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# Ranchers: perceptions of vegetation heterogeneity in the Northern Great Plains

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# Ranchers' Perceptions of Vegetation Heterogeneity in the Northern Great Plains

Maggi Sliwinski, Mark Burbach, Larkin Powell, and Walter Schacht

**ABSTRACT**—Most rangelands in the United States are privately owned and managed for beef production. There is little understanding of ranchers' perceptions about heterogeneity or tools that can be used to increase heterogeneity, such as fire and grazing, even though heterogeneity is crucial for biodiversity conservation. To guide conservationists as they engage with ranchers, we conducted interviews with 12 ranchers in three states to provide a description of ranchers' worldviews as they relate to heterogeneity and disturbances that maintain heterogeneity in rangeland ecosystems. Ranchers expressed a desire to maintain control over their operations by reducing risks and being careful in selecting trusted advisors. Further, ranchers associated some heterogeneity characteristics (e.g., bare ground) with outcomes of poor management, which is problematic for efforts that aim to increase heterogeneity in rangelands. Ranchers value seeing results of new management methods on university experiment stations or neighbors' lands, which may provide a roadmap for conservation planners and NGOs to introduce heterogeneity management strategies to ranchers.

**Key Words:** beef production, private land conservation, qualitative research, ranching, rangeland, vegetation heterogeneity, wildlife conservation

## Introduction

Rangeland biodiversity is declining as a result of both loss and degradation of habitat (Brennan and Kuvlesky 2005; Neilly et al. 2016). Rangelands are largely privately owned (76% of the northern Great Plains) and managed for beef production (Samson and Knopf 1994). Thus, ranchers are key to restoring and sustaining biodiversity in rangeland ecosystems (Neilly et al. 2016).

Beef production and wildlife conservation are not mutually exclusive (Krausman et al. 2009), but there are impediments to using livestock to manage for wildlife habitat on private land. Increased grazing capacity and livestock production on grazing land is typically achieved by increasing grazing efficiency (i.e., percentage consumption of the available forage) through improved grazing distribution (Fuhlendorf and Engle 2001; With et al. 2008). Improving grazing efficiency was the primary purpose of rangeland incentive and investment

programs of the Natural Resources Conservation Service (NRCS) since 2004 (Toombs and Roberts 2009). Grazing efficiency and grazing distribution have been improved through these programs by creating smaller pastures with fencing, establishing more livestock water points, and implementing rotational grazing strategies. Improving grazing efficiency across the Great Plains leads to structurally homogenous rangelands that limit plant and animal biodiversity (Toombs et al. 2010; Becerra et al. 2013). Loss of heterogeneity is problematic because biodiversity (Fig. 1) is dependent on structural heterogeneity (MacArthur and MacArthur 1961; Hovick et al. 2014). Furthermore, biodiversity management is typically not considered in ranch management decisions (Knight et al. 2011). The lack of consideration of biodiversity in rangeland management was recently highlighted by a study that revealed temperate rangelands have the least intact biodiversity of any habitat type in the world compared to historical conditions (Newbold et al. 2016).

Some range scientists are calling for a paradigm shift away from managing for grazing efficiency to manag-

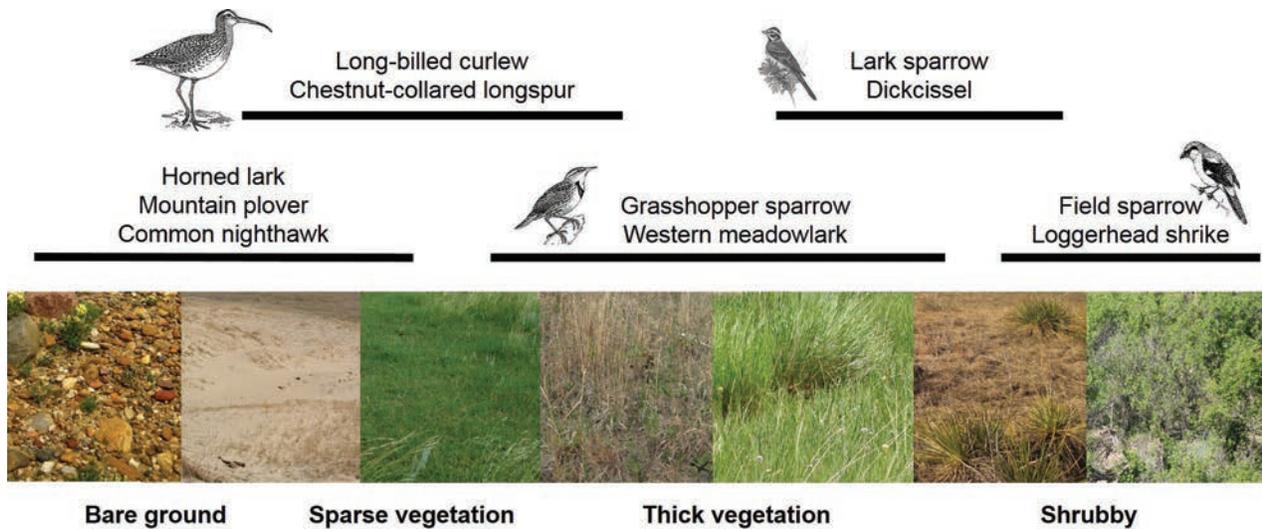


Figure 1. To demonstrate the relevance of heterogeneity to biodiversity, we have highlighted the habitat requirements of different bird species found in the northern Great Plains. A diverse bird community in the northern Great Plains requires a variety of habitats, from bare ground to shrubby areas. For example, common nighthawks (*Chordeiles minor*) nest on rocky and bare ground surfaces, grasshopper sparrows (*Ammodramus savannarum*) nest in moderately thick grassy habitats, and loggerhead shrikes (*Lanius ludovicianus*) require shrubby habitats. To have each of these species, and thus high biodiversity, each of these different habitat types is required, and if each habitat type is present the area would have habitat heterogeneity.

ing rangeland ecosystems for structural heterogeneity at larger scales (Fuhlendorf et al. 2012; Freese et al. 2014). Various methods of restoring rangeland heterogeneity have been promoted in the literature, such as patch-burn grazing (Fuhlendorf et al. 2009; Toombs et al. 2010; Johnson et al. 2011). However, private ranchers and agencies that assist them have been slow to adopt range scientists' recommendations that would lead to heterogeneity (Toombs and Roberts 2009; Becerra et al. 2017). Even though the human dimension of grazing management is as important as the ecological dimension (Briske et al. 2011), there is a knowledge gap concerning ranchers' perceptions of rangeland heterogeneity on a landscape scale. Scientists should explore relevant issues with the study population before doing intensive explanatory quantitative studies. Thus, the purpose of this study was to explore ranchers' worldviews as they related to vegetation heterogeneity and tools used to create it in relation to wildlife habitat in the northern Great Plains.

