Evaluating grazing partnerships on Wisconsin's public grasslands:

Adaptive collaboration in agroecology research

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Introduction

"[T]hings that appear to be distinct are nevertheless caught in a network of mutual dependence and influence that is the substantiation of their unity… it is as impossible to say exactly where the trouble began as it is to say where it will end. The influences go backward and forward, up and down, round and round, compounding and branching as they go" (Wendell Berry, *The Art of the Commonplace,* p. 105)

This thesis is part of the work of an interdisciplinary agroecology research group exploring the many interconnected opportunities and challenges of grazing cattle on public land in Wisconsin. Within this group, my research explores the development of public-private partnerships, and different organizational tools and frameworks to facilitate the cooperation and relationships between the Wisconsin Department of Natural Resources (WDNR), private graziers, grazing specialists, and university researchers and graduate students. My work complements that of the other graduate students on the grazing research team, whose work is primarily ecological and biophysically focused, and particularly complements the work of Courtney Robinson, who coauthored the first chapter of this thesis work with her investigation of producer economic interests.

The first chapter of my thesis work describes how the agroecology research group at UW-Madison and other partners implemented *adaptive co-management* (ACM) strategies to investigate the ecological and socioeconomic dimensions of rotational grazing as a management tool on Wisconsin public grasslands. The chapter outlines how the UW-Madison team employed features of ACM in the development of public-private grazing partnerships and research projects, and how those partnerships evolved according to three 'phases' of ACM implementation. We identify four key takeaways for grazing public lands in Wisconsin resulting from Phases One and Two, and describe them in detail toward the end of the chapter. We close the chapter with

recommendations and considerations for implementing Phase Three of ACM for rotational grazing on public grassland in Wisconsin.

Courtney Robinson contributed to Chapter One in three main ways: a literature review of adaptive co-management, a synthesis of Phase One activities and results, and takeaways from the ACM process thus far. She also presents findings from her producer survey beyond the contingent valuation module, as well as the results of a producer focus group. My own contributions to the chapter included a description of the Wisconsin grazing project as a case study, a synthesis of Phase Two activities and results, a description of the use of ACM core concepts throughout phases One and Two, and a discussion of next steps for Phase Three. However, we both contributed data, writing, and editing throughout the entire chapter. Because of differences in recommendations from our committee members, the chapters were edited separately and are not identical.

The second chapter of this thesis details the use of tools from *program evaluation* in agroecology research. Though the rich, complex interdisciplinary scope of agroecology research can provide tremendous insight about agricultural systems, numerous disciplinary and funding constraints pose difficulties in maintaining such a broad conceptual lens in applied research. I propose that program evaluation could provide tools and methods to benefit agroecology research, particularly addressing the issues of defining boundaries and assessing change. I use tools from program evaluation to assess the development of the public-private research partnerships for grazing of public lands in Wisconsin, and illustrate the use of evaluation-specific methodologies at both *formative* and *summative* project stages. Finally, I use evaluation techniques to define specific outcomes and activities for successful grazing on public lands in Wisconsin, and recommendations and suggested plans to achieve these goals.

These two chapters relate to each other by offering two sets of tools for agroecological research and multifunctional land use. The adaptive co-management framework provides principles to develop partnerships in equitable natural resource management, research, and conservation agriculture, while program evaluation presents the tools to assess and monitor that management. Both have potential for application and relevance for agroecology research as tools for addressing complex problems with many interconnected ecological, social, and economic variables of "mutual dependence and influence." I propose that looking to applied organizational tools and frameworks is the next step for agroecology research, reaching outside academia and collaborating with many people and parts of the food system as we continue striving for a 'beneficent agriculture.

Chapter 1: Rotational grazing on public grassland in Wisconsin: A case study in Adaptive Co-Management

Greta Landis and Courtney Robinson

Abstract

The exploration of rotational grazing as a management tool in Wisconsin presents a case study for adaptive co-management (ACM) in agroecology research. In this chapter we describe how an interdisciplinary research team of graduate students and faculty from the University of Wisconsin-Madison (UW-Madison), land managers from the Wisconsin Department of Natural Resources (WDNR), grazing specialists and consultants from the Wallace Center Pasture Project, and private grass-fed beef and dairy producers used ACM as a framework to investigate the opportunities and challenges of using rotational grazing as a management tool on Wisconsin public grasslands. We followed the three phases of ACM laid out by Olsson et al. (2004b) and Butler et al. (2015): 1) preparing the system for change, 2) seizing a window of opportunity, and 3) building social-ecological resilience of the new desired state. Here, we describe our process and findings from Phases One and Two as an example of ACM implementation and its value for resource management. According to the ACM framework, we drew four conclusions from the work in Phases One and Two: 1) the importance of context in grazing contract design, 2) the opportunities of collaboration identified by public land managers and graziers, 3) the challenges of collaboration for public land managers and graziers, and suggested solutions, and 4) the process of identifying graziers most interested in public pasture rental, and the implications on land managers. We close the paper with suggestions for implementing Phase Three of ACM—building socio-ecological resilience—for rotational grazing on public grasslands in Wisconsin.

Introduction: Grazing public lands as a complex management challenge

Rotational grazing partnerships between public land managers and private cattle producers offer the potential to maintain and improve public grasslands, while increasing the profitability of grass-fed beef and dairy. While constraints on public land management have allowed detrimental encroachment of woody and non-native plants on state grasslands, Wisconsin research has shown that rotational grazing can reduce woody species, enhance soil and water quality, and improve biodiversity in the Upper Midwest (Alber, Brink, & Jackson, n.d.; Compton, Hedtcke, & Harrington, n.d.; Harrington & Kathol, 2009; Hedtcke, 2013; Oates et al., 2015; Oates & Jackson, 2014; Paine LK, 2002; Taylor & Neary, 2008). Grazing has increased in popularity since the 1990s along with other alternative management strategies, but land access remains a significant barrier for beef and dairy operations, particularly for beginning farmers (Brock and Barham 2008; Merrill 2006). The possibility of private rotational grazing on public grasslands could present an exciting win-win opportunity for collaborative conservation, but the development of a public grazing program in Wisconsin will face multiple social and ecological challenges that may impede successful implementation.

The Wisconsin Department of Resources (WDNR) and other state and federal agencies are responsible for maintaining thousands of acres of public grasslands across the state (‘Wildlife Areas’ 2016). A goal of grassland management across these public-access areas is to maintain the landscape for wildlife such as grassland songbirds and upland game birds (Murray, Ribic, & Thogmartin, 2008; Ribic & Sample, 2001; Sample & Mossman, 1997). In contrast to the expansive rangelands of the American West, the grasslands and prairies of the Upper Midwest are more fragmented, smaller, more densely vegetated and require frequent disturbance to

maintain an open, herbaceous plant community relatively free of encroaching woody vegetation and invasive species.

Political changes and financial constraints are rapidly decreasing the available personnel and resources available for grassland management and the implementation of labor-intensive practices such as controlled burning, herbicide applications, and mowing (Teague et al., 2011). There is growing interest in using rotational grazing as a supplemental management tool and as a way to engage with agricultural communities, but many land managers are cautious because of the history of overgrazing and land degradation in the West (Briske et al. 2011). Research on rotational grazing is typically context-specific, making it difficult to prescribe the practice as a tool on state wildlife areas that vary in size, soil type, terrain, vegetation, and wildlife use (Lyon et al. 2011). Grassland management with rotational grazing presents what Briske and coauthors (2011) refer to as a 'complex adaptive system,' which requires the integration of social and biophysical components and drivers to understand use, effects, and management direction.

Graziers also face unique challenges with grazing for land management. Rotational or management-intensive rotational grazing (MIRG) refers to grazing where only one portion of pasture is grazed at a time, allowing the remaining pasture to rest and regrow (Oates, Undersander, Gratton, Bell, & Jackson, 2011; Paine, Undersander, & Casler, 1999). Pastures are divided up into paddocks and livestock are rotated from one paddock to the next based on the growth stage of the forage. Typically, paddocks are 1 to 2 hectares (ha) and stocking densities are 40 to 100 head ha^{-1} (Paine et al., 1999), though under certain circumstances smaller paddocks and/or higher stocking densities may be preferred. Often livestock are confined to each paddock for a period of 12 hours to two days and are rotated through paddocks on a 15-to-40-day,

weather-dependent cycle. This style of grazing contrasts with continuous grazing, where animals have access to the majority of the pasture at a given time and are not actively rotated between paddocks (Briske et al., 2008; Oates et al., 2011; Paine et al., 1999). There are general guidelines for rotational grazing in the Upper Midwest (e.g., Undersander et al. 1991), but each grazier's management strategies will vary based on their specific context, where biophysical and socio-economic variables such as management goals, cattle breeds, operation size, weather, personal values and market premiums for grass-fed products all affect grazing decisions (Lyon, Bell, Croll, Jackson, & Gratton, 2010; Lyon, Bell, Gratton, & Jackson, 2011).

In combination, the nuances of rotational grazing decisions paired with public land-specific grassland management constraints make for a complex challenge. Ensuring that the needs of both parties are met effectively is both a social and ecological challenge that requires collaboration, adaptation, and iterative learning. Adaptive collaborative management, also called adaptive co-management or ACM, offers a framework for resource management that facilitates such a process.

Adaptive Co-management Framework

Adaptive co-management (ACM) emerged in the 1990s as a combination of co-management and adaptive management strategies for conserving and governing natural resources, particularly to address the complexity and uncertainty of social-ecological systems (Bown, Gray, & Stead, 2013; Olsson, Galaz, & Boonstra, 2014; Plummer et al., 2012). In contrast to traditional, hierarchical or government-mandated models of conservation management, ACM takes a distinctly iterative and learning-oriented approach to management, emphasizing knowledge generation, collaboration, and sharing power and conflict-resolution responsibilities between stakeholders (Butler et al., 2015)). ACM has been characterized in a

number of ways, but here we use six core characteristics and three phases of implementation to describe ACM (Armitage et al., 2009; Berkes, Colding, Folke, Applications, & Oct, 2007; Folke, Hahn, Olsson, & Norberg, 2005; Olsson, Folke, & Hahn, 2004; Plummer & Armitage, 2007) These six characteristics are:

1. A shared vision, goal, or defined problem with learning objectives, approaches, outcomes, and risks to provide a common focus among stakeholders;
2. Continued dialogue, interaction, and collaboration among stakeholders;
3. Shared responsibility, decision making, and control over resources;
4. Recognition of the power and autonomy of different stakeholders;
5. Commitment to generating and sharing knowledge;
6. Ongoing assessment, reflection, and learning in the face of uncertainty.

In addition to these six characteristics, Olsson and coauthors (2004) described three phases of implementation for management initiatives using the ACM framework:

1. Preparing the system for change;
2. Seizing a window of opportunity;
3. Building social-ecological resilience of the new desired state.

Adaptive co-management draws many of these characteristics, phases, and central tenants from complex systems theory and literature on ecological resilience. In complex systems theory, ecosystems develop by cyclical, adaptive processes nested at different spatial and temporal scales (Berkes & Ross, 2013; Holling, Gunderson, & Peterson, 2002; Peterson, Allen, & Holling, 1997; Plummer & Armitage, 2007). The resilience of a system has evolved from an ecological concept (Holling, 1973) to one that describes social-ecological systems, institutions, and organizational structures (Plummer & Armitage, 2007). In short, the resilience of a system is its

ability to absorb or buffer disturbance, self-organize in structure and function, and its capacity to learn and adapt to change and uncertainty (Berkes & Ross, 2013). Resilience and complex systems are central to the organization and aims of ACM because they center around human interaction, learning, and sustainability in social-ecological systems.

Applications of ACM:

According to scholars of ACM, context-specific goals and practices are perhaps the most critical features of resilient ecological management. ACM requires the development of a shared vision, learning objectives, approaches, and outcomes, discussion of potential risks, and a strategy to understand and incorporate the socio-ecological feedback in all iterations of management. Stakeholders have a shared vision, goal, or problem to help the group stay focused and maintain trust (Kendrick, 2003; Weick, 1993).

Competing interests and values among stakeholders in the application of ACM are normal, leading to conflict and complex social relationships. Therefore, collaborative decision-making processes that involve all stakeholders equitably are critical for dealing with such conflict (Butler et al., 2015). Armitage et al. (2009) found that repeated interactions among stakeholder groups and individuals and a commitment to open communication increase trust. The sharing of management decisions, power, and responsibility may involve multiple institutional and organizational linkages among user groups or communities, government agencies, and nongovernmental organizations (cross-level interactions) (Folke et al., 2005). Similarly, recognizing and addressing how power influences a resource management system requires trust-building, conflict resolution and social learning (Armitage et al., 2009).

Ecosystem management is an information-intensive endeavor that requires knowledge of complex socio-ecological interactions in order to monitor, interpret, and respond to ecosystem

feedback at multiple scales (Berkes et al., 2007). Some scholars have pointed out that linking different systems of knowledge requires an active role of individuals or organizations as coordinators and facilitators in co-management processes (Halls et al., 2005). Sometimes these coordinating bodies are referred to as "bridging organizations" (Folke et al., 2005)

The iterative, learning-oriented processes of ACM allow for continual improvements to management approaches in response to ecological and social change, but are slow to develop, or will fail to develop at all, without policy environments that are supportive of learning (Armitage et al., 2009). Ostrom (2005) explains that all policies must be viewed as ongoing learning experiments that need to be monitored, evaluated, and adapted over time. Further, Folke and coauthors (2005) explain that the challenges with managing a socio-ecological system are accepting uncertainty, being prepared for change and surprise, and enhancing the adaptive capacity of the system to deal with disturbance. They argue that non-resilient social-ecological systems are vulnerable to external change, whereas a resilient system may make use of disturbances as opportunities to transform into more desired states.

Understanding grazing on public lands in Wisconsin: An ACM case study

The grazing research project discussed here was initiated in the autumn of 2014 with the award of a five-year USDA-NIFA Hatch grant to a University of Wisconsin-Madison agroecology research group. The grant, titled, 'Understanding the opportunities and challenges of grazing public land in Wisconsin' was proposed with the intent of (1) exploring solutions for both public grassland management and land access issues for private livestock producers, and (2) further developing understanding of the ecological and socioeconomic impacts of rotational grazing in the Upper Midwest. The group proposed that improved understanding of rotational grazing and its subsequent effect on plant communities, soil properties, and the potential

socioeconomic pitfalls and opportunities of public-private grazing partnerships could provide critical insights for grassland conservation, producer profitability, and many ecosystem services. The agroecological emphasis of the research group and the public-private scope of the proposal necessitated a collaborative approach between public land managers, private graziers, and other groups to investigate the questions around grazing on public lands. As such, building partnerships with different individuals and organizations was key to the goals of building grassland and grazing knowledge, and developing practices to manage, support, and respond to grassland resources. Though the partnerships came together without the initial use of the ACM framework, partway through the second year we noted that our project followed many features of ACM, and that ACM could guide activities and decision-making for the remaining years of the project. The sections below outline how our project has already followed an ACM framework and provide suggestions for how we can utilize ACM in the remaining years of collaborative research.

