures and hierarchy. Solely focusing on the products of TDR (e.g., publications), and disregarding the influences of *voice* in teams may result in the oversimplification of communication conflicts that unravel indispensible lessons for enhancing team dynamics, fieldwork and consequently scientific data collected and analyzed (Kuziemsky et al., 2009; Latour, 1987; Thompson, 2009). My fieldwork experience and my subsequent in-depth analysis of conversations and observations revealed a need, if not an urgency, for me to more closely examine the role of voice in TDR and its influence on the scientific process. While my ethnographic experience exposed a variety of nuances in voice, this paper would have been very different if all of the Mongolian and US collaborators contributed to collaboratively writing the SEC team's fieldwork stories. As Lingard et al. (2007) assert, "Constructing knowledge as a group means that we tell different stories from those we would otherwise, so we must be conscious of this and reflect on why we tell the stories we do" (p. 516). It is important to recognize the role of storytelling and how this process gives voice to team members' varied experiences. Whether we reflect upon all of the possible different stories, or focus on a few, any reflection and listening to the voices in a TDR team allows deeper understanding of the team members' diverse identities, language, hierarchy and structures that ultimately shape the outcomes of transdisciplinary research and the science collectively produced.

REFERENCES

Aneas, M. A., & Sandín, M. P. (2009). Intercultural and cross-cultural communication research: Some reflections about culture and qualitative methods. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 10). Retrieved from http://www.qualitative-research.net/index.php/fqs/article/viewArticle/1251

Atkinson, P., & Hammersley, M. (1994). Ethnography and participant observation. In *Handbook of qualitative research* (Vol. 1, pp. 248–261).

Becher, T., & Trowler, P. R. (2001). *Academic tribes and territories . Buckingham: Society for Research in Higher Education*. Open University Press.

Borg, M., Karlsson, B., Kim, H. S., & McCormack, B. (2012). Opening up for many voices in knowledge construction. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 13). Retrieved from http://www.qualitative-research.net/index.php/fqs/article/view/1793

Bracken, L. J., & Oughton, E. A. (2006). "What do you mean?"The importance of language in developing interdisciplinary research. *Transactions of the Institute of British Geographers*, *31*(3), 371–382.

Braun, D. (2012). Why do Scientists Migrate? A Diffusion Model. *Minerva*, *50*(4), 471–491. http://doi.org/10.1007/s11024-012-9214-6

Brewer, G. D. (1999). The Challenges of Interdisciplinarity. *Policy Sciences*, *32*(4), 327–337. http://doi.org/10.2307/4532473

Carlile, P. R. (2004). Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries. *Organization Science*, *15*(5), 555–568. http://doi.org/10.1287/orsc.1040.0094

Clark, A. M. (1998). The qualitative-quantitative debate: moving from positivism and confrontation to post-positivism and reconciliation. *Journal of Advanced Nursing*, *27*(6), 1242–1249.

Collins, P. H. (1993). Toward a new vision: Race, class, and gender as categories of analysis and connection. *Race, Sex & Class*, 25–45.

Couldry, N. (2010). *Why voice matters: Culture and politics after neoliberalism*. Sage Publications.

Creswell, J. W. (2008). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications, Incorporated.

Cummings, S., Regeer, B. J., Ho, W. W., & Zweekhorst, M. B. (2013). Proposing a fifth generation of knowledge management for development: investigating convergence between knowledge management for development and transdisciplinary research. *Knowledge Management for Development Journal*, *9*(2), 10–36.

Daniels, & Walker. (2001). *Working through environmental conflict the collaborative learning approach*. Westport, Conn.: Praeger.

Peoples, J., & Depoe, S. (2014). Introduction: Voice and the Environment- Critical Perspectives. In *Voice and Environmental Communication*. NY: Palgrave Macmillan.

Giddens, A. (1984). *The constitution of society: introduction of the theory of structuration*. Univ of California Press.

Goring, S. J., Weathers, K. C., Dodds, W. K., Soranno, P. A., Sweet, L. C., Cheruvelil, K. S., …

    Utz, R. M. (2014). Improving the culture of interdisciplinary collaboration in ecology by

    expanding measures of success. *Frontiers in Ecology and the Environment*, *12*(1), 39–47.

    http://doi.org/10.1890/120370

Gray, B. (2008). Enhancing Transdisciplinary Research Through Collaborative Leadership.

    American Journal of Preventive Medicine, *35*(2), S124–S132.

    http://doi.org/10.1016/j.amepre.2008.03.037

Grimm, P. (2010). Social desirability bias. *Wiley International Encyclopedia of Marketing*.

Hagoel, L., & Kalekin-Fishman, D. (2002). Crossing Borders: Toward a trans-disciplinary

    scientific identity. *Studies in Higher Education*, *27*(3), 297–308.

    http://doi.org/10.1080/03075070220000680

Hennink, M. M. (2008). Language and communication in cross-cultural qualitative research. In

    Doing cross-cultural research (pp. 21–33). Springer. Retrieved from

    http://link.springer.com/chapter/10.1007/978-1-4020-8567-3_2

Khagram, S., Nicholas, K. A., Bever, D. M., Warren, J., Richards, E. H., Oleson, K., …

    Brauman, K. A. (2010). Thinking about knowing: conceptual foundations for

    interdisciplinary environmental research. *Environmental Conservation*, *37*(04), 388–397.

    http://doi.org/10.1017/S0376892910000809

Kitson, A., & Phil, D. (2009). Knowledge translation and guidelines: a transfer, translation or

    transformation process? *International Journal of Evidence-Based Healthcare*, *7*(2), 124–

    139. http://doi.org/10.1111/j.1744-1609.2009.00130.x

Kuziemsky, C. E., Borycki, E. M., Purkis, M., Black, F., Boyle, M., Cloutier-Fisher, D., …

    Interprofessional Practices Team (alphabetically). (2009). An interdisciplinary team

communication framework and its application to healthcare "e-teams" systems design. *BMC Medical Informatics and Decision Making*, *9*(1), 43. http://doi.org/10.1186/1472-6947-9-43

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Harvard university press.

Latour, B. (1998). From the world of science to the world of research? *Science*, *280*(5361), 208–209.

Lingard, L., Schryer, C. F., Spafford, M. M., & Campbell, S. L. (2007). Negotiating the politics of identity in an interdisciplinary research team. *Qualitative Research*, *7*(4), 501–519.

Manathunga, C. (2009). Post-colonial perspectives on interdisciplinary researcher identities. *Academic Research and Researchers, Eds. Angela Brew and Lisa Lucas*, 131–45.

Mezias, S. J., Chen, Y. R., & Murphy, P. (1999). Toto, I don't think we're in Kansas anymore. *Some Footnotes to Cross-Cultural Research. Journal of Management Inquiry*, *8*, 323–333.

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin III, F. S., & Redman, C. L. (2008). Epistemological pluralism: reorganizing interdisciplinary research. *Ecology and Society*, *13*(2), 46.

Mountz, A., Miyares, I. M., Wright, R., & Bailey, A. J. (2003). Methodologically becoming: power, knowledge and team research. *Gender, Place and Culture: A Journal of Feminist Geography*, *10*(1), 29–46.

Muhammad, M., Wallerstein, N., Sussman, A. L., Avila, M., Belone, L., & Duran, B. (2014). Reflections on Researcher Identity and Power: The Impact of Positionality on

Community Based Participatory Research (CBPR) Processes and Outcomes. *Critical Sociology*, 0896920513516025.

Nadasdy, P. (2003). *Hunters and bureaucrats power, knowledge, and aboriginal-state relations in the southwest Yukon*. Vancouver: UBC Press.

Ranganathan, S. (2007). Philosophy of Language, Translation Theory and a Third Way in Semantics. *Essays in Philosophy*, *8*(1), 1.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, *141*(10), 2417–2431. http://doi.org/10.1016/j.biocon.2008.07.014

Roux, D. J., Rogers, K. H., Biggs, H., Ashton, P. J., & Sergeant, A. (2006). Bridging the science-management divide: Moving from unidirectional knowledge transfer to knowledge interfacing and sharing. Retrieved from http://researchspace.csir.co.za/dspace/handle/10204/953

Roux, D. J., Stirzaker, R. J., Breen, C. M., Lefroy, E. C., & Cresswell, H. P. (2010). Framework for participative reflection on the accomplishment of transdisciplinary research programs. *Environmental Science & Policy*, *13*(8), 733–741.

Srivastava, P., & Hopwood, N. (2009). A practical iterative framework for qualitative data analysis. *International Journal of Qualitative Methods*, *8*(1).

Stokols, D., Hall, K. L., Taylor, B. K., & Moser, R. P. (2008). The science of team science: overview of the field and introduction to the supplement. *American Journal of Preventive Medicine*, *35*(2), S77–S89.

Stokols, D., Misra, S., Moser, R. P., Hall, K. L., & Taylor, B. K. (2008). The Ecology of Team Science. *American Journal of Preventive Medicine*, *35*(2), S96–S115. http://doi.org/10.1016/j.amepre.2008.05.003

Thomas, R., Tienari, J., Davies, A., & Merilainen, S. (2009). Let's Talk about "Us": A Reflexive Account of a Cross-Cultural Research Collaboration. *Journal of Management Inquiry*, *18*(4), 313–324. http://doi.org/10.1177/1056492608324457

Thompson, J. L. (2007). *Interdisciplinary research team dynamics: A systems approach to understanding communication and collaboration in complex teams*. VDM Publishing.

Thompson, J. L. (2009). Building Collective Communication Competence in Interdisciplinary Research Teams. *Journal of Applied Communication Research*, *37*(3), 278–297. http://doi.org/10.1080/00909880903025911

Wagner, C. S., Roessner, J. D., Bobb, K., Klein, J. T., Boyack, K. W., Keyton, J., … Börner, K. (2011). Approaches to understanding and measuring interdisciplinary scientific research (IDR): A review of the literature. *Journal of Informetrics*, *5*(1), 14–26.

Wall, S., & Shankar, I. (2008). Adventures in transdisciplinary learning. *Studies in Higher Education*, *33*(5), 551–565.

Wolf, E. R. 1923-1999. (2010). *Europe and the people without history*. Berkeley, Calif.: University of California Press. Retrieved from http://www.CSU.eblib.com/EBLWeb/patron/?target=patron&extendedid=P_865264_0

Wolf, M. (2014). Culture as translation–and beyond ethnographic models of representation in translation studies. *Crosscultural Transgressions. Research Models in Translation Studies II, Historical and Ideological Issues*, 180–192.

CHAPTER FIVE

Conclusions

Reflective Adaptive Processes and participatory mapping serve as examples of approaches for integrating knowledge in inter- and transdisciplinary research contexts. In this dissertation, I have applied these participatory processes to examine transdisciplinary team communication and integrate local knowledge of Mongolian socio-ecological systems. Integrating and transferring multiple knowledge types (e.g., disciplinary and local knowledge) entails examining the role of voice in transdisciplinary research. Hence, I provide a reflexive account of voice in transdisciplinary fieldwork and the influence of language, identity, hierarchy, and financial structure in the expression of voice or opinion in transdisciplinary field contexts. My conclusions in this dissertation are based on the literature and the SEC project, where I served as participant observer for four years (2011-2015) and gathered ethnographic data consisting interviews, field notes, emails, and SEC team documents.

In this dissertation's first manuscript, I bridged theories on learning, systems thinking, and reflective inquiry for applying Reflective Adaptive Processes or participatory reflection in transdisciplinary contexts. I applied SEC as a case study to demonstrate how participatory reflection served as a tool to facilitate, apply and collectively reflect on research team communication and stakeholder engagement across funder, researchers and research end users in transdisciplinary research. I highlighted the importance of participatory reflection in program evaluation in a transdisciplinary research project, particularly the reflection on research team achievements in the context of society's need and goals. Thus, I provide stakeholder engagement and accountability indicators for research team members to collectively reflect upon. Finally, I

provided lessons learned and principles for facilitating participatory reflection in transdisciplinary research. These principles and lessons were based on the experience of the SEC field team and the literature in learning, adaptive co-management, and knowledge integration in inter and transdisciplinary research contexts.

Participatory mapping is another process and tool for integrating diverse knowledge systems in transdisciplinary research. My second dissertation manuscript highlights the *process* of participatory mapping and the *narrative content* behind the maps collectively developed by Mongolian herders and their families. While many researchers and NGOs have applied participatory mapping to create GIS maps of pasture territories, I applied participatory mapping to explore how herders discussed their world views about their pastures and boundaries. I specifically focused on herders' narratives of their pastures as they discussed their sense of places and socio-ecological boundaries imbedded in their home pastures.

Similar to participatory reflection applied in this dissertation's first manuscript, the process of participatory mapping facilitated the collective reflection about herders' pastures and allowed for the integration of herders' local ecological knowledge on Mongolian socio-ecological rangeland systems. This was especially evident as families across different generations discussed and negotiated the boundaries and location of their pastures and winter camps. Integrating my researcher lens and interpretation of herders' narratives, I have labeled the boundaries of winter, spring, and summer camps as human-demarcated boundaries.

Herders' narratives of these human-demarcated boundaries are coupled with discussions of biophysical features (e.g., rivers, vegetation types) or boundaries delineating their pastures and influencing herder mobility. I examined the coupled relationships of these coupled biophysical and human-demarcated boundaries that include local knowledge and adaptive practices

influencing herder mobility and livelihoods. Examining these coupled socio-ecological boundaries may be significant for development agencies and researchers intending to move beyond the management of biophysical boundaries in pastures and integrate adaptive management in sustaining rangelands resilience. Exploring herders' narratives of their pasture boundaries highlights the local meanings of Mongolian rangelands and recognizes indigenous worldviews crucial for knowledge integration and social learning in transdisciplinary research.