## Methods

To meet the purpose of this study, a qualitative, naturalistic approach was used, which involved in-depth interviews that resulted in rich and contextual qualita-

tive data. This strategy is useful because it allows participants to talk both broadly and deeply about topics related to vegetation heterogeneity, and allows the researcher to explore and clarify topics that arise during the interview (Marshall and Rossman 2010). Qualitative data are particularly well suited for developing a deeper understanding of ranchers' experiences (Marshall and Rossman 2010) and thus fit the purpose of this research. Patton (2015) and Merriam and Tisdell (2016) contend that the findings of qualitative inquiry can offer guidance in making future decisions. Patton (2015) argued that these reasonable extrapolations "are modest speculation on the likely applicability of findings to other situations under similar conditions. Extrapolations are logical, thoughtful, case-derived, and problem oriented rather than statistical and probabilistic" (713). This study explored ranchers' opinions (1) of various types of habitat that are required by different species of wildlife, such as bare ground and denser grass or shrubby areas, and (2) about ways these habitats can be created, such as through grazing, fire, and burrowing mammals.

This research involved human participants. The University of Nebraska–Lincoln Institutional Review Board certified this research project as Exempt Category 2 prior to its completion, under IRB number 20141114643 EX project ID 14643. Informed consent was obtained from participants prior to completing the research interviews.

### *Participant Characteristics*

Interviews for this study were completed in the western semiarid rangeland regions of Nebraska, South Dakota, and North Dakota. We focused on the western regions in each of these states because these are areas of largely intact rangeland that are used primarily for ranching. To identify ranchers for this study in Nebraska, key informants from the University of Nebraska Extension Service were asked for contact information of ranchers who might be willing to participate. In South Dakota, an NRCS agent and members of the South Dakota Grasslands Coalition provided contact information of ranchers. In North Dakota, mentors from the North Dakota Grazing Lands Coalition, who are ranchers, participated in interviews.

Eighteen individuals were contacted for interviews and 15 responded positively to the request; however, only 11 interviews were completed with 12 individuals (one interview was with a husband-wife team): four in North Dakota, four in South Dakota, and three in Nebraska. Two interviews were not completed because we could not find a common time, and two others were not completed because the individuals did not ranch in the study area. Beef production was each participant's primary source of income, and all but one were commercial cow-calf operations. Three of the ranchers also had secondary jobs and three of the operations included custom grazing. The participating ranchers were predominantly men between the ages of 30 and 70, which is comparable to rancher characteristics from the USDA Census of Agriculture (United States Department of Agriculture 2015). Grazing strategies used varied among the different ranches, and included short-duration grazing (SDG), season-long, continuous grazing, and deferred rotation grazing.

### *Data Collection*

Ranchers were interviewed using a semi-structured, open-ended interview guide and clarification and probing questions were used to prompt elaboration on matters raised by participants or on topics that had not been previously considered by the researchers. Each interview lasted approximately one hour and was completed at a location of the participant's choosing. The interviews were audio-recorded and transcribed verbatim. When participants no longer revealed new

insights, we assumed our pool had reached saturation and concluded the interview process.

During the interviews, the key concept of interest was landscape heterogeneity, although this term was not directly used because heterogeneity can have different meanings to different people. Instead, images of rangelands and management schemes were used to help ranchers visualize the landscape and management scenarios and aid in consistent interpretation of the scenarios. In the context of this research, heterogeneity is the existence of patches with different habitat structures (e.g., an area with bare ground next to an area with taller, dense grass) in a given area of interest (Addicott et al. 1987), and a figure similar to Figure 1 was shown to producers to help explain this concept. Further, the importance of large patches of habitat was emphasized because most animals have minimum area requirements (Noss 1983). This type of heterogeneity is important for biodiversity in the Great Plains because the evolution of species in the region was tied to the dynamic nature of the grassland ecosystem, where ecological drivers such as burning, grazing, burrowing animals, and drought interacted over space and time to create a highly heterogeneous environment. Thus, some species require bare ground whereas others require taller, denser grass structure (Fig. 1).

### *Analysis*

A thematic analysis was used to interpret the interview responses (Marshall and Rossman 2010). First, the interview transcripts were read to familiarize ourselves with the data and note commonalities or disparities among ranchers. Next, each transcript was coded using in vivo codes with the aid of MaxQDA analysis software (VERBI Software 2014). After coding was completed, an iterative process was used to collapse codes into overarching themes. The themes were related to this study's central phenomenon of ranch management for vegetation heterogeneity.

### *Rigor*

To improve the reliability and broaden the scope of this research, we maximized the diversity of perspectives (Marshall and Rossman 2010) by including participants from three different states and varying backgrounds. Because only one of the researchers completed the cod-

ing process, the thematic analysis was completed twice six months apart and reviewed both times by an external reviewer to ensure that there was consistency in the interpretation of the data.

Member checking was used to ensure the findings were valid. To complete member checking, we mailed copies of the initial findings to participants and asked them to report errors in our interpretation of their responses or the use of supporting quotes, experiences, and perceptions. None of the participants requested any changes to the findings. Finally, an expert review was completed by two experts in qualitative research methods to assess the reliability of the findings. The experts concurred that the findings, interpretations, and conclusions were supported by the data.

## Findings

The 11 interviews resulted in 141 pages of single-spaced textual data. Through a thematic analysis of the interviews, seven themes emerged relating to ranchers' views of vegetation heterogeneity, biodiversity, and ranch management. Each of these themes is described below.

### *Theme 1: Maintain Control by Reducing Risk and Increasing Flexibility*

Ranchers deal with uncontrollable dynamics, such as swings in the weather and changing markets. Thus, it was important for the ranchers interviewed to use management strategies that would ensure ranch survival into the next year. Ranchers often maintained control by reducing risk and increasing flexibility.

