

THESIS

HOME ON THE DIGITAL RANGE:  
RANGE-RELATED WEB OUTREACH AND RANCHERS' INTERNET USE

Submitted by

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## ABSTRACT

### HOME ON THE DIGITAL RANGE:

#### RANGE-RELATED WEB OUTREACH AND RANCHERS' INTERNET USE

Access to the internet continues to improve in rural areas, ensuring ranchers will have increasing opportunities to use the Web to find information about management practices that may provide ecological and financial benefits to their ranches. While past studies have examined the role of the internet in informing daily decision-making by agricultural producers, no studies have focused specifically on describing and analyzing the use of the internet by ranchers in the Western United States. This study uses a mixed-methods approach to assess the extent and patterns of ranchers' internet use in Colorado and Wyoming, identify barriers to greater use, and establish a typology of Web use behavior by ranchers. We also assess a sample of current range-related websites by measuring the presence or absence of features and characteristics shown by past research to enhance potential impacts on site visitors. Our findings indicate that internet use is widespread, and that age, education, and risk tolerance can predict the extent to which a rancher will rely on the internet for day-to-day ranch management. A cluster analysis delineated four separate Web usage typologies among ranchers with which outreach personnel can determine the potential utility of digital outreach tools for their programming based on their target audience and topics of outreach. The website assessment found that educational sites in our sample could improve their potential perceived credibility and their potential impact on visitors' attitudes by using testimonials and quotations more frequently. Based on these findings, we recommend that rangeland outreach personnel determine the potential benefits of incorporating online outreach depending on which typology or typologies of Web-using ranchers

they are targeting. Additionally, range-related websites should attempt to incorporate as many message characteristics and structural features as possible to maximize their potential perceived credibility by website visitors, and to increase their potential for altering their attitudes about a topic.

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# CHAPTER I

## INTRODUCTION

Ranchers are responsible for managing a number of biotic and abiotic resources that provide ecological, cultural, and economic services on American rangelands. Rangelands are defined generally as uncultivated land capable of providing suitable habitat for domestic and wild animals (Holechek, Pieper, & Herbel, 1998), or as lands having native vegetation that is grazed or can be grazed, including grazable forestland, grasslands, shrub-dominated lands, and pasturelands (Bedell, 1998). The United States has about 770 million acres of rangeland, constituting 34% of the total land base in the country (Joyce, 1989). These rangelands provide a variety of products and services, such as forage for livestock and wild ungulates, soil conservation, water retention, and recreational space, among other uses (Havstad et al., 2007). Though ranchers face many obstacles to maintaining their use and stewardship of rangelands, and though the nature of ranching operations is shifting from full-time livestock production to a more diverse spectrum of operation types, ranchers will continue to play a major role in preserving these working landscapes for years to come (Brunson & Huntsinger, 2008).

Ranchers in Western rangelands often manage their landscapes in a manner that maintains ecosystem services (Havstad et al., 2007). At present, land managers and their rangelands face a number of obstacles to maintaining such services, yet new tools are emerging that aid in evaluation and decision-making processes. Invasive species such as *Bromus tectorum*, commonly known as cheatgrass, are contributing to the ecological and economic damage of rangelands across the West (Knapp, 1996), and natural disasters pose sudden and often unforeseeable hardships for livestock producers on rangelands. Exurban development poses a

threat both to rangeland ecosystems and to the ranchers who depend on them (Brunson & Huntsinger, 2008). As such new challenges and opportunities emerge for rangeland managers, fast and efficient information dissemination has become more crucial than ever. Simultaneously, the capacity for timely information dissemination continues to rise at an unprecedented speed as the internet and related information technologies diffuse throughout the United States (Rogers, 2001), including rural areas with predominantly agricultural economic foundations.

Despite the importance of timely information dissemination for range management, and the ever-increasing presence of information technology, little is known about internet use by ranchers. This study will identify current trends of internet use by ranchers in Colorado and Wyoming and evaluate current use of the internet as a rangeland management outreach tool and as a source of information.

## **BACKGROUND**

Several fields of scientific research contributed to the design of this research and guided its objectives. Studies of the diffusion of innovations provide insight into the spread and use of both the internet and the rangeland management innovations discussed on the Web (Rogers, 2001). A number of studies of the spread of innovations specifically among ranchers inform the questions and the methods of this study. Previous research on internet outreach in natural resources management shaped the project's study of extant outreach websites and provided a basis upon which the framework of semi-structured interviews about internet outreach were based. Studies of information-seeking behaviors in Web surfers, and the role of trust and credibility, informed both the design of the research and the interpretation of our results.

## **Innovation Diffusion**

The study of how new and potentially beneficial technologies or ideas spread, termed *innovation diffusion*, is essential for understanding the processes by which ecologically beneficial tools and concepts may disseminate amongst ranchers. Everett Rogers, who has been described as the father of innovation diffusion research (McGrath & Zell, 2001), describes *innovation diffusion* as the process by which new ideas or technologies that are perceived as advantageous spread throughout a social system (Rogers, 2003). Innovation diffusion theories arose out of studies of the diffusion of agricultural technologies and practices (Ryan & Gross, 1943). As such, they may be the best framework by which to evaluate the spread of innovative technologies or cognitive frameworks among natural resource professionals. To diffuse successfully, an innovation must have five primary attributes that demonstrate its advantage over previous systems: relative advantage, which is the perceived superiority of the innovation over other methods; compatibility with the technological, cultural, social, and economic system; a complexity not exceeding that of necessity; trialability, which is a term for the ease by which the innovation may be tested without major commitment; and observability of the superior outcomes of the innovation (Rogers, 2003).

Rogers also developed a typology of individual approaches to the adoption of innovation, defining a spectrum of five approaches distributed in a normal curve: innovators, early adopters, early majority, late majority, and laggards (Rogers, 1958). In Rogers' (1958) typology, innovators, comprising less than 3% of the population, are the first to try and adopt new practices. Early adopters (13.5% of the population) see the innovation adopted by the innovators and are the next to incorporate it into their lives. The early majority (34%) then picks it up, prior

to the majority of the rest of the population, followed later by the late majority (34%) and the so-called laggards (16%) (Rogers, 1958).

Rogers' typologies have received much criticism for their focus on wealthy, large-scale agricultural producers and the potential to widen financial gaps between individuals perceived as being open to innovation and those deemed to be slow to adopt them (Goss, 1979). For example, land-grant universities widely backed the adoption of a system of tomato production requiring the purchase of a then-new variety of mechanical harvester and tomato at high cost to tomato-growers (Hightower, 1972). This expensive innovation reduced the number of workers needed on tomato farms while increasing the overhead costs of tomato growers, which led to a decline both in the number of tomato growers and farmhands in the United States (Hightower, 1972).

However valid these critiques may be, Stephenson (2003) argues that the potential for causing social and economic disruption to agricultural producers by adherence to innovation diffusion theory may be mitigated by increasing the availability of information to *all* producers, and taking steps to target producers of various innovation typologies based upon their needs and information preferences. He advocates consideration of the sizes and economic capacities of various segments of an outreach professional's region (Stephenson, 2003)—in short, he argues, effective, timely, tailor-made information may be the best way to prevent further rural social inequality and agricultural depopulation. Given the relatively low cost of the internet and its potential for information delivery, rather than promoting some producers over others, the Web may offer a much-needed source of nearly instantaneous information accessible to the majority of ranchers.

## **Diffusion of the Internet**

The internet is both a medium by which innovations diffuse, and an innovation that continues to spread at an astounding speed. “Since 1989 the internet has been the most rapidly diffusing innovation in the history of humankind,” Everett Rogers asserts (2001, p. 97). As an innovation, the internet possesses many qualities that promote its use and diffusion in rural areas, such as its high degree of relative advantage over previous methods of communication, including letters on paper or telephone calls, or previous methods of gathering information such as going to a library or contacting an expert on the topic. Following the initial costs and difficulty of obtaining internet access, an individual may find more information than ever before with less effort than any other medium of information transfer (Rogers, 2001).

As the number of technologies providing internet access increase, the availability of internet access is becoming more widespread and increasingly portable (Putzer & Park, 2010). A study applying innovation diffusion theory to the spread of smartphones among medical professionals found that personal attitudes towards the adoption of innovations predicted the intention of individuals to use the smartphone (Putzer & Park, 2010), highlighting the applicability of innovation diffusion theory to the spread of digital communication technologies. Another study of the adoption of smartphones with internet access found that the perceived usefulness of smartphones was a positive influence on the intention to use smartphones (Park & Chen, 2007), confirming the role of perceived utility as an impetus to adopt a digital innovation, as Rogers (2001) asserted.

Congruent with Rogers’ description of the internet as the most rapidly diffused innovation in history, the U.S. Census Bureau’s Current Population Survey data indicated that as of 2009, almost 69% of American households used the internet at home. The United States

Department of Agriculture's Agricultural Statistics Board discovered in a 2011 survey that 70% of farms (a term that included ranches in the survey) in the American West have and use the internet (USDA Agricultural Statistics Board, 2011)—the highest regional use rates in the nation. A 2013 survey of ranchers in Wyoming found that 82% of respondents had internet access (Kachergis et al., 2013). While the data are too general to be conclusive regarding internet use habits among ranchers, they indicate at the very least that this research may fill both a void in scholarship on rural internet use and provide insight into the potential diffusion of ecologically innovative management tools.

### **Diffusion of Innovations among Ranchers**

Innovation diffusion as it occurs within a context of ranching has received more study than internet use in the same sphere. Extant research has investigated the economic (and to a lesser extent, social and cultural) factors that correlate with adoption of specific innovations in ranching communities, though no connection as yet has been made theoretically or empirically between the these innovations and internet use.

Didier and Brunson (2004) studied innovation among Utah ranchers and also carried out a meta-analysis of a number of studies into ranchers' tendency to innovate. The authors found that dependence on ranch income was an accurate predictor of innovativeness; another study cited by the authors found that the potential of an innovation to increase income was also a factor in its adoption (Rowan & White, 1994). Dedication to the perpetuation of the ranch was positively associated with innovation adoption (Rowe, Bartlett, & Swanson, 2001).

Didier and Brunson then developed their own predictors of likely innovators, finding that multigenerational ranchers, full-time ranchers, and ranchers who live on the ranch are all more likely to innovate (Didier and Brunson, 2004). These findings appear to demonstrate a

correlation between personal, financial, and familial ties to a ranch and increased likelihood of being an innovator or early adopter. A more recent analysis of ranchers' participation in conservation programs found that larger operations were more likely to adopt the programs (Lubell et al., 2013).

Certain factors also predict a lessened likelihood of innovation. Financially disadvantaged ranches are less likely to overcome their risk-aversion and therefore are less likely to innovate (Peterson & Coppock, 2001). Attachment to familiar methods of ranch management and operation, whether individual or community-wide, is a significant cultural barrier to adoption of innovation (Grigsby, 1980). Didier and Brunson found that legal factors, including fear of litigation, design of government programs, and public land regulations were also substantial obstacles to innovative behavior (Didier and Brunson, 2004).

Kennedy (2005) and Kennedy and Brunson (2007) found a significant factor perhaps related to compatibility of an innovation: lifestyle preferences promoting specific cultural values. Kennedy's 2005 study of rancher innovations in Colorado found that preferences for a certain lifestyle promoting "independence, self-sufficiency, and individualism" by an individual rancher, or a ranching family as a whole, could strongly support or greatly weaken the desire to adopt a particular innovation (p. 19). While outreach efforts from Colorado State University Extension were highly developed in the rancher communities of West-Central Colorado, Kennedy and Brunson (2007) found that lifestyle preferences often ultimately determined whether or not Extension-endorsed innovations were adopted or discarded.

This study is partially based on a 2009 study of adoption of innovations by ranchers in Colorado and Wyoming, that found that attitudes towards the adoption of innovations significantly predicted the actual implementation of innovative management and business



practices by ranchers on their operations (Kelley, 2010). The results of the study indicated that younger ranchers, ranchers with more education, and ranchers with higher gross annual income were more likely to adopt innovations (Kelley, 2010). Ranchers' attitudes towards specific innovations (for example, new grazing management methods) were more likely to be positive if the innovations increased their grazing capacity, reduced the undesirable species on their property, or offered a direct financial gain (Kelley, 2010). Kelley (2010) also found that risk tolerance, which is a rancher's attitude towards new management practices, acted as a mediating variable between rancher characteristics (such as gross annual income and education) and the adoption of innovations.

### **Uses of the Internet by Agricultural Producers**

To use the internet effectively to provide ranchers with information about potentially ecologically and economically beneficial innovations, we need to know more about how ranchers use the internet. Though general data exist quantifying the number of agricultural producers with internet access, we found only one study that asked ranchers about the frequency of their internet use. Eighty-two percent of ranchers in their survey reported using the internet (Kachergis et al., 2013). A large proportion of the study's respondents indicated regular Web use, with 42% of respondents using the internet on a daily basis, and another 31% using it one or more times per week (Kachergis et al., 2013).

Other than the survey from Wyoming asking about internet access, the most relevant studies available address general farming and agribusiness with no specific information on ranching. Gaining an understanding of ranchers' preferred uses of the internet may prove critical to determining how to disseminate rangeland management tools to them.

Research by Mishra and Park (2005), including analysis of U.S. Department of Agricultural statistics on farmers' internet use, found that American farmers used the internet for nine primary reasons. In descending order of importance, farmers used the internet to: track input and commodity prices; obtain information from a nonspecific variety of sources; obtain information specifically from the U.S.D.A; communicate with other producers; keep farm records; communicate with advisory services; use online banking; pay bills; and secure loans. Another survey conducted by Extension in Iowa quantified types of internet use by farmers with internet access (Arbuckle, 2011). The results indicate high levels of use for obtaining information on management practices, indicating that some agricultural producers actively seek innovations online.

### **Message Characteristics, Structural Features, and Credibility**

Given the availability and abundance of range-related information on the Web, information must be easily accessible, relevant, and trustworthy for users to find it useful (Hutchinson & Ruyle, 2006). While little research has been done on website credibility specific to range science, previous studies identified attributes of websites that engender greater perceived credibility by Web surfers (Metzger, Flanagin, & Medders, 2010).