Integrating and transferring different knowledge systems (e.g., disciplinary knowledge, local knowledge) in transdisciplinary research requires an understanding of the role of voice or opinions shared in inter and transdisciplinary research teams. My reflexive account of conducting socio-ecological fieldwork in Mongolia reveals the complex network of actors in transdisciplinary research and how those actors' voices and opinions are shaped by identity, language, financial structures and hierarchy within a research project. These may influence research communication processes critical for integrating knowledge, collectively understanding Mongolian rangeland socio-ecological systems, and co-developing project products. Figure 5.1 contributes to this dissertation conceptual framework presented in the introduction and includes the facets of voice integral to transdisciplinary research contexts.
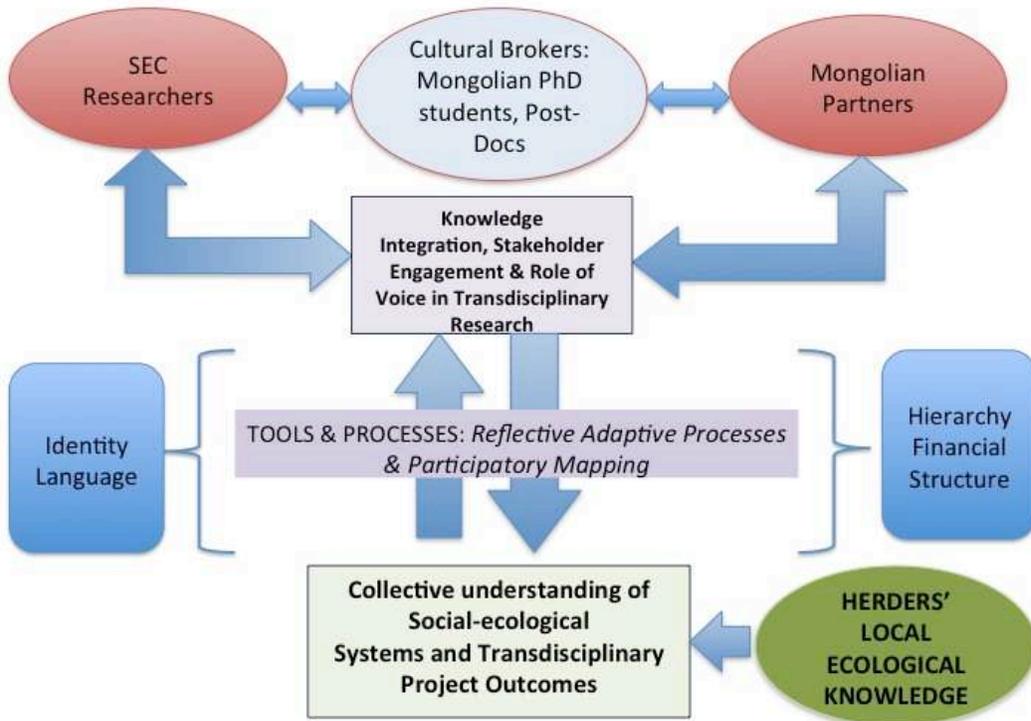
Figure 5.1. The influence of identity, language, hierarchy, and financial structure influences the processes and tools of knowledge integration and transfer in transdisciplinary research contexts.

The application of knowledge integration tools (e.g. participatory reflection and participatory mapping) and the open dialogue about the role of voice in transdisciplinary research may provide holistic analyses of coupled human-environment relationships vital for representing socio-ecological systems and engaging stakeholders. Future work could investigate the willingness and barriers of transdisciplinary teams to adopt knowledge integration tools in inter and transdisciplinary research contexts. As mentioned in the first manuscript of this dissertation, there are time and energy costs associated with transdisciplinary research and these costs may influence the adoption of participatory tools for integrating diverse knowledge systems and stakeholder voices. Aligning these "transdisciplinary costs" with outreach and policy

products deemed legitimate by funding institutions may facilitate the adoption of knowledge

integration tools and processes essential in genuine stakeholder engagement. A substantial

contribution to understanding knowledge integration in transdisciplinary contexts could entail the

quantitative and qualitative evaluation of knowledge integration tools in their effectiveness at

engaging funders, researchers, and research end-users.

CHAPTER 6

Afterword

My PhD experience at Colorado State University (CSU) has certainly been a privileged one that was full of adventures, challenges, and support from my committee and colleagues. This afterword is a reflection of my overall PhD experience, including my four years with the Graduate Degree Program in Ecology, the influence of CSU's Center for Collaborative Conservation, and my international travel for fieldwork and teaching. I close each section with some advice and recommendations for graduate students. Specific experiences and lessons learned with my SEC project work can be found in Appendix D.

Graduate Degree Program in Ecology (GDPE)

In December of 2010, I had obtained my Master's of Science degree from the Human Dimensions of Natural Resources at CSU. Having experienced the practice and training in the ecological and social sciences for my undergraduate and MS degrees, I was eager to start my PhD in GDPE where I could further learn the language of ecology and examine coupled human-environment systems. I had the opportunity to further take anthropology classes such as ethnography, participatory monitoring and evaluation, and indigenous ecologies with Dr. Kathy Pickering. These anthropology courses were pivotal to my understanding of socio-ecological systems and the colonial world views underpinning the framing and approaches of complex natural resource problems.

Interestingly, I was also taking classic ecology classes such as ecosystem ecology and evolutionary genetics at the same time as I was delving into all of these anthropology courses.

My ecosystem ecology class with Dr. Joe Von Fischer was very memorable and he was very enthusiastic as he focused on processes and mechanisms on diverse facets of ecosystems. Throughout my undergraduate training in ecology and evolution, we were given enormous amounts of information on seemingly random and linear ecological concepts. My graduate class on ecosystem ecology involved much more detail on biophysical processes than my undergraduate class. However, my exposure to systems thinking and developing systems maps during my Master's degree equipped me to focus on the relationships among the mechanisms and elements of the ecosystems we were studying. My notes consisted of systems maps with arrows and linking concepts and mechanisms. Taking notes in this manner was risky for me as a new doctoral student in ecology. However, studying and practicing systems maps enabled me to view the relationships in ecological systems and inspired me to question the gaps in how coupled human-environment systems are framed and investigated.

The juxtaposition among my anthropology and classic ecology classes revealed the different and seemingly incompatible views of ecological systems. In my classic ecology classes, human factors, if there were included at all, were always attributed to anthropogenic impacts to biophysical systems, such as changes to the nitrogen cycle due to increased fertilizer run-off. My anthropology classes did not at all touch on biophysical processes and it appeared to not be compatible with the overall learning goals and objectives. While it is not my purpose to compare both types of courses, I highlight some of the differences and my experiences with my GDPE courses to shed light on how scholars such as myself are still trained separately in the classic sense of social and ecological sciences. This separation in coursework and training consequently influences the separation of methods applied in coupled human-environment research work. For example, the social science sampling and analyses are conducted separately from ecological

sampling, resulting in potentially disparate research findings on the socio-ecological systems being studied.

I have provided advice to several GDPE graduate students, particularly in coursework. For graduate students studying socio-ecological systems, please do not expect courses that perfectly integrate social science and ecological methods addressing coupled human-environment problems. With the support of your advisor or any GDPE affiliate faculty, I suggest co-developing a one credit seminar that integrates your interests in socio-ecological systems. This seminar would also serve as course credits for GDPE students. I have successfully initiated a seminar on Human Dimensions of Natural Resources course cross-listed with GDPE's one credit seminar course as part of the required curriculum. While I co-lead the course and some of the discussions, faculty speakers mostly lead the presentations and seminars, which certainly eased the time and energy load of facilitating the entire seminar. There are also many WCNR Centers, the Center for Collaborative Conservation (CCC) that can help integrate social and ecological sciences through joint seminars, research, and fellowships.

Center for Collaborative Conservation (CCC)

I first heard about the CCC in November of 2008, when they first sent out the call for proposals on research involving community-based conservation and management. I was an unfunded Master's of Science student then at CSU and I was searching for funds that could support my work on coastal resource management in my home country of the Philippines. My proposal was surprisingly accepted and I became part of the first cohort of CCC fellows at CSU. It was a very inspiring and empowering experience to receive my first grant in graduate school as well as be part of a very supportive network of fellows and professors learning to apply and

integrate collaborative conservation in their work. Since my fellowship started in 2009, I have continued to be part of this network of fellows that enabled all of us to build upon each other's work.

One of my more memorable experiences with the CCC was working with my good colleague and CCC fellow David Knight. Prior to David's fellowship, I had convinced him to focus his fellowship proposal on coastal management and field education with the local governments I worked with in Cebu, Philippines. The project involved taking local governments, fish wardens, and elementary and high school teachers to visit their Marine Protected Areas (MPAs) and include lessons learned from these trips called "lakbay aral" or travel learning into their curriculum. I was fortunate to help him get set up with the project in the Philippines in between my doctorate field work in Mongolia. While David took the lead in our project, it truly was an honor for me to introduce David to the fish wardens, local governments, and teachers that were so appreciative and enthusiastic of our project. One of the fish warders, the late Nonong Burreros, was nationally and world renowned for his leadership in coastal management and coastal law enforcement. Nonong Burreros was so enthusiastic about our project that he would occasionally explain, " This [project] has never been done in this manner before!" Nonong passed away from cancer a couple of years after our project ended in 2012. His passion for managing marine resources was certainly contagious and inspirational, particularly for researchers such as David and myself as we learned about the social and political context of coastal resource management.

My dissertation work had nothing to do with the coastal management work and publications I did with David and the CCC. Despite this situation, I certainly do not regret the time spent with David, Nonong, CCC and the stakeholders we worked with in Cebu. The

relationships made and sustained was what kept my interest and motivation to continue my graduate school education. I knew I was passionate about coastal management, particularly in the Philippines, and I had no doubt that sustaining contacts through CCC fellowships and colleagues was the right thing to do. For PhD students who may have an urge to do other projects unrelated to their dissertation, my advice would be to pursue these projects you absolutely know you are passionate about. Yes, there are time and energy costs associated with pursuing other projects. However, I advice PhD students to genuinely reflect on the potential processes and outcomes that result from these seemingly unrelated projects. Oftentimes, these processes will equip PhD students with other tools and experiences helpful beyond one's dissertation and life in graduate school.

International Fieldwork and Teaching

I have been privileged to travel internationally for fieldwork in Mongolia and teaching socio-ecological field methods in Belize. My international fieldwork has certainly shaped my ways of communicating with individuals and research teams having different cultures and world views of how fieldwork should be accomplished. Some of my fieldwork experiences are shared in my dissertation chapters and Appendix D.

Teaching a socio-ecological course with Dr. Jen Solomon in Belize for the last two summers has also been a very fulfilling experience. My previous field education work in Costa Rica, Philippines, and Colorado has inspired me to seek field teaching opportunities that involve collectively experiencing ecosystems (e.g., snorkeling in coral reefs) and learning about the strategies stakeholders practice to address socio-ecological issues. Teaching in Belize provided me with the opportunity to answer my calling to field education and sharpen my teaching skills.

It was challenging and unexpectedly almost a 24-hour job as Jen and I spent late nights planning logistics, grading papers and journal entries, and dealing with students' interpersonal issues as they worked in their team projects. Despite these challenges, it was truly a privilege and honor to learn alongside students as we collectively experienced the incredible Belizean ecosystems and formed friendships with locals across the country.

Similar to the other projects I pursued in graduate school, teaching in Belize was unrelated to my dissertation and was not required for me to complete my PhD. I knew, however that I wanted to continue international field education after my PhD. The Belize field course also funded me for a short period of time, which was essential for my situation since my PhD funding ran out after two and a half years. Perhaps I would have finished my PhD sooner or produced more publications if I had not pursued the Belize course. Reminiscing my experiences and lessons learned from the field course, I have no regrets. My advice for PhD students who may feel conflicted about graduate school opportunities unrelated to their dissertation is to question whether they would pursue similar opportunities (i.e., teaching field courses) after graduate school. If the answer is yes, then I suggest pursuing these opportunities despite the risk and time costs involved. One will never know whether these opportunities will be available again, considering that inevitable change and uncertainties will continue beyond graduate school.

Concluding Thoughts

Writing my dissertation and conducting my PhD research were key events in my graduate school experience. Despite the significance of PhD research, the projects unrelated to my dissertation, international travel, and relationships I have formed throughout graduate school made up the bulk of my experience at CSU. I have been privileged to obtain funding to return to

my home country of the Philippines and continue my coastal management work with close friends and colleagues. I have traveled internationally for fieldwork in Mongolia and taught socio-ecological courses in Belize. More importantly, I have formed and maintained long lasting relationships with Mongolian, American, Philippine and Belizean colleagues who inspired me to finish my PhD and continue to love life beyond graduate school.

APPENDIX A

Letter of Consent for Interviewing SEC Team Members

(This letter has been edited to obscure the identities of the SEC Team members and the University that has sponsored the SEC)

Socio-ecological Complexity Project (SEC)

February 19, 2011

Dear Team,

We are writing to you to request your consent to participate in a series of interviews regarding communication and collaboration processes concerning sec. Our intentions are to listen to your perspectives about SEC, to understand and help make sense of the challenges and opportunities in doing complex, interdisciplinary work. I also intend to use interviews for publication and we will ensure that identities will be kept confidential. However, there are limits to which your identity will be obscured. Because of the small number of participants in this study, you may be identified indirectly from your responses.

Attached is consent to participate form. If you are willing to participate in the interviews, please sign the attached form and return it to Arren Allegretti via email (amendezona@gmail.com).

For questions or concerns, please don't hesitate to contact us via email.