### MAKING A LIVING

All ranchers discussed the importance of ensuring that they could make a living from ranching, and they could only do so if their operation was prosperous. One rancher said, "I am still looking out trying to make sure I am going to have enough to eat next year and five years from now. . . . It's been my family's way of staying alive for 130 years." However, some ranchers lamented that the promise of fast money seemed to encourage overgrazing and converting rangeland to cropland. With high cattle prices, one rancher complained that a lot of people were overgrazing. Another spoke about how his

county used to be half cropland and half pasture, but now there was more than twice as much cropland as pasture, and he blamed this change on the high price of corn. Even so, the participants agreed that "we're all driven financially."

Some of the ranchers interviewed were using incentive programs to help them maintain their income while also managing for conservation objectives. When asked what might encourage a rancher to engage in conservation activities, one participant said, "Benefits. Usually that means either on the ground or, quite frankly, cash. The Great Plains Project, when I started dividing my pastures, paid for 75% of the fencing." Another said, "I'm sure you dangle the monetary carrot in front of ranchers, they'd be willing. Money will make most people do anything." Thus, even though the promise of money can cause some ranchers to engage in practices that are bad for wildlife, it can also be wielded by conservation agencies for the good of wildlife by helping ensure ranchers can make a living.

Finally, one rancher mentioned that ranchers generally have more freedom to try different things than their parents did, because they face fewer financial pressures. He said, "My dad, he didn't *want* to abuse the land, but he needed to make it work." He talked about the fact that much of the land, cattle, and equipment are paid off, allowing ranchers today to be more considerate of nonproduction outcomes. Further, ranchers now have safety nets from the government that were only available to crop producers in the past. These factors take some of the pressure off ranchers when trying to make a living.

### MANAGING FOR THE WEATHER

The weather weighs heavily on the minds of ranchers as an unpredictable factor that still needs to be managed: "Grasslands are awful tough to deal with because of drought and weather. I used [my] irrigated land to change that variability." Many of the ranchers mentioned managing in a way that protected them from drought specifically: "[Ungrazed areas] leave us some forage and protection for the next year even in a drought when we don't get good growth." One rancher reported trouble on neighboring land: "One pasture was overgrazed last year, but we've had quite a wet year, and the individual has gotten by with it. But if we wouldn't have gotten the rain, he was looking at selling a third of his livestock." Interviewed ranchers believed those who did

not manage for drought are apt to be living paycheck to paycheck, a situation that can be avoided with proper management.

#### HISTORY OF WHAT WORKS

Many ranchers had a reluctance to change because “the easiest way to lose your shirt is doing something different than grandpa did.” A change in management is a risk when there is a long history of successful management strategies that still work. One rancher stated, “If you want to be rich, don’t ever experiment. You see what somebody else does, what works.” Thus, by continuing to do what worked in the past and only what worked for others, the ranchers maintained control and reduced risk in their operations. However, there also was recognition of *why* something is done a certain way: “I think sometimes, in our field, it’s very easy for people to get stuck in a rut of, well, we’ve always grazed the south pastures in July because Grandpa did, and we don’t have a reason why.” Understanding why management was done in a certain way may facilitate change if the rancher recognizes that the circumstances have changed.

#### CHANGE IS SLOW

One rancher explained how it took him 20 years of observing, learning, and making incremental changes before he fully bought into different approaches, such as short-duration grazing. Another said, “Change happens one generation at a time, one funeral at a time.” The threat of going broke can help to speed up change. When asked why he had decided to change his management style in the past, one rancher responded, “I was about to go broke.” Another rancher said, “Not being profitable speeds up change pretty quick.” Thus, although change was often slow and difficult for ranchers, there were times when change was necessary. Change was often associated with maintaining control and ensuring that the family would continue to be supported by the ranch.

#### *Theme 2: Wildlife Is Not Our Focus*

Many of the ranchers appreciated wildlife on their land, and felt that their management strategy supported

wildlife; however, they clearly stated that wildlife was not their focus. For instance, one rancher said, “Making sure I can still afford to pay the taxes is way more valuable to me than making sure the mountain plover has habitat.” Some ranchers were not concerned about managing habitat for wildlife because they did not believe rangeland wildlife could ever be completely lost.

Prairie dogs were a particularly controversial subject for ranchers because of the view that prairie dogs degrade areas and compete with cattle for forage (Lybecker et al. 2002). One rancher said, “They’re more of a nuisance than anything else. . . . Once they’re established, that resource is essentially destroyed for anything other than a prairie dog town or wildlife habitat.” Some ranchers even stated that prairie dogs were bad from an ecosystem standpoint, while at the same time expressing an understanding that they are part of the native ecosystem. The reason underlying this view of prairie dogs likely relates back to the first theme, with ranchers wanting to control their resource: prairie dogs can be controlled. One rancher said, “I don’t care what kind of program there is, prairie dogs need not be involved in ranching. They get out of control too quick.” Conversely, one rancher joked that if he could have a shooting range for prairie dogs, and make money off them, he might be more willing to host a prairie dog town on his land.

These negative sentiments for prairie dogs were also expressed in discussions about wildlife that require more bare-ground habitat, like mountain plovers (*Charadrius montanus*) or burrowing owls (*Athene cunicularia*). One rancher said, “I’ll be very honest with you, I have not given much thought to those species that require bare ground,” while another expressed that he was fine with birds that require denser vegetation thriving more than birds needing bare ground and short vegetation.

Although wildlife is not the focus for ranchers, several ranchers included native diversity as a management goal: “I see multitude of species, both plants, animals, and insects, as the benchmark or template of what we should be using in production agriculture.” Another rancher said, “I think diversity and balance is very important. I’m a firm believer in the importance of diversity because we lost our diversity.”

#### *Theme 3: The Miracle of Animal Impact*

Most animal impact is a result of domesticated livestock. These livestock have the same general impacts

as bison, which provided most of the animal impact prior to European settlement: consumption of forage, trampling of vegetation, and the deposition of dung and urine. All the interviewed ranchers held strong beliefs in the importance of livestock for the health of rangelands, and some spoke of the importance of animal impact and how the benefits from grazing livestock were like a miracle. One said, “As far as the grass that comes, the weed suppression, what it does for the trees, I mean it’s unbelievable. And it’s all animal impact.” Many of the ranchers also described their management as recreating what the bison had done for millennia, with quick heavy impact on the vegetation and then long periods of rest. One rancher said, “That’s exactly what all of us are trying to do, mimic nature. Just much smaller scale.”