In the first year of information-gathering for the project, and the second year of implementing pilot grazing projects and graduate research, the university research team acted as a 'bridging organization' between local graziers, grazing specialists, land managers and administrators with the WDNR, Wallace Center's Pasture Project, and other organizations (Folke et al., 2005). Over this first year of research, the university team attended meetings and workshops collecting data on the interests and issues already part of the dialogue around grazing as a land management tool. In this 'bridging organization' role, the team worked to catalyze and facilitate the discussion around grazing management wherever possible. Two events—a grazing network annual conference and a workshop on grazing for WDNR land managers—were particularly critical in developing research questions and building partnerships for the grazing

project in the first year, while other events emerged according to an ACM framework in the following years. We will discuss the information-gathering activities and events that lead to the development of five pilot grazing management partnerships, and takeaways from the pilot partnerships after their first year of implementation.

While the information-gathering process and the implementation of pilot projects were guided by six key features of ACM, the evolution of the research partnerships and graduate thesis projects also matched the three phases of ACM implementation identified by Olsson et al. (2004) and further developed by (Butler et al., 2015) (Table 1). Here, we outline events as they developed throughout the first two phases of ACM, and propose key findings for the eventual launch of Phase 3 for grazing management practices in Wisconsin (Figure 1).

Methods: Phase 1 and Preparing the System for Change

In the first phase, 'preparing the system for change,' bridging organizations or actors "build ecological knowledge of the problem, develop bridging social networks between stakeholders from different levels, and provide a vision and goal for an alternative pathway" (Butler et al. 2015). In the Wisconsin grazing context, this phase was triggered by the encroachment of woody species on Wisconsin's public grasslands, and the challenges public land managers faced in controlling the encroachment, and research interests in rotational grazing practices in the state. As land managers sought alternative management methods and became interested in the potential win-win opportunity of using rotational grazing for land management, from UW-Madison were awarded a USDA-NIFA Hatch grant to conduct research on the social and ecological opportunities and challenges to rotational grazing on public lands. The grant proposal was produced as a result of stakeholder input and researcher interest. Together, the WDNR and UW-Madison researchers sought to build ecological knowledge of the problem and

the use of grazing as a solution through an information-gathering phase that included stakeholders meetings, survey of cattle producers, producer focus group, and visits to public land sites (Appendix 1).

Meetings with Stakeholders

Three key stakeholder meetings took place during the information-gathering phase: a planning meeting with key stakeholders, a workshop for WDNR land managers, and a poster session at GrassWorks grazing conference.

1. Key stakeholder meeting - October 23, 2014 - WDNR, grazing specialists and UW-Madison

The UW-Madison research team met with WDNR wildlife staff and grazing specialists to define the vision, goals, and potential problems of rotational grazing for grassland management. Twelve individuals attended the meeting: two grazing specialists, two WDNR wildlife managers, and eight representatives from the UW-Madison research team. During the meeting the UW-Madison research team introduced the project scope and potential for collaboration, facilitated activities to develop possible research questions, and together the group generated a prioritized list of biophysical and logistical factors to select sites, and proposed additional participants from the WDNR. In addition, the WDNR representatives discussed policy and process considerations for research on public lands with an emphasis on process and timing. Grazing specialists provided an initial discussion of factors that might influence participation by graziers and producers.

The research questions that emerged from the group activity were mostly focused on comparing the impacts of multiple types of grazing, including: comparing the impacts of rotational grazing with other kinds of land management; biophysical and biological impacts from rotational grazing; forage quality measurements for cattle on public grasslands; strategies to

involve the public; tensions and relationships between producers and WDNR land managers; logistics and cost-benefit analyses of equipment and infrastructure. These themes were used to develop graduate student research questions and projects, and ultimately will be answered in Phase Two.

There were nine main categories for site selection that were identified through the second group activity:

1) Infrastructure, such as water and fencing equipment;
2) Variable biophysical traits across sites;
3) Proximity to graziers;
4) DNR acceptance of grazing management;
5) Interests of the public users;
6) The size of the site;
7) Research capacity at the site;
8) Land manager interests and goals at the site;
9) Ecological sensitivity of the site.

A detailed list is presented in Appendix 1. The UW-Madison research team used this information to select viable sites for the grazing trials in Phase Two.

2. WDNR land manager meeting - March 2, 2015 - Viroqua, WI

The WDNR held a meeting on March 2, 2015 on using grazing as a land management tool. The meeting took place in Viroqua, Wisconsin and was attended by WDNR ecologists, biologists, technicians, limited term employees, and administrators, grazing specialists, Minnesota Department of Natural Resources representatives, and UW researchers. During the meeting the UW-Madison research team gave a short presentation on grazing public land. As

part of the presentation we collected real-time anonymous input on land manager interest in using grazing as a land management tool through audience response technology with clickers. We asked attendees to answer multiple choice questions about their interest in using grazing for land management, their concerns, where they would apply grazing, and vegetation and wildlife management goals that would show up on the PowerPoint presentation as real-time frequency tables. In addition, we collected data through an anonymous questionnaire following the presentation.

This meeting was an important initial data source on the opinions of land managers on using grazing as a land management tool. 26 individuals at the meeting provided data on a variety of topics regarding grazing as a land management tool. 58% of respondents had prior experience with grazing, either from growing up in a farming family or using grazing for land management in Wisconsin or elsewhere. Attendees listed experience with both goats and cattle for land management. 93% of attendees said they were interested in using grazing as a habitat management tool. The WDNR professionals said they would apply grazing to cool-season or warm-season grass- dominated lands, restored prairies, native remnant prairies, woodlands, savannas, and wetlands. The main vegetation management goals of attendees were woody plant suppression, weed/invasive plant suppression, and to promote greater species diversity. Attendees also voted on their top wildlife habitat goals that they hope grazing will help them with; the top choices were promoting habitat for upland game birds, grassland birds, threatened and endangered species, and non-game animals.

In addition to the interactive voting, questionnaires following the presentation provided further information on the opportunities and challenges to using grazing as a land management tool. The most frequently cited opportunities included using grazing to control invasive species,

manage grasslands with heavy brush and woody species control, and to save money (Figure 1, Appendix 2).

Despite seeing potential for using grazing for land management, attendees also voiced concerns. Foremost among these were associated with infrastructure, such as fencing and water supply for cattle, and in particular financing fence installation. Another key concern focused on finding experienced graziers who would be willing to adhere to restrictions such as residual height, timing, and access to sensitive areas. Lastly, attendees were unsure as to how to access informational resources (such as grazing specialists) that could help write contracts and implement grazing (Figure 2, Appendix 2).

3. GrassWorks Grazing Conference 2015

To begin the information gathering process among producers, members of the university research team attended the GrassWorks Grazing conference in January 2015. Regional grazing networks are a key system for farmer education and support in Wisconsin (Paine, Klemme, Undersander, & Welsh, 2000). The research team presented a poster and initiated informal discussions about three different vegetation scenarios and five variables (available acreage, distance to travel, duration of grazing period, herd size, and cost per acre) for decision-making to rent public land for conservation grazing partnerships. The scenarios presented for discussion were a cool-season grass dominated site, a shrub and cool-season grass-dominated site, and a weedy mixed warm-and cool-season grasses site. During the presentation period the researchers facilitated discussion and collected 37 written comment-cards on these variables and additional ideas and concerns related to grazing public lands. The poster was also displayed unattended for the final day of the conference, and accumulated some additional anonymous written feedback

during that time. Over 350 graziers, researchers, education and outreach specialists, and agricultural business partners from Wisconsin and the Upper Midwest attended the conference.

These conference discussions provided strong evidence for the importance of trade-offs that make grazing partnerships feasible and economically viable. Graziers demonstrated a systems approach to the decision-making variables presented, where changes in one variable would result in related changes in their decision-making for other variables. For instance, with an increase in the cost of pasture rental, graziers expressed expectations for higher quality forage or longer grazing periods. This theme of flexibility continued throughout the poster presentation and discussion. Graziers were willing to travel between ten and fifty miles, wanted to graze herds as small as ten animal units and as large as 200. The additional comments were focused around themes of logistical issues, such as liability and ownership of equipment, and potential risks to animals such as predators or public land users. There were numerous questions surrounding infrastructure on public land—permanent perimeter fencing, portable electric fencing, water sources, and road access—and who would fund, install, and maintain it.

Statewide survey of cattle producers

Drawing on the trade-offs identified by producers, we conducted a mail survey of non-dairy cattle producers across Wisconsin in 2016. The selection process followed a stratified design based on herd size and whether a producer said they practiced rotational or management-intensive grazing on the 2012 U.S. Census of Agriculture. Farmer selection relied on a confidential list frame managed by the National Agricultural Statistics Service (NASS). The final sample consisted of 1,172 farmers and the surveys were mailed using a modified Dillman method of two mailings (Dillman, Smyth, & Christian, 2008). Returned surveys from 142 active

beef producers were used in analysis for an effective response rate of 12% after removing ineligible returns.

The survey had four sections: (1) cattle operation information; (2) contingent valuation module; (3) perceptions of benefits and barriers to renting public land; and (4) demographics. The survey results have been divided into three sections:

1) Perceptions of benefits and barriers to renting public land;
2) Contingent valuation module;
3) Producer intentions.

Perceptions of benefits and barriers to renting public land

The 'perceptions' section of the survey contained three questions on the most important concerns and opportunities they consider related to renting public land, and eight attitudinal questions related to environmental conservation and feelings toward government (see full questionnaire in attached supplementary material). Producers were primarily interested about the potential closeness of public land to their farm (Figure 3). The next most popular first choice was "none of the above," which may be a reflection of lack of interest in renting public land by many survey respondents. While popular, only 16% of the respondents who voted for this answer also agreed to rent public land in the grass-dominated grazing scenario. This is in comparison to answers like "access to additional pasture" and "grazing with a conservation focus" which had 50% and 40% enrollment rates respectively.

Producers are primarily concerned with liability issues, forage quality and quantity, and the distance of the land from their farm, or nothing is of primary concern (i.e. "None of the above") (Figure 1). Respondents had largely positive conservation attitudes, however only a

minority was willing to work with a public agent or graze public land (Figure 2). About half of the respondents were not interested in grazing public land.

Contingent Valuation Results

An econometric analysis of responses to the contingent valuation module in the Grazing Public Lands survey showed that producers with a greater number of animal units in their operation, who are younger, and who have less diverse operations (fewer different types of cattle) are more likely to be interested in renting grass-dominated public land. Producers who have more positive attitudes toward conservation and working with government and who have a lower proportion of pasture to farmland owned are more likely to be interested in renting shrub-dominated public land.

Producer Intentions

In total, 33% of respondents to the hypothetical survey scenarios agreed to rent for both the grass-dominated and shrub-dominated scenarios (n=135 and n=105 respectively), signaling interest by the producer community in grazing public land. Debriefing questions asked respondents to specify how many acres they would rent, what class of animal they would put on the pasture, the maximum distance they would travel to graze their cattle under the grazing opportunity, and if they would still rent at the agreed price if they had to provide interior and perimeter fencing. These debriefing questions were asked once per grazing contract scenario conditional on enrollment and tied to the offer price at which the respondent first agreed to enroll.

For the most part, producers are willing to rent less than 40 and up to 640+ acres at all survey offer prices (Table 9, Appendix 3). The maximum distances producers are willing to travel range from 20-75 miles and do not seem to be correlated with price. In addition, producers

are still willing to rent even if they must provide fences (Table 10, Appendix 3). These percentages are likely to be higher if the contract covers a longer time period such as three, five or seven years.

Producer Focus Group

A focus group of cattle producers was held on October 15, 2016 in Seneca, Wisconsin to further develop the survey results and to collect qualitative data on producer interest in grazing public lands in Wisconsin. There were nine focus group participants with a variety of operation types, all from the southwest part of Wisconsin where grazing is more common (Table 3). The focus group lasted for two hours during which participants responded to a variety of questions on renting pasture generally, and renting public land specifically (Appendix 4).

The focus group results provided further evidence that producers are interested and willing to make tradeoffs based on the specific context. When thinking generally about renting land (public or private) participants considered infrastructure, forage quality, distance of the land from their farm, whether someone can monitor the cattle, and their operation's needs. All of these variables are flexible however, depending on the situation.

When discussing how many acres to rent, participants said they consider herd size and time to travel and monitor the animals, financial constraints, extent of their control over the entire pasture, and the quality of forage. Many participants expressed a preference to control an entire pasture rather than share it with another grazier, and were willing to pay more in order not to share. They also mentioned that they almost always base their decisions on the cattle they already have, and only in rare market circumstances would they be willing to buy more cattle to fill a large area of land. When deciding what class of cow to put on the pasture, participants explained they would put their best cows on the best pasture available, which is often their home

pasture. Additionally, dairy cows will be kept close to home while dry cows, heifers, or cow/calf pairs may be kept on a rented pasture. Producers also considered what types of cows are on a neighboring pasture when deciding which class of animals to put on rented land.

The focus group participants had largely positive or neutral feelings about the idea of using rotational grazing as a land management tool on public land. There was agreement that the land managers need clear management goals and plans to integrate grazing on the land. One of the focus group participants explained that the idea of working with a public agency was an opportunity to help change public attitudes positively toward livestock and grazing. However, most participants also made it clear that grazing contracts would need to meet their own economic goals, and expressed concerns about infrastructure (fencing, water access, and handling facilities. However, most participants said they would be willing to work with most situations, including spending the time to educate and collaborate with public land managers, provided that the grazing contracts met their economic goals. There was also a general sentiment that contracts for rotationally grazing public land should have clear specifications and penalties for non-compliance to help ensure the right producers are interested (Table 8).

Participants provided further insight into concerns about liability and public access to the land. Some potential liability issues mentioned included grazing near an interstate highway or other busy road, having a bull on the pasture, public land users accidentally leaving gates open or touching calves. The group mentioned a few possible solutions to mitigate these issues, including renter's insurance, clear and detailed signage, and self-closing gates.

Finally, when asked what advice they would give the director of a public grazing program in Wisconsin, participants said they would recommend contracts with restrictions to help ensure appropriate graziers are on the land. They also felt that there would need to be

incentives for graziers to make them interested in the opportunity. Similarly, they suggested that there be flexibility in the grazing contract or flexibility within the grazing program to allow for contextual contracts that meet everyone's needs.

Visits to potential grazing sites on public lands

In addition to data collection with producers, site visits were conducted with 20 land managers at 13 state-owned properties between May and July of 2015, with 35 sites between them proposed for grazing management. The intention of the site visits was to collect biophysical data on public sites with grazing potential and to collect qualitative data on land manager interests and concerns with grazing as a land management tool (Table 4). Biophysical data were collected on indicators developed from the initial stakeholder meeting (October 2014). Land managers were interviewed during site visits using a conversational interview guide, and the interview questions were informed by land manager interests and grazier concerns identified at the previous meetings (Patton, 2002).

Discussion during site visits focused around the biophysical attributes, land management history, conservation goals that would make the sites most viable for grazing partnerships and research. Conversing with land managers in person and physically walking the sites instead of looking at listed information encouraged dialogue around biophysical observations and logistical questions about the specific feasibility of rotational grazing management. The site information, land history, and land management goals were compiled by the research team and brought to the WDNR to collectively select sites for pilot grazing projects and monitoring by the research team.