Sincerely,

Arren Mendezona Allegretti, MS

APPENDIX B

Participatory Maps, Field Notes on Sites, Codes, and Word Map on Field Notes

IKH TAMIR, ARKHANGAI MAPS

Ikh Tamir, Arkhangai Map #1
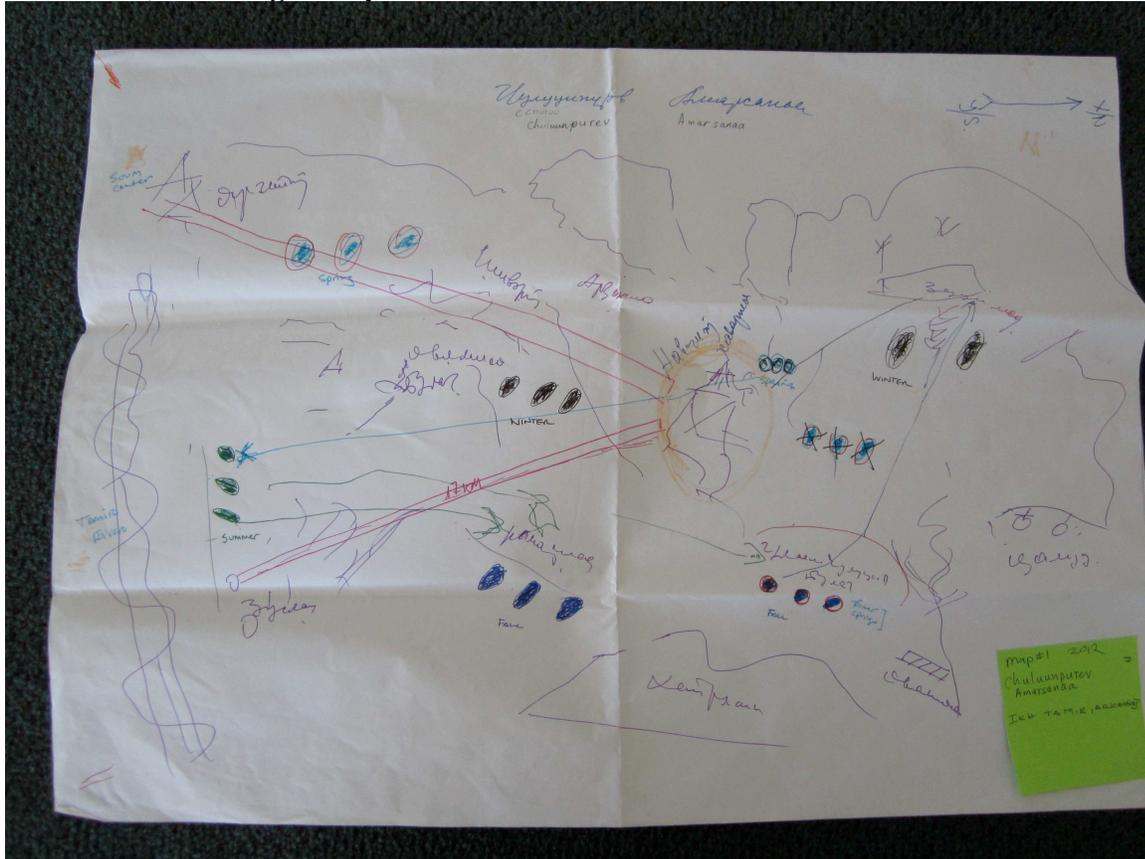
Ikh Tamir, Arkhangai Map #2
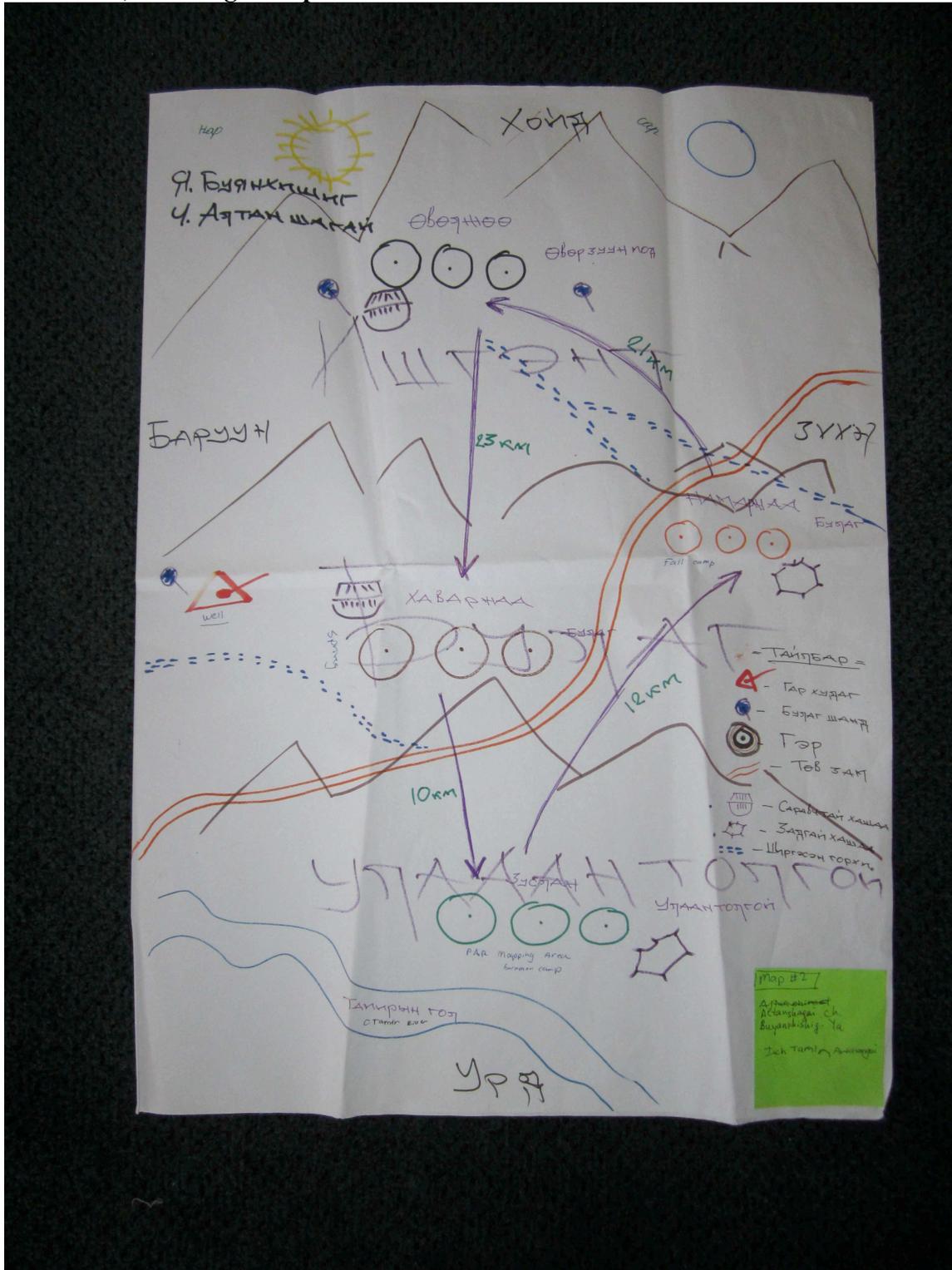
Saikhandulaan, Dornogovi Map #4

Saikhandulaan, Dornogovi Map #6
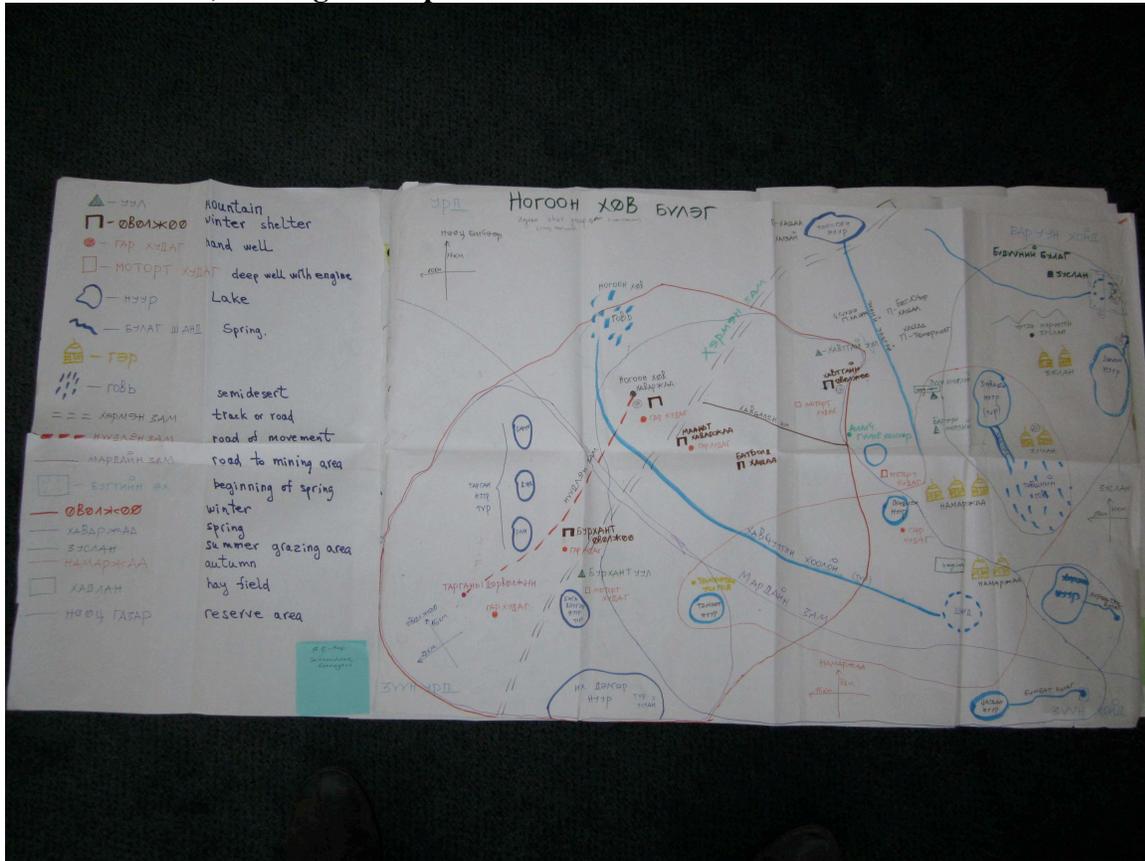
Tsagaan Ovuu, Dornod Map #7
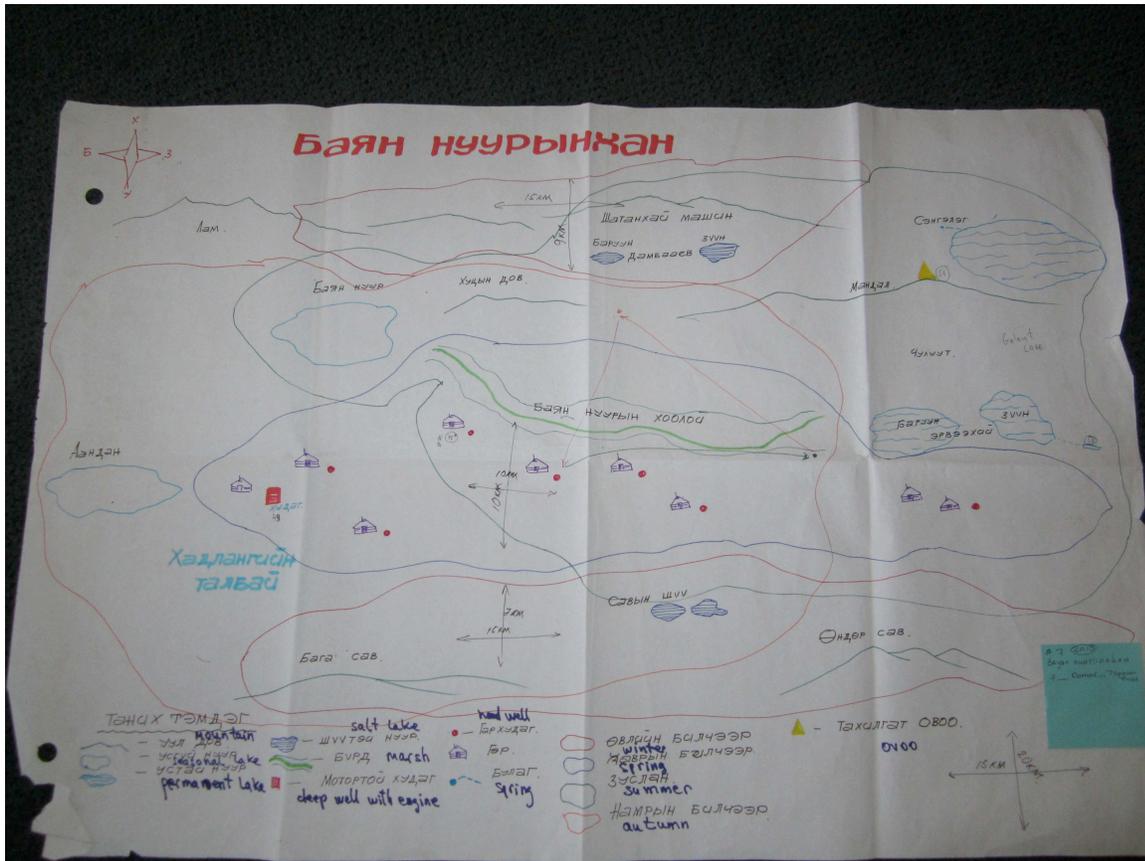
PARTICIPATORY MAPPING LOCATIONS

(BASED ON AMA, ML, AND ZULAA'S FIELD NOTES)

18.07.2013 ''Tsagaan ovoo'' soum of Dornod aimag place name is ''Bayan lake valley''
18.07.2013 Land officer of Sergelen soum of Dornod aimag
19.07.2013 Sergelen soum of Dornod aimag herder Davaasuren
20.07.2013 Herder group senior Chuluunbaatar, Tugrug bag of Tuhum soum of Sukhbaatar aimag
21.07.2013 Environmental officer Delgertur, Altanshiree soum of Dornogovi aimag
21.07.2013 Herder Erdenebat, Saikhandulaan soum of Dornogovi aimag
22.07.2013 Saikhandulaan soum of Dornogovi aimag

2012-2013 Aimags

Aimag	Soum	Bagh	Donor Group	Herder Group
Dornod	**'Tsagaan ovoo''**		**non-CBRM**	**Bayan nuiriinkhan**
	Sergelen		WB (herder group)	
Sukhbaatar	Tuhum	Tugrug	?	No map, not in ML notes
Dornogovi	Altanshiree		UNDP	
Dornogovi	Saikhandulaan		Non-CBRM	2 herder groups
Arkhangai	Ikh Tamir	Ishghent	SDC	Ishghent Bulag
Tov	Undurshireet		SDC	1 herder group/family

3 Traditional Herder groups (1 in Tsaagan Ovuu, Dornod and 2 in Saikhandulaan, Dornogovi).
3 CBRM Herder groups (1 Undurshireet, Tov and 2 in Ikh Tamir, Arkhangai)

PARTICIPATORY MAPPING EXERCISES AND FOCUS GROUP ACTIVITY

Process: Draw on the paper a map of the following. Define your symbology – what do your shapes and drawings mean? Use post-it notes to additional comments and information about different places.