Hong (2006) describes website features associated with credibility in terms of message characteristics and structural features to differentiate informational content from factors relating to the layout and interactivity. Message characteristics are defined by the content of the website's information and its delivery. Structural features are those aspects of the site that undergird its architecture, layout, navigational hierarchy, and interactive features. Structural and message characteristics are complementary and interrelated, but conceptually distinct in that structural

features such as navigational options or domain name may influence perceived credibility but are distinct from the information itself (Hong, 2006).

Message characteristics consist of three primary dimensions: the accountability of the information presented, the quality of the information, and the impression of credibility of the information (Hong, 2006). Informational accountability includes providing sources for information, such as citations and links, and disclosure of a website's organizational or professional affiliations (Metzger, 2007). Message quality is less easily delineated, but can include factors such as the professionalism of the writing and the timeliness of the information (Hong, 2006). Features such as testimonials, quotes, and statistics enhance the impression of message credibility (O'Keefe, 2002).

Structural features can include factors intrinsic to the site such as the domain name, navigational options, contact information, and third-party endorsements (Hong, 2006). Other factors fitting Hong's (2006) definition of structural features, though not explicitly listed, could include search options, ranking in search engine results, and paywalls (Metzger, 2007).

### **Information Foraging Theory**

Web surfers seeking information online behave much as an herbivore seeking a palatable plant to eat. The aptly-named information-foraging theory argues that individuals will try to maximize the utility of information they locate while striving to minimize the cost in time or effort in finding it (Pirulli & Card, 1999). Recent work on information-seeking online emphasized that "information seekers are likely to cope with the perceived costs of information search and overload by seeking strategies that *minimize* the cognitive effort and time" (Metzger, Flanagin, & Medders, 2010, p. 417). Consequently, while the internet requires little effort to

access information, the limiting factors of its usefulness are the mental energy and time required to sort through information (Pirolli, 2005).

As the name suggests, information-foraging theory is based on the optimal foraging theory of Stephens and Krebs (1987), which posits that an organism will expend more energy to find more nutritious food until a point of diminishing returns is reached. In a similar fashion, information-foraging theory suggests that a Web surfer will expend time and cognitive effort proportionate to the perception of the availability and worth of the information sought until a point of diminishing returns is reached (Pirolli, 2005). In other words, if a Web user wants information on a particular topic, their information-seeking behavior will likely be defined by a compromise between effort expended and the perceived benefits of the information.

In practice, this means that if a site or grouping of websites has useful information but is difficult to navigate, an individual may simply resort to information of lesser perceived utility if it is easier to find. As such, the navigability of a website and accessibility of the information are critical to the website's efficacy in achieving outreach goals.

### **Previous and Current Uses of the Internet for Disseminating Ecological and Management Information to Land Managers**

The internet has been used as a tool for spreading ecological information and management tools to agricultural producers and land managers both in the United States and abroad. Digital dissemination of information has been used among dairy farmers in Turkey (Boz, Akbay, Bas, & Budak, 2011), agricultural producers in India (Meera, Jhamtani, & Rao, 2004; Sharma, 2003), sheep and goat farmers in Maryland (Schoenian & Fritz, 2005), and a number of other contexts. Other digital outreach websites more specific to ranchers and land managers in the intermountain West exist as well, such as SageSTEP, Rangelands West, the BEHAVE

Program, a general website for range ecology from CSU Extension, and forthcoming cheatgrass management sites (also from CSU). However, thus far, none of these projects has measured the impact of their digital outreach on the behavior of ranchers.

A number of outreach tools are also being used, as varied as the contexts in which they are employed. Such tools include wikis (Kinsey, Carleo, O'Neill, & Polanin, 2010); spatial browsers (Neelakantan et al., 2011); read/write Web 2.0 tools (Cifuentes, Sharp, Bulu, Benz, & Stough, 2009); webinars (Rich et al., 2011); and comprehensive centralized sites that consolidate a number of media varieties, such as video, pamphlets, and online courses ("BEHAVE Program: Learning Tools," n.d.). In the intermountain West, no empirical study has established which of these tools individually or in combination are preferred by ranchers, whether or how they influence ranchers' awareness, knowledge, or use of innovations.

## **OBJECTIVES AND ORGANIZATION**

Two overarching objectives defined the direction and methods of this research, each seeking to explore a half of the binary exchange between outreach and the adoption of innovative practices or technologies by ranchers. First, we seek to assess the current use of the internet for range-related outreach and communication. To that end, Chapter II, "Monitoring the Digital Range," assesses range-related websites using a framework based on past studies of the credibility of outreach websites. Second, in Chapter III, "Home on the Digital Range," we attempt to determine the extent and patterns of ranchers' use of the internet to inform their ranch management. These two chapters are written as stand-alone articles in a manuscript format. As such, some sections of the literature reviews in each are nearly identical, and all chapters will have separate literature cited sections. The overall goal of this research is to provide research results that improve the ability of outreach personnel to communicate timely and useful

information to ranchers such that ranchers in turn may maintain or enhance the resilience of rangelands and the communities that depend on them.

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CHAPTER II  
MONITORING THE DIGITAL RANGE:  
AN ASSESSMENT OF RANGE-RELATED WEBSITES

**SUMMARY**

Access to the internet continues to grow in rural areas, ensuring ranchers will have increasing opportunities to use the Web to find information about management practices that may provide ecological and financial benefits to their ranches. This study assesses a sample of current range-related websites by measuring the presence or absence of features and characteristics shown by past research to enhance potential impacts on site visitors. We found that educational sites in our sample could improve their potential perceived credibility and their potential impact on visitors' attitudes by using testimonials and quotations more frequently. Based on these findings, we recommend that range-related websites should attempt to incorporate as many message characteristics and structural features as possible to maximize their potential perceived credibility by website visitors, and to increase their potential for altering their attitudes about a topic.

**INTRODUCTION**

Everett Rogers characterized the internet as “the most rapidly diffusing innovation in the history of mankind” (2001, pg. 97). While urban areas witness the fastest growth of internet use and availability, rural areas are also rapidly developing the ability to reliably access the internet (DiMaggio & Hargittai, 2001). A 2012 survey of ranchers in Wyoming found that 82% of respondents had internet access, with 75% respondents reporting high-speed access (Kachergis et al., 2013). Moreover, 73% of respondents with internet access reported accessing the internet one

or more times per week (Kachergis et al., 2013). The near-ubiquity of the internet, as well as the relative ease with which users can find information online, ensures it will play a significant role in the future of natural resources and Extension educational outreach (High & Jacobson, 2005; King & Boehlje, 2000).

As a result of this expanding potential to use the internet as a medium for range outreach, myriad websites addressing issues relating to rangeland management have been developed. Sites such as Rangelands West, the Range Science Information System, and eXtension offer free resources to Web surfers seeking information on rangeland systems (Hutchinson, Pfander, Tanaka, & Clark, 2011). A simple search on any popular search engine for terms such as “rangeland ecology” or “rangeland management” returns thousands of results. As Hutchinson and Ruyle (2006) point out, the issue facing web users searching for range-related information is not its lack, but sorting through the surplus to find information that is directly relevant to their questions and situation. In this paper, we conduct a preliminary assessment of the credibility of range-related websites and analyze the differences between three types of range-related websites in terms of the potential efficacy of their outreach.

### **Message Characteristics, Structural Features, and Credibility**

Given the availability and abundance of range-related information on the Web, information must be easily accessible, relevant, and trustworthy for users to find it useful (Hutchinson & Ruyle, 2006). While little research has been done on website credibility specific to range science, previous studies identified attributes of websites that engender greater perceived credibility by Web surfers (Metzger, Flanagin, & Medders, 2010).

Hong (2006) describes website features associated with credibility in terms of message characteristics and structural features to differentiate informational content from factors relating

to the layout and interactivity. Message characteristics are defined by the content of the website's information and its delivery. Structural features are those aspects of the site that undergird its architecture, layout, navigational hierarchy, and interactive features. Structural and message characteristics are complementary and interrelated, but conceptually distinct in that structural features such as navigational options or domain name may influence perceived credibility but are distinct from the information itself (Hong, 2006).

Message characteristics consist of three primary dimensions: the accountability of the information presented, the quality of the information, and the impression of credibility of the information (Hong, 2006). Informational accountability includes providing sources for information, such as citations and links, and disclosure of a website's organizational or professional affiliations (Metzger, 2007). Message quality is less easily delineated, but can include factors such as the professionalism of the writing and the timeliness of the information (Hong, 2006). Features such as testimonials, quotes, and statistics enhance the impression of message credibility (O'Keefe, 2002).

Structural features can include factors intrinsic to the site such as the domain name, navigational options, contact information, and third-party endorsements (Hong, 2006). Other factors fitting Hong's (2006) definition of structural features, though not explicitly listed, could include search options, ranking in search engine results, and paywalls (Metzger, 2007).

### **Accessibility**

While credibility is essential to the efficacy of Web-based outreach, accessibility is equally important. The aptly-named information-foraging theory argues that individuals will try to maximize the utility of information they locate while striving to minimize the cost in time or effort in finding it (Pirolli & Card, 1999). Recent work on information-seeking online

emphasized that “information seekers are likely to cope with the perceived costs of information search and overload by seeking strategies that *minimize* the cognitive effort and time” (Metzger, Flanagin, & Medders, 2010, p. 417). Consequently, while the internet requires little effort to access information, the limiting factors of its usefulness are the mental energy and time required to sort through information (Pirolli, 2005).

As the name suggests, information-foraging theory is based on the optimal foraging theory of Stephens and Krebs (1987), which posits that an organism will expend more energy to find more nutritious food until a point of diminishing returns is reached. In a similar fashion, information-foraging theory suggests that a Web surfer will expend time and cognitive effort proportionate to the perception of the availability and worth of the information sought until a point of diminishing returns is reached (Pirolli, 2005). In practice, this means that if a site or grouping of websites has useful information but is difficult to navigate, an individual may simply resort to information of lesser perceived utility if it is easier to find. As such, the navigability of a website and accessibility of the information are critical to the website’s efficacy in achieving outreach goals.

These past studies provide a framework by which we can assess the inclusion or absence of features that theory indicates are linked to the perceived credibility, accessibility, and usefulness of a website. While evaluating the aesthetic appeal of individual websites can provide insight as to their perceived credibility, such evaluations require the recruitment of a sample of individuals to evaluate visual appeal and are beyond the scope of this assessment. Our assessment does provide a system that can be used by rangeland and Extension webmasters to quickly evaluate how many features contributing to the perceived credibility and utility of a

website are present on their webpages, and which features may be missing that can be added to improve the site's outreach potential.

Our objectives were to assess the use of website features shown by past research to be associated with perceived credibility, and to determine if any differences exist between different types of websites (educational, commercial, and advocacy) in the use of these features.

## **METHODS**

### **Research Design**

This study used data from a content analysis of 40 websites addressing rangeland management and ecology (Appendix A). Websites were identified through a number of methods, including searches on popular search engines for terms relating to rangeland ecology and management, scientific and trade journal articles about rangeland management websites, recommendations gleaned from discussions and interviews with natural resource professionals and ranchers, and links from websites already recruited through the aforementioned means. Sites that primarily focus on rangelands were included, as were sites with other primary foci that regularly addressed rangeland management topics, such as cattle producers' periodicals that frequently discussed rangeland management topics. The number of websites chosen reflected the maximum number of sites the researcher could assess in the available time frame for the assessment.

Site selection was not intended to include all range-related websites, but rather to locate readily accessible range-related sites matching the above criteria. It is not possible to determine if the sample selected is representative, given the number of websites on the World Wide Web; however, based on our searches for range-related topics on popular search engines, we believe the websites we selected are some of the most well-known or readily available. Data for the



content analysis were gathered by means of an assessment form. The form contained both objective variables based on previous research addressing credibility and navigability (Hong, 2006; Metzger, 2007; Sutcliffe, 2002). Objective variables were mined directly from website content and included variables measuring structural attributes and message characteristics.

The structural characteristics assessed were selected based on prior research, and were coded by their presence or absence on the website. These included the presence or absence of a central linking page, statement of purpose, electronic and physical addresses, a contact page, an “about” page, and the listing of sponsors or affiliates. Other characteristics such as domain type, links to social media accounts or sharing buttons, word counts, the navigational options, and the type and number of media formats used were recorded as well.

The message characteristics for the assessment were selected based on prior research as well. We recorded the number of peer-reviewed cited sources, as well as the presence or absence of statistics or numerical data, quotes, and testimonials on each website.

Brief qualitative summaries of the topics included on each website were recorded based on webpage content and then coded using qualitative methods to construct a list of primary topical categories based on recurrence among multiple websites. Topics included grazing management, invasive or weedy species, rangeland monitoring, seeding, use of herbicides, wildlife, prescribed fire, targeted grazing, woody plant management, and public land management policies.

Despite the subjective nature of many factors associated with perceived credibility and accessibility, many of the variables measured were objective in that they measured the presence or absence of website characteristics that theory suggests are linked to credibility or accessibility. We constructed index coefficients for both message characteristics and structural characteristics

that were the sum total of the number of characteristics present out of those which we measured. The message characteristics coefficient had a possible high score of four, if the website featured citations of peer-reviewed sources, statistics or numerical data, quotes, and testimonials—for the purposes of this exploratory analysis, the presence or absence of the feature was recorded as a one for each individual variable, and the absence as a zero. The structural features coefficient had a maximum score of seven, if the website had a central linking page, statement of purpose, electronic address, physical address, contact page, “about” page, and the sponsors and affiliated organizations listed. We combined these two variables to form an overall credibility coefficient with a maximum value of 11 and a minimum value of 0.

Following the compilation of these data, we post-coded the websites based on their domain type (e.g. .edu would be educational) and/or stated goals into three categories: commercial sites, advocacy sites, and educational sites. Sites with clear financial motivation, subscription fees for services, or marketable goods and/or services were grouped as commercial (n = 7). Advocacy sites primarily expressed a political opinion or argued for a legal or political change in the management of public rangelands (n = 9). Educational sites were comprised of sites with the primary purpose of providing information on a topic or topics related to rangelands and/or providing access to scientific range-related research (n = 24).

## **Analysis**

Due to the exploratory nature of the website assessment, our primary focus was to determine patterns of structural and message attributes among a sample of range-related sites to inform future research. First, we calculated the frequency of individual and collective structural attributes and message characteristics grouped by both website type and domain type (e.g. .edu, .com, .org) and used Pearson’s Chi-square tests to determine differences in the use of individual

message or structural features between different website and domain types. Second, we conducted non-parametric Kruskal-Wallis tests to determine if there were differences between the three website categories (commercial, advocacy, & educational) in terms of their overall credibility coefficients (CC), structural coefficients (SC), and message characteristics (MC), with website category as the independent variable and CC, SC, and MC as the dependent variables. The same test was also performed with domain type (.com, .org. or .edu) as the independent variable.