In addition to the biophysical site information, the land managers presented a number of site-specific questions, concerns, and goals related to their experiences and the specific features of the properties they managed. While land managers were interested in grazing management for

a variety of reasons, the lack of generalizable research and information about site-specific problems made land managers cautious as well. For example, land managers were concerned about finding an experienced grazier who would be willing to cooperate with site-specific conservation goals and participate in knowledge exchange. Land managers also felt uncertain about the upfront investment in equipment and infrastructure such as permanent exterior fencing and water tanks. Though land managers wanted to maintain ownership of the equipment to make the partnership more attractive to potential graziers, there were a number of limitations on the time and personnel required to purchase and install it. In addition, land managers were wary of potential negative reactions from public land users such as hunters and bird-watchers, and wanted to install infrastructure that would permit those activities.

Overall, land managers expressed interest and optimism in the opportunities around grazing as a land management tool. As with the Viroqua meeting, many sites were situated in areas that made them difficult to mow or burn to maintain grassland bird habitat. Grazing cattle offered potential versatility for managing shrub encroachment and invasive species. In general, the lands proposed were low quality in biodiversity and habitat, so grazing offered a way to actively manage property while allowing WDNR personnel to focus on other work. Finally, a few land managers considered rotationally grazing private cattle on the landscape as a way to engage with and build relationships with the agricultural community.

Results: Phase 2 and The Window of Opportunity

In this phase of ACM implementation, groups implement their alternative management plans, monitor change, and respond to both successes and problems. In the Wisconsin grazing project, the research team, graziers, and public land managers began working collaboratively to implement grazing trials on the ground and monitor their biophysical and socioeconomic

impacts. This phase of ACM was implemented through graduate research projects, the initiation of five grazing partnerships through pilot projects, and a number of pasture walks and workshops related to the pilot projects. The installation of infrastructure and introduction of cattle drew on funding, effort, and knowledge from the land managers, with input form graziers, the research team, and grazing specialists. The following section details two significant themes from ACM literature that emerged from the development of the pilot grazing projects: 1) ongoing adaption to trade-offs and trial-and-error in grazing management and, 2) potential for social change on the project through communication and knowledge exchange.

Development of pilot grazing projects and graduate research

The transition from Phase One of ACM into Phase Two came with the selection of several sites for pilot grazing projects and graduate research on the ground during the 2016 growing season. The WDNR and UW-Madison research team collaboratively selected five sites from the original 35 visited in 2015 to conduct research monitoring on pilot grazing projects. The UW research compiled biophysical and management information from potential sites, including plant community characteristics, their level of shrub encroachment, and their geographic distribution around the state. All pilot project locations were selected for their potential for habitat improvement under grazing management, with the aim of reducing woody shrubs and invasive species and encouraging plant community diversity and grassland bird habitat. However, the development of grazing partnerships was ultimately dictated by land manager interest and enthusiasm for the projects and the likelihood of finding a local grazier to participate.

With the aim of generating applied ecological knowledge, the graduate research projects at each pilot location were directly informed by the interests and priorities identified by land

managers and graziers during Phase 1. Students developed on-site trials at three sites to compare grazing in combination with other grassland management practices such as mowing and herbicide application, and monitored plant community composition and soil conditions at all five sites. Students also surveyed grassland birds under different grazing treatments and monitored invertebrate communities. Additional graduate research projects generated plans for program evaluation to assess the successes and problems of the overall five-year project. Research is ongoing and the majority of site-specific findings will not be discussed here.

The main methods used to generate the following results in Phase Two include observations from the grazing trials in five locations, follow-up interviews with the grazing trial actors (part of ongoing program evaluation), and meetings and workshops with stakeholders. The follow-up interviews and site visits were conducted near the end of the first grazing season in August of 2016 at each of the 5 sites with a total of 9 land managers and 4 graziers. The interviews focused on reflections on the first season of grazing projects, current observations of the vegetation and wildlife, and goals and plans for future years of grazing. The interviews were analyzed using open coding, guided by grounded theory (Chamaz 2000; Corbin and Strauss 1998) and its application in the work of previous agroecology research groups (Lyon et al., 2010, 2011). Notes were read after each interview, and the topics of discussion were adjusted and refocused based on the previous interviews. Identifying information has been removed for participants' privacy.

Trade-offs and trial-and-error in pilot projects

As discussed throughout the interviews, implementing the five pilot projects entailed negotiating a number of trade-offs to establish fair grazing partnerships between land managers and graziers. With agency funding, the WDNR purchased and installed infrastructure including

permanent fencing and water tanks, gates, portable interior electric fencing, and improved loading and access areas at 4 out of 5 pilot sites. Land managers explained that this ownership arrangement offered the WDNR power to remove a grazier from the property if there were problems achieving their conservation goals, and simultaneously meant the graziers had fewer upfront financial barriers to grazing public land. In the instance where the grazier installed his own permanent fence, a ten-year grazing contract compensated the upfront costs and labor, while the other graziers had year-to-year or 5-year contracts. At the end of the first season, several land managers explained they planned to reuse equipment such as moveable water tanks for future grazing projects. Though delays in fencing installation, electrical issues with interior fencing, and malfunctions with pumps and water tanks were the primary frustrations in the first season, initial concerns about the investment of time and personnel for the startup of grazing projects were diminished by the end of the first season.

At a number of grazing sites, grazing specialists brokered partnerships between the WDNR and graziers who had appropriate animals for the available forage on their sites. Dairy heifers grazed a site dominated by reed canary grass and other cool-season grasses, while highland cattle were grazed on the site with the highest shrub density. Two Red Angus beef cattle herds were grazed on sites with mixed warm and cool season grasses and patches of low-to-medium shrub density. One particularly passionate grazier was working to train his herd to eat weedy and undesirable species such as thistles and ragweed. Interviewees identified matching cattle breeds to sites with appropriate forage quality as an important factor to keep graziers satisfied with the health of their herds and land managers meeting their conservation goals.

Four of the five graziers of the pilot projects lived within 10 miles of their grazing site, close enough for frequent rotations and monitoring cattle health and vegetation heights during

grazing. One grazier traveled over an hour to graze cattle, but noted he was an exception because of he had no pasture rental fee in his contract and was committed to the learning exchange.

At the end of the first season, land managers could compare rotational grazing to other grassland management techniques with much more detail and depth than during the initial site visits. The versatility of rotational grazing was brought up numerous times. Most land managers felt that when implemented appropriately, it was more responsive, precise and adaptable than mowing, less labor-intensive and more lasting than herbicide, and more flexible in timing than controlled burning. Trade-offs between cost and control over conservation objectives became particularly evident during these conversations, as well as the desire for cost-effective management that could be easily controlled and adapted. In general, land managers noted the high start-up costs of rotational grazing in equipment, infrastructure, and planning, but were quick to discuss its cost-saving benefits after the initial investment. The clarification that it was not 'money-making' but 'money-saving' was a frequent area of emphasis, that grazing is active management that can relieve agency personnel and labor. Land managers noted that with recent staffing issues and turnover, using grazing to supplement mowing, herbicide applications, and controlled burns offered substantial relief in workload for staff. Though land managers at 3 of the 5 pilot projects still cited a lack of knowledge and experience as a potential challenge going forward, they expressed more confidence in maintaining control of their conservation goals working with a grazier they trusted.

Communication and decision-making

The land managers and graziers working on pilot projects had varying experience levels with rotational grazing, and as such, flexibility and communication were critical for successful grazing partnerships. In the early stages of the pilot project most land managers prioritized

working with an experienced grazier with good observation skills to manage wildlife goals. In cases where the land managers had some experience with grazing they were more open to working with producers who were inexperienced with rotational grazing. In situations where land managers had little-to-no grazing experience, graziers, grazing specialists, and university research team had more influence in the implementation of grazing projects.

While the land managers and graziers noted that interest in grazing public lands was not overwhelming among graziers in their communities, they did acknowledge an increase in questions and interest during the first season related to the partnerships. The majority of interviewees noted that success in the five grazing projects was not determined by grazier experiences with rotational grazing, their age, rental history, or their interest in conservation, but their commitment to the health of their cattle and interest in making the partnership successful and profitable.

Though aware of the risks and challenges, the graziers participating in the pilot projects had few concerns about the startup challenges of grazing public lands. One commented that the project had not been a high priority for him that summer, while another noted that his herd was no worse off on public pasture than at home. The risks and challenges they did bring up surrounded the topic of cattle health, citing issues with flies, potential illness, predators such as wolves, insufficient shade, and poor weight gains. However, all deemed their cattle health and body condition acceptable and none had serious concerns about predators or negative interactions with the public at the end of the first season.

Even with these positive experiences from the first year and a desire to engage the community and demonstrate active management on otherwise ‘wasted’ or ‘idle’ grasslands, land managers continued to express caution about the projects. While the grazing specialists assisting

the project prescribed conservative stocking densities for the first year to avoid overgrazing, many of the land managers felt significant pressure from their agencies and stakeholders to be successful with the grazing partnerships. One land manager explained that for every 30 successful projects, only one would reach the public, but that one bad example could shut a project down, noting that in the process of engaging the agricultural community the WDNR could not forget their stakeholders among hunters and other public land users. Similarly, another land manager noted that grassland habitat is not typically prioritized in the same way that forests and wetlands are in the state, and that a shift in cultural consciousness might be necessary to see support for grazing.

Knowledge exchange and social change in pilot projects

The potential of grazing partnerships as a social opportunity gained substantial emphasis by land managers and graziers over the course of the first grazing season. Good interpersonal relationships were important in the first year of the pilot project, particularly regarding knowledge exchange between farmers and land managers. Close communication was key for monitoring, adapting to changes, and keeping up to date on observations as well as activities of the graduate research projects. Both land managers and graziers discussed the importance of knowledge exchange and communication with the broader community through press releases, posting informational signs at the grazing site, or answering questions from friends and neighbors. There were assumptions that the public's immediate reaction would be one of distrust or indifference about cows and conservation, but believed that with patient explanations and improved ecological results the project partnerships could change perceptions of both the WDNR and farming community in a positive way.

Many land managers, particularly those in rural counties, expressed the potential for their partnership with local graziers to change public perceptions of the WDNR. They frequently referenced the possibility of graziers as spokespeople for the WDNR, representing them as an active, innovative part of the community initiating partnerships in conservation. One land manager noted that in general, the agricultural community does not have the same kind of buy-in that hunters do for conservation, whose purchase of tags fund numerous conservation projects. They explained that bringing graziers onto wildlife areas was a way to involve them more directly in stewardship. Graziers recounted questions they fielded from neighbors and friends about their activities throughout the first season, one noting that the conservation partnership had even become a business feature and a selling point for his products in local markets.

Pasture walks and workshops

To discuss, share, and compare experiences between these five pilot projects, a number of events were held before and during this first season. The graduate students and research team attended the 2016 GrassWorks Grazing conference to give a presentation on project progress, solicit feedback, and organized a panel discussion with one grazier and two land managers from different agencies to discuss their experiences with grazing management. Graziers expressed interest in the structure of grazing contracts, forage quality and availability as well as in the social implications of grazing, what interactions with the public were like, and what kind of outreach or education was conducted. This venue provided the research team with opportunity to gain feedback from a broader community of graziers, and the discussion reinforced the themes of trade-offs, communication, and decision-making already in play in the planning of the pilot projects.

Additionally, monthly conference calls organized by the WDNR administrators between land managers, researchers, and grazing specialists invited partners to provide updates and ask one another questions throughout the season. Two August pasture walks gave partners a chance to give small presentations and engage in dialogue prompted by the biophysical changes occurring on the landscape under grazing management. Each pasture walk hosted about 20 people, with one attended largely by graziers and one attended largely by land managers. Because of the contextual problems and opportunities with biophysical and socioeconomic features of each pilot project, pasture walks offered a venue for land managers, researchers, and graduate students to see different solutions in action and report back on lessons-learned during the first season. Discussion ranged from the broad, statewide goals of grazing as a management tool to small-scale, project-specific problems and benefits. Topics included the potential benefits of grazing for wildlife, watershed improvements, economic relief for the WDNR, and social engagement with the community, as well as anecdotal information about interactions with the public, reduction of specific weedy species, and problem solving around infrastructure issues. Land managers in particular spoke highly of the pasture walks as an opportunity to ask detailed questions and get feedback from others, building the discussion around the future sustainability of the grazing projects (Table 5).

Discussion: Considerations for grazing public land in Wisconsin

Phase three of ACM implementation, 'building resilience of the desired state,' or in this case, building the sustainability of grazing as a land management tool in Wisconsin, will be highly dependent on activities and lessons-learned in Phases One and Two. While Phase Three of ACM for grazing public lands will likely be initiated after the end the UW-Madison funded

research projects, there are a number of key observations and conclusions at this mid-point that will be critical to the future of conservation grazing structured by ACM.

First, though it is clear that land managers and graziers are interested in the possibility of grazing public lands, the motivations for participating in such a program are different for both groups. Graziers are mainly motivated by economics of grazing projects, willing to work with a variety of contract parameters as long as they are making a profit. Land managers are driven by the desire to manage grassland more efficiently and more economically, while prioritizing habitat management for key grassland species. Ultimately, the success of any public grazing program will require an understanding of key tradeoffs, goals, and collaborative problem solving. This section of the paper highlights four key considerations from our research results to assess in other grazing programs on public land through an ACM process: Contextual contract design, the opportunities and challenges of public and private groups, and types of interested graziers (Table 7).

Contextual contract design

From the results of the statewide producer survey and producer focus group, it is clear that producers in Wisconsin are interested in grazing public land as long as it is economical. They are generally willing to deal with grazing restrictions, short contract terms, cooperation with and time teaching a land manager, low quality forage, long travel distances and more, as long as it is still economical. This is crucial information for a land manager or public land agency looking to implement grazing on public land because it suggests that contracts can be tailored to address these tradeoffs. A higher rental price requires higher quality forage, longer contract length, shorter distance for the grazier to travel, fewer infrastructure installation requirements, or reduced time investment working with land managers. Alternatively, a lower rental price changes

the attractiveness of lower-quality forage, for a shorter contract length, farther away, and producer-installed infrastructure such as fencing (Table 7). Thus far, the research is inconclusive as to which variables (if any) are more important in producer decision-making.

At the same time, land managers face their own management tradeoffs. Factors that land managers must consider are biophysical (land size, vegetation, wildlife), economic (land use, investment of time and personnel, infrastructure, available producers), and social (knowledge, institutional momentum, stakeholders, and agriculture-community relationships). We recommend flexible contracts that emphasize transparency and fairness, or a suite of contract options based on typical public land scenarios with guidelines and best practices for implementation.

Opportunities for graziers and public land managers

As previously described, both land managers and graziers see opportunities in rotational grazing as a land management tool on public land. Namely, that rotational grazing can be a win-win solution to woody species encroachment on public grasslands. For land managers, grazing offers versatility, an opportunity to save costs while simultaneously improving wildlife on a small (localized) and large (landscape) scale. Graziers see opportunities in reduced pasture rental rates. Both groups mentioned grazing public land as an opportunity to improve relationships with the public. Land managers see it as an opportunity to strengthen social networks with the agricultural community who may see ungrazed land as “wasted” or “unused,” and with public land users like hunters and hikers. Graziers also mentioned the opportunity to improve relationships with other members of the agricultural community and general public who may lack knowledge of, or have a negative view of, livestock farming. Additionally, some producers mentioned their willingness to work with a land manager to improve their mutual understanding

of how grazing can help managers meet their wildlife goals. Understanding the shared and separate visions for opportunity with rotationally grazing public land provides the shared focus that is key to ACM, and should be integrated into future grazing programs.