1. Create a map of the most important points/places
    Why are these places important? What do they represent?

2. Identify at least 3 known points (Identify landmarks: road intersection, stream confluence, high point)
    What do landmarks represent?
    If possible get GPS points, provide place names, locations in relationship to other key landmarks

3. What is a neighboring area? What defines the boundary?
    Social and jurisdictional boundaries
    Ecological and physical boundaries

4. What causes movement?
    Can you identify boundaries on your map and explain why it is a boundary?
    What things change that make/define a boundary?
    Camps X season

5. How do you "read" the landscape – recognize different places, know which routes to follow?

Focus group activity:
The purpose of the participatory mapping is to gather from communities their perspectives of the landscape and determine how this aligns with other types of information. A key aspect of this is to focus on boundaries and how boundaries influence movement of herder groups.
The focus group is divided into groups of 4-5 and given a butcher sheet of paper on which to draw their map. A collective discussion is undertaken to determine the purpose and content of the map.
1. Preliminary discussion about map, purpose, and content
    a. Why make the map?
    b. Who will use the map?
2. Information to include on map
    a. Natural features: rivers, mountain, lakes, pastures (major landmarks)
    b. Human made features: villages, roads, agricultural areas, migration routes, summer, winter camps
    c. Special areas (if group desires to share)
3. Participants to create map
    a. Determine symbols
    b. Language of map

  c. Area and extent of map
4. Transect walk or drive
  a. Validate and share further detail of area mapped
  b. Take GPS points in field
5. Sharing the map
  a. Each group describes their maps, identifying key locations in migration routes
  b. Usually, leads to further discussion about movement patterns
  c. Identify links to policy, rules of locality

The maps will be analyzed by identifying key landmarks, deriving GPS coordinates for these locations.   The maps will be scanned and georeferenced. An overlay and patchwork analysis will be conducted on the maps to determine the relationship of fine scale patterns of movement with ecological and social science data collected in the field and to ascertain relationships with existing boundaries. The data is aggregated in that a community landscape is mapped, no individual households or individual resources are identified

Summer 2013 Activity
Participatory mapping, focus groups, and interviews – **mapping your nutag.**

Questions:

1. How long have you been a herder?

2. When do you move your herds?

3. How do you move your herds?

4. Why do you move your herds?

5. Why do you move your herds to the particular pasture that you go to?

6. How do you know when you are in a different place of the landscape?

7. When grazing herds, are boundaries recognized? How and in what ways?

8. How do boundaries change with:
  a) season -- grazing
  b) issue -- disaster, health of grazing area (grazing rights), land tenure
  c) assistance -- links to NGO, other research projects
  d) networks -- kinship networks, migration networks, stream networks

AMA COMMENT:
Thanks for putting this together. I feel that this list of questions target herder movement and associated boundaries. The system map that came up from the par mapping narratives resulted

from these questions. That being said, I don't think there is a need to re-organize these questions to fit within the constructs of the systems map. I think that these constructs (e.g., land tenure, access to resources) will re-surface once herders do the mapping. If they don't, then we have more to add to the picture.

One question we could ask them is about their PUG and if PUGs influence their movement. If you are not in a GreenGold site, then you and BB could ask about how their community-based institution (e.g., SLP by World Bank or voluntary herder groups by UNDP) influences how they herd and move. Alternatively, herders from non-CBNRM soums could be asked about informal or traditional herder groups in driving their herding practices and movement. I'm not so sure if this is too personal though. **I suppose we could simply ask if they practice otor and if any group (kin, PUG or CBNRM, friends) influences the way they herd and practice otor. I** hope these guys are not fatigued by interviews from other folks

OPEN CODES OF PARTICIPATORY MAPS

Prelim Codes for Maps 2012
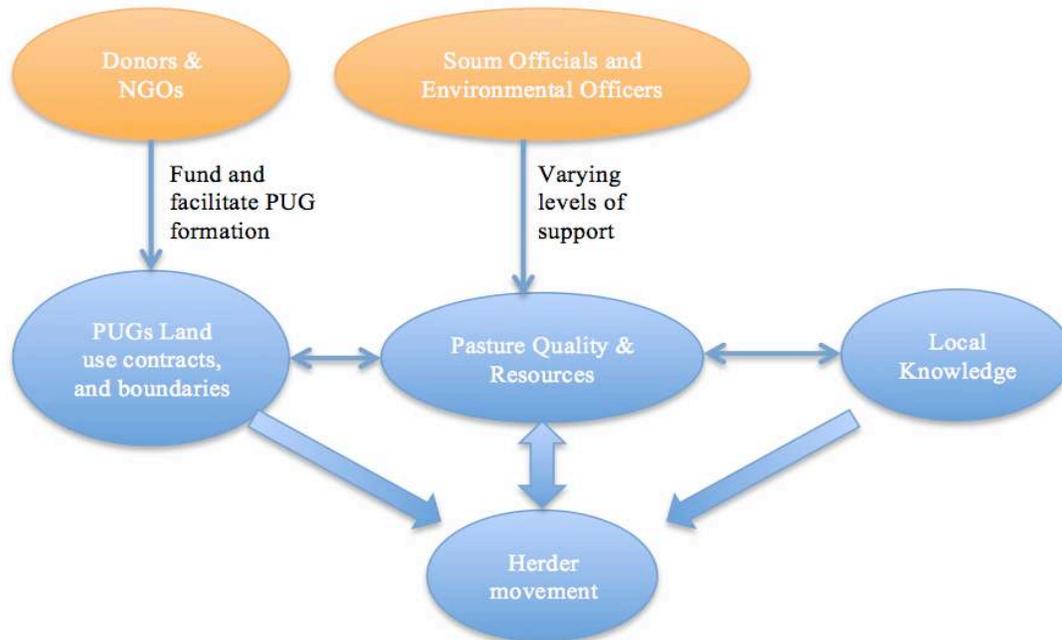
Prelim Codes for Par Maps 2013- Actual Maps
1_IkhTamir_Arkhangai
Open Coding and Memo Writing
This map was made in IkhTamir, Arkhangai during the 2012 field season with Melinda, Batbuyan and I. This map along with others in Ikh Tamir were already coded in 2012, along with my field notes for my anthro paper.

This map was created by the herder group or family Chuluun Purev Amarsanaa. I need to clarify if this is a herder group or a family part of the Ishghent herder group. Ishghent is funded by the SDC through the GG project.

Upon reviewing the map, the Tamir river (as pointed out by Mongolian colleague Chantsaa), was the main indicator that the mapping occurred in Ikh Tamir. The Tamir river was located in the southeast (lower left hand corner of their map). Their map was oriented E due to the N/S arrow on the upper right hand corner of the map.

Items identified on the map are typical of other maps seen:
seasonal movements,
presence of springs,
locations of winter,
summer, Fall (2 locations) camps,
distance of moves rom summer to winter camps, ;

mountain ranges and peaks are identified; soum center
==winter shelters==
There was no legend created for this map.
My field notes elaborate on the overall context of IkhTamir, Arkhangai. Here are some of my notes:

1) River bounds grazing
2) Herders cross river but livestock stay
3) Roads (pink pen)- importance of transportation as stated in codes???
4) Identified spring, winter,fall, and summer campsites

" yes, we move out of ==PUG boundary== up to 150 km; move by car to take advantage of good pasture along the way- TRANSPORTATION CODE

2_IkhTamir_ Arkhangai
Open Coding and Memo Writing
This map was made in IkhTamir, Arkhangai during the 2012 field season with Melinda, Batbuyan and I. This map along with others in Ikh Tamir were already coded in 2012, along with my field notes for my anthro paper.

This map was created by Buyankhishig, leader of the Ishgehent group funded by SDC. Buyankhishig also participated in the SEC Kickoff meeting and was part of the panel sharing his thoughts on herding, adaptation practices. Buyankhishig's thoughts on 2011 Annual meeting panel discussion (taken from annual meeting report written by me and taken from my field notes)

- Ikh Tamir communities of herders currently protect ==reserve pasture land== and water resources. After 2010 dzud, there were an additional 13,000 animals from other herders that did not participate in the community-based efforts. As a result, the pasture land was severely degraded. During extreme weather conditions, it is difficult to appropriately manage pastures. Herders do understand these problems
- Mr. Buyankhishig agrees with Mr. Chinbat about the necessity to put fences around the hay-making field that will be important in springtime.
- Herders are supportive of hay-making groups.

With regards to the actual maps lead by Buyankhsihig and his family: Ths map was very detailed having a detailed legend, direction (north arrow), depicting that he had experience making these maps before. It is obvious that he had participated in ==" participatory mapping" sessions facilitated by SDC== in the green gold project.
The participatory mapping took place in their summer camps where piles of Larix logs were neatly stacked by their gers (see pictures). The grass was a yellow-green color indicating that rain had occurred. We also experienced the rain earlier in the day and the road erosion.
The map contains the following:
- ==Summer camps==
- Tamir river
- ==Summer-winter-fall pastures==
- Aspect- sun and moon
- Mountain peaks
- Spring locations
- Wells
- Roads

- Distances of movement
- Spring to summer- 10 km
- Summer to Fall: 12 KM
- Fall to winter: 21 Km?

From field notes of what is in this actual map:
- 3 valleys that have their own name
- "each time you have to cross a valley, you have to cross a pass"
- soum center NOT MAPPED
- spring
- ephemeral river
- <mark>winter and spring shelters (different from spring camps)</mark>
- oriented north
- Otor is 80 k for several years
- Otor direction is different from when they look for a better pasture

3_IkhTamir_Arkhangai
Open Coding and Memo Writing
This map was made in IkhTamir, Arkhangai during the 2012 field season with Melinda, Batbuyan and I. This map along with others in Ikh Tamir were already coded in 2012, along with my field notes for my anthro paper.

       <mark>The PUG name is Bulag</mark> that is a special place name. Items written in field maps concerning this map:
- Id well for winter and spring
- Soum center is not included in extent
- Map oriented north

In the map itself,
- <mark>Trucks by winter camps</mark>
- <mark>Winter camps</mark>
- Distance of seasonal movement
- 10km- summer to fall pastures
- corals?
- mountain ranges- one of them has vegetation and the other one doesn't and appears drier (brown color pen)
- <mark>Yellow flowers drawn in by corrals and summer camps</mark>
- Presence of well/spring

Memo: I am doubtful that this map (4_Saikhandulaan) and the next 2 maps (5_Saikhandulaan; 6_Siakhandulaan) were constructed in Saikhandulaan (soum), Dornogovi since there is no clear place name on these maps, no label from ML, and no specific reference to these in the field notes. Additionally, the field names say that participatory maps were made in Altanshiree, but there are no maps to reference these to Altanshiree. I am sure about the maps taken in Ikh Tamir(maps 1-3) since I was present and the Tamir river is clearly labeled. In addition, I am sure about the Tsaagan Ovuu, taken in Dornod since this is clearly labeled in the map. The remaining maps that are unclear in terms of place include Saikhandulaan, Dornogovi, Altanshiree,

Dornogovi, and Sergelen in Dornod. I would assume that the remaining 3 maps would be either from Altanshiree or Sergelen This is really key since some herder groups represent a CBNRM and other don't. I am really leaning in that these 3 maps occur in the desert, because they have the word "govi" in it.

4_Saikhandulaan Dornogvi

Memo: This very simple map or "primitive" as Tungaa calls it (I disagree with the primitive word) was taken in Dornogovi aimag. There isn't a lot of detail in terms of specific boundaries present and the lake ius the most prominent feature with a green area labeled govi next to it. There is also a main wetlands next to the green area and rivers feeding into this green area. A spring is also evident next to the lake with the same symbols of the green area. A well is shown next to the lake. Gers are also very prominent just below the mountains. The place names for their winter shelters are very interesting such as great bedding for livestock. I am not sure what the yellow triangles are near the mountains. These yellow triangles are likely ovoo's or a pile of rock or cairns indicating location and potentially territory. Othermaps such as the Tsaagan_Ovuu_Dornod map indicates a yellow triangle as an ovoo.

Codes on the map:

- River
- Concave landscape
- Main wetlands
- Govi
- Lake
- Spring
- Gers
- Mountains
- Place names
- Rivers
- Well
- Summer camps

5_Saikhandulaan_Dornogvi

Memo: This is probably the most detailed map among all the participatory maps taken for this project. The winter, summer, fall, and spring camps boundaries are clearly marked with different colors. The herder group name is clearly labeled in the upper left corner of the name: Nogoon Khuv group. It is interesting that this group name is the same one for the Sergelen in Dornod. However, I doubt that this group is from Sergelen since the word govi is written on the map and Sergelen in in Dornod (not in govi area).

The winter camp, reserve area, and spring camp boundaries overlap. Overall these camps, the winter camp is largest. The map is oriented in the direction of the winter camps. Winter shelter seem to be very clearly marked and are in close proximity to hand wells. Ephemeral water sources are also clearly labeled. There are specific place names for each type of lake (fat lake (targan), tur (ephemeral lake)). Finally, this is the only map that has the road to the mining area clearly labeled. Ephemeral stream and roads cuts across all 3 camp boundaries: winter, reserve area, fall, spring. Summer camp overlaps with the fall camp and is separated by a main tributary that leads to fall camps and a deep well with engine. I am assuming that the bright blue line separating winter, summer and fall camps is a tributary since it originates in a lake and is labeled "first opening."

Some distance scales in summer camps are provided. For example, in the summer camp area it is labeled (pointing upwards of map; nw direction) that from summer camp onwars is the 11 km boundary and and 15 km to the south. It might be safe to assume that their summer camp boundaries or area is (11 x 15 km) taken into account.