Prior to settlement of the Great Plains, bison movements were strongly associated with fire (Biondini et al. 1999). However, fire was not part of the management strategy of any of the ranchers interviewed. Ranchers mostly agreed that fire was a “tool in their toolbox” but that they had no interest in using it because they believed it reduced rangeland productivity and forage availability. For instance, one rancher said, “I don’t ever want to burn a pasture that I can graze. If I can stomp the material into the ground it makes more sense than it does to burn it off.” Grazing by livestock was the principal tool for rangeland management by ranchers interviewed, especially because ranchers viewed fire as unsafe and unable to provide any benefits that were different from grazing. One rancher explained how fragmentation in his area due to urbanization made the use of fire impossible, even though he thought it could be beneficial. Another rancher said, “I can string up an electric fence a whole lot faster than I can put a fire out.” Other ranchers were concerned with smoke from fires causing problems for neighbors and communities. Thus, livestock grazing was easier to manage than fire, safer than fire as a management tool, and more effective than fire. One rancher said, “In this part of the world, that [residual dead vegetation] can be maintained for years if it isn’t broken up by something. Once it falls over, it can’t be broken up by anything but hooves.”

#### *Theme 4: Managing to the Middle*

Participants were asked about the different types of habitat that are required by the spectrum of bird species that exist in the Great Plains. Most of the participants

thought there was a lot of habitat variability across the landscape, sometimes because of management and sometimes because of abiotic factors. For example, one rancher described some spots in his pasture that were unable to support any grass: “We have bentonite clay pan areas that pretty much stay bare. They used to be bigger areas that were bare; now we shrunk them way down.” This rancher managed to reduce bare areas, thus potentially reducing habitat heterogeneity.

For ranchers, “managing to the middle” was a product of managing their risk. Ranchers did not want to risk soil erosion by grazing too heavily, and they also did not want to let too much grass remain unused because it is considered wasteful and increases the risk of wildfires. Further, they wanted to be able to maintain operations through droughts. One rancher said, “I think cover is the key to a lot of this. . . . You have to keep the soil covered, you have to keep your rangeland covered.” Most ranchers did not want bare ground because it would negatively impact long-term beef production. However, because of logistics, some ranches have an area that is consistently overused: “I have a calving area and just dedicated that to destroy that piece of land.” If many ranchers have a dedicated calving pasture, there is possibly habitat at the bare-ground end of the spectrum across the landscape, which is necessary for wildlife diversity.

Most of the ranchers interviewed were strongly opposed to increasing bare ground on purpose: “You’re going to have a real difficult time convincing most holistically minded ranchers that they should have bare ground. That, for one thing, is just so devastating to the soil ecosystem.” Some of the ranchers had worked very hard to move their operations away from having a lot of bare ground and stated that it was a constant battle to ensure that the land did not move toward bare ground and erosion. Thus, ranchers manage to the middle for plant-use efficiency for livestock production.

#### *Theme 5: Perceptions of the Good Rancher and Maintaining Relationships*

Most ranchers interviewed were concerned about being viewed as good ranchers by their peers, because “everybody looks over the fence.” This reality had an impact on how ranchers managed their pastures. When asked what their opinion was of some photos that showed bare ground, a common participant response was “bare ground just means someone’s not monitoring some-

thing very closely” or “that’s a detriment of overgrazing . . . you find that when things are overgrazed.”

The desire to maintain neighborly relationships is one reason underlying the slow acceptance of prairie dogs. One participant said:

If a prairie dog town got over onto my neighbor’s and he wasn’t getting any money for it, and despised prairie dogs and wouldn’t care if someone was willing to pay him \$10,000 a year for a prairie dog town, then that causes a conflict between my neighbor and I, and I don’t want that.

A different participant said that “money may not be enough to keep friendships” when prairie dogs were involved. The same might be said for using prescribed fires: “If I go out here and light a pasture on fire my neighbor is going to hate me.” One participant said outright that “there’s a lot of fear of what your neighbors are going to think or what they’re going to say that holds a lot of things back.” Maintaining good relationships in a ranching community was important to ranchers interviewed; thus, neighbors’ perceptions can limit change and the acceptance and adoption of different management strategies. Alternatively, these relationships might encourage change: one rancher mentioned how his neighbors asked for help to implement a grazing management program that was similar to his own, after they expressed an interest in obtaining similar results.

#### *Theme 6: Trust Insiders, Mistrust Outsiders*

The participants interviewed seemed to trust the motivations and intentions of people within their communities, like cattlemen’s associations, and naturally mistrusted those who were from the outside, like non-profit organizations. One rancher stated that he wanted to know the source of outsiders’ money or, in other words, what their underlying motivation was for speaking with ranchers. Another described why he trusted the Grazing Lands Coalition, a grassroots organization, in his state: “I know a lot of the guys that are on their board, or have a lot of influence with them, and I trust their opinions.”

Generally, ranchers reported some level of disregard or mistrust of information coming through outside or unknown channels. Many of the participants explained that researchers or scientists often cannot understand

the intricacies of ranching and how everything a family does revolves around their business. One rancher said, “They’re scientists, they don’t come live in our shoes,” and another said, “I bet there’s very few of your ecologist buddies that ever get out on a ranch, I mean to actually talk.” This sentiment was echoed for other outsiders: “Nobody likes to be told something, which is the way a lot of conservationists come across.”

Even research from trusted sources may be disregarded, because participants understand that research is typically done in a controlled setting: “Yeah, the university did it, and they can control different things,” and “They have plenty of research, but it’s the application that they lack.” Ranchers lamented the resources that a university or research organization has, which gives them the flexibility to try risky approaches that are not available to most ranchers. Finally, participants viewed some research as patronizing: “It’s the PhD attitude. I’m just, we’re just dumb ranchers, and ‘I’m the PhD.’ When you sit down, you gotta get past that.”

One rancher had this advice for fostering a productive dialogue: “I think it’s really important to approach it to understand enough about both sides that you can really find a common ground.” Another participant said, “First they have to know something; they just can’t be a stand-around-feel-gooder.” Some participants mentioned Audubon’s Conservation Ranching Program, which certifies bird-friendly beef products, and how Audubon had approached the ranchers for advice and consulting: “I’ve been working with Audubon since they actually approached us. Those kinds of groups make me kind of nervous. But he wanted to talk to me, so we talked.”

#### *Theme 7: Love of Rangelands*

Ranchers loved not only the rangeland landscape but also their role in protecting and managing their land. One said this about the importance of protecting rangeland:

The rangeland plays a major part in humans’ existence. . . . I mean it’s no different than eliminating rainforests. There’s the same value to me in [rangeland] as there is in rainforest, or any forest for that matter. It’s all part of a balance that we need to maintain as a society.