Finally, to determine if a relationship exists between the overall credibility coefficient and the type of digital media used to convey information on the websites, we performed a correlation between the CC and a summary index of the number of media types on each website (e.g. videos, downloadable documents, audio files, etc.).

All analyses were performed using SPSS 20 (*IBM SPSS Statistics for Windows*, 2011), and results were considered significant at  $\alpha = 0.05$ . Due to the non-random selection method and unequal number of websites in each category or domain type, our results should not be generalized beyond the 40 websites included in this assessment. The results of this research lay the groundwork for more comprehensive analyses of range-related Web outreach.

## **RESULTS**

Three of the four message characteristics differed significantly among website types, as did one of the seven structural features (Table 2.1). Educational websites used citations more frequently than commercial or advocacy websites. Commercial and advocacy websites used testimonials and quotes with greater frequency than educational websites. All three types of websites used statistics with similar frequencies. Commercial sites listed affiliate organizations and sponsors significantly less frequently than the other two site types.

The mean value for the message coefficient was 2.68 out of a possible maximum score of 4 for all websites surveyed. Advocacy sites had the highest mean MC at 3.44, with educational and commercial sites trailing with means of 2.46 and 2.43, respectively. Despite the pragmatic significance of the higher MC value for advocacy sites relative to the other two website categories, a Chi-square test revealed no statistical significance between the categories' means.

The overall mean SC for all websites was 5.3 out of a possible maximum score of 7. Commercial sites had the highest mean SC at 5.57, with advocacy sites just below at 5.56; educational sites followed with a mean of 5.13. An ANOVA showed no statistical difference between the categories.

There were no statistically significant differences between any of the website types with regards to the structural or overall credibility coefficients. We found a significant positive relationship between the overall credibility coefficient and the number of different digital media types used ( $r=.422$ ,  $p<.01$ ).

## **DISCUSSION**

The differences in the use of quotes, testimonials, and citations across website types highlight the distinct communication styles of the advocacy and commercial websites on the one hand and educational sites on the other. Advocacy and commercial sites used citations relatively rarely compared to the educational sites, but they made use of testimonials and quotations more frequently than did the educational sites. The only structural feature that differed significantly between website types was due to the lack of information about sponsors or affiliates on commercial sites compared to other site types accounts.

The disparity in the use of citations reflects the fact that many of the educational sites have ties to universities and scientific research programs. Educational websites also used quotes

and testimonials less than the other website types—perhaps because more qualitative or anecdotal methods of conveying information may be viewed as less scientific by the authors of those websites' content. A slight majority of advocacy sites used citations as well. Advocacy sites relied on past scientific research to support a political stance on a particular issue.

The significant correlation between the overall credibility coefficient and the number of media types may simply be a reflection of the relative resources at a webmaster's or organization's disposal, as generating media in multiple formats can require greater time and funds, and websites with more resources may be better able to employ a greater number of message characteristics and structural features than websites with less funding. Alternately, this difference could be a reflection of the degree of investment in the site a webmaster or organization has, or a function of how much or how little Web-savvy the site's webmaster has, as there are many ways to augment a website's features on a small budget. This question merits further study to determine which inputs are the most predictive of high credibility coefficient values—money, time, webmaster's expertise, or some combination of the above.

The lack of significant relationships between website types for the overall and structural coefficients indicates that, for this limited sample, the differences in message features were not large enough to overcome the similarities in the majority of the structural features. Past research on Web communication relating to health topics suggests that structural features do not influence a website visitor's attitudes about an issue, while message characteristics do (Rains & Karmikel, 2009). In other words, while structural features influence the perceived credibility of a website, message characteristics may influence both the perceived credibility of the site and the attitude of a visitor about the issues the site discusses.

## IMPLICATIONS

Our website selection methods limit the generalizability of our findings; however, the results highlight some of the potential strengths and shortcomings of digital range-related communication. Politically or commercially motivated range-related websites tended to have more features shown in past studies to potentially improve the perceived credibility of a website. In other words, the advocacy and commercial websites, on average, use more of the tools in the webmaster's toolbox to convince a visitor that their sites are credible sources of information. Much of this advantage resulted from the use of quotes and testimonials, message features not used as frequently on the educational websites in the sample.

Although sites specifically targeting scientists may eschew the use of testimonials and quotes with potentially little consequence to their outreach goals, past research demonstrates that the communication of scientific information to laypersons and non-academic audiences benefits strongly from the addition of more narrative-like communication styles. Publications using narrative styles of communication about scientific topics improve comprehension, as research in health communications demonstrates (Hinyard & Kreuter, 2007), and activate different learning styles and cognitive pathways in readers (Graesser, Olde, & Klettke, 2002). Thus, the educational websites in our sample could potentially improve their perceived credibility as well as their impact on the attitudes of visitors about a topic by combining the use of quotes and testimonials with their already robust use of statistics and citations. For sites with scholarly or scientific affiliations, the increased use of quotes and testimonials could also aid in clearly communicating scientific results without the potential confusion stemming from the use of scientific jargon, succinctly and personally conveying the pragmatic implications of the information a webmaster or organization desires to communicate. Conversely, commercial and

advocacy sites could potentially improve their perceived credibility by incorporating citations from peer-reviewed scientific literature.

The evident dichotomy between sites favoring citations and sites favoring quotes and testimonials reveals that, in our sample, scientific sites could benefit from incorporating more personal, human voices to augment their science-based information, and sites that rely heavily on anecdotal information or qualitative voices may benefit from drawing upon scientific research to support their ideas. Further research is needed to investigate the influence of website features on the perceived credibility of the website, ideally by means of recruiting participants to report their perceptions of specific websites' credibility and comparing these ratings to the credibility coefficients of the sites.

**Table**

**Table 2.1.** The results of Chi-square tests comparing the frequency of message characteristics and structural features associated with perceived credibility in three types of range-related websites. According to Vaske (2008), a Cramer’s V of 0.1 is a minimal effect, 0.3 is a typical effect, and 0.5 is a substantial effect size.

|                                | Website Type                   |                                  |                                    | X <sup>2</sup> | Cramer’s<br>V | p     |
|--------------------------------|--------------------------------|----------------------------------|------------------------------------|----------------|---------------|-------|
|                                | Advocacy<br>(n = 9)<br>% (No.) | Commercial<br>(n = 7)<br>% (No.) | Educational<br>(n = 24)<br>% (No.) |                |               |       |
| <i>Message Characteristics</i> |                                |                                  |                                    |                |               |       |
| Testimonials                   | 100 (9 )                       | 85.71 (6)                        | 54.17 (13)                         | 7.55           | .434          | .023* |
| Quotes                         | 100 (9)                        | 85.71 (6)                        | 37.50 (9)                          | 12.99          | .570          | .002* |
| Citations                      | 55.56 (5)                      | 0 (0)                            | 66.67 (16)                         | 9.70           | .492          | .008* |
| Statistics                     | 88.89 (8)                      | 71.43 (5)                        | 87.50 (21)                         | 0.18           | .176          | .539  |
| <i>Structural Features</i>     |                                |                                  |                                    |                |               |       |
| Electronic Address Listed      | 77.78 (7)                      | 100 (7)                          | 58.33 (14)                         | 4.82           | .347          | .090  |
| Physical Address Listed        | 88.89 (8)                      | 100 (7)                          | 75 (18)                            | 0.26           | .259          | .263  |
| Affiliates/Sponsors Listed     | 88.89 (8)                      | 57.14 (4)                        | 95.83 (23)                         | 0.43           | .431          | .024* |
| About Page                     | 88.89 (8)                      | 100 (7)                          | 83.33 (20)                         | 1.40           | .187          | .497  |
| Contact Page                   | 44.44 (4)                      | 71.43 (5)                        | 75 (18)                            | 2.85           | .267          | .241  |
| Statement of Purpose           | 100 (9)                        | 71.43 (5)                        | 62.50 (15)                         | 4.62           | .340          | .099  |
| Link Page                      | 66.67 (6)                      | 57.14 (4)                        | 62.50 (15)                         | 0.15           | .062          | .927  |



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CHAPTER III  
HOME ON THE DIGITAL RANGE:  
RANCHERS' WEB ACCESS AND USE

**SUMMARY**

Access to the internet continues to grow in rural areas, ensuring ranchers will have increasing opportunities to use the Web to find information about management practices that may provide ecological and financial benefits to their ranches. While past studies have examined the role of the internet in informing daily decision-making by agricultural producers, no studies have focused specifically on describing and analyzing the use of the internet by ranchers in the Western United States. This study uses a mixed-methods approach to assess the extent and patterns of ranchers' internet use in Colorado and Wyoming, identify barriers to greater use, and establish a typology of Web use behavior by ranchers. Our findings indicate that internet use is widespread, and that age, education, and risk tolerance can predict the extent to which a rancher will rely on the internet for day-to-day ranch management. A cluster analysis delineated four separate Web usage typologies among ranchers with which outreach personnel can determine the potential utility of digital outreach tools for their programming based on their target audience and topics of outreach. Based on these findings, we recommend that rangeland outreach personnel determine the potential benefits of incorporating online outreach depending on which typology or typologies of Web-using ranchers they are targeting.

**INTRODUCTION**

The internet is “the most rapidly diffusing innovation in the history of mankind” (Rogers, 2001, pg. 97). While urban areas witness the fastest growth of internet use and availability, rural

areas are also rapidly developing the ability to reliably access the internet (DiMaggio & Hargittai, 2001). A 2012 survey of ranchers in Wyoming found that 82% of respondents had internet access, with 75% respondents reporting high-speed access (Kachergis et al., 2013). Moreover, 42% of respondents reported using the internet on a daily basis, with another 31% using it one or more times per week (Kachergis et al., 2013). The near-ubiquity of the internet, as well as the relative ease with which users can find information online, ensures it will play a significant role in the future of natural resources and Extension educational outreach (High & Jacobson, 2005; King & Boehlje, 2000).

As a result of this expanding potential to use the internet as a medium for range outreach, myriad websites addressing issues relating to rangeland management have been developed. Sites such as Rangelands West, the Range Science Information System, and eXtension offer free resources to Web surfers seeking information on rangeland systems (Hutchinson, Pfander, Tanaka, & Clark, 2011). A simple search on any popular search engine for terms such as “rangeland ecology” or “rangeland management” returns thousands of results. As Hutchinson and Ruyle (2006) point out, the issue facing web users searching for range-related information is not its lack, but sorting through the surplus to find information that is directly relevant to their questions and situation.

This study identifies and describes current trends of internet use by Colorado and Wyoming ranchers and evaluates the current and potential future use of the internet as an outreach tool. Specifically, we document how many ranchers use the internet and how, as well as the biggest barriers to greater internet use. Within the population of ranchers with internet access in our sample, we determine the extent to which information gleaned from the internet influences ranchers' decision-making both generally and in specific rangeland and ranch management areas.

Finally, we identify patterns of individual use to determine the types of Web users outreach personnel may target for specific types of outreach activities.

### **Innovation Diffusion**

The study of how new and potentially beneficial technologies or ideas spread is termed *innovation diffusion*. Innovation diffusion provides a framework for examining the processes by which ecologically beneficial tools and concepts may disseminate amongst ranchers. Everett Rogers, who has been described as the father of innovation diffusion research (McGrath & Zell, 2001), describes innovation diffusion as the process by which new ideas or technologies that are perceived as advantageous spread throughout a social system (Rogers, 2003).

To diffuse successfully, an innovation must have five primary attributes that demonstrate its advantage over previous systems: relative advantage, which is the perceived superiority of the innovation over other methods; compatibility with the technological, cultural, social, and economic system; a complexity not exceeding that of necessity; trialability, which is a term for the ease by which the innovation may be tested without major commitment; and observability of the superior outcomes of the innovation (Rogers, 2003).

The internet is both an innovation and a medium by which innovations may be diffused. Rogers (2001) observes that the internet possesses extremely high relative advantage over previous methods of communication, and he describes it as being one of the most quickly-diffused inventions in the history of mankind. Following the initial costs and difficulty of obtaining internet access, an individual may find more information than ever before with less effort than any other medium of information transfer (Rogers, 2001).

## **Diffusion of Innovations among Ranchers**

Innovation diffusion among ranchers has received more study than internet usage in the same sphere. Extant research has investigated the economic (and to a lesser extent, social and cultural) factors that correlate with adoption of specific innovations in ranching communities, though no connection as yet has been made theoretically or empirically between these innovations and internet use.

Didier and Brunson (2004) studied innovation among Utah ranchers and carried out a meta-analysis of a number of studies into ranchers' tendency to innovate. The authors found that dependence on ranch income was an accurate predictor of innovativeness; similarly, another study cited in their meta-analysis found that the potential of an innovation to increase income increased the likelihood of adoption (Rowan & White, 1994). The authors developed specific predictors of likely innovators, finding that multigenerational ranchers, full-time ranchers, and ranchers who live on the ranch are all more likely to innovate (Didier and Brunson, 2004). A more recent analysis of ranchers' participation in conservation programs found that larger operations were more likely to adopt the programs (Lubell et al., 2013). These findings appear to demonstrate a correlation between personal, financial, and familial ties to a ranch and increased likelihood of being an innovator or early adopter.

Certain factors also predict a lessened likelihood of the adoption of innovation. Financially disadvantaged ranches are less likely to overcome their risk-aversion and therefore are less likely to innovate (Peterson & Coppock, 2001). Attachment to traditional methods of ranch management and operation, whether individual or community-wide, is a significant cultural barrier to adoption of innovation (Grigsby, 1980). Didier and Brunson found that legal

factors, such as fear of litigation, design of government programs, and public land regulations were also substantial obstacles to innovative behavior (Didier and Brunson, 2004).

Kennedy (2005) and Kennedy and Brunson (2007) found a significant factor perhaps related to compatibility of an innovation: lifestyle preferences. Kennedy's 2005 study of rancher innovations in Colorado found that preferences for a certain lifestyle by an individual rancher, or a ranching family as a whole, could strongly support or greatly weaken the desire to adopt a particular innovation. While outreach efforts from Colorado State University Extension were highly developed in the rancher communities of West-Central Colorado, Kennedy and Brunson (2007) found that lifestyle preferences often ultimately determined whether or not Extension-endorsed innovations were adopted or discarded.