Map codes:

- In legend:
- Mountain
- Winter shelter
- Hand well
- Deep well with engine
- Lake
- Spring
- Semidesert
- Track or road
- Road of movement
- Road to mining area
- Beginning of spring
- Winter (added camp border)
- Spring (camp border)
- Summer grazing area
- Autumn (camp border
- Reserve area
- Hay field

6_ Saikhandulaan_Dornogovi
Memo: This map is almost a replica of 5_Saikhandulaan_Dornogovi, considering that it was made from the same group although group name is not labeled in the map (Nogoon Khuv). This maps is also oriented the same way as [5_Saikhandulaan_Dornogovi} with the permanent lake being in the center top of the map and a main tributary crossing herder paths (winter camp to summer camps), animal shelter, and a narrow valley. . The herder path from winter camps to summer camp is labeled with a 30 km distance, whereas the other maps does not label it. The road to the mining area is also labeled. Mountain peaks (east and west muugli) are labeled beside ephemeral lake.
Map content/figures:
- Hand well
- Winter camps
- Roads
- Ephermeral stream
- Shelter for animals
- Herder paths from winter camp to summer camp
- Springs
- Lakes
- Spring camp
- Ephemeral lake
- Place names for lakes
- Depressed area
- **Spring camp**

7_TsaaganOvuu_Dornod
Memo: Similarly detailed map as compared to 5_Saikhandulaan map. The herder group name is marked in bold red lettering at the top of the map: Ban Nurrbinjan. This map has clearly mapped fall, winter, spring, and summer boundaries with an ovuu. Scale and direction of winter camp area is marked (15x 9km). This herder group has 2 winter camps, the fist that is 15 by 9 km wide with two permanent lakes and the second is located south or bottom of the maps that is15x 7 km with also two permanent lakes. A marsh intersects the spring camp and hand wells are located on the other side of the marsh. Perhaps triangle indicates concentrated movement by the marsh area, or a place the herders encounter more often since it intersects the autumn, summer, and spring camps.
A triangle represents herder movement across the marsh and movement among spring, summer, spring and fall camps.
The map appears to be oriented north (hoydt or xoydt). The spring camp area is 10x a0km wide while the winter camp boundary is 7x15 km just south of the spring camp boundary. The largest area is the fall camp boundary that overlaps with the winter and spring camp boundaries.
- herder groups name Bayan nuuriinkhan
- direction arrow
- seasons
- distance metrics for each of seasons
- waters features including permanent and seasonal lakes
- wells- hand versus deep well
- springs

- ger locations
- distance between seasonal pastures
- extent of seasonal pastures
- summer pastures overlaps different
- two different winter areas
- didn't identify the explicit camps for seasonal pastures
- GPS points on specific points: 48, 49, 51, 52,
- Winter camp extents #1: 15 by 7 km
- Winter camp extent #2: 15x 9
- Spring camps_ 10 km x10 km
- Movement directions and patterns across summer, autumn and winter (triangular). ML suspects that spring isn't there is livestock give birth to their young and movement is less
- Spring movement pattern overlaps with summer movements by place
- Legend:
Mountain, seasonal and permanent lake, salt lake, marsh, winter, spring, summer fall pastures, ovoo

PAR MAPS CODES

Seasonal Camps, Shelters Code
- Winter camp extents #1: 15 by 7 km
- Winter camp extent #2: 15x 9
- Spring camps_ 10 km x10 km
- summer pastures overlaps different
- two different winter areas
- didn't identify the explicit camps for seasonal pastures
- distance between seasonal pastures
The spring camp area is 10x a0km wide while the winter camp boundary is 7x15 km just south of the spring camp boundary. The largest area is the fall camp boundary that overlaps with the winter and spring camp boundaries.

A triangle represents herder movement across the marsh and movement among spring, summer, sprind and fall camps.

This herder group has 2 winter camps, the fist that is 15 by 9 km wide with two permanent lakes and the second is located south or bottom of the maps that is15x 7 km with also two permanent lakes

fall, winter, spring, and summer boundaries with an ovuu.

- Summer grazing area
- Autumn (camp border
- Reserve area
- Winter (added camp border)
- Spring (camp border)
- Winter shelter
Summer camp overlaps with the fall camp and is separated by a main tributary that leads to fall camps and a deep well with engine.

I am assuming that the bright blue line separating winter, summer and fall camps is a tributary since it originates in a lake and is labeled "first opening."

- The winter camp, reserve area, and spring camp boundaries overlap. Overall these camps, the winter camp is largest.
- The winter, summer, fall, and spring camps boundaries
- Summer camp
- The place names for their winter shelters are very interesting such as great bedding for livestock
- Trucks by winter camps
- Winter camps
- Yellow flowers drawn in by corrals and summer camps
- winter and spring shelters (different from spring camps)
- Summer camps
- Tamir river
- Summer-winter-fall pastures
- winter shelters
- locations of winter,
- summer, Fall (2 locations) camps,
distance of moves rom summer to winter camps,

CODES FOR PARTICIPATORY MAPPING NARRATIVES

Step 1: Code the "meaning units" in the essay. Meaning units are words, phrases, lines of text, sentences, or paragraphs that hold meaning. This step is referred to as "open coding" or "first level coding."
Step 2: Take the list of open codes you generated and organize them into categories that are suggested by the open codes. This step is referred to as "axial coding" or "second level coding." The second level categories are induced from the open codes.

RQ1: What factors influence herder movement?
RQ2: How are these factors manifested through herders' knowledge of their home pasture or nutag?
RA3 What are the spatial relationships among seasonal movements and herders' knowledge of their nutag?
RQ4: How do herders experience boundaries in herder movement?

Open Codes	Axial Coding (secondary coding)
Tsagaan Ovuu, Dornod	Soum
snow cover is influential in herder movement	Snow cover-factor for HM (herder movement)
Tsaagan Ovuu: Drought: influences herder movement into protected area	Drought-factor for HM (herder movement)
crowding by wells	Well crowding
2009-2009 Dzud winter	Dzud
Summer before 2008-2009 dzud, there were heavy rains so they lost a lot of animals. Unexpected rain resulted in increased vulnerability because herders could not move as easily.	Dzud vulnerability
Tsaagan Ovu of Dornod:Reciprocity Norms during drought and bad weather: "When pasture is bad local herders moving ''Saviin ar''. They can't reject another soum herders come in their pasture. "	Paradox in land tenure; Reciprocity norms
Tsaagan Ovu of Dornod: Inter-aimag migration during drought and "bad" pasture conditions	Inter-Aimag migration-outcome from dzud ;factor for HM (herder movement)
Tsaagan Ovu of Dornod: Kinship or family members are registered in different soums, permitting legal movement	Kinship, Soum Registration, and Land Tenure
Herder Observations of specific good pastures before migration of other herder families " Before, Pasture is good south area of region but now another herders move in this region this condition is against. "	Herder Observations of "good" and "bad" pastures- specific areas before and after migration
ML: **informal/traditional herder group in**	Participants of Par Mapping- one case of

Tsagaan Ovoo. Participatory mapping with 10 men, one woman, and 5 children.	formal herder groups
. Some years have been good, others bad; this year rain good, many seasonal ponds	Variability in weather; Herder observations of precipitation
moved to other locations in winter and fall – 7 – 13 km where there is more grass and less snow – amount of snow determines where to move; currently – short term grazing, mover 5-6km; leave early or stay late	Distance of seasonal movement depending on amount of grass
– amount of snow determines where to move	Snow movement- factor influencing HM
originally horses and cattle, but now mixed herd that includes sheep and goats	Changing herd composition
Within soum, individuals can move; moving as a group means group must negotiate access to pasture for permission; cross border movement means soum to soum discussion	Formal soum negotiation for pasture access
Importance of wells and salt for determining movement as well;	Wells access and salt availability- factor influencing HM
no fences around springs	Water tenure and infrastructure (lack of or presence)
Families with few animals don't move as much; stay near water resources	Herd size influencing movement
Must register within soum by family for access to pasture; not many people follow the law; depend upon traditional sharing of pasture resource	Kinship; Legitimacy of pasture access and land tenure
; not many people follow the law	Land law enforcement and compliance
depend upon traditional sharing of pasture resource	"Traditional sharing of pasture resources."
Many maps made by Center for Policy Research (CPR)	*Capacity-building; boundary setting through maps with external help*
Mongolian Land Law, 2010: privatization of land, .05 hectare for family; 1 hectare for winter camp	Mongolian land law, privatization with kinship; winter camps; land law allotment
Soum Center planning for countryside; database of winter campsites	Soum registration of campsite
Process: request winter/spring campsites (permanent structures); determine if area is suitable; granted certificate – suitability determined by uses, wildlife, overlapping with others?	Process of securing winter campsites; legitimacy and legalization processes for land tenure; land tenure

Fundamental in Mongolia: freedom to move anywhere; however regulations exist to register where to graze;	Paradox of land tenure; Tenure paradox- can move anywhere but have regulations where to graze… so you really can't move anywhere
grant temporary right to graze by paying fee – method to try to prevent overgrazing	Temporary access rights to graze; legitimacy for temp grazing
Overgrazing is assessed by monitoring sites – 6 sites in TO (Tsagaan Ovuu)	Monitoring overgrazing
committee to assess health of pasture includes: land officer, meteorological staff, ecological staff and pasture management officer	Legitimized committee to monitor pasture health
periodically move, however currently people are not moving;	Change in herder movement patterns; lack of movement
identifying wells, resting and reserve areas	Pasture resources; entities of pasture management (resting and reserve areas)
Sergelen	
maps of all winter grazing camps; seasonal pastures, and water points	*Presence of western based maps for winter grazing areas, water points, and seasonal pastures*
4 meteorological sites and 8 pasture sites, updating and determining new winter pastures	Legalization/determination of new winter pastures; monitoring (meteorological)
>180 days – need to register; <180 days – special contract: determining what the fee should be	Special contracts for out-of-soum registration; Rules Registration; formal arrangements; governance.; Gray area for rules: special contract for <180 days of movement to pastures
fined if enter without permission	Consequences of rules breaking: "fined if enter without permission
Create maps for each season – seasonal boundary and stock density, created new lines based on seasonal grazing –	*Official grazing maps per season; formal arrangement*
2003 37 boundary areas; 2007 10 boundary areas – created new lines based on pattern of movement not herder groups	*Boundaries for seasonal grazing and stock density*
herder group belong to one winter campsite -herders have movement boundaries	Winter camps representing herder groups; movement boundaries
Millenium Challenge Program: applied to participate, surveyed land – granted certificate – determine carrying capacity	*Donor Project; Millenium Challenge program where survey landed is provided with a certificate*
Winter – allocated reserve pasture area, national park	National park boundaries
needed new winter campsites	Need for winter campsites
Worked with herders and presented map – agreed on lines, increased pressure of herds – needed new winter campsites; need to know reason for map - purpose and benefit	Need for winter campsites
Process [for obtaining wainter camps]: herders – petition bag government – letter – not other	Official process to granting winter campsites

users – submit to Land Officer – application – winter campsite – gov – certificate – 15 years to possess; building, use, winter, spring season	
Conflict – 3 soums?	Inter-soum conflict
Springs important for summer water – difference in pasture, long and short grasses	difference in summer and winter pastures; vegetation; spring
Importance of technology: cell phones for communication and movement; use mining infrastructure for cell phone technology	Technology; importance of cell phone; for communication
Concerns about mining activity: balance between herding and mining needed; prospecting and exploration going on; determine ways to share benefits; %age of return from mining to herders	Mining concerns and sustaining herding; Sharing benefits from mining and herding
Issue with market: Government reducing the price of meat	Market; Price of livestock and gov't control
there is no exclusive right to grazing – others can graze from outside; difficult to move in winter	Paradox of grazing; nor exclusive right to grazing; movement challengs in winter
; fence spring areas	Boundaries among springs; some fencing
Insurance for lost animals – variably successful, in two forms – compensation for lost animals; or projects for restocking	
Can't predict natural disaster; cause movement outside of aimag/soum; loss of animals	Uncertainty- causes movement outsider soums
We move south west from north east during 4 season	Direction of movement
5 families herding animals with together so government demand to become cooperativeif we refuse this condition we won't take wool and cashmere giveaway (government gives money to herders for their animal wool and cashmere).	Kinship cooperations- driven by govt demand and subsidies for wool and cashmere; market and govt' control
If we won't possess our pasture mining companies will take license of land so we want to possess our pasture land.	Land tenure: need legal certificate to pasture to avoid mining companies of taking land possession; legitimacy; mining;
Mining and farming can't coexist and mining is bad for farming therefore we have to prepare professional who will arrange these problems.	Incompatibility of mining and farming
Where pasture is good there is animals live if pasture is bad animals won't live so animal is	Risks with herding; uncertainty in pasture quality; livelihoods

risky property.	
Plant and grasses are getting better last 3 years. Especially, heavy storm and natural disaster occurred permanently from 2000 to 2010.	Tsaagan Ovu of Dornod: Herder observations of pastures: increase in vegetation quality
We have pasture resource area when we use it winter time. Another soum herders come in our pasture area and we didn't possess our pasture so we couldn't chase them.	Lack of pasture certificate serves as barriers for excluding herders from grazing in a pasture area of a specific famiy group. "We have pasture resource area when we use it winter time. Another soum herders come in our pasture area and we didn't possess our pasture so we couldn't chase them."
If government will give license of land to mining company we can discharge this land in return government give us another pasture land area. Herders wants to possess a little bit of mineral of their pasture area.	Conflicts with land licenses to mining companies and herder groups
We couldn't know weather news so we face to natural disaster where we are live	Uncertainty in weather; technology and access
lost 300 animals when occurred heavy storm in 10-19th of June, 2010. This storm was encompassed Khentii, Sukhbaatar, Dornod and many herders lost their animal.	Livestock loss and vulnerability to dzud.
Another soum herders move in when our pasture is good it is not big problem of our soum herders.	Ok for herders from other soums to move into good pastures (at least for Sergelen); differences in reciprocity norms across soums and aimags
July 20 – Bayandangor?: desertification project – interview only; Sukhbataar; exact soum is questionable	
Formal herder group, 7 families; herding since 1980 in this location; mixed herd -- no camels	Legitimacy; formal herding group; length of herding; herd composition
Build fence to create exclosure and protect pasture; own initiative; expensive 1km X 2km[1x2ha in Zulaas notes] – reserve pasture for family	Fences as physical boundaries; fences as resources; kinship and boundaries; protection of pastures against intruders; Kinship/family budget for fences
Our herding group use it all together and we find fence pasture land budget ourselves.	Kinship/family budget for fences
allow race horses (1 or 2) to graze; move 3 km around this area, do not move far; usually assistants move animals	Rule exceptions for grazing (horses); distance of livestock movement