Challenges for public-private partnerships and suggested solutions

While graziers and land managers noted opportunities with rotationally grazing public land, they also see potential challenges. In the pilot studies, actors are experiencing some of these challenges first-hand, including liability and issues of the public, trust and communication between public land managers and private graziers, contract negotiation and grazing implementation.

Liability and dealing with the public is of particular concern for graziers, though it is important from a land manager perspective as well. Land managers and graziers must share interests with with hunters, bird-watchers, hikers, and other users of public lands. Therefore, co-creating acceptable signage to explain the goals of grazing is crucial for public land. There is also concern that the public may interfere with the cattle in some way. Clear and detailed signage that warns the public of the risks, goals, and plans of grazing cattle may be sufficient to mitigate these liability issues.

Conservation agencies face a number of socioeconomic risks in partnerships, from anti-government sentiment from farmers and public understanding how environmental conservation should be administered. Tension between public land managers and private producers must be overcome in order for a public grazing program to be successful. Many land managers mentioned concerns about finding a grazier that they could trust to follow habitat management grazing restrictions. This is particularly important for land managers because many feel that they have little to no experience with or knowledge of rotational grazing for land management. Even

after pilot projects began to be implemented and relationships were developed between land managers and graziers, many land managers maintained at least some lack of trust.

On the producer side, focus group participants mentioned that while they have extensive experience with managing land for grass health, they lack an understanding of the wildlife management goals of public land managers. Some graziers mentioned frustrating experiences working with public land managers who mandated grazing restrictions without an explanation. This concerns graziers who may be willing to work with a public agent but are worried about misunderstandings or misinterpretations of grazing plans because of a lack of knowledge of wildlife management goals. A clear contract with repercussions to graziers who fail to follow the grazing restrictions may help facilitate trust.

Another significant challenge is the actual contract negotiation and implementation of rotational grazing as a land management tool. As mentioned already, land managers have separate bottom lines that need to be brokered in order for a contract to be enticing for both parties. The use of a third party grazing broker can help facilitate this process. In our pilot studies, a grazing specialist as a broker assisted with contract terms acceptable to both parties and provided input on implementation of the contracts. Managing expectations about implementation challenges along the way will help both parties remain committed and enthusiastic about the partnership when challenges do occur.

What are the characteristics of graziers willing to graze public lands?

As established from the statewide producer survey, cool-season grass-dominated public land is most attractive to a broad range of graziers. In general, producers who have more animal units are more likely to be interested in grazing grass-dominated public land, perhaps because they have a greater need for pasture than producers with smaller amounts of animal units. Younger

farmers are more likely to be interested in renting grass-dominated public land because it is challenging for new farmers to find or purchase pasture. Finally, farmers with few cattle breeds and classes are more likely to want to rent grass-dominated public land, because it is less complicated for them to do so with regard to operation management. However, from the focus group and GrassWorks results, it is clear that producers are interested in grazing grass-dominated public land even if the above variables do not hold. For grass-dominated land, land managers will have an easier time finding interested graziers, and if they do want to advertise they should seek graziers that fit the description above.

Shrub-dominated land is more challenging. The results of the survey showed that graziers with a positive attitude toward conservation and working with government are more likely to be interested in renting shrubland than other graziers, as well as those with smaller proportions of pasture acres to their total farmland acres. Land managers may need to explicitly seek out these types of graziers in order to find an appropriate match.

The survey response bias also provides insight about interested graziers. It is not surprising that older farmers with smaller operations were more likely to respond to the survey, as a group who may be retired or partially retired with family members or hired workers doing much of the farm labor. Smaller operations also suggest more time to fill out surveys because they may be less labor intensive. Contrastingly, the fact that farmers who practice MIRG and who have prior rental experience were more likely to respond to the survey is significant. These farmers would not necessarily have more time to fill out surveys than their counterparts, so their higher response rate may reflect a greater interest in the topic. This suggests that the "right" people are interested in rotationally grazing public land, including those who already have

rotational grazing experience and familiarity with pasture rental are interested in grazing public land, matching the needs of land managers seeking experienced and knowledgeable graziers.

Conclusions: Phase 3 and the future of grazing in Wisconsin through ACM

Phase Three of the ACM process is marked by the formation of a "policy community" that consists of social networks and alliances between stakeholders with arise during the window of opportunity. This community acts to build resilience of the social-ecological system (Olsson et al. 2004b). During this phase groups revisit what they have learned from Phases One and Two in order to build a more resilient management program. By our definitions, the Wisconsin grazing project is still in Phase Two, but Phase Three will incorporate a number of the grazing takeaways discussed here, expanding shared knowledge and building the 'resilience of the desired state.' To conclude, we offer a few recommendations for a successful implementation of Phase Three using the 6 key features of ACM discussed throughout (summarized in Table 6).

The decision-making around grazing as a land management tool for the first season of the pilot projects was successful in part by the flexibility and commitment to learning that land managers and graziers showed during the beginning of Phase 2. To guide future plans, current ongoing graduate research is developing program evaluation tools to assess activities of the pilot projects and provide more structure for ongoing feedback and decision-making. To enable that feedback, constant communication was emphasized again and again throughout the first year of the pilot projects and the implementation of ACM. While pasture walks and conference calls have been successful ways to share and discuss experiences so far, documentation will likely be an important feature of ongoing partnerships and projects. Though the publication of graduate research will aid with documentation, revisiting grazing plans and using frequent reports or other

written summaries about ongoing activities may strengthen the ACM practices and smooth the transition from Phase 2 to Phase 3.

Within the development of evaluation and processes for decision-making is an awareness of fairness and, again, the respective trade-offs and challenges faced by each of the partners. Ultimately, the WDNR holds decision-making power as the owner of the public grazing lands, and land managers directly involved with on-the-ground pilot projects still need to answer to their agency, and potential financial or political changes that could reshape the projects. Balancing that uncertainty for graziers and university researchers will be a factor as the project moves forward. Continuing to respond to feedback and input for decision-making will be important for all partners, aided by an awareness of power in decisions and knowledge exchange. These social and decision-making factors will be key for ACM alongside what biophysical changes happen on the landscape.

The commitment to learning and the idea of change has been consistent throughout the first two phases of ACM grazing research. The ongoing dialogue between land managers, researchers, and graziers immediately involved in pilot grazing projects as well as with larger groups at conferences, meetings, workshops, site visits has directly informed the research questions and direction of the grazing projects. However, one of the goals discussed among land managers, graziers, and researchers is a broader social change in the understanding of conservation and land use in Wisconsin, integrating the public land user into the grazing management. This has been tentatively broached in phases One and Two through press releases, in-person conversations with community members and neighbors, and the installation of informational signage at the grazing sites, but a larger and more inclusive approach with public

stakeholders has not been taken. Gaining support and understanding from community members will be key as the project moves forward.

Something lacking from the ACM approach thus far has been the input of the public. Because grazing land management in Wisconsin is still in pilot stages, the WDNR will facilitate public engagement based on agency protocol. As the research team and partners gain understanding of how grazing partnerships on public land will transpire, the WDNR will feel ready to involve the public through educational events and listening sessions. We acknowledge that this will be a crucial part of successful grazing on public land in Wisconsin.

Finally, to build the sustainability of this alternative land management partnership, there need to be provisions in place to continue without the university as a bridging organization. While other funding sources may support continued research and monitoring on the same five pilot grazing sites or other new ones, the WDNR and grazing specialists involved in public-private partnerships may need to find other organizations to assist with brokering relationships, developing research questions, and encouraging the learning process. These key features of grazing as a potential land management tool in the Upper Midwest and area for agroecology research guided by ACM will require ongoing research efforts in coming years. The role of adaptive co-management and increased interest in conservation agriculture, ecosystem services, and community resource-sharing will be critical to sustain complex agroecological systems with resilience.

Chapter 1 Tables and Figures

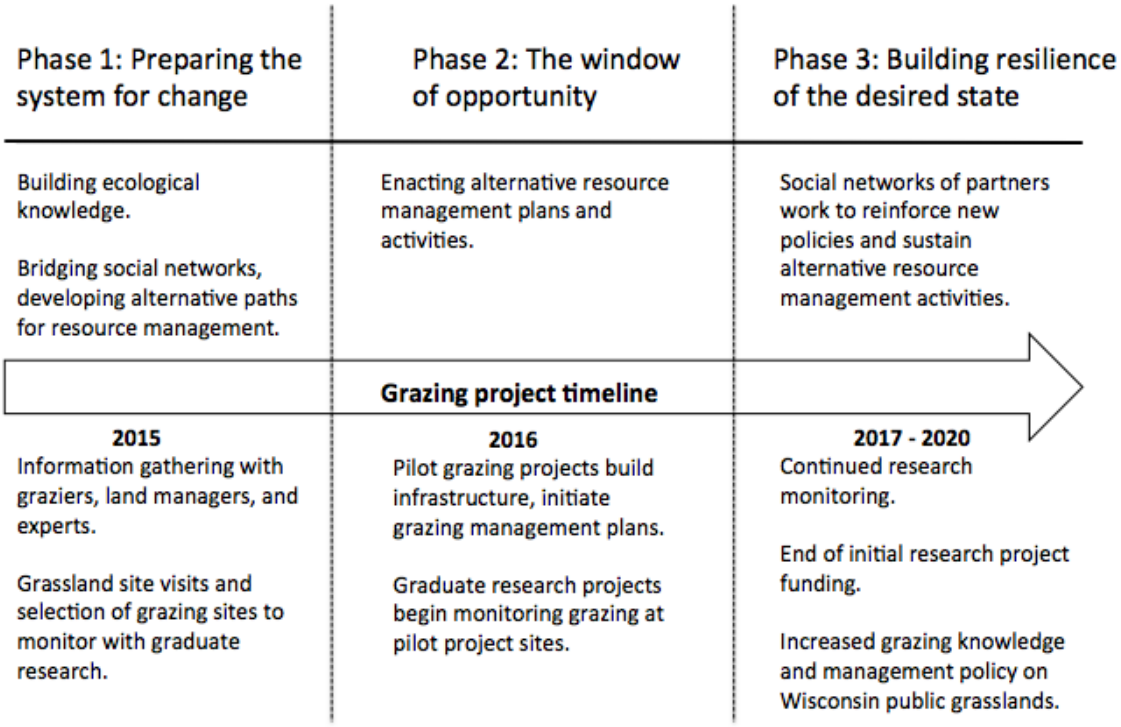

Figure 1: The three phases of adaptive co-management, adapted from Olsson et al. (2004b) and Butler et al. (2015) overlaying a timeline of the Wisconsin grazing project.

Table 2: Key findings and application from Phase One throughout ACM process in the Wisconsin Grazing project

Event or data collection method and Participants		Key findings	Application/use in ACM process
Initial key stakeholder meeting (Oct. 2014)	Grazing specialists, WDNR representatives, University researchers	• Collective research interests • Nine main site-selection factors for pilot projects	Collective research interests were incorporated into graduate student research questions and projects. Site selection factors were used as indicators during initial WNDR site visits and field interviews.
WDNR land manager meeting in Viroqua (Mar. 2015)	WDNR ecologists, biologists, technicians, and administrators, Grazing specialists, Representatives from the Minnesota Department of Natural Resources, University researchers	• Main land manager vegetation management goals • Land manager experience levels with grazing • Types of grassland managers want to implement grazing on • Main wildlife management goals • Opportunities and concerns regarding grazing as a land management tool (land manager perspective)	Land manager vegetation and wildlife management goals, and types of grassland available for grazing management informed the producer survey hypothetical contract scenarios.
GrassWorks grazing conference (Jan.2015)	Dairy and beef producers from across Wisconsin, University researchers	• Trade-off considerations/decisions faced by producers • Initial idea of distance willing to travel • Logistical concerns and risk considerations	Informed the producer survey
Grazing survey (Aug. 2015)	Cattle producers whose cattle receive at least part of their ration from pasture	• Main producer concerns and interest in grazing public land • Producer attitudes toward conservation and public land agencies • Influencers on producer willingness to rent public land • How much land producers would like to rent, how far they are willing to travel, and what type of cattle they would put on the land in various scenarios	All data can be used to inform the design of a public grazing program in Phase 3
Producer focus group (Sept. 2016)	Cattle producers who have at least some non-dairy cattle	• Qualitative information on producer decision-making and tradeoffs when considering renting public land for rotational grazing	All data can be used to inform the design of a public grazing program in Phase 3
Site visits and field interviews (2015-2016)	WDNR land managers University researchers	• Site-specific biophysical information and land management goals • Site-specific land management history	Biophysical data was used to select sites for the pilot projects

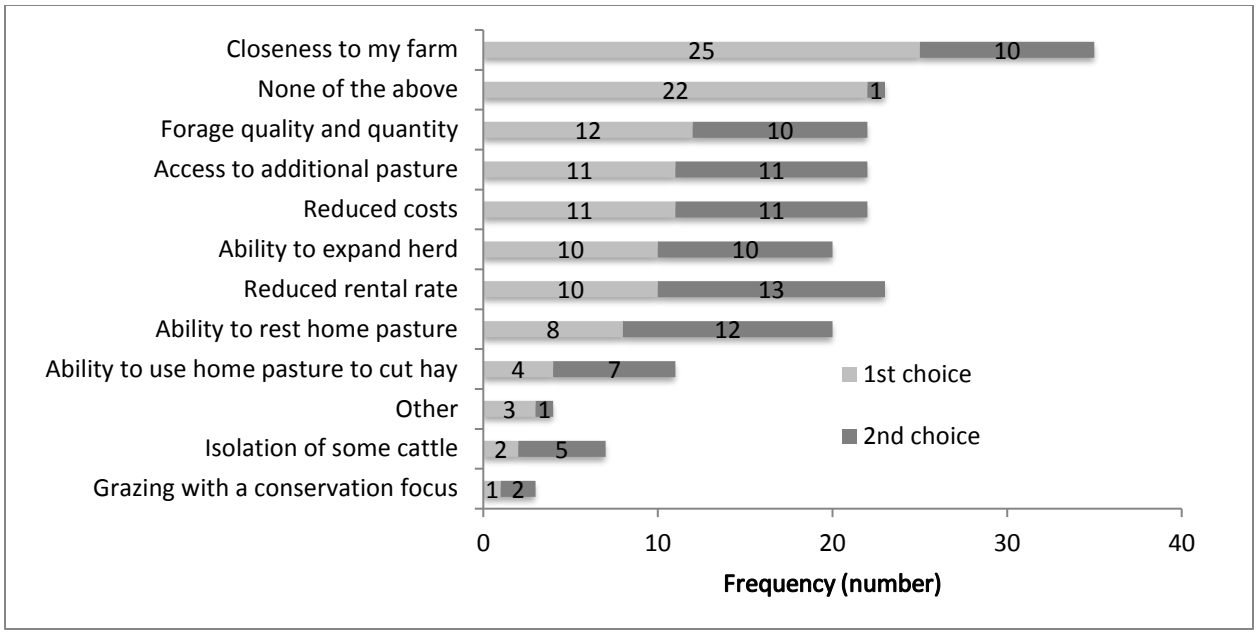

Figure 2: Statewide producer survey identified the primary and secondary opportunities that graziers consider when assessing public land for grazing.