A study of adoption of innovations by ranchers in Colorado and Wyoming—upon which this survey is largely based, as part of the same ongoing project—found that attitudes towards the adoption of innovations (i.e. risk tolerance) significantly predicted the actual implementation of innovative management practices by ranchers on their operations (Kelley, 2010). The results of the study indicated that younger ranchers, ranchers with more education, and ranchers with higher gross annual income were more likely to adopt innovations (Kelley, 2010). Ranchers' attitudes towards specific innovations were more likely to be positive if the innovations increased their grazing capacity, reduced the undesirable species on their property, or offered a direct financial gain (Kelley, 2010).

### **Diffusion of the Internet**

The internet is both a medium by which innovations diffuse and an innovation that continues to spread at an extremely high speed (Rogers, 2001). As an innovation, the internet possesses many qualities that promote its use and diffusion in rural communities, such as its high



degree of relative advantage over previous methods of communication or gathering information. Following the initial costs and difficulty of obtaining internet access, an individual may find more information than ever before with less effort than any other medium of information transfer (Rogers, 2001).

### **Uses of the Internet by Agricultural Producers**

To use the internet effectively to encourage ranchers to adopt ecologically and economically beneficial innovations, we need to know more about how ranchers use the internet. Though general data exists quantifying the number of agricultural producers with internet access, we have located no data to describe how online information sources influence ranchers' decision-making. The most analogous data available concerns general farming and agribusiness with no specific information on ranching. Gaining an understanding of ranchers' preferred uses of the internet may prove critical to determining how to disseminate rangeland management tools to them.

Research by Mishra and Park (2005), including analysis of U.S. Department of Agriculture statistics on farmers' internet use, found that American farmers used the internet for nine primary reasons. In descending order of importance, farmers used the internet to: track input and commodity prices; obtain information from a nonspecific variety of sources; obtain information specifically from the U.S.D.A; communicate with other producers; keep farm records; communicate with advisory services; use online banking; pay bills; and secure loans. Another survey conducted by Extension in Iowa quantified types of internet use by farmers with internet access (Arbuckle, 2011). The results indicate high levels of use for obtaining information on management practices, indicating that some agricultural producers actively seek innovations online.

## **Information Foraging Theory**

Accessibility is essential to the efficacy of Web-based outreach. The aptly-named information-foraging theory argues that individuals will try to maximize the utility of information they locate while striving to minimize the cost in time or effort in finding it (Pirolli & Card, 1999). Recent work on information-seeking online emphasized that “information seekers are likely to cope with the perceived costs of information search and overload by seeking strategies that *minimize* the cognitive effort and time” (Metzger, Flanagin, & Medders, 2010). Consequently, although the internet requires little effort to access information, the mental energy and time required to sort through information potentially limit its usefulness (Pirolli, 2005).

As the name suggests, information-foraging theory is based on the optimal foraging theory of Stephens and Krebs (1987), which posits that an organism will expend more energy to find more nutritious food until a point of diminishing returns is reached. In a similar fashion, information-foraging theory suggests that a Web surfer will expend time and cognitive effort proportionate to the perception of the availability and worth of the information sought until a point of diminishing returns is reached (Pirolli, 2005). In practice, this means that if a site or grouping of websites has useful information but is difficult to navigate, an individual may simply resort to lower-quality information if it is more accessible and still perceived as useful. That is not to say that a Web surfer will necessarily resort to completely unreliable sources if they are easier to find than reliable sources; rather, that information-seeking behavior is determined by a compromise between the perceived utility of information and the accessibility of the information. As such, the navigability of a website and accessibility of the information are critical to the website’s efficacy in achieving outreach goals.

While our review of the literature found many previous studies addressing the use of the internet by agricultural producers in general (e.g. crop farmers, dairies, feedlots, etc.) we found no studies about the use of the internet by Western rangeland-based livestock producers. This study seeks to address this knowledge gap to determine the potential for the internet to be used as a tool for outreach aimed at ranchers. We assess and describe the scope and manner of internet use by ranchers in six regions of Colorado and Wyoming, determine the characteristics of ranchers most likely to rely on the internet as a source of information, and delineate specific Web-use typologies of ranchers with internet access.

We approached this study with five hypotheses about ranchers' patterns of internet use.

Hypothesis 1: Ranchers will most often report using the internet for business-related purposes, based on studies of internet use by agricultural producers in other regions (Arbuckle, 2011; Mishra & Park, 2005)

Hypothesis 2: Ranchers' wealth, operational scale (in acres of private land and animal units), risk tolerance, education and age will be the best predictors of internet use in the day-to-day management of their ranches. Past research has demonstrated these attributes are predictive of internet use and/or the adoption of innovations (Kelley, 2010; Kennedy & Brunson, 2007; Kennedy, 2005; Rogers, 2001).

Hypothesis 3: Risk tolerance will act as a mediating variable between wealth, operational scale, education and age for predicting the reliance of ranchers on the internet for daily ranch management. This hypothesis is based on the results of Windy Kelley's (2010) research, which identified risk tolerance as a mediating variable between demographic and operational attributes of a rancher and their adoption of innovations.

Hypothesis 4: Lack of time to find information online and lack of trust in Web-based sources of information will be the greatest obstacles to ranchers' internet use, in accordance with information foraging theory (Pirolli, 2005).

Hypothesis 5: There will be regional differences in the barriers to internet use associated with accessibility (namely lack of access to the Web, slow connections, and unreliable connections) due to differences in communication technology infrastructure.

## **METHODS**

Our study used a mixed-methods approach, combining a survey and qualitative interviews of ranchers in Colorado and Wyoming. The mail survey constitutes the backbone of the study, while the qualitative interviews were used both to inform the design of questions on the survey and to interpret the quantitative results.

### **Sampling Frame**

The National Agricultural Statistical Service in Denver compiled a list of potential participants who met the following criteria: own more than 20 animal units and manage at least 100 acres (40.47 hectares) or more of private, public, or leased pastures. Feedlots and dairies were excluded because their land management practices and economic goals are different from ranchers'. Six regions of Colorado and Wyoming were targeted (Appendix B). A random sample of 200 ranchers was selected from each of the six regions, for a total of 1200 survey recipients. These procedures followed the same protocol and targeted the same regions as a previous survey conducted in 2009 that assessed ranchers' risk tolerance, knowledge of state-and-transition models, and perceptions of cheatgrass (Kelley, 2010).

## **Survey Instrument Design**

We developed questions for the survey based on a need to evaluate two outreach projects as well as obtain new data on range management practices and information-seeking behavior. A number of questions were retained from a previous survey sent in 2009 to the same sample of ranchers in order to facilitate analysis of changes over time.

Questions about internet use were new in the 2013 survey and were developed based on qualitative interviews with ranchers and natural resource professionals. The 2013 survey was not pretested because a very similar instrument was tested and implemented in 2009.

The survey contained seven sections (in order): Operation Characteristics, Natural Resource Management Goals, Management Practices and Programs, Perceptions and Management of Cheatgrass (*Bromus tectorum*), Perceptions of State and Transition Models (STMs), Information Needs and Preferences, and Background. The first and last sections asked for information on the characteristics of the ranch operation and the survey respondent's demographic attributes, respectively. Questions regarding ranchers' operational goals for natural resource management were included in the second section. The sections on cheatgrass and STMs were adapted from the 2009 survey and were intended to collect data on current perceptions of the two topics that could be compared to the data from the 2009 survey. The section on information needs held the questions regarding internet access and use.

## **Survey Implementation**

The survey was implemented in four phases based on a modification of Dillman's method (2000), including a pre-survey letter, survey, reminder postcard, and replacement survey (Appendices C, D, and E). In the first week, NASS mailed pre-survey letters to all selected participants informing them that the survey would arrive in the mail the following week. The

next week, NASS sent surveys with prepaid and pre-addressed envelopes for participants to return the surveys. One to two weeks later, the same individuals received reminders to complete the survey if they had not already done so. Finally, replacement surveys with prepaid envelopes were sent one to two weeks after the reminder. After approximately two weeks without receiving new responses, the NASS office in Cheyenne conducted a non-response bias check via telephone with more than 10% of the non-respondents (Appendix F).

### **Measurement of Central Concepts**

Most questions were structured such that responses would be a dichotomous yes or no, including check boxes to indicate management practices or information sources used. Many questions were framed as scales, where variables were intended to measure degrees of influence on management decisions or degrees of agreement or disagreement with a statement. Half of the back cover was left blank with an invitation to write any additional comments following completion of the survey.

**Patterns of internet access.** Three questions asked specifically about methods of internet access, frequency of access, and barriers to internet access. Respondents were asked to check all methods of internet access they use, or mark the check box for no access if they have no internet access. Frequency of internet use was measured by means of an ascending five point scale ranging from non-use of the Web to daily use.

To assess barriers to internet use one question listed nine potential obstacles to internet use and asked rancher respondents to check all that apply, and indicate which barrier was the single largest obstacle to greater use of the internet on the ranch. The list of obstacles was compiled based on qualitative interviews carried out prior to drafting the instrument. Finally, we asked ranchers to mark which information sources on a list they used the Web to access.

**Reliance on the Web for decision-making.** Twenty-five variables measured ranchers' self-reported reliance on the Web to make decisions. One question asked generally about the importance of the internet for day-to-day operation management, with a 5 point scale ranging from "not at all important" to "extremely important." A list of 24 ranch and rangeland management topics was provided, with respondents asked to indicate to what degree the internet influences their decisions in each management area. These questions also used a 5 point scale, from "not at all" to "very high degree." Because this section was intended to determine how ranchers with internet access integrate it into their management, we coded any responses from respondents with no access as missing. The questions were grouped into three management areas: ranch business management, resource management, and livestock herd management.

**Risk tolerance.** The question about risk tolerance asked ranchers to choose which of five categories best matched their approach to the adoption of new innovations. The five categories were directly based on Rogers' (2003) five categories of adopters: innovators, early adopters, early majority, late majority, and laggards. The question provided brief descriptions of each approach from which ranchers selected the approach they felt best matched themselves. Responses were entered into the database on a scale of 1 to 5, with 1 fitting Rogers' (2003) laggards category and 5 indicating an approach fitting the innovator category.

### **Survey Analysis**

We carried out analysis of the data using the Statistical Package for the Social Sciences program, version 21 (*IBM SPSS Statistics for Windows*, 2012). Surveys were included if they were not blank and if they met our sampling specifications (one survey was excluded because it was a dairy operation). Data were checked for potential sampling bias by running Chi-square tests and ANOVA to determine if the non-response check data differed from the mailed survey

data. Respondents to the bias check had a slightly higher average gross annual income than respondents to the mailed survey (0.5 higher on a 9-point scale), and were an average of 5 years younger. There were no statistical differences in other variables such as educational level, reliance on the internet, or risk tolerance. Based on these results, we determined that the differences were not indicative of significant sampling bias and we incorporated the bias check responses into our dataset.

To determine how many ranchers had more than one method of accessing the internet, we computed an index of the number of access methods each rancher respondent used. This index was the sum of the number of devices respondents indicated they used.

We carried out a mediation analysis using the three step approach put forth by Baron & Kenny (1986) to determine if risk tolerance acted as a mediating variable, as we hypothesized. We used Sobel's (1982) method to test the significance of mediation. After determining the degrees of mediation, we altered our model and conducted a multiple regression analysis with reliance on the internet as a dependent variable and age, education, and risk tolerance as predictor variables.

We used Chi-square analyses to assess whether there are regional differences in the following obstacles to internet use: lack of internet access, slow internet speed, and unreliable/intermittent internet connection.

Cluster analysis was used to detect and characterize different patterns of internet use by ranchers. We ran a factor analysis of each of the three subsections of the 24 questions asking about the degree to which online information influences ranchers' decisions in the specific management areas: ranch business management, resource management, and livestock herd management. Based on the results of factor analyses of each of the three subsections of the



variables and the conceptual coherence of variable groupings, we compiled four indices by averaging the responses in the selected variables. The ranch business management variables were split into two indices: the sales and purchases index, and the business management index (Table 3.1). The other two subsections, namely resource management and livestock herd management, formed the remaining two indices based on the factor analyses, which grouped all the variables of each subsection together.

We ran cluster analyses with SPSS adapted from the methodology of Vaske, Timmons, Beaman, and Petchenik (2004). We ran four cluster tests ranging from 2 to 5 clusters in order to facilitate comparison. We checked the results of each analysis against the tests with one more or one fewer cluster using crosstabs, to determine the best balance between nuanced and simple clusters. The cluster test with four clusters most ably differentiated ranchers' reliance on the internet in various facets of operation management while maintaining the generalizability of our findings.

### **Qualitative Interviews**

Qualitative data were gathered by means of semi-structured interviews. We began the interviews prior to the drafting of the survey to facilitate question design, and continued our interviews during and after the time period when surveys were sent and returned. Participants were recruited with a convenience and snowball approach, whereby ranchers or natural resource professionals we had already met were asked to participate and to recommend other individuals for potential recruitment.

Potential participants were contacted via email or telephone provided with an introductory letter and fact sheet about the research and procedures (Appendices G and H). If an individual expressed willingness to participate, they were sent consent forms (Appendix I) and

an interview was scheduled. We conducted six interviews with seven ranchers, interviewing one couple together due to their complementary use of the internet, and one couple separately because they had described their internet use patterns as dissimilar. The other two participants were the only participants interviewed in their families.

We used an interview guide to ensure consistency in the questions we asked (Appendix J); however, to maintain the flow of conversation and the engagement of participants, we did not ask the questions in the exact same order, and we skipped questions that had already been answered during the course of the interview. Interviews were audio recorded, transcribed and coded.

### **Interview Analysis**

Coding is the process in which actions and topics that are present in the data are assigned a word or phrase intended to be “essence-capturing” (Saldana, 2012, pg. 3). First, we took notes on the topics and patterns we found in each of the interviews. Next, we re-examined our notes and applied a standardized set of codes based on the common topics and themes that came up in the interviews.

The most substantive analysis came from organizing the codes into matrices, domains, and taxonomies (Gibbs, 2008; Spradley, 1979). Domains are a way of grouping codes or concepts by virtue of their role or expression in a larger process, forcing the researcher to contextualize smaller units of data into larger concepts. We took these concepts and converted them into a taxonomy, which as the name implies is a hierarchical organization of themes, concepts, and then codes, based on shared characteristics.