Many of the participants talked about the love of wide-open spaces or of being able to see long distances. One participant said, “It was the life, living in the country, and that feeling of wide-open spaces, working hard and sleeping well at the end of the day.”

Even with the strong belief in the importance of ranching and rangelands, there were mixed goals for the next generation. One rancher had told his children to get out of agriculture, saying, “I don’t believe it’s really a viable way to make a living in the future.” Many of the participants, however, were encouraging the younger generation to remain in agriculture. “So many people in agriculture aren’t very positive. I mean it’s a challenge, it always is, but there’s so many opportunities.” Two ranchers we interviewed had been told by their parents to leave, which they both did, but later they went back to the ranch. One said, “We moved back for family. Well, family means the ranch.”

## Discussion

Efficient and sustainable beef production is paramount in the rancher’s worldview. In this case, sustainability was the ability of the ranch to continue producing beef into the future. Although there has been a paradigm shift within rangeland conservation circles toward managing for vegetation heterogeneity (Fuhlendorf and Engle 2001; Freese et al. 2014), our interviews showed that a similar shift had not occurred among ranchers in this study. Rather, the ranchers reported being very aware of how their management affected the sustainability of their ranch from the standpoint of forage and beef production, because of the impact on their livelihood, whereas wildlife or biodiversity were secondary objectives for management. These views, which are held by those managing the land, should be known and addressed by conservationists if rangeland biodiversity is to be increased. Further, our interviews suggested that conservation planners can improve producers’ odds of achieving wildlife objectives through demonstrations that connect habitat conditions, such as heterogeneity, and counts of wildlife.

### *The Rancher as Steward*

The ranchers in this study held strong views about what qualifies as good stewardship of rangelands, including

sustainable use of the forage resource, preventing soil erosion, and ensuring that there is vegetation cover on the ground whenever possible. Inefficient use of forage plants for livestock production and allowing bare ground to expand were viewed as poor stewardship. These factors aligned closely with the rangeland health paradigm, which is used by both government agencies and university extension educators when providing technical assistance to ranchers (Symstad and Jonas 2011). Thus, ranchers viewed themselves as stewards of their rangeland and were concerned about rangeland health.

From the perspective of beef production, fire was not valued because it removes forage for livestock. From the perspective of ranchers as stewards, it was also logical that fire was not appreciated because many viewed fire as degrading rangeland by creating bare ground, thus decreasing rangeland health as it is typically measured by the USDA (Briske et al. 2005; Symstad and Jonas 2011). Thus, fires did not align with livestock production goals, and they did not align with ranchers’ stewardship goals. This viewpoint is supported by NRCS policies: landowners are sometimes paid to not graze after a fire even though functional rangelands have fire-grazing interactions and grazing following fire does not necessarily have a negative consequence (Allred et al. 2011; Scasta et al. 2015).

We observed strong views among ranchers that “prairie dogs have no place on the ranch.” This most likely stemmed from both the stewardship and production perspectives, where bare ground is bad when assessing rangeland health and where prairie dogs compete with livestock for forage (Lamb and Cline 2003). However, ranchers may simultaneously believe that prairie dogs are a natural part of many rangeland ecosystems—that “God must have put prairie dogs there for a reason”—but that they should be eradicated. State and federal policies supporting the control and eradication of prairie dogs reinforce the production and stewardship perspectives of ranchers, where the goals are to decrease bare ground and increase vegetation cover.

Soil health was an important consideration for many ranchers in this study. In situations where a rancher was restoring cropland or degraded areas, strategies to improve soil health are an important starting point. Because of society’s concern with degradation caused by livestock grazing in the western USA (Fleischner 1994; Gutwein and Goldstein 2013), the adoption of rotational grazing practices may have increased to reduce degrada-

tion (Gutwein and Goldstein 2013). The continued belief in the power of livestock grazing to solve a multitude of rangeland problems, as was described in the “miracle of animal impact” theme, is supported by NRCS policies that promote rotational grazing through fence installation at the expense of other management goals (Toombs and Roberts 2009).

### *Challenges to Address*

Some ranchers in this study had worked very hard through carefully planned grazing management to reverse trends of increasing bare ground, degradation, and erosion. Thus, asking a rancher to increase bare-ground habitat on their ranch for the benefit of certain wildlife species is problematic for ranchers because it increases risk and decreases flexibility. In a volatile system like the livestock industry, moving beyond the basic need of providing a living for their family to higher-level considerations, like wildlife management, may be difficult to justify for ranchers. This is a reason that the paradigm shift occurring among some rangeland professionals has not crossed to private ranchers; it is easy for those whose basic needs are not met through beef production to make recommendations about management. Cinner and Pollnac (2004) used similar reasoning to explain why wealthier families in a fishing village in Mexico were more likely to be amenable to a holistic approach to conservation than poorer families; wealthier families' basic needs were met, whereas poorer families' basic needs were not met. Ted Turner, an iconic rangeland conservationist and a champion for rangeland biodiversity on his ranches (Turner Enterprises 2017), is a perfect example of this dichotomy. Turner is not supporting his basic needs from his bison (livestock) operations, and thus has the ability to take ecological conservation into consideration. Some of the participants in this study noted Turner's support of prairie dogs, and even praised him for it, but stated they could not be expected to support prairie dogs in the same way.

Even with a growing body of evidence that fire and prairie dogs are important components of rangeland ecosystems, views on fire and prairie dogs are still negative. The theory of cognitive dissonance provides a possible explanation for this phenomenon. When confronted with information that conflicts with their views, people are more likely to maintain their views than change their

attitudes or actions based on the new information, and may subsequently avoid situations where their views are challenged (Festinger 1962; Tanaka et al. 2011). However, cognitive dissonance can be motivational (Elliot and Devine 1994) and have an impact on ranchers' views of managing rangeland ecosystems. Cognitive dissonance presents a unique challenge in that private ranchers may avoid information that challenges their beliefs, which will make the job of convincing them of the importance of heterogeneity, fire, and even prairie dogs that much more difficult for outsiders such as conservationists.

Another challenge similar to cognitive dissonance stems from the cultural cognition thesis, which suggests that individuals believe their behavior is socially beneficial when they and their peers find it honorable (Kahan et al. 2010). Thus, there is a self-reinforcing system that exists in agricultural communities, where there is a lot of pressure to manage in a way that is acceptable to the community, as was examined in the theme “perceptions of the good rancher and maintaining relationships.” In this type of system, it may be difficult to enact change or to alter policies because of social pressures.