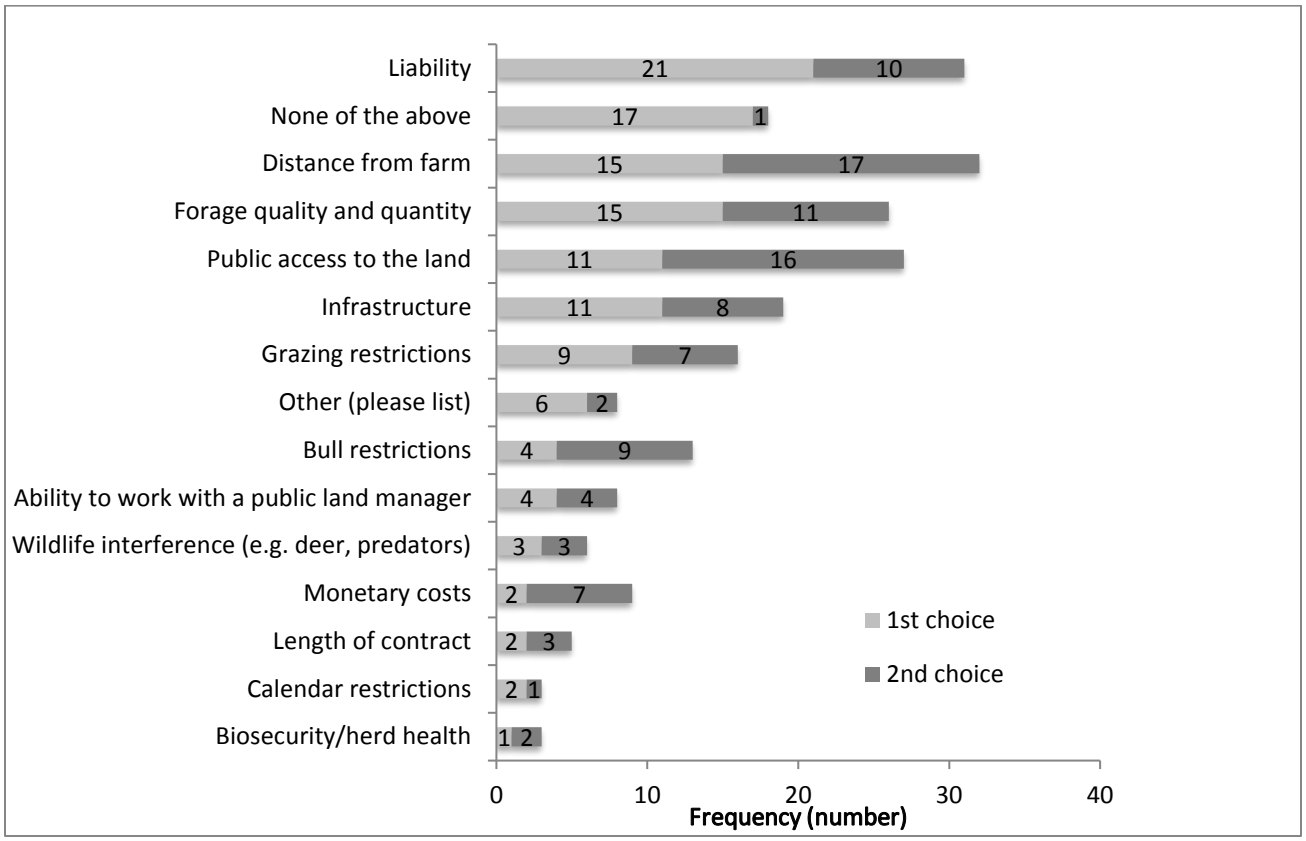

Figure 3: Statewide producer survey identified the primary and secondary concerns that graziers consider when assessing public land for grazing.

Table 3: Producer focus group participants and their operation characteristics.

Participant	Types of cows	Rental experience
1	Organic dairy	Currently rents 40-50 acres
2	Beef heifers	Currently rents 25 acres
3	Beef cattle and heifers	Past rental experience; currently doesn't rent
4	Dairy cows	Past rental experience; currently doesn't rent
5	Dairy cows, steers, heifers, dry cows	Currently rents 100-200 acres
6	Dairy cows, dairy heifers, steers	Currently rents a fair amount
7	Pure-bred cows, feedlot	Currently rents several hundred acres
8	Dairy heifers	Currently rents 55 acres
9	Dairy cows, heifers, calves	Does not have rental experience

Table 4: Topics of interest from site visits and conversational interviews with land managers, focused on biophysical site attributes and land management questions.

Biophysical site attributes	**Land management questions:**
1. Acreage 2. Terrain and soil type 3. Existing infrastructure 4. Road access 5. Available water and electricity 6. Pre-existing fencing 7. Shade availability	• What is the typical land use for this site? • What is the management history of this site? • What are the common wildlife species? • Vegetation of interest? • What are the conservation goals of grazing management? • Are there any known graziers in the area?

Table 5: Key findings and application from Phase Two throughout ACM process in the Wisconsin Grazing project.

Event or Data collection method and Participants		Key findings	Application/use in ACM process
Site selection meeting (July 2015)	WDNR administrators and university researchers.	• Assessment of feasibility and trade-offs for grazing management across the 35 sites surveyed • Defined interests for graduate research projects across sites: brush density and plant community variety, grassland bird populations	Collaborative decision-making on sites for initial implementation of grazing management. Research interests were built into the design of pilot projects.
GrassWorks Grazing Conference (Jan. 2016)	WDNR ecologists, biologists, technicians, and administrators, grazing specialists, dairy and beef producers, university researchers	• Deepened understanding of grazier interests: grazing contracts, cattle health, forage, infrastructure issues • Interactions with the public and community education on grazing conservation management	Brought the project to a larger community of graziers to solicit feedback, broaden interest, and encourage group leaning.
Pilot projects and graduate research projects (May-Oct. 2016)	Grazing specialists, dairy and beef producers, WDNR biologists, technicians, and administrators, university researchers and graduate students	• Site-specific findings are in development.	Graduate projects were directly informed by the interests and concerns expressed by partners throughout Phase 1.
Pasture walks (Aug. 2016)	Grazing specialists, dairy and beef producers, WDNR biologists, technicians, and administrators, university researchers and graduate students	• Discussion of goals and problems from grazing season.	The WDNR showed commitment to learning on multiple scales, on site-specific pilot projects and at an administrative level to better allocate support and resources.
Site visits and field interviews (Aug.-Sept. 2016)	WDNR land managers, participating graziers, graduate students	• Site-specific feedback on first year of pilot projects • Deepened understanding of interests, issues, and goals for the future	Developing tools for program evaluation will assess the project activities and provide feedback for decision-making. Contributes to iterative learning and changes.

Table 6. Integration of ACM components throughout phases 1 and 2
The six core components of ACM were utilized throughout Phase One and Phase Two in order to most effectively explore the opportunities and challenges associated with grazing public lands in Wisconsin, develop pilot projects based on initial learnings, and to ultimately devise a shared vision for alternative grassland management in Wisconsin using grazing.

Core Concept of ACM	Phase 1 of Grazing partnerships: activities and participants	Phase 2 of Grazing partnerships: activities and participants
Common focus or shared vision	• Shared goal of a win-win solution to woody species encroachment on public grasslands • Information-gathering with graziers, grazing specialists, land managers, and university researchers	• Phone calls and meetings with partners • Grazing plan provide vision for grazing management • Document outlines learning objectives and research methods
Communication and collaboration	• First meeting of UW, WDNR and grazing specialists • Land manager meeting in Viroqua and GrassWorks Grazing Conference • Conversations between graduate students, grazing specialists and WDNR wildlife specialists to inform the design of their projects • 2015 site visits and land manager interviews	• Pasture walks, land manager workshop • Grassworks 2016 panel discussion • Ongoing phone calls with partners • Development of grazing plans for pilot projects
Shared control and responsibility	• Determination of pilot project sites • Within UW team, shared governance approach with project investigators and graduate students	• Pilot project implementation • Signage at pilot sites and public relations • Grazing plans and contracts
Autonomy and recognition of power	• Conversations between UW and WDNR about levels of power at WDNR to inform process • Consideration of potential for political backlash and reprisal to DNR and other colleagues due to their inherently political positioning	• Ongoing grazing decisions at each pilot site • Graduate student research plots
Generating and sharing knowledge	• Viroqua land manager meeting (UW, WDNR) • Grassworks 2015 (graziers) • Site visits and field interviews (land managers) • Grazing focus group (graziers)	• Follow up interviews with pilot grazing sites (land manager, graziers) • Hook Lake workshop for land managers • Pasture walks (UW, land managers, graziers)
Ongoing assessment, reflection, and learning	• Information gathered from land manager and grazier meetings incorporated into research design and pilot project site selection • Grazing survey developed based on iterative process	• Pilot projects will update their grazing plans annually • New graduate students will build on and adapt research based on learning

Table 7. Suggested considerations and practices for grazing public lands.

Key findings and takeaways	**Suggested considerations and practices**
Contextual grazing contract design	• Grazing public land must be economically viable for interested graziers • Contracts should accommodate tradeoffs around economic variables, such as forage quality, contract length, time, and infrastructure investments in their rental rates
Opportunities for graziers and public land managers	• Grazing offers potential cost-effective ecological management on a both a small scale and landscape scale • Public land rentals offer graziers affordable pasture access • Improving relationships with the public through active land management and agricultural land stewardship

Challenges for graziers and public land managers, and *suggested solutions*	• Liability and interactions with the public
	  • *Clear, detailed or interpretive signage*
	• History of negative stereotypes and poorly communicated goals between graziers and land managers
	  • *Using good communication and trust-building techniques*
	• Contract negotiation and implementation
	  • *Managing expectations, clearly defining roles and activities*

Which Wisconsin graziers are interested in grazing public land, and what does that mean for public land managers?	• Grass-dominated land is more attractive to most graziers • Graziers with a positive attitude toward conservation, working with public agencies, or those with smaller pasture acreage are more likely to rent shrub-dominated lands • Graziers experienced with MIG and pasture rental are more likely to be interested in grazing public lands

Table 8. Producer focus group: relationships between rental variables

	Distance	Forage quality	Contract length	Willingness to teach/initial effort	Infrastructure installation/provision
Price	negative	positive	positive	positive	negative
Distance		positive	positive	negative	negative
Forage quality			negative	positive	positive
Contract length				positive	positive
Willingness to teach/initial effort					negative

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Appendices

Appendix 1. List of prioritized list of biophysical and logistical factors for consideration in grazing site selection from October 23, 2014 stakeholder meeting

This list was captured from an initial key stakeholder meeting during Phase One. They are suggested factors that should be considered for site selection for the pilot projects in Phase Two. The list is arranged in order of number of group mentions, with the most popular categories first. Each category is in bold, with the actual comments written below.

Infrastructure

- Road and electric access
- Accessibility
- Ease of access (for producer and researcher and manager)
- Vehicle/equip access
- Water access
- Proximity to water/stream too close
- Access to water lines/electricity (fence)
- Water access for cattle
- Acceptable conditions for grazier: 1. Access; 2. Fencing; 3. Water
- Availability of infrastructure (fencing, watering, handling facilities)
- Infrastructure (fencing/water) present, or worth installing based on expected returns
- Infrastructure development (Flat? Wet? Dry? Hilly? Rocky?)

Variable biophysical traits across sites

- Vegetation type – cool/warm, prairie rest, shrub, wet/dry
- Different soil types
- Variable biophysical traits across sites (soil, veg)
- Include a range of soil types
- Different shrubby species
- Sites in different landscapes (%grass varies)
- Have both native and cool season sites
- Soil/plant/landscape characteristics
- Low slope

Proximity to graziers

- Close to interested graziers
- Proximity to interested/capable producer
- Interest from local livestock community
- Number interested producers and proximity
- Willing graziers nearby

DNR acceptance

- Minimal use conflict
- DNR property master plan objectives and approved activities

- Pasture establishment on sharecropping
- Site poses challenges for typical management practices
- Revenue generation to DNR

Public

- Public access risk?
- Current public land uses (i.e. hiking, water access)
- Acceptance from larger community of grazing
- Stakeholder/user acceptance

Size of site

- Large enough to provide ample forage to grazier
- Grassland large enough for multiple treatments
- Large enough for plots and to try to avoid animal behavior issues while in confinement

Research capacity

- Locational capacity for research treatments
- Sites that fit with research questions
- Can we envision benefits of grazing for the biota, beyond brush control, that might broaden the sideboards for site selection? - E.g. include c.s. monocultures to monitor impact on diversity

Land manager

- Flexibility of land manager to work with scientists
- History of management actions on the property (Rx? Rowcrop? Herbicide? "Traditions")
- Used to working with ag producers and contracting

Sensitivity

- Not highly sensitive (rare/endangered species, sensitive for public)
- Sensitivity of land to animals – "conservative" natives, seasonal wetness

Appendix 2. Land manager opportunities and concerns identified for grazing public land, collected at March 2015 meeting in Viroqua, Wisconsin