After comparing these taxonomies of concepts to our research questions, we formulated matrices to compare and contrast responses. Matrices are essentially comparative tables, with a

coding category on one side—such as obstacles to using the internet to augment ranches—and the three interviews as comparative categories. These help visually establish commonalities between participants as well as differences.

## **RESULTS**

The adjusted response rate for the survey was 34%. To calculate the adjusted response rate, we subtracted the number of undeliverable surveys and the number of respondents who no longer fit our sampling parameters from the 1200 surveys sent, and included the responses to our bias check in the total number of responses (259 valid mailed surveys and 136 bias check responses). Response rates were similar across regions ( $n = 60-72$ ), with the exception of a lower response rate in southeast Wyoming ( $n = 53$ ).

### **Rancher Respondents' Characteristics**

Rancher respondents had an average age of 60.5 years old (range 24 to 92) and had been managing their operations for 28.6 years (Table 3.2). The average rancher respondent received 46.4% of their gross annual income from livestock (Table 3.2), relied on private property for 77.4% of their ranching land, sourced 86.1% of their labor from family members, and owned livestock holdings totaling 238 animal units (Table 3.2). Most ranchers finished high school and completed one or more years of college, and 37.7% obtained a college or post-graduate degree (Table 3.3). The median gross annual income for respondents was between 80,000 and 199,000 dollars (Table 3.4).

### **Method and Frequency of Internet Access**

Most rancher respondents reported having internet access, with 63.7% having high-speed access, 14.3% using smartphones with internet access, 9.8% using dial-up connections, and 76.1% having any of the above forms of internet access on their ranches. Nearly 24% reported

that they have no ability to access the internet from their ranches (Table 3.5). Of ranchers with internet access, 84.7% used only one device to access the Web, while 15.3% reported having two methods of accessing the Web (Table 3.6). A slight majority of ranchers, 51.1%, reported accessing the internet on a daily basis, while 20.2% indicated they never accessed the internet (Table 3.7).

### **Ranchers' Rangeland and Ranch Management Information Seeking**

Almost 40% of ranchers reported using the internet to access information from Extension, private ranching and range-related companies, industry magazines, scientific journals, and federal agencies (Table 3.6). Between 20 and 30% of respondents used the Web to access local or regional newspapers, conferences or workshops, and agricultural organizations (Table 3.8).

Rancher respondents (including respondents with no internet access) reported that they had used the internet to look up grazing management (42.2%), drought management (38.3%), rangeland monitoring (26.6%), cheatgrass management (12.5%), and state-and-transition models (5.5%). Approximately 51% of all respondents (including those without internet access) indicated they had never used the internet to look up any of those five topics (Table 3.9).

### **Influence of the Internet on Rancher Decision-Making**

The degree of influence information ranchers found online had on their decisions varied by topic. Online weather forecasts had a moderate to very high degree of influence on management decisions for 84.2% of respondents with internet access—the most influence of any type of online information listed in the survey (Table 3.10).

Online information also influenced ranchers' economic decisions. A majority of respondents indicated that information they obtained on the Web had a moderate to very high

degree of influence on livestock marketing (62.2%), buying or selling ranch equipment (61.1%), and livestock purchases (53.2%). Almost half of respondents indicated a similar degree of influence for purchasing hay or feed (48.7%), while 42.8% reported a moderate to very high degree of influence on their decisions regarding infrastructure development (Table 3.10).

Online information had less influence on ranchers' natural resource management decisions compared to their ranch business decisions. About half of respondents indicated online information had a moderate to very high influence on their decisions regarding drought mitigation and management. More than 40% of respondents reported a moderate to very high influence of online information to their decisions about managing invasive or weedy species (40.6%) and grazing management (43.1%).

The majority of ranchers with internet access reported the internet had moderate to very high degrees of influence on their livestock management decisions, with the exception of information relating to low-stress handling (43.1%). More than half of respondents reported that Web-based information influenced livestock genetics (60.4%), health (63.2%), and nutrition (57%) to a moderate or higher degree.

### **Factors Associated with Increased Internet Use**

We hypothesized that wealth, operational scale (in acres of private land and animal units), risk tolerance, education and age would be the best predictors of internet use in the day-to-day management of their ranches. The regressions we conducted demonstrated that risk tolerance partially or fully mediated the relationship between each of the demographic variables and reliance on the internet except for the number of animal units owned (animal units showed no relationship to the mediator or criterion variables). Risk tolerance fully mediated both gross annual income and private acres owned, while partially mediating age and the last year of formal

education completed. Sobel's test of the significance of mediation (Table 3.11) demonstrated that all the variables shown to be mediated by the regression tests were significantly mediated (Figs. 1.1 to 1.5). These tests confirmed our hypothesis that risk tolerance mediated the relationship between rancher demographic characteristics and their use of the internet for ranch management, with the exception of animal units owned.

Gross annual income and private acres owned were excluded from the final regression model because they were fully mediated. The final model regressed age, last year of school completed, and risk tolerance as predictor variables on reliance on the internet for daily ranch management as the dependent variable (Table 3.12). This model accounted for 18% of the variation and had a typical to substantial effect size (.436) (Vaske 2008). Thus, younger ranchers, ranchers with more formal education, and ranchers with greater risk tolerance are all more likely to report a heavier reliance on the internet for ranch management decisions. Ranchers with higher gross income and more private acres were more tolerant of taking risks, and therefore were indirectly more likely to use the internet due to the full mediating effect of risk tolerance on internet reliance.

### **Barriers to Internet Use**

Based on information foraging theory (Pirolli & Card, 1999) we hypothesized that lack of time to find information online and lack of trust in Web-based sources of information would be the greatest obstacles to ranchers' internet use. Lack of time was the most frequent response, with 21.5% of respondents listing time as the single biggest barrier to greater internet use. No internet access (13%), lack of experience using the Web to find information (12.4%), and difficulty determining which online sources to trust (11.9%) were the next most cited obstacles to increased reliance on the Web. These results confirm our hypothesis that lack of time would

be the most significant barrier. We reject our hypothesis that determining which websites to trust would be the second most important barrier, as it was the biggest barrier for approximately 1 in 10 respondents but not the second most common *primary* barrier (Table 3.13). However, lack of trust was the second most commonly reported of all barriers when ranchers were asked to check *all* the barriers that applied rather than the single biggest (Table 3.14). Approximately 1 in 3 ranchers indicated it was a barrier, but only about 1 in 10 indicated it was the biggest barrier.

Data from qualitative interviews indicated that local connectivity issues may pose some barriers to increased adoption of the internet on ranches in rural areas. We hypothesized that regional differences in infrastructure development necessary for reliable internet access would result in significant differences in the reported barriers to Web use. Chi-square tests comparing geographic regions of respondents to three variables measuring connectivity issues found a significant difference in perceptions of internet speed across regions ( $p = .034$ ), and no significant differences across regions in terms of lack of internet access or intermittent/unreliable connections (Table 3.15). Ranchers in northwest Colorado and southeast Wyoming reported slow connections as a barrier to internet use more frequently than did other regions (Table 3.15).

### **Typology of Web-Using Ranchers**

A cluster analysis identified four distinct groups of ranchers based on their responses to questions asking about the degree of influence online information has on specific range and ranch-related topics (Table 3.16). The first cluster (26.8% of respondents with internet access) was “not at all” influenced by online information in their ranch management decisions.

The second cluster (40.1% of respondents with internet access) reported a “moderate degree” of influence of online information on decisions involving ranch purchases or sales (e.g. equipment purchases or livestock marketing), and livestock herd management. This group

reported only a “slight” influence of online information on natural resource management and business management decisions (Table 3.16).

The third group was characterized by a “moderate degree” of influence in all four indices of ranch management topics (25.4% of respondents with Web access). The mean in all four ranch management indices for this group ranged between 2.6 and 3.2 on the scale, indicating a consistently moderate influence of the internet on ranch management decisions for ranchers in this cluster (Table 3.16).

The fourth group was the smallest (7.7% of respondents), but emerged as a distinct cluster in every test run with more than two clusters. This group indicated online information had a “high degree” of influence on their ranch purchases and sales as well as livestock herd management decisions (Table 3.16). They also reported a “moderate degree” of influence of Web-based information on their business management and resource management decisions. This group could best be characterized as Web-oriented.

We combined groups three and four due to four’s low sample size and determined that 33.1% of ranchers with internet access report a moderate to high degree of influence on any of the four ranch management areas. In the ranch sales and purchases and livestock herd management areas, 73.2% of ranchers with internet access fell into clusters characterized by moderate to high degrees of influence by Web-based information.

## **DISCUSSION**

A number of researchers and outreach professionals have written about the high potential for the use of the internet in natural resource-related and agricultural outreach (High & Jacobson, 2005; Jackson, Hopper, & Clatterbuck, 2004; King & Boehlje, 2000; Schoenian & Fritz, 2005).



Our results confirm that the internet could be a useful outreach tool for providing ranchers with timely and relevant information to augment their decisions.

### **Internet Use is Widespread**

The results of our survey indicate that most ranchers in the six regions surveyed have integrated the internet into their operations to some extent, and many have come to use it regularly to inform their management. As one rancher interviewee stated, “everybody's on the internet some”—while this isn't true in a literal sense, our results show that even some ranchers with no internet access on the ranch have gone online. About 17% of the respondents with no internet access on their ranches reported infrequently accessing the internet elsewhere, indicating that even ranchers with no access to the Web at home may seek off-ranch access—the rancher's statements in the interview aptly summarize our results.

A prior survey asking respondents about internet use in Wyoming reported that 82% of respondents had internet access and 42% of respondents with internet access used the internet daily (Kachergis et al., 2013). While our survey had a slightly lower percentage of respondents with on-ranch access (76.1%), we also found a higher percentage of ranchers who used the internet on a daily basis (51.1% of *all* respondents). This may result from regional differences in internet use or access between Wyoming and Colorado.

### **Rancher and Ranch Characteristics Predict Internet Use**

Past research has demonstrated measurable links between the characteristics of a farm or ranch manager or their operation and the degree to which the internet is integrated into their operation (Mishra & Park, 2005). Similarly, other studies have found links between these variables and the risk tolerance of a rancher (Kelley, 2010) as well as the adoption of new management practices (Kennedy & Brunson, 2007). Our results demonstrated similar

relationships between a rancher's personal and operational characteristics and the degree to which they rely on the internet. Age, education, and risk tolerance were significant predictors of dependence on the internet for daily ranch management—younger ranchers, more educated ranchers, and ranchers who are more open to implementing new practices are all more likely to use the internet. However, our model accounted for less than 20% of the variance, determining additional factors leading to greater internet use will require additional investigation. In interviews, ranchers also commented on the existence of a generational gap in reliance on the internet for finding information: "I think it's probably a generational thing, you know, the internet came into my life pretty late and I'm just not used to using it. And I'm not as attuned to using it."

### **Who are the Digital Ranchers?**

Our cluster analysis demonstrated that ranchers can be loosely grouped into four patterns of internet use.

**No influence.** The results of the cluster analysis indicate that approximately one in four ranchers with internet access make little or no use of it for ranch decision-making. The possible reasons for this are manifold—some ranchers may lack the time to access it frequently enough, others may see no need for it because their informational needs are met elsewhere, and some ranchers may have internet access but lack the familiarity with Web use to incorporate it fully. As one rancher described, ranchers with entrenched information-seeking habits may find it difficult or see it as unnecessary to integrate a new source of information into their operation:

"But just, I guess, by a lifetime of habit, I'm more used to referring, you know, my questions, referring to neighbors who may know something about what I'm looking for. The CSU Extension office, I use them a lot, a tremendous amount. Also our NRCS, you know, Natural Resource Conservation Service, I rely on them quite a bit too for help. And the FSA."

**Sales and herds.** Other ranchers rely on the internet to a moderate degree when it comes to decisions about sales and purchases of livestock and ranch equipment, and making decisions affecting livestock genetics, health, nutrition, and handling. This accords with prior research from Iowa which found that producers use the Web to keep careful track of the market conditions influencing their income and expenses (Arbuckle, 2011). However, the same study from Iowa reported a low use of the internet to look up information on livestock production, which suggests possible regional differences in internet use with regards to livestock herd management.

Two of our six interviewees described internet use patterns closely matching this statistical cluster. Both of these ranchers primarily rely on the internet for information on livestock markets and animal health.

“I would say that the primary use for our internet—for the internet—has been checking on market conditions, but also we use it for business communications, vet books—we look up the Merck veterinary manual online frequently[. .]And we’ve used the internet to price equipment, to find out where to buy it and what to buy both with the chemicals and with the spraying equipment. It was useful for that.”

“I do a lot of market searches checking livestock markets and futures markets. I do a lot of communication with, on behalf of the, with the state livestock board of immunizations[. .]”

While one of these ranchers has a spouse who used the internet to look up other topics, both of the participants quoted above emphasized during the interviews that purchases and sales and topics related to livestock herd management formed the bulk of their personal online activity.

**Moderate Web users.** This group of digitally-savvy ranchers is characterized by a moderate reliance on Web-based information for all the categories of ranch management we

measured. The moderate degree of influence reported by respondents in this category indicates their use of the Web to find information on a wide range of topics rather than a specific subset of management issues. One interviewee who best matches this category reported looking up such diverse topics as snowpack levels, weed spraying practices, plant identification, wildfire locations and severity, henhouse plans, and bull prices online. Nevertheless, she indicated the internet remained but one of many information sources for her if she had a question about a specific topic:

“First I would ask a person. Maybe a couple of people. And then I might look it up on the internet. And talk to the Extension agent.”

**Web-oriented ranchers.** The smallest cluster delineated in the analysis consists of ranchers whose decisions in ranch sales and purchases and livestock herd management are highly influenced by the Web. Their decisions in resource management and business management were moderately influenced by online information.

Of the interviewees, the couple with similar internet habits most closely matches this category. Though one of the pair had grown up on a ranch, both had made significant incomes in off-ranch careers and had been highly educated in their fields to prior to purchasing their property at an age far younger than our average survey respondents or other interviewees. They had a ranch website and conducted much of their ranching business online. The couple reported looking up similar topics as our “moderate Web user” interviewee, but placed much higher emphasis on the importance of the Web for their ranch management: “I think the internet will continue to be an increasingly valuable tool,” one stated. This aligns with our survey findings regarding age, education, and risk tolerance predicting internet dependence.