A final challenge is that heterogeneity is both a foreign concept and is promoted by “outsiders” who ranchers do not readily trust (Becerra et al. 2017). This problem has been documented in forest ecosystems, where “experts” ranked certain management practices as high priorities, but the forest owners considered the same practices to be of minor importance (Van Gossum et al. 2005). Either outsiders should work toward gaining the trust of ranchers to discuss heterogeneity, or trusted individuals like extension staff should begin to communicate the concept of heterogeneity and its importance for healthy rangelands.

### *Recommendations and Opportunities*

If policies can be changed based solely on science, there are two policies that might be changed easily. Policies that encourage landowners to be wary of fire reinforce existing beliefs about the harmfulness of fires in rangeland systems (e.g., signs along federally owned rangelands warning that “rangeland fires are destructive”). State and federal policies about prairie dogs also run counter to ecologists' current understanding of the keystone role of prairie dogs in rangeland systems (Davidson et al. 2012). These policies perpetuate misconceptions about fire and prairie dogs rather than

promoting a better understanding of natural processes in rangeland ecosystems. Unfortunately, it is unlikely that these policies will change simply based on available science, because policies are value-laden.

Prior to attempting to change policies, it will be necessary for rangeland conservationists to work with ranchers to begin the hard work of changing attitudes (Serbruyns and Luysaert 2006; Pasquini et al. 2010). University extension staff have a key role to play by acting as liaisons between ranchers and scientists (Pasquini et al. 2010), as do current efforts by nonprofit groups like The Nature Conservancy's Fire Learning Network, which engages multiple stakeholders in restoring landscapes that rely on fire (The Nature Conservancy 2015). The fact that some ranchers feel less financial pressure may also make this process easier than in the past.

Research has shown that strong motivators for staying in ranching are often noneconomic (Liffmann et al. 2000; Rowe et al. 2001), as was presented in the theme "love of rangelands." Ranchers also want to maintain status within their community and be viewed as good ranchers. Furthermore, they are working in a complex industry, which may limit their innovativeness and willingness to consider change (Didier and Brunson 2004). Thus, social status, respect among community members, and the condition of the industry must be accounted for when developing new programs for ranchers to promote heterogeneity. Engaging with a community's respected ranchers and innovators to promote new management strategies might be a useful strategy.

A barrage of educational materials is unlikely to help change attitudes among ranchers, because ranchers are unlikely to engage with information that conflicts with their values (Tanaka et al. 2011). Participants in this study provided insights for addressing these problems in that "seeing is believing," which is in line with previous research showing that innovations must be testable by the rancher prior to full implementation (Pannell et al. 2006). Universities, state and federal agencies, and nonprofit organizations must begin using their resources to show ranchers the importance of vegetation heterogeneity in rangeland biodiversity. Field days, research ranches, and landowner workshops that focus on examining heterogeneity are some tools that can be used. Van Gossum et al. (2005, 598) came to a similar conclusion in their forest management study, and suggested that "local pilot forests could prove to be useful in removing some of the practical difficulties." University Extension and NRCS, two trusted groups,

will be key in encouraging ranchers to attend these types of events (Pasquini et al. 2010).

Incentive-based programs are popular to encourage behavioral change on private land (Langpap 2006). Indeed, many ranchers in this study mentioned that money can be motivational. Some concerns with incentives that ranchers in this study highlighted included the loss of control over their own operations and concerns over what neighbors may think of their changed management. Further, many of the ranchers believed their management was conducive to diverse rangeland wildlife, and some ranchers may already be supporting rare species on their property. These ranchers would be left out of any incentive programs to encourage behavioral change; therefore, payments for ecosystem services might be another necessary program in rangeland ecosystems, where conservationists are attempting to prevent conversion of native habitats to other uses, such as cropland (Smith and Sullivan 2014). These concerns should be addressed in any new programs by engaging ranchers in the development of the programs.

Finally, although money can be a driving factor that makes incentive-based programs useful, research has shown that recognition for conservation efforts can be an effective strategy for encouraging behavioral change or maintaining good practices (Pasquini et al. 2010). This type of incentive is also less expensive. Thus, any of the above practices can be supplemented with awards (e.g., Leopold Conservation Award) that recognize ranchers who excel at conservation, and when there is a lack of funding, this type of program may supersede monetary incentives or payments for ecosystem services.

## Conclusions

Ranchers in this study enjoyed having wildlife on their property and were proud of the efforts they had taken to support that wildlife. However, the ranchers' principal goal was keeping the ranch in business, which in their view required efficient use of the vegetation resource for grazing livestock production. Managing for heterogeneity was not considered reasonable when optimizing harvest efficiency of available vegetation and livestock production were their primary objectives. There is no reason for ranchers to consider using tools that create heterogeneity when heterogeneity is not appreciated. Additionally, fire and burrowing animals, which are principal drivers of heterogeneity on rangelands, were

not acceptable when they both appear to reduce vegetation production and increase bare ground. Ranchers in this study, therefore, generally discounted heterogeneity and associated practices, because they conflicted with their long-held beliefs and objectives.

Conservationists should recognize that production, economic, and cultural factors drive ranchers' management decisions. Incentives, both monetary and nonmonetary, will be useful in engaging ranchers in conservation, and economic downturns may present an opportunity to approach ranchers when they are more open to alternative forms of income (Powell 2015). This suggestion is in line with a host of recent research (e.g., Czap et al. forthcoming) demonstrating that the adoption of conservation practices is more likely with a combination of monetary and nonmonetary incentives. Our work suggests that efforts to influence management decisions on private land will be most effective when they include active engagement, such as on-ranch demonstrations of new management strategies that take account of biodiversity, as well as working with influential community members.