Fencing for sand and trucks also carry sand	Transportation necessary for transporting sand; desertification?
Fencing for sand and trucks also carry sand	Desertification issues
Altenshiree, Soum Center:	
Land Officer and Environmental Officer:	
Movement of herders – land law and privatization; range condition	land law and privatization; range condition
obtain information from bag govt about new winter shelters – ensure not conflicts with neighboring herders; fees charged to herders for winter/spring camp – permanent structures – pay fee/tax based on size of area; usually don't collect fees from outsiders	Government power and availability of winter shelters; conflicts with neighboring herders; fees for winter camp structures (ulja); fees based on area; differential enforcement for residents and outsiders (no fee collections for outsiders)
Larger numbers of animals are moved by people that are hired; absentee ownership of animals	Absentee herding
edge of soum are over-used areas	Overgrazing in soum boundaries
movement between soums – agreements to move, conducted on an annual basis, are not the same every year	Flexible inter-soum grazing arrangements
4 monitoring sites; some are fenced; same committee oversees	Monitoring; fencing on monitoring; overseeing monitoring committee
[Monitoring?] Fees go to aimag budget or to national budget – used to come to soum	Monitoring; budget for monitoring; monitoring budget between local and national government; co-management
Bag level: determine areas to rest, discuss with herders – moves up governmental chain…	Local government scales (bag) determines rest grazing areas with herders; soum government approves?
All must register in own soum; formal agreements;	Government registration; formal agreements
Know landmarks due to generational knowledge and recognition	Local knowledge and physical boundaries (landmarks)
July 21: Altenshiree, Dornogovi	
herder group, UNDP group	*Donor; official donor group*
-8 families (all his sons…) in herder group	Kinship; formal herder group
Organized into pasture group; to halt desertification and improve environment	
fenced 2 hectare reserve, spring, wells	Formal herder group activities; fencing around springs

Created map for project – how things should work; their vision of how land should be managed; territory needs to have adequate size to accommodate animals and need to move	*Official maps and external help; boundary setting and participatory mapping*
Land not used – ability to protect for own use; distance on map = 15 km (NS); 70km (EW)	Herder area?
Long time resident; worked to develop boundary; divided several times; boundary issues with neighboring soum	Conflict and boundaries issues with neighboring soum; developing boundaries
Concerns about mining; prospecting and exploration for coal; link to springs; plans to establish power station	Mining and threats to land and water tenure
70 (bag center); 71 (edge of boundary); 72 (mark for Russian topos, survey marker); 75 (broken well) (77 – coal mine by hwy)	Not sure
Herder family – informal group	Informal herder groups
2 families; 10 years herding in that place	Size of informal herder group
Graze from mountain range to valley; dependent on springs	Grazing range of informal herder group
ninja mining - -destroyed spring in upper mountain area; lots of ninja mining – supplement income, sell gold at aimag center	Mining and threats to water tenure, quality, and livelihoods
Later rains, usually very heavy and extreme – not like before	Herder Hydroclimatic observations
drought; moved far due to drought in 2005	2005 drought
– 200 km with 5 other families; neighboring aimag – people come to this place; dependent upon springs even when there are temporary pools from rain	Kinship access and Spring dependence
21.07.2013 Environmental officer Delgertur, Altanshiree soum of Dornogovi aimag We take tax of winter and spring camp for 1 km^2 to 25₮ for 3000₮ to 1 year from our registration herders. We do not take tax another soum herders.	Formal taxes for winter camps from registered herders
Herders of Airag, Saikhandulaan, Delgerekh soum of Dundgovi aimag come in our soum and approximately 10-20 herding family with 30000 animals entered from those soums for 1 year. Herders entered to our soum caused by bordered with our soum, other part of pasture	Number of migratory herders and animals from neighboring soum

do not use and weather condition.	
Government officer make agreement with another soum government officer when winter time if weather is getting worse they enter some number of animals our pasture area.	Formal inter-soum agreements for grazing during drought and bad weather
In 2006, 2007, winter season was bad so we send some herders to Galshar soum of Khentii aimag, Ikhkhet soum of Dornogovi aimag. We have 4 pasture station.	Herder experiences of 2006-2007 harsh winters- allowing inter-soum herder movement
Herder groups talk about which part of pasture will rest of some period and make decision then introduce it Conference of Agent Citiizen. Then soum government officer was made order so 600 hectare of pasture land now we do not use it some period.	Formal agreements for pasture rest and use
Herder groups talk about which part of pasture will rest of some period and make decision then introduce it Conference of Agent Citiizen. Then soum government officer was made order so 600 hectare of pasture land now we do not use it some period.	Pasture Resting Agreement process: herder group discussion, conference of agent citizen, and final approval for soum government order
We face to problem of springs are dried out caused by new coal mining.	Herder observations of water availability due to mining: water= mining
Saikhandulaan, Dornogovi	
Talked to herder/farmer on way to soum – sells produce at soum and aimag center	Markets- soum and aimag centers
hard to herd and farm at the same time	Supplemental livelihoods (herding and farming)
GPS points: 76 (farming site)	Farming sites
Pastoral and Cooperative Unit Officer: Deals with enterprises and pasture management;	Accountable soum officials in pasture management and enterprise
Pastoral and Cooperative Unit Officer: organizes into groups that are larger than 9 members	**Pastoral and Cooperative Unit Officer duties**
2 types of cooperatives – agriculture/cultivation and processing for market (felt);	Herder "groups" called cooperative- difference between official herder groups?
No pasture groups; not divided into herder groups	Herder group organization
Reserve pasture approved by soum parliament'; Government officer resolve otor pasture area	Soum govt approval of reserve pastures and otor

(where few winter and spring camp this pasture will become otor) caused by weather condition.	
Reserve pasture ; Government officer resolve otor pasture area (*where few winter and spring camp this pasture will become otor*) caused by weather condition.	Reserve pasture selection- based on decreased winter and spring camp presence
Agreement with neighboring soum to graze in neighboring area due to drought	Formal agreement for inter-soum grazing
reciprocal agreement; charge fee for visitors	Reciprocity norms
June, In 2013, government officer make order herders can move everywhere their soum and aimag otor pasture area.	Power of soum government to dictate herder movement
We take tax from another soum herders caused by number of animals.	Formal arrangements for permitting outsiders to access resources
We take tax from another soum herders below 500 sheep unit 1 sheep impose to 100₮, above 500 sheep unit impose to 150₮ and above 1000 sheep unit 200₮ in otor pasture area.	Tax dependent on number and type of animals
Drizzling and heavy rain was occurred lately started to August this year.	Herders Hydroclimatic observations: 2013 heavy rain in August
A lot of golddigger is near the our winter camp and we can looking for gold.	Presence of miners near winter camps
In 2005, dzud was occurred therefore we move over 200 km.	2005 Dzud cause 200km movement
Next soum herders entered our pasture but it is not big problems for us. Animals drink water from well and usually graze mountain range.	Some inter-soum movement is not an issue for some herder groups
We cannot move far because we do not have truck. Our animal is few so we use one pasture for year.	Transportation influential in moving quantity of animals
We have got 200 animals mostly goats.	Herd composition
Animals drink water from well and usually graze mountain range.	Herd behavior (influence whether herders accept other herders grazing from other soums?)
2012 Field Notes	
Winters are "easier" but springs are harder in terms of dryness and less precipitation.	Local knowledge; precipitation;
formation of PUGs creates more boundaries, coupled with climate change.	PUG boundaries

BB mentioned large pasture areas are subdivided into smaller boundaries where access is limited. As a result, different PUG groups intermarry, even if folks are from the same bloodline (incest). The pasture boundaries are no longer dictates by climate and precipitation, but by PUGs	Kinship and CBNRM access; Kinship and land tenure
. Nutag to pre-democracy [and pre-privatization] means a larger area dictated by livestock movement to distant areas. Younger herders see Nutag as a smaller area, where pasture overuse is likely.	Differences in intergenerational views of nutag areas; NUTAG

Because of good pasture, select certain pasture with water- main criteria to decide where to go winter camps – warm and protected by the wind
    Spring- lower in elevation
    Summer- choose a place with water
	Criteria for movement and weather

Contract for winter and spring - certificate belongs to a certain person- to use for a certain [#] of years - summer and fall – [need] another certificate for grazing rights - certificate, but not a contract	Contracts and grazing rights
When do you decide to move? - dependent on water availability - e.g., if you have spring winter camps- look whether [there is] growing grass in summer campsites	Water availability and movement
Herder: I have my own vehicle for transport. Animal will be herded to summer site and Herder will take a vehicle. If animal is weak, you can't herd quickly. This is dependent on herdsmen, how fast he can get to	Vehicle and Mobility; market
Pasture Users Group (PUG). Green Gold divided lands and some participated in the meeting.	PUG boundaries; formal agreements
-legitimacy of the concept of PUGs -conflict among donor groups Herders' self-regulate	PUG legitimacy

153

Small reserve	
PUG group- small - local government is not involved in PUG boundary - can't just divide land by PUG	Size of PUG and local government involvement
2009/2010 - some PUG pastures[convene?) by s - how	PUG pastures
Fall- come early to winter camps; staying longer and come early to area. For searching for good pasture, eating all available pasture (not good pasture)	Timing of movement to winter camps; pasture quality
==Ishgent PUG- 26, 000 ha; 46 pure members; 66 households== ==223 People- Ishghent==	PUG members
==Nutag- means relatives, moving from pastures, common property, land belonging to everyone==	Nutag conceptions
What are the limitations to their livelihood? - winter is getting colder- more colder than before - spring is windy- greater number of windy storms - Spring ends in May, but now extends till June - Spring dries plants - Growth of plants is low, not enough - In fall, water shortage	Livelihoods and climate change; hydroclimatic observations
See drawing in field notebook. Herders in point A ask permission from herders in point B. Point B herders give permission [reciprocity]. Herders camp 2-3 days with livestock to reach point B (a distance of 150 km). Point A Herders arrive in Point B in the end of spring.	Herder movement and permission
- Movement is to look for salt	Pature resources and salt
- Make negotiations with PUG [for access to pasture]	Formal negotiations within PUG
Q: Are there times that local herders say that are different from local officials[are there conflicting interests between local herders and local officials?]	Decentralization- herders make decisions for access and NOT local officials; LOCAL boundaries determining access

- local herders are the ones that give permission; local officials are just representative - Access is negotiated with local boundaries	
Salt and Water- reasons why herders move across boundaries	Pasture resources determining herder movement
How do they know where the PUG boundaries are? - Physical points - See other herders - [boundaries] are marked by wooden stakes - mountain passes	Physical points for determining PUG boundaries
Low water availability- conflict	Limited resource use and conflict
" Is there a need to install water[wells]? A few well, most of the people concentrate on the river… result is overgrazing	Utility of pasture resources for prevention of overgrazing (well installment)
A: Establish wells, reduce grazing pressure	Utility of pasture resources for prevention of overgrazing (well installment); grazing pressure
River bounds grazing; herders cross river but livestock stay	River boundaries and pasture health
e.g., pasture rotation is not well-coordinated	pasture rotation as a formal agreement
To strengthen PUG, need more funding for diversification of income sources= Boyankhsihig's opinion	Income diversification
We learned a lot about why he puts his winter camp relative to others.	Reasons and criteria for winter camps; formal and informal agreements for winter camps
ML: Contact with other herders when herders move to a different PUG boundary? APUG leader Yes, since 2012, contract between [esitsted]. Herders, 2 PUG groups and soum givernor; set-up a small space [forum?]?	Formal arrangements for moving out of PUG boundaries; PUG boundary
In 2007, when green gold started, [conflict] reduced - weather conditions improved, contract with government which allows people to pass through territory.	NGO presence and reduced conflict; formal agreements (govt contracts).
Herder groups are also established in	Dev. of herder groups for formal agreements in

neighboring soums that pass through a specific corridor	movement between PUG and soum boundaries
ML: In terms of internal movement, what are the criteria for selecting winter,s pring, fall, and summer camps? APUG leader: Depends on individual herders 1) good enough pasture- Most of the herders have their own winter camps that are inherited	Kinship for winter camps; Pasture resources determining movement
APUG: 2 Rivers- Tuul and Mos- [both]polluted from skin processing factories [in UB] ML: How do you know this is having an impact on herders? APUG: Lambs and Babies die. Lab inspection, but no reults. For human consumption, tuul water is not good. Before 2010, people could drink from the river. Parliamnet are discussing the river clean-up	Privatization- capitalism; Impacts of Private companies; Water pollution issues
APUG: Putting well in winter camps are crucial. Wells have been allocatd in specific contexts, sometimes inappropriate	Placement of pasture resources (well).

APUG: Rotate from other pasture to prevent dung build-up; move 2-300 m
  • see herdermovement illustration in journal*
  • Herder movement is part of agreement contract with local government (soum governor)
	Pasture rotation- formal agreement; local governance

APUG: Climate change makes people to think more broadly and make pasture rest.	Climate change and formal agreements for pasture management
APUG: Summer time, plants dry out. In early spring, when the rains come and then freeze comes of all of a sudden. Temperature changes are drastic	Climate change; Herder hydro-climatic observations
APUG: Not only herders participated, but boundaries marked by 24 land officers that helped draw map. Active participation from herders[?]	Roles (land officers; APUG); Pasture management
APUG: Yes, we are comfortable with boundaries	Comfort and feelings with "boundaries"

"Some of the winter camps are outside the PUG boundary. In 2006, redrawing of administrative boundary that eliminated/displaced"	PUG boundaries and Displacement; redrawing boundaries
ML: When was Otor National grazing area established? APUG: 1997-1996; maybe earlier as a territory for grazing. In 2002, otor grazing for neighboring aimags was established To get to OTOR area, herders are encouraged to go along the soum boundary instead of the Tamir area.	Otor; formal agreements for otor; aimag and soum levels involved; Policies and 2002 Land Law; Re-routing of herder movements; new norms with PUG system
ML: has timing changed from where and how you moved your animals? Herder: Not big change; observe desertification. Territory changes, seems different from when he was younger. Move 6-10 km movement with animals between spring-fall-summer	Integenerational views of territory changes and movement; desertification; hydroclimatic observations
Herder: Fall- move 2-3 times between 6-10 km. Not too far	Frequency of herer movement;Herder movement=less than Ikh Tamir
[ML]: Distance change between summer and fall camps? Herder: 6-10 km	Distances between summer and fall camps.
ML: Have certain way that you move animals? Herder: Follow good pasture. Each person has a pattern of movement	Pasture resources determining movement; Individual herders pattern of movement
ML: More signs of erosion nowadays? Herder: For signs of wind erosion, changing flooding regime;[influences] changing fattening of animals (less nutrition); quality of plants	Erosion and degradation; Hydroclimatic and vegetation observations; Climactic state and precipitation
ML: What does Nutag mean to you? [Herder]: Nutag: Area with good pasture (criteria) • Types of grass • Water availability • Salt Nutag Also includes place where you born	Meaning of Nutag; Pasture resources and birthplace determining nutag.
Observation: herder and some texting while	Technology; Dzud; Inter-soum migration

being interviewed [In times of] Dzud- people from dundgovi come and graze pastures [of PUG in Ondurshireet)	during dzud
- Winter and Spring camps close because of contract - Winter and spring camps – inherited by father	Proximity of winter camps due to PUG contracts; kinship; Land-use contract determining use and location of summer and winter camps
[In times of] Dzud- people from dundgovi come and graze pastures [of PUG in Ondurshireet) Soum admin discuss areas to graze during times of dzud where herders from other soums move into areas where soum was not hit so badly.	Dzud; formal arrangements for grazing; reciprocity Reciprocity and internal norms among herders. Perhaps not quite clear in land contract- not sure
Nutag- pasture which he grazes	Meaning of nutag
No investment in fencing	Ecological Zone and Pasture resources influencing formal agreements (investment in fencing if pasture resources are available)