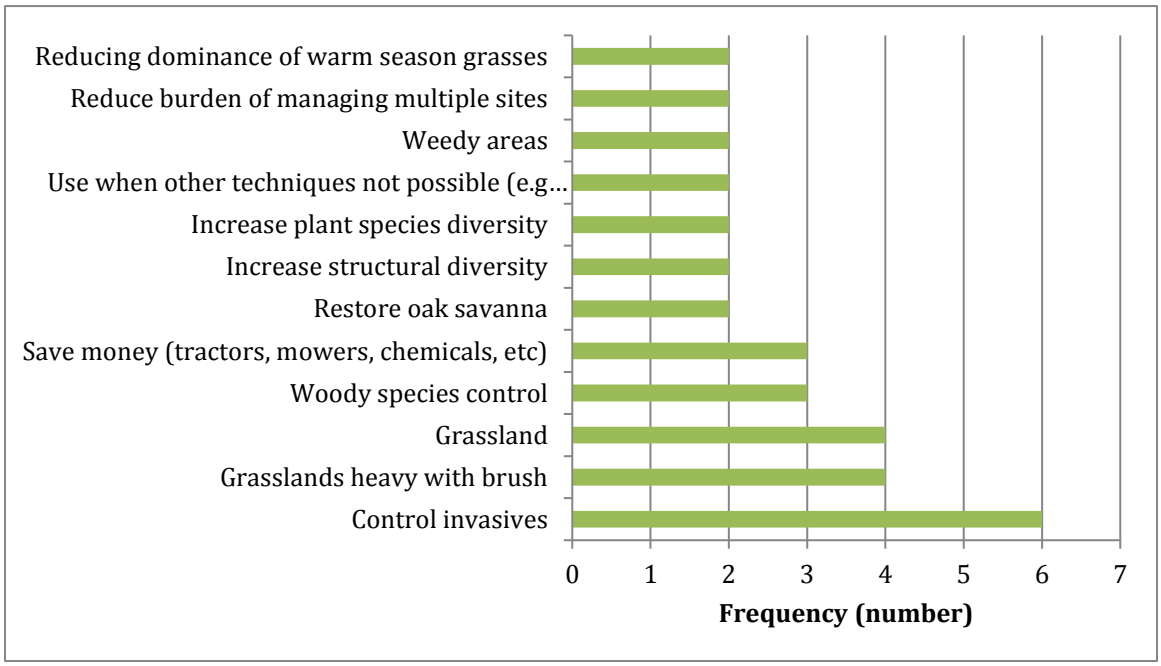

Figure 1: Opportunities for habitat management from Viroqua land manager meeting

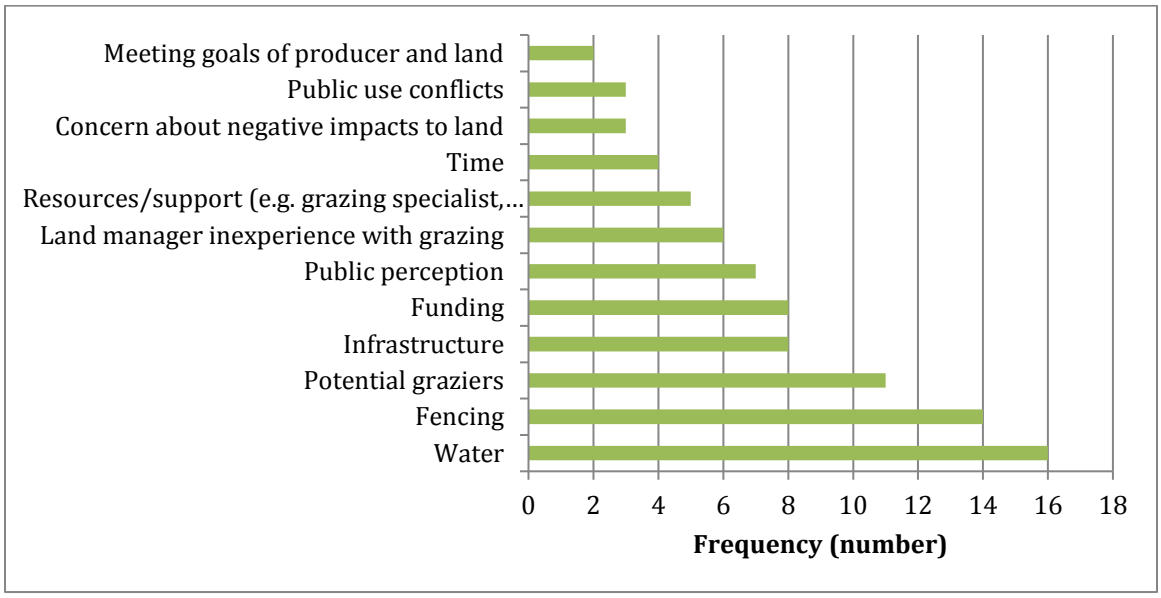

Figure 2: Concerns about grazing as a land management tool from Viroqua land manager meeting

Appendix 3. Grazing Public Lands survey results

Table 9: Acreage, animal class, and travel distance interest by rental price

Type of pasture	Rental Price/acre	Acres	Class of animal	Max. distance
Grass dominated	$5	less than 40 to 640+	dry beef, cow-calf pairs, finish animals, young stock	50
Grass dominated	$10	less than 40 to 640+	dry beef, cow-calf pairs, finish animals, young stock	50
Grass dominated	$15	less than 40 to 640+	dry beef, cow-calf pairs, finish animals, young stock	50
Grass dominated	$20	less than 40 to 319	cow-calf pairs, finish animals, young stock	20
Grass dominated	$25	less than 40 to 319 and 640+	dry beef, cow-calf pairs, finish animals, young stock	40
Grass dominated	$30	less than 40 to 319 and 640+	dry beef, cow-calf pairs, finish animals, young stock	40
Grass dominated	$35	less than 40 and 80-159	cow-calf pairs, finish animals, young stock, heifers	30
Grass dominated	$40	less than 40, 80-159, and 640+	dry beef, cow-calf pairs, finish animals, young stock, heifers	50
Grass dominated	$45	80-159	dry beef, cow-calf pairs	20
Shrub dominated	$5	less than 40 to 640+	dry beef, cow-calf pairs, young stock	50
Shrub dominated	$10	less than 40 to 640+	dry beef, cow-calf pairs, finish animals, young stock	50
Shrub dominated	$15	less than 40 to 640+	dry beef, cow-calf pairs, young stock	50
Shrub dominated	$20	less than 40 to 319 and 640+	dry beef, cow-calf pairs, young stock	40
Shrub dominated	$25	less than 40 to 319 and 640+	dry beef, cow-calf pairs, young stock	75
Shrub dominated	$30	less than 40 to 79 and 640+	cow-calf pairs	50
Shrub dominated	$35	40-79 and 640+	cow-calf pairs	50

Table 10: Willingness to rent public land even if have to provide the fence infrastructure

Pasture	**Price**	**Agreed to rent**	**Would still rent if had to provide fences**	**%**
Grass-dominated	$10	17	6	35%
Grass-dominated	$25	14	4	29%
Grass-dominated	$40	4	1	25%
Grass-dominated	$5	12	1	8%
Grass-dominated	$20	5	2	40%
Grass-dominated	$35	4	1	25%
Shrub-dominated	$10	11	2	18%
Shrub-dominated	$20	9	3	33%
Shrub-dominated	$30	2	2	100%
Shrub-dominated	$5	10	2	20%
Shrub-dominated	$15	9	2	22%
Shrub-dominated	$25	4	1	25%

Appendix 4. Producer focus group results

Grazing Public Lands Focus Group Questions:

- Tell us who you are, what kind of cattle you raise, where your operation is located and whether you have rented pasture before.
- What are the most important things you consider in deciding whether or not to rent a pasture?
- If you were to rent pasture to graze your animals, how would you decide how many acres to rent?
- If you were to rent pasture to graze your animals, how would you decide which class of animal to put on the pasture?
- What do you think about using rotational grazing as a land management tool on public grasslands?
- Beyond what you already mentioned about renting land in general, What are the most important things you would consider in deciding whether or not to rent *public* land?
- Survey respondents said **liability** is an important concern for them when thinking about renting public grassland. Any thoughts on that response?
- Survey respondents said **public access** to the land is an important challenge for them when considering renting public land. Why might graziers be concerned about this?
- In our survey, producers who practice managed intensive grazing are more interested in renting under these scenarios than producers who don't. Why might this be the case?
- In the comments section of the survey, a couple of producers expressed frustration around the possible competitive advantage of producers who get to rent cheap government land. I would like to know what you think about this concern. Do you feel similarly? Can you tell me more about your feelings on this?
- If you had a chance to give advice to the director of a public grazing program, what advice would you give?
- I wanted you to help me evaluate the findings from a statewide grazing survey focused on the potential for grazing public lands. I also wanted to learn your thoughts and opinions on renting public land for grazing. Is there anything I missed that you think is important for the discussion of rotationally grazing public lands?

Chapter 2: Integrating program evaluation and agroecology research: Building partnerships and practices for grazing public lands

Greta Landis

Abstract

Agroecology encourages a complex and systems-based approach to agricultural research, but even applied, participatory projects often lose their systems view with the limitations of disciplinary expertise, funding, and tractable research questions. Though it is not commonly used in agricultural research, formal *program evaluation* presents a set of methodologies and strategies for defining boundaries and assessing change. This field could provide agroecology with tools to document activities, engage with partners, and monitor changes in food systems and agroecology research. We use program evaluation to assess a collaborative agroecology research project exploring the opportunities and challenges associated with grazing of public lands by private livestock operators in Wisconsin. We describe the need for program evaluation in agroecology research projects, and illustrate the use of evaluation-specific methodologies at both formative and summative project stages. Finally, we use evaluation techniques to define specific outcomes and activities for successful grazing on public lands in Wisconsin, and explore plans to achieve these goals.

Introduction

Recent interest in multifunctional agricultural resources and landscapes has brought with it a mainstreaming of agroecology research (Bland 2002; Mendez et al. 2013; OECD 2009). Once simply described as the ecology of food systems (Francis et al. 2003), agroecology has expanded to refer to numerous aspects of agricultural studies, incorporating sociology, anthropology, economics, crop science, and biology (Buttel 2003; Tomich et al. 2011). In addition to this academic focus, agroecology has also been referred to as a particular set of farming practices and a number of social movements, encompassing ecologically sustainable farm activities alongside environmental- and food-justice activism (Wezel et al. 2009), and more recently, policy (Sevilla-Guzmán and Woodgate 2013).

This multifaceted view of food systems arguably produces a richer understanding of the socioeconomic and ecological dynamics of agriculture than traditional, production-oriented agricultural research, but poses a number of challenges in implementing focused, manageable research projects. Discipline-specific funding and resources, conventionally narrow, specialized expertise, and academic publishing timelines all pose potential barriers to complex, long-term agroecological research. Further, as Bland and Bell (2007) discuss, the systems-view of agriculture struggles particularly with the concepts of *boundary* and *change*. Traditional, reductionist agricultural research maintains precise—if unrealistic—boundaries, whether at a farm property line or the edge of a field plot. The interconnectedness of agroecological research poses a number of challenges for structured, answerable scientific inquiries: How should researchers define the boundaries of farming systems and assess change within or outside of those systems? How can researchers be thorough and rigorous across all social, economic, and biophysical dimensions of their investigations, especially when resources are limited?

Some have addressed these issues on a conceptual level and offered guiding principles, spatial and theoretical frameworks, and other heuristics to frame agroecological research (Buchanan 2016; Bland and Bell 2007; Bell et al. 2010; Wezel et al. 2016). Others suggest that transdisciplinary, participatory, applied research maintains a broad scope by inviting nonacademic concerns and interests to guide the generation of new agricultural knowledge (Cuéllar-Padilla and Calle-Collado 2011; Lyon et al. 2010; Mendez et al. 2013). Though Mendez and coauthors (2013) argue that agroecology should be participatory and action-oriented in the scope of its research, even projects involving many stakeholders and partners struggle with the same questions of boundaries and the determining the extent of agroecological changes or impacts.

However, it is because of its multifaceted approach to food systems research that we argue that agroecology is well suited to adapt and apply methodologies from other fields to address the complexity of agricultural systems in applied research. We present a set of techniques and applications from the field of *program evaluation* to provide agroecology with tools to bridge this transition from principles to practices, to add measurability to its complex conceptual scope. Evaluation is built around similarly broad and complex approaches to inquiry, but provides action-oriented methodologies for investigation and assessment that could interface well with agroecology research.

Defining evaluation for agroecology

Though program evaluation itself is not a specifically agroecological endeavor, the field is guided by many of the same goals, assumptions, and principles as agroecology. As a field, program evaluation developed in public education the 1920s, but has since spread to a variety of disciplines and grown into an independent profession (Hogan 2007). Scriven (1967) describes

program evaluation as a set of methodologies for determining the merit or worth of programs or policies, while Trochim (1998) articulates program evaluation more specifically, as:

> …a *profession* that uses *formal methodologies* to *provide useful empirical evidence* about *public entities* (such as programs, products, performance) *in decision-making contexts* that are inherently *political* and involve multiple often-conflicting *stakeholders*, where *resources* are seldom sufficient, and where *time-pressures* are salient (emphasis in original).

Evaluation differs from research or academic inquiry more generally in that it is nearly always applied, politically situated, non-objective, and built around the premise that an evaluation will produce judgments and recommendations about program quality or effectiveness (Mertens and Wilson 2012). Though modern evaluation methodologies began in the realm of U.S. public education to measure student performance and test new programs (Hogan 2007), they have expanded into many areas including business, industry, public policy, and international development (OECD 2013). Cooperative extension programs have used evaluation practices for nearly 50 years (Suvedi et al. 1999), but the application of program evaluation in conservation and environmental programs has only been very recent, and remains rare in agricultural contexts (Black and Groombridge 2009; Dziegielewski and Kiefer 2010; Wilder and Wapole 2008). Evaluation can take many of forms and address any number of questions about a program, policy, or product, and can be conducted by individuals within a program or by an external, independent evaluator, but is typically oriented around the implementation, effectiveness, or accountability of a program to its stakeholders or beneficiaries (Longest 2015). Evaluation provides a set of tools to answer questions such as: Was the program conducted as planned? Were stated goals achieved? What evidence is there to demonstrate the results to those involved?

The design of an evaluation plan is based on four types of standards, and an iterative framework for implementing evaluation activities according to those standards (Mertens and

Wilson 2012; Longest 2015; AEA 2004). The standards fall into four categories—utility, feasibility, propriety, and accuracy—that are considered and applied throughout the evaluation process, from initiating input from stakeholders or partners to describing the program and its context, to data collection and reporting (Figure 1). Documenting and thoroughly describing the program to be evaluated is particularly crucial to the evaluation process, and a variety of evaluation-specific methods and tools such as *needs and assets assessments* and developing program theory through *logic models* aid in conceptualizing these steps in evaluation implementation (Mertens and Wilson 2012; Taylor et al. 2003). A clear and thorough program description should include the purpose or rationale of the program, the need that it addresses, the expected or desired changes or results of the program over the short- and long-term, and the activities and resources needed to achieve those short- and long-term effects (Mertens and Wilson 2012; Longest 2015). Additional information includes contextual factors that could contribute to the success or failure of the program, and the program's current stage of development. These initial assessments develop the boundaries of what will be evaluated, and the features, activities, or impacts of the program for evaluation.

Integrating program evaluation and agroecology

An emphasis on iterative, participatory, action-oriented inquiry with a systems-view makes evaluation particularly well suited for integration in agroecology research. Mendez and coauthors (2013) have already defended the overlap between agroecology and participatory action research methodologies, but many of the same principles apply to the interface of agroecology and program evaluation. Both fields apply a mix of methods and range in their areas of inquiry from socioeconomic to ecological and biophysical, on small and large spatial or temporal scales. Both have a focus on inclusion of local knowledge and utility for stakeholders,

and both take a systems-based lens to inquiry that incorporates contextual factors (Longest 2015; Wezel et al. 2016). The long-term sustainability focus of agroecology complements the focus on feasibility and accountability of evaluation, as well as their respective attitudes toward both cultural and biological diversity (Altieri 1999; Thomas and Kevan 1993). There is also a growing attitude of self-reflection and criticism in both fields, an acknowledgment of researcher or evaluator perspectives and biases that could affect the quality or sustainability of their work and contribute to weaknesses in the quality of the inquiry (Bell et al. 2004; Mertens and Wilson 2012).

While others have more generally argued for the integration of evaluation into research, the work has primarily been biomedical (Westfall et al. 2007) and few attempts have been made to bring evaluation into research in other community, educational, behavioral, or environmental research. Urban and Trochim (2009) note that researchers and practitioners are often operating on different scales and timelines, but that evaluation:

> …provides ways to handle complexity, link local and global, account for dynamic changes in the system or program, recognize the natural evolution of the program, and help identify leverage points… [e]valuation is uniquely situated in this system because evaluators have a connection to both the practice and research realms (539).