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### References

- Addicott, J. F., J. M. Aho, M. F. Antolin, D. K. Padilla, J. S. Richardson, and D. A. Soluk. 1987. "Ecological Neighborhoods: Scaling Environmental Patterns." *Oikos* 49:340–46.
- Allred, B. W., S. D. Fuhlendorf, D. M. Engle, and R. D. Elmore. 2011. "Ungulate Preference for Burned Patches Reveals Strength of Fire-Grazing Interaction." *Ecology and Evolution* 1 (2): 132–44. <https://doi.org/10.1002/ece3.12>.
- Becerra, T. A., D. M. Engle, R. D. Elmore, and S. D. Fuhlendorf. 2013. "Contrasting Preference for Grassland Landscapes among Population Groups in the Central and Southern Great Plains." *Rangeland Ecology & Management* 66 (5): 529–38. <https://doi.org/10.2111/REM-D-12-00174.1>.
- Becerra, T. A., D. M. Engle, S. D. Fuhlendorf, and R. D. Elmore. 2017. "Preference for Grassland Heterogeneity: Implications for Biodiversity in the Great Plains." *Society & Natural Resources* 30 (5): 601–12.
- Biondini, M. E., A. A. Steuter, and R. G. Hamilton. 1999. "Bison Use of Fire-Managed Remnant Prairies." *Journal of Range Management* 52 (5): 454–61.
- Brennan, L. A., and W. P. Kuvlesky. 2005. "North American Grassland Birds: An Unfolding Conservation Crisis?" *Journal of Wildlife Management* 69 (1): 1–13.
- Briske, D. D., S. D. Fuhlendorf, and F. E. Smeins. 2005. "State-and-Transition Models, Thresholds, and Rangeland Health: A Synthesis of Ecological Concepts and Perspectives." *Rangeland Ecology & Management* 58:1–10.
- Briske, D. D., N. F. Sayre, L. Huntsinger, M. E. Fernández-Giménez, B. Budd, and J. D. Derner. 2011. "Origin, Persistence, and Resolution of the Rotational Grazing Debate: Integrating Human Dimensions into Rangeland Research." *Rangeland Ecology & Management* 64 (4): 325–34. <https://doi.org/10.2111/REM-D-10-00084.1>.
- Cinner, J. E., and R. B. Pollnac. 2004. "Poverty, Perceptions and Planning: Why Socioeconomics Matter in the Management of Mexican Reefs." *Ocean and Coastal Management* 47 (9–10): 479–93. <https://doi.org/10.1016/j.ocecoaman.2004.09.002>.

- Czap, N. V., H. J. Czap, M. Khachaturyan, M. E. Burbach, and G. D. Lynne. 2018. "Experiments on Empathy Conservation: Implications for Environmental Policy." *Journal of Behavioral Economics for Policy* 2:2 (early view). <http://sabeconomics.org/jbep/early-view/>.
- Davidson, A. D., J. K. Detling, and J. Brown. 2012. "Ecological Roles and Conservation Challenges of Social, Burrowing, Herbivorous Mammals in the World's Grasslands." *Frontiers in Ecology and the Environment* 10 (9): 477–86.
- Didier, E. A., and M. Brunson. 2004. "Adoption of Range Management Innovations by Utah Ranchers." *Journal of Range Management* 57 (4): 330–36.
- Elliot, A. J., and P. G. Devine. 1994. "On the Motivational Nature of Cognitive Dissonance: Dissonance as Psychological Discomfort." *Journal of Personality and Social Psychology* 67 (3): 382–94. <https://doi.org/10.1037/0022-3514.67.3.382>.
- Festinger, L. 1962. *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.
- Fleischner, T. L. 1994. "Ecological Costs of Livestock Grazing in Western North America." *Conservation Biology* 8 (3): 629–44.
- Freese, C. H., S. D. Fuhlendorf, and K. Kunkel. 2014. "A Management Framework for the Transition from Livestock Production toward Biodiversity Conservation on Great Plains Rangelands." *Ecological Restoration* 32 (4): 358–68.
- Fuhlendorf, S. D., and D. M. Engle. 2001. "Restoring Heterogeneity on Rangelands: Ecosystem Management Based on Evolutionary Grazing Patterns." *BioScience* 51 (8): 625–32.
- Fuhlendorf, S. D., D. M. Engle, R. D. Elmore, R. F. Limb, and T. G. Bidwell. 2012. "Conservation of Pattern and Process: Developing an Alternative Paradigm of Rangeland Management." *Rangeland Ecology & Management* 65 (6): 579–89. <https://doi.org/10.2111/REM-D-11-00109.1>.
- Fuhlendorf, S. D., D. M. Engle, J. Kerby, and R. G. Hamilton. 2009. "Pyric Herbivory: Rewilding Landscapes through the Recoupling of Fire and Grazing." *Conservation Biology* 23 (3): 588–98. <https://doi.org/10.1111/j.1523-1739.2008.01139.x>.
- Gutwein, M., and J. H. Goldstein. 2013. "Integrating Conservation and Financial Objectives on Private Rangelands in Northern Colorado: Rancher and Practitioner Perceptions." *Rangeland Ecology & Management* 66 (3): 330–38. <https://doi.org/10.2111/REM-D-11-00206.1>.
- Hovick, T. J., R. D. Elmore, and S. D. Fuhlendorf. 2014. "Structural Heterogeneity Increases Diversity of Non-Breeding Grassland Birds." *Ecosphere* 5 (5): 1–12. <https://doi.org/10.1890/ES14-00062.1>.
- Johnson, T. N., P. L. Kennedy, T. DelCurto, and R. V. Taylor. 2011. "Bird Community Responses to Cattle Stocking Rates in a Pacific Northwest Bunchgrass Prairie." *Agriculture, Ecosystems & Environment* 144 (1): 338–46. <https://doi.org/10.1016/j.agee.2011.10.003>.
- Kahan, D. M., D. Braman, J. Monahan, L. Callahan, and E. Peters. 2010. "Cultural Cognition and Public Policy: The Case of Outpatient Commitment Laws." *Law and Human Behavior* 34 (2): 118–40. <https://doi.org/10.1007/s10979-008-9174-4>.
- Knight, K. B., T. P. Toombs, and J. D. Derner. 2011. "Cross-Fencing on Private US Rangelands: Financial Costs and Producer Risks." *Rangelands* 33 (2): 41–44. <https://doi.org/10.2111/1551-501X-33.2.41>.
- Krausman, P. R., D. E. Naugle, M. R. Frisina, R. Northrup, V. C. Bleich, W. M. Block, M. C. Wallace, and J. D. Wright. 2009. "Livestock Grazing, Wildlife Habitat, and Rangeland Values." *Rangelands* 31 (5): 15–19.
- Lamb, B. L., and K. Cline. 2003. "Public Knowledge and Perceptions of Black-Tailed Prairie Dogs." *Human Dimensions of Wildlife* 8 (November): 127–43. <https://doi.org/10.1080/10871200390205165>.
- Langpap, C. 2006. "Conservation of Endangered Species: Can Incentives Work for Private Landowners?" *Ecological Economics* 57:558–72. <https://doi.org/10.1016/j.ecolecon.2005.05.007>.
- Liffmann, R. H., L. Huntsinger, and L. C. Forero. 2000. "To Ranch or Not to Ranch: Home on the Urban Range?" *Journal of Range Management* 53 (July): 362–70.
- Lybecker, D., B. L. Lamb, and P. D. Ponds. 2002. "Public Attitudes and Knowledge of the Black-Tailed Prairie Dog: A Common and Controversial Species." *BioScience* 52 (7): 607. [https://doi.org/10.1641/0006-3568\(2002\)052\[0607:PAAKOT\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2002)052[0607:PAAKOT]2.0.CO;2).
- MacArthur, R. H., and J. W. MacArthur. 1961. "On Bird Species Diversity." *Ecology* 42:594–98.
- Marshall, C., and G. B. Rossman. 2010. *Designing Qualitative Methods*. 5th ed. Thousand Oaks, CA: Sage Publications.
- Merriam, S., and E. Tisdell. 2016. *Qualitative Research*. San Francisco: Jossey-Bass.
- Neilly, H., J. Vanderwal, and L. Schwarzkopf. 2016. "Balancing Biodiversity and Food Production: A Better Understanding of Wildlife Response to Grazing Will Inform Off-Reserve Conservation on Rangelands." *Rangeland Ecology & Management* 69 (6): 430–36. <https://doi.org/10.1016/j.rama.2016.07.007>.
- Newbold, T., L. N. Hudson, A. P. Arnell, S. Contu, A. De Palma, S. Ferrier, S. L. L. Hill, et al. 2016. "Has Land Use Pushed Terrestrial Biodiversity beyond the Planetary Boundary? A Global Assessment." *Science* 353 (6296): 288–91.
- Noss, R. F. 1983. "A Regional Landscape Approach to Maintain Diversity." *Bioscience* 33:700–706.
- Pannell, D. J., G. R. Marshall, N. Barr, A. Curtis, F. Vanclay, and R. Wilkinson. 2006. "Understanding and Promoting Adoption of Conservation Practices by Rural Landholders." *Australian Journal of Experimental Agriculture* 46:1407–24.
- Pasquini, L., R. M. Cowling, C. Twyman, and J. Wainwright. 2010. "Devising Appropriate Policies and Instruments in Support of Private Conservation Areas: Lessons Learned from the Klein Karoo, South Africa." *Conservation Biology* 24 (2): 470–78. <https://doi.org/10.1111/j.1523-1739.2009.01344.x>.