COLOR CODES:
CODE 1= GOVERNANCE WITHIN AND BETWEEN SOUMS
       CODE 11= PUGs AND ROLES
          ROLE OF NGOS AND DONORS
       CODE 13= HERDER MOVEMENT; LINKED WITH GOVERNANCE
       Accountable Personnel and Approval
       Formal Soum Agreements and Inter-Soum Migration
       Legitimacy, Land-Use Certificates
       Soum taxes, fees and inter-soum grazing
       Land-laws, Enforcement, Compliance
       Soum Contracts and Rules
       Paradox
       Conflict with Neighboring soums
       Herder Perceptions of Agreements and Reciprocity
       Land Tenure and Mining

CODE 4= WINTER CAMPS, SHELTERS, & ACCESS
       CODE 2= KINSHIP

CODE 8= MARKETS AND GOVT' ASSISTANCE
       CODE 6 = TECHNOLOGY AND TRANSPORTATION
       CODE 7= RISK AND UNCERTAINTY WITH LIVELIHOODS
       CODE 3= DZUD AND INTERAIMAG MIGRATION
       CODE 5= MINING AND LIVELIHOODS

CODE 10 = WESTERN BASED MAPS, TERRITORIES, AND BOUNDARIES

CODE 12= NUTAG
       CODE 14= LOCAL KNOWLEDGE AND HYDROPHYSICAL OBSERVATIONS

CODE 13= HERDER MOVEMENT; LINKED WITH GOVERNANCE
       CODE 9= WATER TENURE AND PASTURE RESOURCES

Soum Governance
   Accountable Personnel and Approval
- Accountable soum officials in pasture management and enterprise
- Pasture Resting Agreement process: herder group discussion, conference of agent citizen, and final approval for soum government order
- Local government scales (bag) determines rest grazing areas with herders; soum government approves?
- Legitimized committee to monitor pasture health
- Pasture resources; entities of pasture management (resting and reserve areas)
- Local government involvement and PUGs

   Formal Soum Agreements and Inter-Soum Migration
- Formal agreement for inter-soum grazing
- Soum govt approval of reserve pastures and otor
- Formal inter-soum agreements for grazing during drought and bad weather
- Herder experiences of 2006-2007 harsh winters- allowing inter-soum herder movement

- Formal agreements for pasture rest and use
- Pasture Resting Agreement process: herder group discussion, conference of agent citizen, and final approval for soum government order
- Government registration; formal agreements
- Flexible inter-soum grazing arrangements
- Official process to granting winter campsites
- Formal soum negotiation for pasture access
- Soum Registration, and Land Tenure
- Soum registration of campsite
- Hay collection in Ikh Tamir; different than Ondurshireet
- PUG boundaries, displacement
- Land-use contract determining use and location of summer and winter camps
- norms among herders. Perhaps not quite clear in land contract- not sure
  - corridors for grazing
-

Legitimacy, Land-Use Certificates
- Legitimacy; formal herding group; length of herding; herd composition
- Legalization/determination of new winter pastures; monitoring (meteorological)
- Lack of pasture certificate serves as barriers for excluding herders from grazing in a pasture area of a specific famiy group. "We have pasture resource area when we use it winter time. Another soum herders come in our pasture area and we didn't possess our pasture so we couldn't chase them."
- Land tenure: need legal certificate
- Process of securing winter campsites; legitimacy and legalization processes for land tenure; land tenure
- Kinship; Legitimacy of pasture access and land tenure
- Temporary access rights to graze; legitimacy for temp grazing
-

Monitoring
- Monitoring; budget for monitoring; monitoring budget between local and national government; co-management
- Monitoring overgrazing

Soum taxes, fees and inter-soum grazing
- Power of soum government to dictate herder movement
- Formal arrangements for permitting outsiders to access resources
- Tax dependent on number and type of animals
- Formal taxes for winter camps from registered herders
- Government power and availability of winter shelters; conflicts with neighboring herders; fees for winter camp structures (ulja); *fees based on area*; differential enforcement for residents and outsiders (no fee collections for outsiders)
- *fees based on area*

Land-laws, Enforcement, Compliance
- Government power and availability of winter shelters; *conflicts with neighboring herders*; fees for winter camp structures (ulja); fees based on area;
- *differential enforcement for residents and outsiders (no fee collections for outsiders)*
- Mongolian land law, privatization with kinship; winter camps; land law allotment
- Land law enforcement and compliance
  - Soum center mapped; different Ondorshireet

- Roles of environmental officers
- I'm assuming that this had something to do with the land law
- Otor national grazing area; Otor
- Different from Ikh Tamir- soum center marked
- Importance of soum centers to Ondurshireet herders, especially for winter camps. Maybe this is part of the reason why they drew soum centers as part of their nutag in their maps.

Herder groups talk about which part of pasture will rest of some period and make decision then introduce it Conference of Agent Citiizen. Then soum government officer was made order so 600 hectare of pasture land now we do not use it some period.

Our soum has agriculture and felt cooperative. Herders working with together. Government officer resolve otor pasture area (where few winter and spring camp this pasture will become otor) caused by weather condition.

We take tax from another soum herders below 500 sheep unit 1 sheep impose to 100₮, above 500 sheep unit impose to 150₮ and above 1000 sheep unit 200₮ in otor pasture area.

-

Soum Contracts and Rules
- Special contracts for out-of-soum registration; Rules Registration; formal arrangements; governance.; Gray area for rules: special contract for <180 days of movement to pastures
- Consequences of rules breaking: "fined if enter without permission

Paradox
- Paradox of grazing; nor exclusive right to grazing; movement challenging in winter
- Paradox of land tenure; Tenure paradox- can move anywhere but have regulations where to graze… so you really can't move anywhere
- Fundamental in Mongolia: freedom to move anywhere; however regulations exist to register where to graze; assign winter and spring sites; grant temporary right to graze by paying fee – method to try to prevent overgrazing; Overgrazing is assessed by monitoring sites – 6 sites in TO; committee to assess health of pasture includes: land officer, meteorological staff, ecological staff and pasture management officer; periodically move, however currently people are not moving; land and pasture management includes identifying wells, resting and reserve areas
-

Conflict with neighboring soums
- Conflict and boundaries issues with neighboring soum; developing boundaries
- Government power and availability of winter shelters; *conflicts with neighboring herders*; fees for winter camp structures (ulja); fees based on area; differential enforcement for residents and outsiders (no fee collections for outsiders)
- Inter-soum conflict
-

Herder Perceptions of Agreements and Reciprocity

- Some inter-soum movement is not an issue for some herder groups
- Ok for herders from other soums to move into good pastures (at least for Sergelen); differences in reciprocity norms across soums and aimags
- Paradox in land tenure; Reciprocity norms
- "Traditional sharing of pasture resources."- assume reciprocity is part of traditional sharing of resources based on literature

Land Tenure and Mining

- to pasture to avoid mining companies of taking land possession; legitimacy; mining;
-

Markets and Govt Assistance

- Kinship cooperations- driven by govt demand and subsidies for wool and cashmere; market and govt' control
- To strengthen PUG, need more funding for diversification of income sources= Boyankhsihig's opinion

We move south west from north east during 4 season. 5 families herding animals with together so government demand to become cooperative if we refuse this condition we won't take wool and cashmere giveaway (government gives money to herders for their animal wool and cashmere). If we won't possess our pasture mining companies will take license of land so we want to possess our pasture land.

-
-

Talked to herder/farmer on way to soum – sells produce at soum and aimag center	Markets- soum and aimag centers

-

National and government control

- National park boundaries
- Inter-Aimag migration-outcome from dzud ;factor for HM (herder movement)
- Monitoring?] Fees go to aimag budget or to national budget – used to come to soum
- budget between local and national government; co-management
-

Factors influencing movement

- Snow cover-factor for HM (herder movement)
- Drought-factor for HM (herder movement)
- amount of grass
- Snow movement- factor influencing HM
- Wells access and salt availability- factor influencing HM
- land law and privatization; range condition
- Inter-Aimag migration-outcome from dzud ;factor for HM (herder movement)
- Dzud
- Dzud vulnerability
- Herd size influencing movement
  -
  Herder movement and pasture resources
- Pasture resources
- Pasture resources; salt
- Reasons and criteria for winter camps
- Pasture resource

- Pasture quality
- Seasonal herder movement
- Criteria for movement and weather
- Land-use contract determining use and location of summer and winter camps
- Kinship patterns for inheriting winter camps
- Water availability

Movement of herders – land law and privatization; range condition; planning is conducted at end of year, modified in June/July; obtain information from bag govt about new winter shelters – ensure not conflicts with neighboring herders; fees charged to herders for winter/spring camp – permanent structures – pay fee/tax based on size of area; usually don't collect fees from outsiders

-
-

KInship

- Kinship; Legitimacy of pasture access and land tenure
- Lack of pasture certificate serves as barriers for excluding herders from grazing in a pasture area of a specific famiy group. "We have pasture resource area when we use it winter time. Another soum herders come in our pasture area and we didn't possess our pasture so we couldn't chase them."
- Kinship access and Spring dependence
- **-8 families (all his sons…) in herder group   Kinship; formal herder group**
- Kinship/family budget for fences
- Fences as physical boundaries; fences as resources; kinship and boundaries; protection of pastures against intruders; Kinship/family budget for fences
- Lack of pasture certificate serves as barriers for excluding herders from grazing in a pasture area of a specific famiy group. "We have pasture resource area when we use it winter time. Another soum herders come in our pasture area and we didn't possess our pasture so we couldn't chase them."
- Kinship cooperations- driven by govt demand and subsidies for wool and cashmere; market and govt' control
- Kinship; Legitimacy of pasture access and land tenure
- Kinship, Soum Registration, and Land Tenure
- Kinship cooperations- driven by govt demand and subsidies for wool and cashmere; market and govt' control
- Kinship, Soum Registration, and Land Tenure

Winter Camps, Shelters, Access
- *Presence of western based maps for winter grazing areas, water points, and seasonal pastures*
- Winter camps representing herder groups; movement boundaries
- Need for winter campsites
- Need for winter campsites
- difference in summer and winter pastures; vegetation; spring
- Reserve pasture selection- based on decreased winter and spring camp presence

Mining and Livelihoods,Tenure
- A lot of golddigger is near the our winter camp and we can looking for gold.
- Presence of miners near winter camps
- ninja mining - -destroyed spring in upper mountain area; lots of ninja mining – supplement income, sell gold at aimag center
- Mining and threats to water tenure, quality, and livelihoods

- Concerns about mining; prospecting and exploration for coal; link to springs; plans to establish power station
- Mining and threats to land and water tenure
- If government will give license of land to mining company we can discharge this land in return government give us another pasture land area. Herders wants to possess a little bit of mineral of their pasture area.
- Conflicts with land licenses to mining companies and herder groups
- Concerns about mining activity: balance between herding and mining needed; prospecting and exploration going on; determine ways to share benefits; %age of return from mining to herders
- Mining concerns and sustaining herding; Sharing benefits from mining and herding
- We face to problem of springs are dried out caused by new coal mining.
-

Transportation and Technology
- We cannot move far because we do not have truck. Our animal is few so we use one pasture for year.
- Transportation influential in moving quantity of animals
- Transportation necessary for transporting sand; desertification?
- Technology; importance of cell phone; for communication
    - Technological assistance and donors

Animals drink water from well and usually graze mountain range. We have got 200 animals mostly goats. We cannot move far because we do not have truck. Our animal is few so we use one pasture for year.

Uncertainty with Herding as a Livelihoods
- Can't predict natural disaster; cause movement outside of aimag/soum; loss of animals
- Uncertainty- causes movement outsider soums
- Where pasture is good there is animals live if pasture is bad animals won't live so animal is risky property.
-
- Risks with herding; uncertainty in pasture quality; livelihoods
- We couldn't know weather news so we face to natural disaster where we are live
- Uncertainty in weather; technology and access
-

Conflicts
Conflicts with land licenses to mining companies and herder groups

Western-Based Maps, Territories, Boundaries
Many maps made by Center for Policy Research (CPR)
Capacity-building; boundary setting through maps with external help
Create maps for each season – seasonal boundary and stock density, created new lines based on seasonal grazing –
Official grazing maps per season; formal arrangement
2003 37 boundary areas; 2007 10 boundary areas – created new lines based on pattern of movement not herder groups
Boundaries for seasonal grazing and stock density
Millenium Challenge Program: applied to participate, surveyed land – granted certificate – determine carrying capacity

Donor Project; Millenium Challenge program where survey landed is provided with a certificate
Created map for project – how things should work; their vision of how land should be managed; territory needs to have adequate size to accommodate animals and need to move
Official maps and external help; boundary setting and participatory mapping

Water Tenure and Pasture Resources
- Well crowding
- no fences around springs
- Water tenure and infrastructure (lack of or presence)
- Formal herder group activities; fencing around springs
- \

Nutag
Changing views of nutag; nutag
Contracts and grazing rights

PUG
- Legitimacy of PUGS; PUG
- Local government involvement and PUGs
- Hay collection in Ikh Tamir; different than Ondurshireet
- To strengthen PUG, need more funding for diversification of income sources= Boyankhsihig's opinion
- PUG boundaries, displacement
- Land-use contract determining use and location of summer and winter camps
- norms among herders. Perhaps not quite clear in land contract- not sure

Boundaries
- corridors for grazing
- Grazing pressure River boundaries and pasture health
- Technological assistance and donors
- PUG= boundaries

NGOS/Donors
- o This makes me think that Ishgent is not quite as well-supported and well-connected with donors (contratry to what I originally thought- see comment at the beginning of this document"
- Wells and donors
- other donors involved with Ishgent other than SDC; competition among donors?
- o APUG: Putting well in winter camps are crucial. Wells have been allocatd in specific contexts, sometimes inappropriate (COMMONALITY WITH IKH TAMIR)

Actions with Herding and Seasonal Movement- MY ASSUMPTIONS OF CODES
- **Absentee herding**
- **Otor**
- **Winter camp registration**
- **Kinship ties in labor, movement,and markets**
- **Fending around spring**
- **Flexible inter-soum arrangements**

WORD MAP ON FIELD NOTES

APPENDIX C

Interview Protocols for 2012 SEC Field Season

Interview Protocol for Ecological Training Workshop

June 17-19, 2012

I. Expected interviewees:
1) Senior Scientists
2) Junior researchers
3) CSU professors
4) NGO representatives

II. Elevator Pitch/Introduction
Hello, I am Arren and I am PhD student with the SEC project. As part of my assigned tasks and research, I am evaluating the ecological training workshop outcomes and well as participant's perceptions of the training workshop. Your thoughts are very important for SEC and improving the workshop planning. That said, would you be willing to spend at least 30 minutes of your time to share your thoughts about the workshop? Your names and associated responses will be kept confidential. Thank You!