In addition to the discussion on evaluation and research, and the parallels between agroecology and evaluation (see Table 1), it is worth noting that, with its methods for program description and logic and aim of making judgments and assessments, evaluation is a field focused on the very problems with which agroecology research struggles: *defining boundaries and assessing change*. Evaluation is motivated by the questions of measurability in complex program activities and effects, and includes a variety of methodologies to describe the boundaries of a program, document its resources, activities, and their intended outcomes, incorporate contextual variables

with stakeholder and partner interests, and introduce feedback mechanisms to monitor the intended changes (Longest 2015; Mertens and Wilson 2012; Patton 2002). Though agroecology researchers may involve nonacademic partners in participatory research, they are often operating from a theoretical level with funding and publishing constraints (Lyon et al. 2010) and have no way to know if the knowledge they generate is used effectively. Similarly, practitioners or producers are asked to show the long-term, large-scale effects of their work while operating on a local scale with limited resources (Urban and Trochim 2009). Using evaluation to develop, describe, and assess agroecology research projects, illustrating the boundaries and areas of intended change (Renger and Hurley 2006; Taylor et al. 2003), could maintain the complexity of agroecological inquiry and bridge the gap from principles to practices.

Methods: Evaluation in practice

Using evaluation in agroecology research: Grazing in Wisconsin

We applied program evaluation to an ongoing agroecology research project studying the opportunities and impediments to livestock grazing on public lands managed by the Wisconsin Department of Natural Resources (WDNR). As discussed in Chapter 1 of this thesis, the grazing research project described here was initiated in 2014 with the award of a five-year USDA Hatch grant to a University of Wisconsin-Madison agroecology research group. The grant, titled, 'Understanding the opportunities and challenges of grazing public land in Wisconsin,' was proposed to investigate both public grassland management and land access issues for private livestock producers while addressing an academic knowledge gap on rotational grazing in the Upper Midwest. The agroecology emphasis of the UW-Madison research group and the public-private scope of the proposal necessitated a collaborative approach between public land managers, private graziers, and other groups to investigate the questions around grazing on

public lands. As such, building partnerships with different individuals and organizations was critical to the goals of building knowledge on grazing and grassland resources. As explained in Chapter 1, both graziers and land managers face complex challenges in implementing grazing. Grassland management with rotational grazing presents offers a potential 'win-win' in the form of affordable grassland management for land managers, increased pasture access for graziers, and a chance to improve academic knowledge.

The agroecological scope of this research project between public and private groups of different environmental and socio-economic interests presented a number of opportunities to implement program evaluation. Though the university research team attempted to address the complex array of interests by working with partners on grazing plans and shaping graduate student research questions according to those discussions, it became clear that the interests of partners extended beyond the scope of current research. Evaluation offered a way to identify the underlying logic of a 'win-win' management scenario in more detail, to document those interests and current activities of the grazing research partnership, and to measure success throughout the remaining years of the five grazing research pilot projects.

The need for evaluation: Best practices and best-case scenarios

The potential use of program evaluation in this agroecology research partnership became apparent with the implementation of five pilot grazing projects. However, because of the commitment of all involved to learning and adapting to unknown hurdles and challenges, it was not always clear what the specific details of that 'win-win' scenario might look, or whether the current practices of the projects were still on track to achieve them. The adaptive co-management framework of the partnership (discussed in Chapter 1) allowed for flexibility in the development

and implementation of pilot grazing projects and on-going dialogue about decision-making, but there was little inclusive, detailed discussion about the underlying program rationale or logic.

In other industries or fields such as business, public health, or even agronomy, literature on '*best-practices*' provides guidance for program design and assessment of progress, a standard to evaluate a new project or set of activities. However, as an interdisciplinary field, agroecology faces the challenge of breadth in its research goals, strategies, and methodologies, and a lack of established best practices. The focus on the complexity of food systems and agricultural land management in agroecology makes each research endeavor highly contextual (Bland and Bell 2007; Wezel et al. 2016), and the holistic approach to food systems research often struggles to integrate such a broad lens into applied research and agricultural field experiments (Bell et al. 2011; Wezel et al. 2009). Even in participatory, applied research projects similar in structure to the grazing partnerships, constraints around funding and expertise frequently narrow this broad lens into more traditional, reductive agronomic research (Lyon et al. 2010). With this high degree of complexity, a set of generalizable, prescriptive best practices in agroecology is likely not practical or advisable (Lyon et al. 2011). However, in a collaborative project structure, such as the ongoing Wisconsin grazing partnership, best practices could be used as a frame to define elements of project success and the activities to achieve them.

In this work, we apply techniques from a type of evaluation called a *process evaluation*, and *logic models* to illustrate the project boundaries and intended changes using best practices. A logic model is a visual depiction of change and causal links within a project or program, mapping the activities, resources, and intended outcomes (Taylor et al. 2003), and a process evaluation, most generally, is a survey of the resources, strengths, activities, and plans for a program to identify the discrepancy between what is and "what should be" (Altschuld and

Kumar 2010; Mertens and Wilson 2012). These two approaches helped to more clearly describe the current activities of the grazing project from the perspectives of the land managers and graziers involved, and to consider potential gaps between the current activities and intended outcomes of the project and the 'win-win' management scenario.

Working with project partners to develop a set of project-specific best practices could provide a set of standards to evaluate the project against at its completion: What was the use of best practices, and were they effective in achieving the 'best-case scenario' for grazing management on public lands? We used evaluation techniques to identify the project logic and theory of change underlying the partnerships, and used that more detailed definition of a 'win-win' and our project activities to begin clearly defining our outcomes, and the activities, inputs, and resources it would take to achieve that success.

To clarify, it is not the specific best practices and benchmarks developed here that will be applicable for other agroecology research partnerships, but the process of developing them and pairing them with evaluation tools that could be useful to other agroecological research projects. We plan to use evaluation and best practices in two ways. First, we use a *formative evaluation* plan to increase dialogue around project goals, current activities, and develop a set of activities and outcomes for the remaining years of the pilot grazing projects. Second, we will use those practices and program logic as a set of standards to conduct a *summative evaluation* at the end of the pilot projects, assessing the total of project activities against the best practices developed in the early project stages.

Designing evaluation

Using the concept of best practices to structure our inquiry, we drew on tools from *needs and assets evaluations* to assess the activities of the research partnership to date. This work will focus on the qualitative data collection, following up with project partners at the end of the first grazing season of pilot projects. Ecological research is ongoing and will be included in the summative evaluation of this project at the conclusion of university funding and graduate projects. Formative evaluation will mainly draw on qualitative data presented here, and will continue throughout the remainder of the university involvement in the pilot grazing projects (Table 2).

Conducting evaluation

The bulk of the findings described in this work came out of a set of group interviews and that took place in August 2016. To follow up on the broad set of site visits the *previous* summer, we interviewed graziers and land managers from the WDNR at each of five pilot grazing project sites, discussing reflections from the first season of grazing project partnerships, observations of ecological changes, and goals for future years of grazing.

We conducted semi-structured, open-ended interviews using a conversational structure. The interview topics and questions were consistent between interviews, but the wording and order was adjusted iteratively with each new site visit. The conversational structure built on the rapport that the research team had developed with the partners, and allowed the researchers to share experiences and react to the input of interviewees (Appendix 1) (Merriam and Tisdell 2015; Patton 2002). A 60 to 90-min interview was conducted at each of the five wildlife areas with the available participating graziers and land managers, with a total of five interviews with nine land managers and four graziers. Interviews were recorded, transcribed, and coded for thematic analysis (Merriam and Tisdell 2015; Mertens and Wilson 2012).

Thematic analysis and iterative grounded theory (Charmaz 2000) guided the coding process, as well and its application in the work of previous agroecology research groups (Lyon et al. 2011; 2010). Themes were generated from initial codes, and then reviewed, categorized and conceptually mapped, and consolidated (Braun and Clarke 2006; Patton 2002). The themes discussed here were included because of their frequent repetition across interviews (Ryan and Berland 2003). Identifying information has been removed and only aggregate data is presented here for participants' privacy.

Results: Defining project practices and success

Central to the discussions at each of the five interviews was the idea of *success*: defining successful grazing for wildlife and vegetation, explaining what successful public-private partnership looked like, and what barriers to success might be on a short-and long-term basis. Though the pilot projects began under the premise of exploring a 'win-win' management scenario to support grassland management and grazing land access, the view of a 'win-win' scenario has increased in complexity over the course of implementation. As the pilot projects develop, we predict that partners will continue to expand their vision on the original vegetation and wildlife goals for grazing, and as such, the project practices should be constantly examined to assess their utility for meeting those goals. Similarly, the evaluation of what activities constitute best practices in a collaborative research and land management project should in itself be a collaborative process.

This work will discuss three themes that emerged as definitions of success, and current project activities to address them: *versatile land managemen*t, *cost-effectiveness*, and *community connections and change*. These three areas of success were broken into specific examples of activities on different from the interviews and used to build a description of the program logic.

Versatile habitat and farm management

Though the ecological priorities of grazing have been at the forefront of the agroecological research partnership, the discussion about how those ecological goals will be achieved has evolved over the course of the pilot projects. Increasing diversity of native vegetation, reducing woody and invasive species, and improving open habitat and structural diversity for grassland birds were consistent ecological goals across all grazing sites. The adaptability versatility of rotational grazing was also a frequent discussion topic throughout the interviews, that cattle could access areas that were not easily reachable by mowing or impractical for controlled burning or herbicide applications. While grazing is still subject to changes in weather or personnel, the land managers explained that it is not as sensitive to timing as burning, nor does it pose the equipment challenges that mowing does. For their part, the vegetation and ecological goals of graziers still revolved around improving forage for their cattle over the course of the pilot projects, reducing shrubs and encouraging herbaceous growth and higher forage quality. Both groups expressed commitment to the learning process, looking at how the wildlife habitat changed and improved under grazing and how cattle responded to new vegetation conditions.

Cost-effectiveness

The emphasis on the cost-effectiveness of grazing management increased substantially from the initial site visits to the first grazing season. Though for the most part the WDNR personnel did not feel the grazing partnerships needed to generate income for the agency through rental fees, there was significant discussion around the ‘savings’ of grazing as a management tool. Reducing agency inputs, including time, personnel, herbicides and equipment rentals were

at the forefront of WDNR justifications for the grazing partnership. Balancing these savings with the cost of upfront investment and installation of fencing, water, and signage meant that land managers frequently clarified that grazing was not necessarily a money-making management scheme, but a money-saving one. As discussed in Chapter 1 of this thesis work, graziers maintained that the partnership had to continue to be safe and profitable for their businesses. Cattle for the most part seemed to be achieving their target weight gains on the forage available, but grazier interest and investment of time for checking equipment and rotating the herds was, unsurprisingly, contingent on the health and safety of their cattle.

Both land managers and graziers expressed commitment to learning and interest in innovation and ongoing improvements to make the partnership more cost-effective. Graziers suggested mowing and haying in combination with grazing wherever possible to encourage herbaceous vegetation. There was frequent discussion and speculation about trials with multi-species grazing, using combinations of goats, cattle, horses, or sheep to target different vegetation issues. Both groups also expressed the possibility of subleasing grazing contracts to increase stocking densities on sites where cattle were not damaging shrub species and get other graziers involved on the landscape.

Community connection and change

The third and perhaps most surprising theme to emerge from discussions around successful management was a social one: using grazing management and research partnerships as a way for both graziers and land managers to connect with their communities and positively change public perceptions. From the land managers' standpoint, grazing was a way to change public opinion of the WDNR as 'rule-enforcers,' out-of-touch with the needs and interests of production and conservation in the community. They explained that grazing demonstrated active

management on the landscape, as a way to build trust and interest in conservation with the agricultural community who otherwise see public access grasslands as ‘wastelands.’ Graziers explained that the partnership could be a way to increase public knowledge and support about rotational grazing, moving away from the perception of all grazing as continuous overgrazing with negative ecological impacts. Some even saw the partnership as a way to add value to products, building conservation and the history of grassland grazing into their branding of beef and dairy products.

On a statewide and long-term scale, land managers explained that grazing partnerships could be a way to increase support for grasslands culturally, building interest within the agency and across both private and public lands. While both groups mentioned the opportunity of resting private pasture during periods of grazing on public land, some land managers suggested that these partnerships could be a way to encourage stewardship at home. They expressed hope that taking parcels of private land out of grazing rotation could benefit patch-sensitive wildlife, specifically grassland birds that could use the growth of home pasture as surrogate grassland, ultimately building improved wildlife corridors on a regional scale. They hoped to build interest in grasslands enough to justify agency positions for grassland ecologists and grazing specialists, to further build the knowledge and application of new management techniques in the upper Midwest. Land managers seemed to consider a partnership with the university and private graziers as a step toward more innovative practices by the agency in general, a way to shift institutional momentum away from traditional practices and more toward multifunctional land use and conservation.

Discussion

Through the process of defining project success for land managers and graziers, we found gaps between our current practices and the proposed 'best practices,' and developed a more complex definition of project success across both statewide and local, site-specific spatial scales. This process provided an opportunity to revisit the design and activities of the agroecological research partnership, examine the focus and activities, and develop new best practices or project activities believed necessary to achieving different kinds of success. Through the process of developing a program logic and using logic models to visualize the activities of the project, we elucidated gaps between current project activities and idealized ones to discuss with project partners.

It is important to note that the discussion here takes a researcher perspective, and focuses on researcher activities that could be altered or adapted to better support best practices. The next steps for implementing the evaluation plan will require collaborative input from the other agency personnel and graziers involved in the project to validate, modify, or reject these proposed practices and our assessment of the program logic (see Appendix 2), and to discuss their implementation for the remainder of the project (Mertens and Wilson 2012). This process of assessing project practices again is what separates evaluation from research: making collaborative judgments on what is good and important for this project to encourage thoughtful, systematic action going forward (Scriven 1998; Patton 2002). We address each kind of success at small- and large-scale, short- and long-term (Table 3).

We recognize that our suggested best practices will be limited in their implementation by constraints on funding, time, and expertise, so in the spirit of the evaluation standards of feasibility and utility, we prioritize two *research* areas and two *outreach* areas for practices that we believe could more effectively help projects attain successful outcomes.

Best practices for versatile land management: Graduate research

Because graduate research projects were developed from the initial dialogue and interests that land managers discussed with the research team, the research is largely investigating the biophysical features that define success: reducing woody shrubs or invasive species, increasing plant community diversity, and how grassland bird species are utilizing different management types. Though graduate work is largely focused on sampling common or dominant plant species, the presence of native species and diversity are features of the research. Some graziers voiced concerns that university research needs for grazing might not fit their plans for rotation in coming years, so ongoing communication and compromise about the timing of grazing to fit research design is critical.

On a statewide scale, constrained resources and challenging design may limit the ability of researchers to monitor large scale, patch-sensitive wildlife and plant community changes related to the grazing projects. However, remote sensing could offer some options to examine land cover change, and monitoring wildlife on private farms that rest their pastures as surrogate grassland could provide insights to wildlife corridors and plant community change on a large scale with grazing partnerships. These or other research projects could provide a set of best practices to achieve these larger, longer definitions of successful outcomes.

Best practices to address cost-effectiveness: Budgeting and brokering

Though research funding and agency funding provided the means for the initial establishment of pilot projects, to truly compare the costs of grazing public lands to other on-farm or land management practices, project practices should incorporate cost-benefit and budgeting analyses. While current graduate research has surveyed graziers statewide on

economic variables in decision-making and renting public land, there is currently no formal assessment of the labor, inputs, time associated with the five pilot grazing projects. Graduate research or an agency initiative could assess the labor and budget documentation alongside the grazing contracts between graziers and land managers.