## IMPLICATIONS

The results of this survey demonstrate that the internet has great potential as an outreach tool, considering the degree of influence of online information on many ranchers and the approximately 40% of ranchers who indicated using the Web to access Extension and scientific journals—but like any tool, it also has limitations. Our findings demonstrate that online information has a noteworthy impact on ranchers' decisions, however, our results do not provide evidence that the internet is supplanting traditional sources of information. The demographic predictors of internet use indicate the Web will likely increase in importance as a means of informing ranching and rangeland management decisions.

At the scale of individual ranchers, our results confirmed that lack of time was the single largest barrier to greater dependence on the Web. The results also demonstrated that obstacles to ease of use (namely lack of experience using the internet), finding information specific to a rancher's situation, and determining which sources to trust were commonly-reported issues, with about 1 in 3 ranchers indicating them as obstacles (Table 3.14). This corroborates the theoretical underpinnings of both Pirolli and Card's information foraging theory (1999) and credibility theory (Metzger, 2007) which indicate that the ease with which information can be accessed as constraints on the usefulness of a website for outreach purposes, as does the difficulty determining which digital information sources can be trusted. Outreach websites could minimize these constraints by ensuring visitors can find relevant information quickly, and by taking steps to ensure the website's credibility is readily perceptible. While webmasters cannot influence the lack of experience a rancher has with finding information online, the increasing rates of internet use in rural areas as well as the changing demographics of today's ranchers may minimize the role of such obstacles in the future.

On a larger scale, our results provide potential target audiences for outreach professionals depending on the outreach project's goals. For example, digital outreach projects directly related to livestock herd management decisions could potentially exert a moderate to high influence on about 73% of ranchers with internet access, whereas Web-based outreach regarding natural resource management could ostensibly exert a moderate to high influence on about 33% of respondents. As risk tolerance was shown to significantly predict internet reliance in our study, as well as the adoption of ranching innovations in previous studies (Kelley, 2010; Kennedy & Brunson, 2007), it is likely that online outreach promoting specific innovations in ranch management could facilitate the diffusion of these innovations across a population. This possibility warrants further study.

The demographics of ranchers in the West are changing. Brunson and Huntsinger (2008) point out that the ranching population of the West, like many rural populations is aging—concordantly, the average respondent in our survey was over 60 years old. Based on these demographic trends and the significant inverse relationship we found between age and internet reliance, it is likely that dependence on the internet for finding information and making operational decisions will increase as properties are handed over to new managers in the coming years. As such, the importance of the internet in rangeland and ranching outreach is likely to increase over time and the internet's role in shaping range management decisions deserves further study.

## Tables

**Table 3.1.** The results of a factor analysis of ten facets of ranch management using varimax with Kaiser normalization to compute new variables with which we conducted a cluster analysis.

| <b>Variables</b>                     | <b>Component 1</b> | <b>Component 2</b> | <b>Variable formed</b>    |
|--------------------------------------|--------------------|--------------------|---------------------------|
| Livestock purchasing                 | .814               | ---                | Ranch sales and purchases |
| Livestock marketing                  | .868               | ---                |                           |
| Buying/selling equipment             | .668               | ---                |                           |
| Buying/selling feed or hay           | .625               | .465               |                           |
| Infrastructure development           | .469               | .533               | Ranch business management |
| Energy development                   | .603               | .406               |                           |
| Tourism/hunting                      | ---                | .444               |                           |
| Participation in government programs | ---                | .720               |                           |
| Conservation easements               | ---                | .824               |                           |
| Estate planning                      | ---                | .711               |                           |

**Table 3.2.** The self-reported characteristics of ranchers who responded to our survey.

|   | <b>Mean</b> | <b>Standard Error</b> | <b>Median</b> |
|---|-------------|-----------------------|---------------|
| <i>Age</i>  | 60.5        | .66                   | 61            |
| <i>Years managing operation</i>                             | 28.6        | .81                   | 26            |
| <i>Percentage of income from various sources</i>            |             |                       |               |
| Livestock   | 46.4        | 2.24                  | 40            |
| Crops   | 15.0        | 1.72                  | 0             |
| Wildlife  | 2.0         | .59                   | 0             |
| Other on-ranch sources                                      | 1.6         | .57                   | 0             |
| Off-ranch sources   | 34.8        | 2.33                  | 20            |
| <i>Percentage of operation in different land ownerships</i> |             |                       |               |
| Private   | 77.4        | 1.54                  | 95            |
| United States Forest Service                                | 4.6         | .71                   | 0             |
| State Land  | 4.6         | .67                   | 0             |
| Bureau of Land Management                                   | 9.1         | 1.06                  | 0             |
| Other land  | 4.5         | .87                   | 0             |
| <i>Percentage of operation labor supplied by family</i>     | 86.1        | 1.40                  | 100           |
| <i>Operation size (animal units)</i>                        | 238.0       | 33.41                 | 90            |

**Table 3.3.** The self-reported educational level of ranchers based on their last year of school completed.

| <b>Level of education completed</b>    | <b>Percentage of respondents<br/>(n = 374)</b> |
|--|--|
| Grade school                           | 0.5  |
| Some high school                       | 3.2  |
| Completed high school or GED           | 26.7   |
| Some college or vocational/tech school | 31.8   |
| Completed 4 year college deg.          | 27.3   |
| Completed GS or professional degree    | 10.4   |

**Table 3.4.** Respondents were asked to indicate their gross annual income by checking the appropriate bracket.

| <b>Income</b>         | <b>Percent of respondents<br/>(n = 293)</b> |
|-----------------------|---|
| Less than \$19K       | 1.7   |
| \$20-49K              | 14  |
| \$50-79K              | 21.2  |
| \$80-199K             | 35.5  |
| \$200-499K            | 17.4  |
| \$500-799K            | 5.1   |
| \$800-999K            | 1.7   |
| \$1-5 million         | 2   |
| More than \$5 million | 1.4   |

**Table 3.5.** Devices used by rancher respondents to access the Web.

| <b>Methods of access</b>    | <b>Percent of respondents (n = 377)</b> |
|-----------------------------|---|
| No internet access on ranch | 23.9                                    |
| Dial-up connection          | 9.8                                     |
| High-speed connection       | 63.7                                    |
| Smartphone                  | 14.3                                    |

**Table 3.6.** The number of devices (e.g. smartphone and computer with dial-up or high-speed connections) used by ranchers with internet access to go online.

| <b>Number of devices</b> | <b>Percent of respondents (n = 287)</b> |
|--------------------------|---|
| One device               | 84.7                                    |
| Two devices              | 15.3                                    |

**Table 3.7.** The self-reported frequency of internet use by ranchers based on a question with the above five categories of access frequency.

| <b>Frequency of Web use</b> | <b>Percent of rancher respondents (n = 366)</b> |
|-----------------------------|---|
| Daily                       | 51.1  |
| Weekly                      | 12.8  |
| Monthly                     | 5.2   |
| Very rarely                 | 10.7  |
| Never                       | 20.2  |



**Table 3.8.** The percentage of rancher respondents who reported using the internet to access the listed sources. The total number of respondents to each question is listed in the column on the right due to the low response rate to this question.

| <b>Source</b>                 | <b>Percent who have accessed this source online (no. who have used the source)</b> | <b>Total no. of respondents</b> |
|-------------------------------|--|---------------------------------|
| Extension                     | 39.7 (29)  | 73                              |
| Private Companies             | 39.2 (20)  | 51                              |
| Industry Magazines            | 36.2 (25)  | 69                              |
| Scientific Journals           | 35.8 (19)  | 53                              |
| Environmental Organizations   | 1.9 (1)  | 54                              |
| County or City Weed Authority | 9.2 (6)  | 65                              |
| Local or Regional Newspaper   | 23 (14)  | 61                              |
| State Government Agency       | 18.8 (12)  | 64                              |
| Federal Agency                | 37 (27)  | 73                              |
| Conferences or Workshops      | 26.6 (17)  | 64                              |
| Family, Friends, Peers        | 13.5 (10)  | 74                              |
| Agricultural Organizations    | 28.8 (19)  | 66                              |
| Professional Associations     | 19.2 (10)  | 52                              |

**Table 3.9.** Questions asked whether ranchers had used the internet to find information on specific topics. Of all respondents, 50.8% reported never using the internet to find information on any of these topics.

| <b>Topic</b>                | <b>Percent of all respondents who used the internet to look up the topic (n = 128)</b> |
|-----------------------------|--|
| Grazing management          | 42.2   |
| Drought management          | 38.3   |
| Rangeland monitoring        | 26.6   |
| Cheatgrass management       | 12.5   |
| State-and-transition models | 5.5  |

**Table 3.10.** Ranchers were asked to what extent the internet influences decisions in each of the categories below on a five-point scale, with 1 being not at all, and 5 being a very high degree.

| Category (no. of valid responses)                              | Mean | Median | Standard error | Percent of respondents |               |                 |             |                  |
|--|------|--------|----------------|------------------------|---------------|-----------------|-------------|------------------|
|  |      |        |                | Not at all             | Slight degree | Moderate degree | High degree | Very high degree |
| <b>Ranch Business Management</b>                               |      |        |                |                        |               |                 |             |                  |
| Livestock purchasing (158)                                     | 2.51 | 3      | .095           | 27.2                   | 19.6          | 35.4            | 10.8        | 7                |
| Livestock marketing (164)                                      | 2.84 | 3      | .097           | 18.3                   | 19.5          | 32.9            | 18.3        | 11               |
| Buying/selling equipment (162)                                 | 2.83 | 3      | .092           | 14.8                   | 24.1          | 35.2            | 15.4        | 10.5             |
| Buying/selling feed or hay (158)                               | 2.47 | 2      | .095           | 27.2                   | 24.1          | 29.1            | 13.9        | 5.7              |
| Infrastructure development (157)                               | 2.33 | 2      | .089           | 28.0                   | 29.3          | 28.7            | 9.6         | 4.5              |
| Energy development (136)                                       | 1.96 | 2      | .091           | 44.1                   | 25.7          | 23.5            | 2.9         | 3.7              |
| Tourism/hunting (133)  | 1.67 | 1      | .088           | 60.9                   | 21.8          | 8.3             | 7.5         | 1.5              |
| Participation in government programs (147)                     | 2.0  | 2      | .085           | 40.1                   | 29.9          | 21.8            | 6.1         | 2.0              |
| Conservation easements (141)                                   | 1.53 | 1      | .068           | 62.4                   | 25.5          | 9.2             | 2.1         | 0.7              |
| Estate planning (146)  | 1.95 | 2      | .093           | 47.3                   | 24.7          | 19.2            | 4.1         | 4.8              |
| <b>Resource Management</b>                                     |      |        |                |                        |               |                 |             |                  |
| Weather forecast/prediction (171)                              | 3.69 | 4      | .096           | 8.2                    | 7.6           | 26.9            | 21.6        | 35.7             |
| Rangeland assessment or monitoring (158)                       | 2.03 | 2      | .079           | 36.7                   | 32.3          | 24.1            | 5.1         | 1.9              |
| Invasive species or weed management (160)                      | 2.24 | 2      | .083           | 30.0                   | 29.4          | 30.0            | 8.1         | 2.5              |
| Grazing management (160)                                       | 2.31 | 2      | .090           | 30.6                   | 26.3          | 30.0            | 8.1         | 5                |
| Rangeland seeding (150)  | 1.96 | 2      | .083           | 42.0                   | 28.7          | 23.3            | 3.3         | 2.7              |
| Prescribed fire (145)  | 1.46 | 1      | .063           | 67.6                   | 22.1          | 8.3             | 1.4         | 0.7              |
| Wildlife or habitat management (154)                           | 1.92 | 2      | .078           | 42.2                   | 31.2          | 21.4            | 3.2         | 1.9              |
| Drought management (160)                                       | 2.42 | 2.5    | .091           | 29.4                   | 20.6          | 31.3            | 16.3        | 2.5              |
| Wildfire or other natural disaster preparedness/recovery (152) | 2.03 | 2      | .089           | 40.8                   | 28.9          | 19.7            | 7.2         | 3.3              |
| Predator control (154)   | 1.97 | 2      | .095           | 48.7                   | 22.1          | 18.2            | 5.8         | 5.2              |
| <b>Livestock Herd Management</b>                               |      |        |                |                        |               |                 |             |                  |
| Livestock genetics/breeding (164)                              | 2.8  | 3      | .099           | 20.1                   | 19.5          | 32.3            | 16.5        | 11.6             |
| Livestock health/veterinary care (166)                         | 2.81 | 3      | .094           | 19.3                   | 17.5          | 34.9            | 19.3        | 9                |
| Feeding/nutrition/forage quality (163)                         | 2.58 | 3      | .091           | 24.5                   | 18.4          | 37.4            | 14.1        | 5.5              |
| Low stress livestock handling (160)                            | 2.34 | 2      | .096           | 31.3                   | 25.6          | 28.1            | 7.5         | 7.5              |

**Table 3.11.** We used Sobel tests (1982) to determine if mediation was significant or not with risk tolerance as the mediator and reliance on the internet as the criterion variable.

| Predictor variables | z-value | Standard error | p-value |
|---------------------|---------|----------------|---------|
| Education           | 2.895   | .022           | .004**  |
| Gross annual income | 2.825   | .021           | .004**  |
| Age                 | 2.763   | .002           | .005**  |
| Private acres       | 2.404   | .015           | .02*    |

\*Significant at the  $p < .05$  level.

\*\*Significant at the  $p < .01$  level.

**Table 3.12.** This regression model excluded all variables fully mediated by risk orientation to provide a predictive model for reliance on the internet by ranchers with known age, education, and risk tolerance characteristics.

| Variable         | Adjusted $r^2$ | Standard error of the estimate | Standardized $\beta$ | $t$    | p-value |
|------------------|----------------|--------------------------------|----------------------|--------|---------|
| Age              | .183           | 1.167                          | -.248                | -4.763 | <.001*  |
| Education        |                |                                | .187                 | 3.575  | <.001*  |
| Risk Orientation |                |                                | .223                 | 4.206  | <.001*  |

\*Significant at the  $p < .01$  level.