- Patton, M. Q. 2015. *Qualitative Research and Evaluation Methods*. 4th ed. Thousand Oaks, CA: Sage Publications.
- Powell, L. A. 2015. "Periodic Corrections to Agricultural Land Values Provide Opportunity for Conservation." *Journal of Soil and Water Conservation* 70 (2): 39A–44A. <https://doi.org/10.2489/jswc.70.2.39A>.
- Rowe, H. I., E. T. Bartlett, and L. E. Swanson. 2001. "Ranching Motivations in 2 Colorado Counties." *Journal of Range Management* 54 (4): 314–21.
- Samson, F. B., and F. L. Knopf. 1994. "Prairie Conservation in North America." *BioScience* 44 (6): 418–21.
- Scasta, J. D., E. T. Thacker, T. J. Hovick, D. M. Engle, B. W. Allred, S. D. Fuhlendorf, and J. R. Weir. 2015. "Patch-Burn Grazing (PBG) as a Livestock Management Alternative for Fire-Prone Ecosystems of North America." *Renewable Agriculture and Food Systems* 31 (6): 550–67. <https://doi.org/10.1017/S1742170515000411>.
- Serbruyns, I., and S. Luyssaert. 2006. "Acceptance of Sticks, Carrots and Sermons as Policy Instruments for Directing Private Forest Management." *Forest Policy and Economics* 9 (3): 285–96. <https://doi.org/10.1016/j.forpol.2005.06.012>.
- Smith, H. F., and C. A. Sullivan. 2014. "Ecosystem Services within Agricultural Landscapes-Farmers' Perceptions." *Ecological Economics* 98:72–80. <https://doi.org/10.1016/j.ecolecon.2013.12.008>.
- Symstad, A. J., and J. L. Jonas. 2011. "Incorporating Biodiversity into Rangeland Health: Plant Species Richness and Diversity in Great Plains Grasslands." *Rangeland Ecology & Management* 64 (6): 555–72. <https://doi.org/10.2111/REM-D-10-00136.1>.
- Tanaka, J. A., M. Brunson, and L. A. Torell. 2011. "A Social and Economic Assessment of Rangeland Conservation Practices." In *Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps*, ed. D. D. Briske, 371–422. United States Department of Agriculture, Natural Resources Conservation Service.
- The Nature Conservancy. 2015. "Fire Learning Network." <https://www.conservationgateway.org/ConservationPractices/FireLandscapes/FireLearningNetwork/Pages/fire-learning-network.aspx>.
- Toombs, T. P., J. D. Derner, D. J. Augustine, B. Krueger, and S. Gallagher. 2010. "Managing for Biodiversity and Livestock." *Rangelands* 32 (3): 10–15.
- Toombs, T. P., and M. G. Roberts. 2009. "Are Natural Resources Conservation Service Range Management Investments Working at Cross-Purposes with Wildlife Habitat Goals on Western United States Rangelands?" *Rangeland Ecology & Management* 62 (4): 351–55. <https://doi.org/10.2111/08-027.1>.
- Turner Enterprises. 2017. Turner Ranches. <https://www.tedturner.com/turner-ranches/>.
- United States Department of Agriculture. 2015. "2012 Census of Agriculture Highlights: Cattle Industry." [https://www.agcensus.usda.gov/Publications/2012/Online\\_Resources/Highlights/](https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/).
- Van Gossum, P., S. Luyssaert, I. Serbruyns, and F. Mortier. 2005. "Forest Groups as Support to Private Forest Owners in Developing Close-to-Nature Management." *Forest Policy and Economics* 7 (4): 589–601. <https://doi.org/10.1016/j.forpol.2003.10.003>.
- VERBI Software. 2014. "MAXQDA." Berlin, Germany: VERBI Software.
- With, Kimberly A., Anthony W. King, and William E. Jensen. 2008. "Remaining Large Grasslands May Not Be Sufficient to Prevent Grassland Bird Declines." *Biological Conservation* 141 (12): 3152–67. <https://doi.org/10.1016/j.biocon.2008.09.025>.