If grazing proves to be an effective ecological management tool at the five pilot projects based on biophysical monitoring, we should investigate potential partnerships with organizations that deal with grazing brokering. As discussed in Chapter 1, the numerous trade-offs and challenges of establishing fair grazing contracts could be difficult on a larger scale when each site has such specific biological and logistical opportunities or barriers. Broadening the project partnerships to grazing organizations and brokering groups could provide support and expertise to making grazing partnerships as cost-effective as possible. This process of outreach to increase information and support could allow the successful implementation of cost-effective grazing on a statewide scale, beyond the initial five pilot projects.

Best practices for community connection: Public perception and outreach

While initial project practices used the partnerships with private graziers and informal interactions with public land users to assess the social impacts of grazing on public land, the statewide, longer-term impacts of changing perceptions of the WDNR and agricultural community are not currently being assessed by research practices. Current project activities and practices have been relatively small scale, conducting internal communication on monthly conference calls, producing a project website, and soliciting feedback through presentations at professional and institutional meetings. Though those internal and institutional practices have made some connections with a broader community outside the grazing pilot projects and

research monitoring, to successfully change public perception we recommend involving the public.

Current project efforts to involve the public have included site-specific signage where land managers and graziers offer their contact information for public land users with questions or concerns, and the partners are currently developing larger, interpretive, informational signs about the historical and ecological background of grazing. Some land managers and graziers have already used press releases and public pasture walks to include other community members, and the research team has discussed different venues for publication beyond peer reviewed journals to include extension bulletins, blog posts, or popular press. However, implementing best practices for social change may require more significant outreach events, advertised public meetings, surveys, and listening sessions. We recommend soliciting feedback more formally from groups of public land users such as hunters or bird watchers to consider a full range of stakeholder interests, perceptions, and concerns, and if the grazing partnerships are heading toward successful changes in community connections.

Next steps: Measuring best practices and meta-evaluation

The formative evaluation process described in this work will lay the groundwork for a summative evaluation plan at the end of the pilot grazing projects and university-funded research monitoring. Using the collaborative process to build on the definitions of success and understanding of current project partnerships, we will present these recommendations of best practices to our partners, and discuss our program logic and evaluation metrics to assess them. We plan to use mixed methods to analyze both qualitative data from interviews and outreach events alongside quantitative evidence, such as ecological and economic data from graduate research, and ongoing documentation of activities or events such as meetings attended,

publications produced, calls received from the public. The research team can provide some of this information, but will require additional resources and buy-in from all project partners.

Additionally, even through this evaluation process, we need to acknowledge that successes defined for each of the partners in the pilot projects may or may not be achieved because of best practices. Evaluation can also provide the tools to analyze contextual factors, barriers, even meta-evaluation (assessment of quality of the evaluation process itself) (Stufflebeam and Coryn 2014), there may be other, unanticipated venues achieve successful implementation of grazing on public lands that do not include best practices. Throughout the evaluation and research process we must recognize the limitations of funding, personnel, time, knowledge, changing political milieu, institutional momentum, and other resources that could get in the way of a successful implementation. We must simultaneously consider the weaknesses, skills, and positioning of the evaluators, operating internally from the university research team. However, we argue that the process of defining and describing successful outcomes, the best-case scenario of a 'win-win,' and developing activities to achieve those successes, will be invaluable to our project and others attempting to bridge the gap between agroecological research and practice.

Conclusions: Evaluation in collaborative agroecology research

Applications of program evaluation have been investigated extensively in public education, medicine, and even in cooperative extension, but have only begun to move into interdisciplinary research. In agroecology, evaluation presents a novel approach to address the complexity of food systems research and map the activities and outcomes of interconnected, multifaceted investigations, provides tools for project design and to define boundaries and assess

change. In such systems research with multiple partners and stakeholders, encouraging input and participation wherever useful and feasible is critical. As Urban and Trochim (2009) note:

> …evaluation planning should encompass the engagement of stakeholders, the development of a comprehensive model of what they think they are engaged in, and the articulation of a plan for evaluation that assesses the degree to which what they expected is what they observed and include contingencies for the unanticipated. Such evaluation planning is at the heart of efforts to integrate or connect the domains of practice and research (551).

Though the specific best practices of research areas and outcomes developed with graziers and land managers for this project will not necessarily be generalizable knowledge in agroecology, the process of qualitative investigation and application of evaluation tools could be useful in designing and implementing other applied, participatory, interdisciplinary research projects. As multifunctional land use and shared resource management becomes more common in agriculture, measuring impacts beyond the immediate project will become increasingly critical. Evaluation provides the framework to monitor of all of these complex goals and outcomes, using tools like needs and assets assessment, developing program theory and logic models, stakeholder engagement and communication techniques, and ultimately, 'evaluative reasoning' to make recommendations and judgments for action. With evaluation, agroecology can make the transition from principles to practices, maintaining complexity and inclusivity in the research we produce for a more beneficent agriculture.

Chapter 2 Tables and Figures:

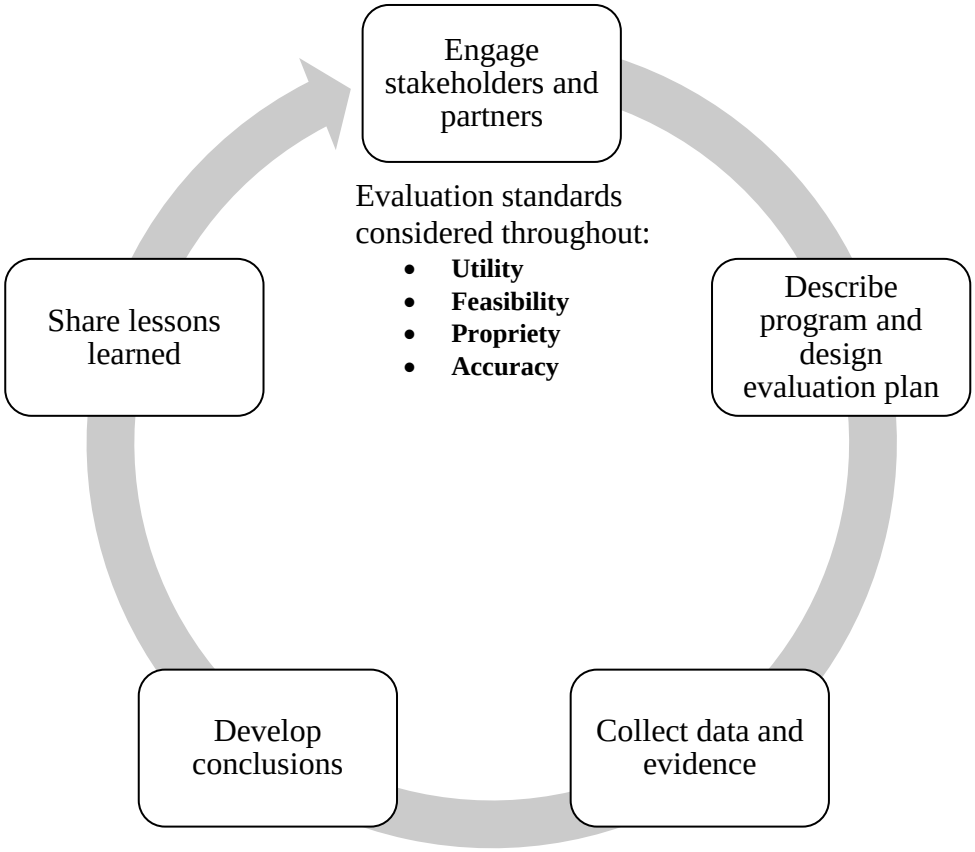

Figure 1: Framework for evaluation implementation and definitions of the four categories for evaluation standards for judging the quality of evaluation. Framework adapted and modified from Longest (2015, p. 319) and from the Centers for Disease Control and Prevention, Program Performance and Evaluation Office. Retrieved from www.cdc.gov/eval/framework.index

Table 1. Summary of agroecology and evaluation principles that guide design, inquiry, and scope.

Agroecology principles	Evaluation principles
• Empowering and participatory in scope, inclusive of local knowledge	• Emphasizes inclusivity, relevance and **utility** for stakeholders
• Contextually-focused to local environments, particular farm and food systems factors	• Integration of political, organizational, and contextual information, emphasis on **accuracy**
• Managing whole systems with holistic lens, considering both socioeconomic and biophysical influences	• Systems- and theory-based, exploring causal linkages between activities and outcomes
• Development of long-term strategies for inquiry and sustainability	• Focused on **feasibility** and applicability, cyclical implementation
• Diversity-focused (biological and social)	• Respect for diversity, **propriety** in values and interests
• Increasing emphasis on reflexivity	• *Meta-evaluation*, and reflection on the evaluator influences in investigation

Table adapted and modified from Mendez et al. 2013; Bacon et al. 2005. Evaluation principles synthesized from Mertens and Wilson; AEA 2004.

Table 2. Formative and summative evaluation questions for the Wisconsin grazing research project.

Evaluation questions	Supplemental questions
Formative questions:	
• What are best practices for this agroecological research partnership?	• How will they be monitored and assessed? • Are they useful? • What is the relevant literature?
• What is the gap between current project practices and best practices?	• What are current project practices? • What areas of interests aren't being addressed? • What are the barriers to implementing best practices?
Summative questions:	
• Did the research partnership use best practices? Did it matter?	• What were the driving activities of the project? • What was successful? What could be improved? • What could other groups adopt from our project process or findings?

Table 3. Summary of definitions of success for pilot grazing project partnerships, on both large and small scales. Knowledge increases from academic research and practitioner experiences are implicitly included in every category listed.

Defining success	**Site-specific, short-term success**	**State-wide, long term success**
Versatile habitat management ***Ecological***	• Shrub reduction • Increasing plant diversity • Increasing grassland bird usage	• Improving state grassland landscape for patch-sensitive wildlife on public and private lands
Cost-effective partnerships ***Economic***	• Reduction of chemical and mechanical inputs, labor, time • Affordable land access • Cattle health and weight gains	• Income from pasture rental • Labor and personnel savings • Increasing grazing land access • Increased brokering of partnerships with up-to-date inventory of public land, interested graziers
Community connections and change ***Social***	• Partnering with the agricultural community • Increasing conservation buy-in from farming and hunting communities • Changing perceptions of 'wasted lands'	• 'Paradigm shift' for more interest and support for grassland habitat • Changing perceptions of WDNR as an agency • Changing scope of possibilities for alternative land management

Appendix 1: Interview guide for group interviews (August 2016)

Format: Semi-structured open-ended conversational interviews. This interview guide is not an exact script. The interviewer will plan to cover all specified topics and issues in the following outline form, but will respond to the situational cues and questions of the group. Bold questions were consistently asked in each interview, regular text are follow-up or probing questions.

Current project practices:

Roles:

- **How would you describe this project to someone outside grazing or the DNR?**
- How would you describe your role in the project?
- How would you change the roles in the partnership?
    - If you had infinite time or resources?

Practices:

- **What things do you feel have gone well so far with the project? Where do you see impacts?**
    - Ecological changes?
    - Communication and teaching? Outreach?
    - Cattle health and gains? Numbers?
- **What things have been frustrating so far in the project?**
    - Communication?
    - Organization?
    - Infrastructure issues?
    - Ecological changes?
    - Interactions with the public?
- **What are your biggest concerns associated with the project?**
- **What do you see as the risks?**
    - What are we doing to prevent and overcome them?
- **What additional support or resources do you wish you had? How would you reallocate work and tasks?**
- What do you consider to have been the most important moments so far in the project? What were the big decisions or changes to what you originally imagined?

Best Practices:

Goals and future assessment:

- **What does success look like for this project?**
    - Ecologically? Economically? Socially? Organizationally?
- What knowledge do you hope to gain?
- If the project is successful in this way, what advice would you give to others attempting this kind of partnership?
    - How would you convey that advice?

    - Published papers? Workshops?

Gap between now and project goals:

- **What changes should be made in the organization of the project in the coming years? Priorities? Efficiency?**
- What changes should be made in the ecological priorities of the project?
- How would you improve our environmental stewardship?
- What changes could be made in the social priorities of the partnership?
    - How would like to you share information between partners?
    - How would you prefer to communicate and make decisions?
    - How do you see our role and responsibility to the public?
- **What additional questions would you like to be addressed in this partnership (or others) in the coming years?**

Do you have any questions for me?
Thank you for your time!
[Remind subjects about audio recording and contact information]

Additional background (if necessary):

Discuss experiences with…

Grazing as a land management tool:

- When and how did you learn about rotational grazing?
- What education did you have on the subject?
- How did you decide to start implementing it?
- Where are you learning / getting your information now?

Site management:

- What made you consider this site for rotational grazing management?
- What is the history of this site?
    - When and how was it acquired by the state?
    - How was it previously managed?
    - What is the soil type/drainage like?
    - What are its primary uses?
    - Who uses it? What interaction do you have with the public surrounding it?
- What made it appealing for cattle?
- What vegetation species do you hope to manage or reduce? Which do you want to increase? Wildlife priorities?
- What are your long-term conservation goals for the site?

Appendix 2: Logic model for WI grazing program activities and definitions of success

The model below was developed to depict the relationships between described program activities and definitions of success for grazing public lands. The left-hand side of the document lists project outcomes according to definitions of success across on the long-term, state-wide scale and short-term, site-specific scale. The right-hand side of the figure lists the inputs, activities, and outputs occurring in the current project structure. Vertical columns express activities, outcomes, and outputs occurring across all categories of success. Assumptions and contextual factors are listed at the bottom of the model.

----------*Project goals*---------- 2015 ----------*Project timeline*---------- 2019

Defining success for grazing public lands	**Large scale, long term outcomes**	**Midterm outcomes**	**Small scale, short term outcomes**	**Inputs**	**Activities**				**Outputs**
Versatile land management *Ecological*	• Improving state grassland landscape for patch sensitive wildlife	Knowledge gains on rotational grazing as a management tool across all areas of success	• Shrub reduction • Increasing plant diversity • Increasing grassland bird usage	• Experimental design and monitoring plans • Research funding	Graduate student research projects	Grazing pilot projects	Project evaluation occurs across areas of success	Ecological monitoring	Publications Presentations and workshops Press releases Example grazing contracts and plans
Cost effectiveness *Economic*	• Income from pasture rental • Labor and personnel savings • Increasing grazing land access • Maintaining inventory of grazeable lands, interested graziers for brokering		• Reduction of chemical and mechanical inputs, labor • Affordable land access • Cattle health and weight gains	• Funding and infrastructure • Labor and personnel • Grazing plans and contracts				Budgeting, internal reporting, and other documentation	
Community connectedness *Social*	• 'Paradigm shift' for more interest and support for grassland habitat • Changing perceptions of DNR as an agency • Changing scope of possibilities for alternative land management		• Partnering with the agricultural community • Increasing conservation buy-in • Changing perceptions of 'wasted lands'	• Signage at each pilot site • Partnership communication plans				Ongoing communication including meetings, pasture walks and conference calls	
Assumptions: The shared goal of a 'win-win' scenario for grazing public lands									
Context: Constraints on graziers (land access), public land managers (funding, personnel, management), and university researchers (agroecological knowledge on applications of rotational grazing and public-private partnerships) brought together these groups into a partnership to explore grazing as a land management tool.									

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