**Table 3.13.** Rancher respondents were asked to choose the single biggest barrier to their use of the internet on the ranch.

| Barrier   | Percent of respondents (n = 177) |
|---|----------------------------------|
| No internet access                                      | 13.0 (23)                        |
| Slow internet speed                                     | 7.3 (13)                         |
| Unreliable connection                                   | 4.0 (7)                          |
| Lack of time to find information online                 | 21.5 (38)                        |
| Determining which websites to trust                     | 11.9 (21)                        |
| Lack of experience using the Web                        | 12.4 (22)                        |
| Difficulty finding information specific to my operation | 7.9 (14)                         |
| Information needs already filled by other sources       | 4.0 (7)                          |
| No barriers   | 10.2 (18)                        |
| Other   | 7.9 (14)                         |

**Table 3.14.** Rancher respondents were asked to choose all barriers to their use of the internet on the ranch that applied.

| Barrier   | Percent of respondents (n = 233) |
|---|----------------------------------|
| No internet access                                      | 15.5 (36)                        |
| Slow internet speed                                     | 19.3 (45)                        |
| Unreliable connection                                   | 11.2 (26)                        |
| Lack of time to find information online                 | 36.5 (85)                        |
| Determining which websites to trust                     | 34.3 (80)                        |
| Lack of experience using the Web                        | 29.6 (69)                        |
| Difficulty finding information specific to my operation | 30.5 (71)                        |
| Information needs already filled by other sources       | 13.7 (32)                        |
| No barriers   | 12.4 (29)                        |
| Other   | 6.4 (15)                         |

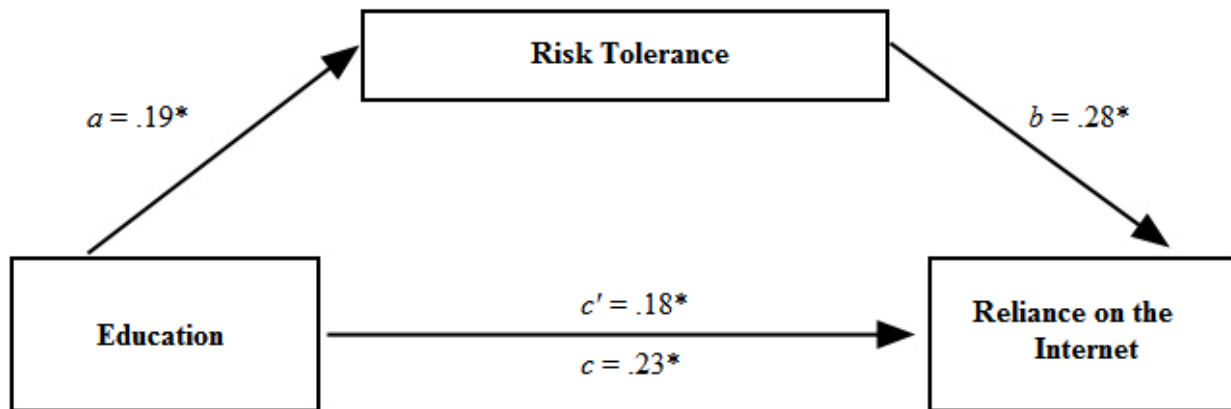
**Table 3.15.** We conducted Chi-square tests to determine if there were regional differences in accessibility-related barriers to internet use. Ranchers were asked to check all barriers that served as obstacles to their use of the Internet.

| Barrier                                | Percent of respondents in each region (frequency) |                       |                    |                    |                    |                  | Sig.      | Pearson |        |
|--|---|-----------------------|--------------------|--------------------|--------------------|------------------|-----------|---------|--------|
|  | Southeast Wyoming                                 | South Central Wyoming | Northeast Colorado | Southeast Colorado | Northwest Colorado | Western Colorado |           |         |        |
| Slow internet speed                    | Is not a barrier                                  | 75 (28)               | 91.2 (23)          | 89.7 (37)          | 82.1 (34)          | 79.5 (28)        | 89.1 (38) | .292    | 6.152  |
|  | Is a barrier                                      | 25 (8)                | 8.8 (11)           | 10.3 (2)           | 17.9 (5)           | 20.5 (11)        | 10.9 (8)  |         |        |
| Unreliable internet connection         | Is not a barrier                                  | 77.8 (27)             | 67.6 (31)          | 94.9 (35)          | 87.2 (32)          | 71.8 (31)        | 82.6 (41) | .034*   | 12.084 |
|  | Is a barrier                                      | 22.2 (9)              | 32.4 (3)           | 5.1 (4)            | 12.8 (7)           | 28.2 (8)         | 17.4 (5)  |         |        |
| No internet access                     | Is not a barrier                                  | 88.9 (32)             | 73.5 (25)          | 94.9 (37)          | 92.3 (36)          | 92.3 (36)        | 89.1 (41) | .064    | 10.421 |
|  | Is a barrier                                      | 11.1 (4)              | 26.5 (9)           | 5.1 (2)            | 7.7 (3)            | 7.7 (3)          | 10.9 (5)  |         |        |
| *Test is significant at the .05 level. |   |                       |                    |                    |                    |                  |           |         |        |

**Table 3.16.** Results of a cluster analysis based on four indices of ranch management decision areas. Ranchers were asked to choose the degree of influence by online information on 24 management areas on a scale of 1 to 5, with 1 being “not at all” and 5 being a “very high degree” of influence. Percentages reported are from respondents with internet access on the ranch.

| Cluster group                       | Mean                    |                     |                     |                           | Percent of Respondents (n = 142) |
|-------------------------------------|-------------------------|---------------------|---------------------|---------------------------|----------------------------------|
|                                     | Ranch Sales & Purchases | Business Management | Resource Management | Livestock Herd Management |                                  |
| <b>No influence (Group 1)</b>       | 1.5                     | 1.2                 | 1.3                 | 1.4                       | 26.8                             |
| <b>Sales and herds (Group 2)</b>    | 2.6                     | 1.7                 | 2.2                 | 2.8                       | 40.1                             |
| <b>Moderate Web users (Group 3)</b> | 3.1                     | 2.6                 | 2.9                 | 3.2                       | 25.4                             |
| <b>Web-oriented (Group 4)</b>       | 4.4                     | 2.8                 | 3.0                 | 4.4                       | 7.7                              |

## Figures



**Figure 3.1** Test of mediation with reliance on the internet as a criterion variable, risk tolerance as the mediator, and education as the predictor variable. Partial mediation was confirmed.

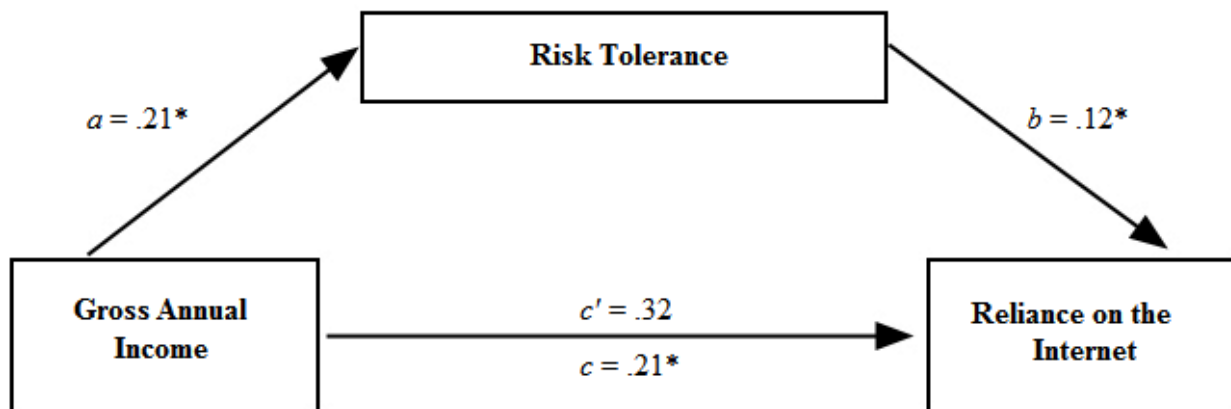
\*All standardized coefficients were significant at the  $p < .05$  level.

a = Coefficient value of the mediator variable regressed on the predictor variable (Adjusted  $R^2 = .03$ )

b = Coefficient value of the criterion variable regressed on the mediator variable (Adjusted  $R^2 = .12$ )

c = Coefficient value of the criterion variable regressed on the predictor variable (Adjusted  $R^2 = .05$ )

c' = Coefficient value of the criterion variable regressed on the predictor variable, when the mediator variable is included in the regression (Adjusted  $R^2 = .12$ )



**Figure 3.2** Test of mediation with reliance on the internet as a criterion variable, risk tolerance as the mediator, and income as the predictor variable. Full mediation was confirmed.

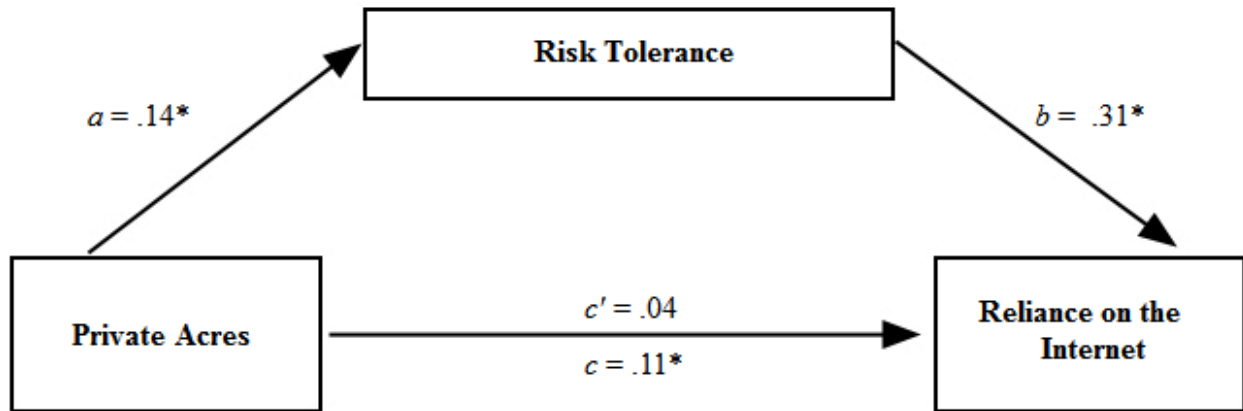
\*All standardized coefficients were significant at the  $p < .05$  level.

a = Coefficient value of the mediator variable regressed on the predictor variable (Adjusted  $R^2 = .04$ )

b = Coefficient value of the criterion variable regressed on the mediator variable (Adjusted  $R^2 = .12$ )

c = Coefficient value of the criterion variable regressed on the predictor variable (Adjusted  $R^2 = .04$ )

c' = Coefficient value of the criterion variable regressed on the predictor variable, when the mediator variable is included in the regression (Adjusted  $R^2 = .12$ )



**Figure 3.3** Test of mediation with reliance on the internet as a criterion variable, risk tolerance as the mediator, and private acres as the predictor variable. Full mediation was confirmed.

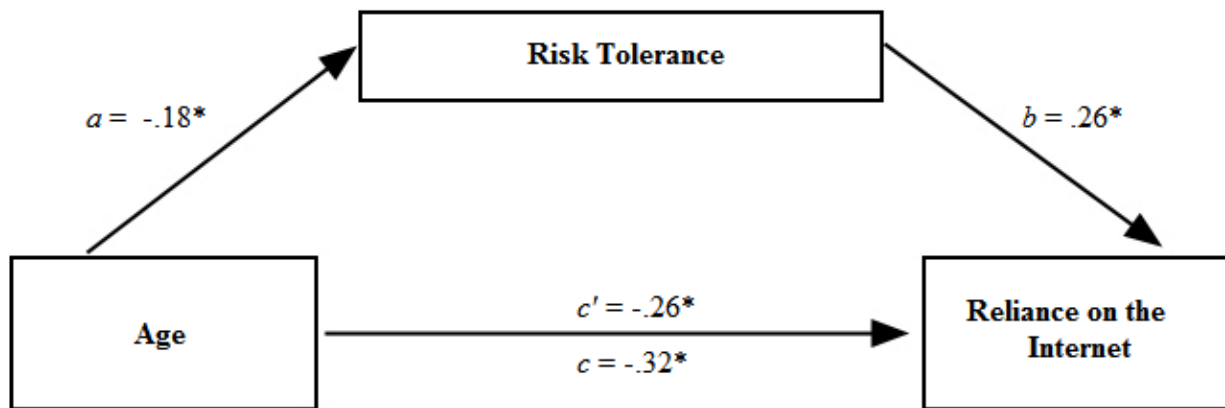
\*All standardized coefficients were significant at the  $p < .05$  level.

a = Coefficient value of the mediator variable regressed on the predictor variable (Adjusted  $R^2 = .02$ )

b = Coefficient value of the criterion variable regressed on the mediator variable (Adjusted  $R^2 = .01$ )

c = Coefficient value of the criterion variable regressed on the predictor variable (Adjusted  $R^2 = .01$ )

c' = Coefficient value of the criterion variable regressed on the predictor variable, when the mediator variable is included in the regression (Adjusted  $R^2 = .01$ )



**Figure 3.4** Test of mediation with reliance on the internet as a criterion variable, risk tolerance as the mediator, and age as the predictor variable. Partial mediation was confirmed.