III. Interview questions

1) Do you feel like you have learned substantially from senior and junior researchers attending this workshop? Why or why not?
2) What are your general thoughts about this ecological training workshop?
3) Can you tell me about why you are interested in attending this workshop?
4) What was most valuable for you in this workshop? Why or Why not?
5) Any other thoughts you would like to share with me? Do you have any questions for me?

Interview Protocol for Ecological Field Season
June 24- Aug.6, 2012

For the local consultant….
1) How are your interactions with the SEC team?
2) Do you feel like you are being compensated for your time?
3) What do you think of the SEC team?

For SEC team…

1. How would you describe the communication among your team members?
    a. Specifically, how would you describe your ability to communicate with your team members?
    b. How would you describe your team members' ability to communicate with you?
2. Can you describe how relationships among your team members?
3. How did your team deal with differences (differences of opinion, differences in expertise, differences in expectations, etc.)?
4. What was challenging about working with your team?

      a. Can you share an example of when something was particularly frustrating for you or for other members of your team?

      b. How did this experience impact your team's ability to work together?

5. What was rewarding about working with your team?

      a. Can you tell me about a time when your team was working really well together?

      b. How would you describe the team's energy at this time?

6. Would you say that your team was "successful" in achieving its goals? Why or why not?
7. How did your team negotiate responsibilities?
8. Did the ecological training methods workshop help you in the field? Why or Why not?
9. Do you feel that you are safe when traveling with the team?
10. Do you feel that you had sufficient rest time? Why or Why not?
11. I am interested in understanding teamwork processes, is there anything else that you can tell me about your experience working in this team?

For Research and Melinda Laituri – Cultural Interpretation of Landscapes

How do you know where these herder winter camps are?
How do you know when you are in a different place of the landscape?
How do you know when it is time to move to a different part of the landscape?
How do you know to find the area where you herd?
How long have you been a herder?
What are some memorable experiences that you have had while you were herding? Why are those memorable?
      Is your family important in determining how you move from place to place?

APPENDIX D

SEC Reflective Essay

My SEC experience

  I started working with the Socio-ecological Complexity (SEC) project as a PhD graduate student in January 2011. I had just defended my master's thesis in Fall 2010 and I was feeling pretty good about my research direction in coastal management. It was Thanksgiving Break and I got a strange email from my master's committee member saying that she had a proposition for me and that I should call her. I was in the Warner College of Natural Resources Computer Lab and I called my committee member on my cell phone. She told me about the SEC project which I knew about and asked if I was interested in being her PhD student. I knew her existing PhD student in SEC and she had told me that her student would not be working with SEC anymore. Basically, she was being fired. I had never heard of a graduate student being fired before and this was the first time I felt uncomfortable. I was honored that she, my former committee member asked me this and I told her that I would think about it. While I had just defended my master's thesis, the plan was to somewhat continue my master's research for my PhD and work with my master's advisor. I planned to continue my research while my husband worked on his PhD in Chemistry.

  There was so much to think about then- my timeline, research, why the PhD student got fired, how I would combine my existing research in coastal management with a project in Mongolia, and the expectations required from this project. I also knew that my master's committee member had been very helpful and constructive with developing my master's thesis project. I knew that working with her would be beneficial and quite fun. I knew the rest of professors in SEC and I really wanted to learn about socio-ecological systems and move beyond the coastal management framework. At that time, it was hard to say no to this offer, especially since it was funded for at least 3 years and that I could learn about interdisciplinary and transdisciplinary work. It was easy to accept the offer and so I said yes with the hope of truly doing interdisciplinary work and research on socio-ecological systems.

  I was initially hired to examine the communication dynamics of SEC. While most of my background is in ecology and applying mixed social science methods, I generally never say no to an offer directly until I attempt to try, practice, and experience a new topic. The deal with my new PhD co-advisor then was to somehow combine my work in coastal management in the Philippines with community-based management work in land-locked Mongolia. I really don't know why my co-advisors and I thought this strategy was plausible. I was optimistic of somehow doing a case-study comparison of community-based management in Mongolia and the Philippines. In the end, I needed to truly focus on one case study and I selected Mongolia primarily because I was getting paid to do work. There I said it- it was funding and my interest in being part of an interdisciplinary team of professors and students that lead me to focus on Mongolia and SEC.

  My first semester with SEC was in the Spring semester of 2011, where I was taking several Anthropology courses including Ethnography and agent based modeling. In my ethnography class, we only had four students with the Chair of Anthropology as the professor. I told the Chair, who now happens to be my co-advisor, about my involvement with SEC and that I was hired to evaluate the communication dynamics in SEC. She was very familiar with SEC, since her student was working directly under SEC's Principle Investigator. She immediately was worried for me and felt like it was a conflict of interest to be evaluating the communication of SEC members, including the PIs and co-PIs, which were in my committee.

  I knew it was tense situation taking the place of another graduate student as well as being assigned to organize virtual meetings, record and transcribe meeting transcripts, have meeting

notes approved and critiqued by the PI, schedule doodle polls with co-PIs who sometimes were in 6 different continents, and then email co-PI professors their "to dos." Yes, I was stressed and I felt like I was pressured to do all this administrative work and giving instructions to co-PIs their "to do" items discussed in our meetings. I also felt pressured to include as much details as possible, particularly since I knew that the PI had criticized the previous graduate student for not including sufficient details in her notes. I read this graduate student's notes and I really thought that her notes weren't bad and fairly good. My advisor at that time was supportive and assured me that I was doing a good job. I did not want to disappoint her and I was so caught up in trying to do a good job and understand the project that I failed to reflect and ask myself if working on the communication dynamics of SEC was what I really wanted to do for my entire dissertation.

It took me almost two years to say to my advisors that I really did not want my dissertation to be all about the communication dynamics within SEC. I wanted to apply different social science methods, including the surveys and integrate different kinds of socio-ecological data, including local ecological knowledge. I found out that it wasn't easy to do what I wanted. There was push back from the PI in using the social science and ecological data that I was so excited to explore further. There were students already assigned to do that work, why have someone else work on that? I was hired to analyze the communication dynamics and that was it.

There were a lot of other disappointments with SEC as well, including the funding aspect. I thought I was going to get funding for 3 years, and it turned out that I only had funding for 1.5 years (Spring 2011-Summer 2012). Yes, the other graduate student had used a semester of funding. My vision of having my funding for my PhD with a topic I was truly passionate about just didn't happen. I thought about quitting or just getting another master's degree. But then again, I felt like I had gone far enough that it would not be right for me to quit. Besides, I was never a quitter and I've been through a lot of disappointments in life. Every time I thought of my colleagues in SEC, I thought I've got it easy. I didn't bring my family over to the United States and support them on a graduate student stipend.

SEC experiences I'm grateful for

As I re-read my research journals and field notes, I can't help but chuckle and ponder about the incredible opportunities with doing field work in Mongolia and work with a semi-dysfunctional transdisciplinary and intercultural team of researchers. I'm grateful for the time I had with the PhD students and post-docs, especially TU and NV. I'm grateful for the time when I told KJ, "yes lets write a CCC grant on this. I'll write this with you and help you structure it." Although I did most of the writing, I knew that KJ would do most of the action work in Mongolia. We got the grant and teachers were involved with data collection and caring the soum storybook. I love facilitating this and making things happen through just a little bit of encouragement, time, and love.

I'm grateful for my field experiences in Mongolia and truly being in the thick of amazement, curiosity, and frustration. I was awed at the different landscapes, including the vast Gobi desert, steppe, and mountain steppe in Arkhangai. After my field experience in 2011, I had the chance to semi-hitchhike with a young American writer who did his study abroad in Mongolia. We did not speak Mongolian, but were determined for an adventure in the Mongolian steppe. We were going to Terelj, a nearby national park where we would stay with the elderly parents of a friend of a friend. We somehow found their ger/ and spent two wonderful nights in their home. It was such a lovely experience to know these sweet elderly parents, especially as they fed us and shared pictures of their grandchildren and children living in the UK and Mongolia.

My second field experience in 2012 Mongolia was wonderful, difficult, and extremely frustrating. As the only CSU representative in our team, I experienced the resentment and misunderstanding shared by many of the Mongolians in our team. They did not truly understand the reasoning behind ecological protocols and the sparse funding in this project. The team did not desire camping and many of them, including the team lead felt that more funding should have been allotted for their housing. There was also friction between the team lead and one of the younger researchers who felt like the protocols were being violated. I also felt like some of the protocols were being violated, and could not fully express myself since I am not fluent in Mongolian. The team was also frustrated with me, especially when I misplaced my personal items and asked if anyone found my tape recorder. I was stressed when the team expected me to cook a big meat filled lunch for 12 members in the 4 weeks of field work. Of course, we all had our assigned days to cook so it was technically fair. I remember all them staring at me as during the 1.5 hour lunch break as I stirred a big pot of spaghetti (quick sandwiches were not an option) and not lifting a finger in helping me because it was my turn to cook. There were a lot of other stresses that summer as well. I had one of my very close friends pass away that summer and I just wanted to be back with my husband. Yes, field work can be lonely and frustrating. I have been though many international field experiences during my master's and community development work in Costa Rica. However, I was just done that summer. My advisor left for another university and I wasn't sure how all this ecological field work would really fit into my dissertation. There was so much to process in terms of my scholarly and life priorities.

My field experiences were both frustrating and beautiful in some manner. I've experienced the social and ecological data collection in 2011 and 2012. I've interviewed, conversed, and have spent a great deal of time with Mongolian and US team members of this project. I'm aware and have witnessed the dysfunctionalities and successes evident in every part of this project. It never has been a "smooth-sailing" process for me, but somehow I've decided to stick with this project. In the end, it is my friends and colleagues in this team that have kept me going. It is their joy, excitement, and love for this project that has inspired to stay and make the best out of what I have for my dissertation.

Lessons Learned

I have compiled my lessons learned outlined in my dissertation journal entries for the last 4 years. The outline below is certainly not an exhaustive list, but provides a somewhat general picture of lessons that I have learned throughout these years.

- It is okay to quit, but timing is everything. Quitting could open new doors that always have been there. Don't wait for things to be really bad- use those warning signs as indicators to gauge your interest and passion.
- Accept offers with extreme caution, even if they seem too good to be true. Provide your intentions and what you want in the beginning, prior to having a contract.
- Pray and reflect
- Take everything with a grain of salt, particularly when you are interviewing professors.
- In any transdisciplinary team, there are members who will not get along and are always not genuine, even if they appear to be so on the outside.

Lessons Learned from 2011 Annual Workshop
- Have workshop presenters stick to the deadline for submitting presentations to be transcribed.
- Triple check the formatting of Mongolian hand-outs and presentations

- Have MFG confirm and play close attention to the spreadsheet of handouts and presentations. For example, I was unaware that the data sharing protocol was not translated to Mongolian. I did not put the data-sharing protocol in the spreadsheet outlining items to be translated. No one had corrected the spreadsheet that was translated.
- Have an organized meeting on the workshop flow and agenda one week before people leave for Mongolia.
- Bring an earpiece splitter for recording translations and simultaneous listening. This worked out great!
- Assign Mongolian note-takers in advance. I had asked BTK this and somehow, she assigned one seemingly in the last minute, resulting in the note-taker hand writing the notes
- World café handouts should not be put in their envelopes, but rather at the tables. This was not communicated to the logistics staff.
- Write out world café questions in Mongolian and English on flip chart paper in advance. Just because these questions were typed on the handouts, it still helps to have them written out.
- Print out English versions of presentations for CSU faculty. Just because, they're presenting, it doesn't mean that they have a print out of their own presentation
- Accept that things will go wrong, be thick-skinned, learn, and soak in the excitement.

Lessons Learned and considerations from taking meeting minutes

- Upon reviewing meeting notes, consider the following:
  - Are there any transcripts or notes where people will be sensitive, lose face, or be emotional?
  - Are there any items that should be deleted- can the rest of the notes stand alone with items that should be deleted?
- Sending the meeting minutes:
  - Do not send the minutes to everyone until it is reviewed by MFG. If they are not reviewed in a week, send MFG a reminder. Do not push foreword until you get the go ahead from the PI.
  - Double-check your recipients. When saying that you sent or did not send an email (even if it is trivial), double-check your inbox!

Conclusions

My story with SEC still continues. I hope that my relationships with my colleagues will still continue and that I will look back at my PhD experience as one that was enriching, fortunate, and life changing in some way. It truly has been a privilege to be part of a transdisciplinary and intercultural team, despite my frustrations and occasional feelings of being stagnant and not contributing in a way that furthers me in my field. Because of SEC, I am aware of academic processes I do not want to get involved in. I am aware of the enormity of transdisciplinary challenges and have witnessed the challenge it takes to lead a diverse group of academics, each with a different level of stake and accountability in the project. I have learned to be a better communicator across disciplines and cultures. I experienced being trusted by my colleagues and I better understand timing for speaking up and keeping my mouth shut. I very much look up to the different PIs in this project and I have witnessed their

strengths, weaknesses, and frustrations as they tackle this project. It has been a challenging road for all of us, and I'm lucky to have experienced traveling his road with professors and colleagues whom I deeply respect and love.