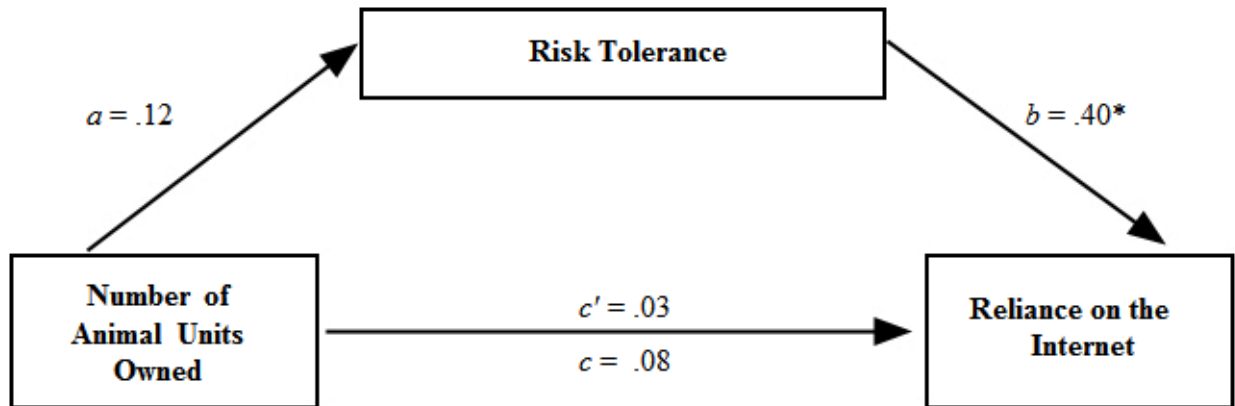
\*All standardized coefficients were significant at the  $p < .05$  level.

a = Coefficient value of the mediator variable regressed on the predictor variable (Adjusted  $R^2 = .03$ )

b = Coefficient value of the criterion variable regressed on the mediator variable (Adjusted  $R^2 = .15$ )

c = Coefficient value of the criterion variable regressed on the predictor variable (Adjusted  $R^2 = .10$ )

c' = Coefficient value of the criterion variable regressed on the predictor variable, when the mediator variable is included in the regression (Adjusted  $R^2 = .15$ )



**Figure 3.5** Test of mediation with reliance on the internet as a criterion variable, risk tolerance as the mediator, and the number of animal units owned as the predictor variable. No mediation was confirmed.

\*All standardized coefficients were significant at the  $p < .05$  level.

a = Coefficient value of the mediator variable regressed on the predictor variable (Adjusted  $R^2 = .01$ )

b = Coefficient value of the criterion variable regressed on the mediator variable (Adjusted  $R^2 = .15$ )

c = Coefficient value of the criterion variable regressed on the predictor variable (Adjusted  $R^2 = .00$ )

c' = Coefficient value of the criterion variable regressed on the predictor variable, when the mediator variable is included in the regression (Adjusted  $R^2 = .15$ )



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## CHAPTER IV

### CONCLUSION

While ranchers have a diversity of operation characteristics and management approaches, they all share a need for access to timely and useful information to make decisions affecting the ecological and financial resilience of their ranches. Our research provides a basis for understanding the current state of range-related websites as well as the use of the Web by ranchers to inform their ranch management decisions. As the economic, ecological, and political landscapes of the West continue to change, our findings indicate that the internet is providing many ranchers with information that influences the decisions they make about essential ranch management activities. As more and more ranches are turned over to younger managers, we anticipate the role of the internet will not diminish, but rather grow with time.

The implications of this research for rangeland outreach personnel are manifold. First, though our results demonstrate that online information has a noteworthy impact on ranchers' decisions, our results do not indicate that the internet is supplanting traditional sources of information. As both interviewees and survey respondents indicated, many ranchers are using the internet as a convenient way to access traditional sources of information such as Extension and federal land management agencies. Additional research is required to determine how online information is processed and how the internet relates to other sources of information as individual ranchers find information and make decisions about adopting innovations by triangulating information from a variety of sources. Past research by Rogers and Beal (1958) indicates that impersonal sources of information figure more prominently when an agricultural producer is learning about an innovation, and personal interactions and social networks play a

larger role if or when a rancher takes steps to operationalize an innovation. Based on our findings and past theory, additional research into how online information is disseminated throughout social networks would provide a more nuanced picture of the scope of the Web's influence on decisions affecting Western rangelands.

Second, ranchers with Web access can be grouped into specific Web use typologies that outreach personnel can target depending on the goals of their outreach projects. Stephenson (2003) suggested the use of targeted, tailor-made information by outreach personnel to avoid creating or exacerbating gaps in knowledge and financial viability among agricultural producers. Our Web use typologies demonstrate consistent and measurable differences in reliance on the Web among ranchers that may facilitate the application of Stephenson's (2003) recommendation to digital outreach. We suggest that rangeland outreach personnel should consider the potential influence of a digital outreach strategy based on which aspect(s) of ranch management the program may fall under (i.e. ranch sales and purchases, ranch business management, resource management, or livestock herd management) and which segments of the population the program is most likely to reach.

Another major consideration for outreach personnel weighing the use of digital outreach in their programs is that ranchers cited lack of time more than any other barrier as the most significant obstacle to their use of the Web. This suggests that outreach programs using the Web should seek to minimize the time it takes for ranchers to find pertinent information on their sites. Our findings corroborated the assertion of information foraging theory (Pirolli & Card, 1999) that information-seeking behavior is a function of the perceived benefits of the information weighed against the constraints of the effort expended in finding information. As such, much like

a well-planned grazing system, outreach websites should be designed to guide visitors into areas where they can readily forage the information that most ably meets their needs.

The assessment of range-related websites indicated that webmasters may take several simple steps to maximize the potential perceived credibility of their websites as well as the impact the site's information may have on visitors' attitudes about a topic. When creating or redesigning a website, it may benefit webmasters to make a checklist of message characteristics and structural features to determine which factors past research has demonstrated are affiliated with perceived credibility may be better incorporated into the website. Commercial or politically-oriented websites in our sample could have benefited from a greater incorporation of citations, while educational websites could consider incorporating more testimonials and quotations. If an outreach website is intended to alter the attitudes of visitors about a topic, particular attention should be paid to maximizing the presence of message characteristics on the website (Rains & Karmikel, 2009). For this reason, even websites with a more scientific orientation could improve their efficacy by incorporating quotations and testimonials to supplement the communication of their research results. In our assessment, the educational sites in our sample had a lower frequency of the use of these two message characteristics than the advocacy or commercial website types.

Our research should be considered a starting point for further investigation into the role of the internet in ranchers' information-seeking and decision making behavior. Further research is needed to determine how online information diffuses through ranchers' social networks. Additionally, more information about how ranchers triangulate information from a variety of sources—including the Web—would provide more context for evaluating the potential efficacy of Web-based outreach efforts.

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APPENDIX A: WEBSITES INCLUDED IN THE WEB ASSESSMENT

| <b>Website Title</b>                                     | <b>URL</b>  | <b>Website Type</b> |
|--|---|---------------------|
| BEHAVE   | <a href="http://extension.usu.edu/behave/">http://extension.usu.edu/behave/</a>   | Educational         |
| Chilton Ranch  | <a href="http://www.chiltonranch.com">http://www.chiltonranch.com</a>   | Advocacy            |
| Colorado Resource Monitoring Initiative                  | <a href="http://www.coloradocattle.org/crmi.aspx">http://www.coloradocattle.org/crmi.aspx</a>                                   | Educational         |
| Colorado Weed Management Association                     | <a href="http://www.cwma.org/">http://www.cwma.org/</a>   | Educational         |
| ECOLOGICAL MONITORING & ASSESSMENT PROGRAM & FOUNDATION  | <a href="http://www.landsward.org/index.asp">http://www.landsward.org/index.asp</a>   | Educational         |
| eXtension Rangeland Education                            | <a href="http://www.extension.org/pages/62505/rangeland-education">http://www.extension.org/pages/62505/rangeland-education</a> | Educational         |
| forestandrange.org                                       | <a href="http://www.forestandrange.org">www.forestandrange.org</a>  | Educational         |
| Global Rangelands  | <a href="http://globalrangelands.org/">http://globalrangelands.org/</a>   | Educational         |
| Grazing Lands Conservation Initiative                    | <a href="http://www.glci.org/">http://www.glci.org/</a>   | Educational         |
| Holistic Management                                      | <a href="http://holisticmanagement.org/">http://holisticmanagement.org/</a>   | Commercial          |
| Idaho Rangeland Resource Commission                      | <a href="http://idrangeland.org">http://idrangeland.org</a>   | Educational         |
| Life on the Range  | <a href="http://www.lifeontherange.org/index.htm">http://www.lifeontherange.org/index.htm</a>                                   | Advocacy            |
| Livestock for Landscapes                                 | <a href="http://www.livestockforlandscapes.com/">http://www.livestockforlandscapes.com/</a>                                     | Commercial          |
| Nevada Rangeland Resources Commission                    | <a href="http://www.nevadarangelands.org">http://www.nevadarangelands.org</a>   | Advocacy            |
| OnePlan  | <a href="http://www.oneplan.org/Range/index.asp">http://www.oneplan.org/Range/index.asp</a>                                     | Educational         |
| Progressive Forage Grower                                | <a href="http://progressiveforage.com">http://progressiveforage.com</a>   | Commercial          |
| Public Lands Council Sage Grouse Conservation Library    | <a href="http://grazingforgrouse.com/">http://grazingforgrouse.com/</a>   | Educational         |
| Quivira Coalition  | <a href="http://quiviracoalition.org/index.html">http://quiviracoalition.org/index.html</a>                                     | Advocacy            |
| Range  | <a href="http://www.rangemagazine.com">http://www.rangemagazine.com</a>   | Commercial          |
| Range Science Information System (RSIS)                  | <a href="http://arc.lib.montana.edu/range-science/">http://arc.lib.montana.edu/range-science/</a>                               | Educational         |
| Rangeland Conservation Science                           | <a href="http://www.rangelandconservation.com/">http://www.rangelandconservation.com/</a>                                       | Commercial          |
| Rangelands West  | <a href="http://rangelandswest.arid.arizona.edu/rangelandswest/">http://rangelandswest.arid.arizona.edu/rangelandswest/</a>     | Educational         |
| RangeNet   | <a href="http://www.rangenet.org/">http://www.rangenet.org/</a>   | Advocacy            |
| Rocky Mountain Cheatgrass Management Project             | <a href="http://wp.natsci.colostate.edu/rmcmp/">http://wp.natsci.colostate.edu/rmcmp/</a>                                       | Educational         |
| Sage Grouse Initiative                                   | <a href="http://sagegrouseinitiative.com/">http://sagegrouseinitiative.com/</a>   | Educational         |
| SageSTEP (Sagebrush Steppe Treatment Evaluation Project) | <a href="http://www.sagestep.org/">http://www.sagestep.org/</a>   | Educational         |

|   |   |             |
|---|---|-------------|
| Savory Institute                            | <a href="http://www.savoryinstitute.com/">http://www.savoryinstitute.com/</a>   | Commercial  |
| Sustainable Rangelands Roundtable           | <a href="http://sustainableangelands.org/">http://sustainableangelands.org/</a>   | Advocacy    |
| Targeted Grazing                            | <a href="http://www.cnr.uidaho.edu/rx-grazing/index.htm">http://www.cnr.uidaho.edu/rx-grazing/index.htm</a>                     | Educational |
| Targeted Grazing                            | <a href="http://sheepindustrynews.org/Targeted-Grazing/index.html">http://sheepindustrynews.org/Targeted-Grazing/index.html</a> | Educational |
| The Center for Native Grasslands Management | <a href="http://nativegrasses.utk.edu/index.htm">http://nativegrasses.utk.edu/index.htm</a>                                     | Educational |
| The Jornada                                 | <a href="http://jornada.nmsu.edu/">http://jornada.nmsu.edu/</a>   | Educational |
| The Landscape Toolbox                       | <a href="http://www.landscapetoolbox.org/">http://www.landscapetoolbox.org/</a>   | Educational |
| The Progressive Rancher                     | <a href="http://www.progressiverancher.com">http://www.progressiverancher.com</a>   | Commercial  |
| The Public Lands Council                    | <a href="http://www.publiclandscouncil.org">http://www.publiclandscouncil.org</a>   | Advocacy    |
| The Society for Range Management            | <a href="http://www.rangelands.org/">http://www.rangelands.org/</a>   | Educational |
| Undaunted Stewardship                       | <a href="http://www.undauntedstewardship.montana.edu/">http://www.undauntedstewardship.montana.edu/</a>                         | Advocacy    |
| Western Watersheds Project                  | <a href="http://www.westernwatersheds.org/">http://www.westernwatersheds.org/</a>   | Advocacy    |
| Wyoming Rangelands                          | <a href="http://www.uwyo.edu/esm/wy/about.html">http://www.uwyo.edu/esm/wy/about.html</a>                                       | Educational |
| Wyoming Weed & Pest Council                 | <a href="http://www.wyoweed.org/">http://www.wyoweed.org/</a>   | Educational |

APPENDIX B: REGIONS TARGETED IN THE SELF-ADMINISTERED MAIL SURVEY

**Region**

Counties

**Southeast Wyoming Region**

Converse

Niobrara

Goshen

Platte

Laramie

Albany

**South Central Wyoming**

Carbon

Sweetwater

**Northeast Colorado**

Larimer

Weld

Yuma

Washington

**Southeast Colorado**

Crowley

Kiowa

Baca

**Northwest Colorado**

Routt

Moffat

**Western Colorado**

Delta

Montrose

Ouray

San Miguel

APPENDIX C: PRE-SURVEY LETTER



*Knowledge to Go Places*  
Department of Forest, Rangeland, & Watershed Stewardship  
Fort Collins, Colorado 80523-1472 USA  
Telephone (970) 491-6911  
FAX (970) 491-6754  
<http://www.cnr.colostate.edu/frws/>

April XX, 2013

Mr./Ms./Mrs. First Name Last Name  
Mailing Address  
City, State, Zip Code

Dear Mr./Ms./Mrs. Last Name,

In about a week you will receive in the mail a request to fill out an important questionnaire. This questionnaire will help to inform two related research and extension projects being carried out with public and private partners in Colorado and Wyoming, including Colorado State University, Colorado State University Extension, and University of Wyoming Extension.

The questionnaire is about ranchers' and land managers' knowledge, management practices, internet use, and information needs related to grazing and rangeland management.

We are writing in advance because we have found that many people like to know ahead of time that they will be contacted. This questionnaire will help us to create tools useful to ranchers and land managers and to evaluate the effectiveness of our research and outreach activities. The information you provide can help us to understand ranchers' and land managers' current knowledge, experiences, and opinions about specific management practices, which will help to inform our future outreach efforts.

Thank you in advance for your time and consideration. It's only with the generous help of people like you that our research and extension projects can be successful in informing future grazing and rangeland management decisions.

Sincerely,

Maria Fernandez-Gimenez, Ph.D.  
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Colorado State University  
(970) 491-0409  
[Maria.Fernandez-Gimenez@colostate.edu](mailto:Maria.Fernandez-Gimenez@colostate.edu)

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Colorado State University  
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APPENDIX D: SELF-ADMINISTERED MAIL SURVEY



# Grazing and Rangeland Management: A Survey for Ranchers

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Your responses will be kept confidential. Survey results will be reported in summary form so that individual responses cannot be identified.

Thank you in advance for your time and consideration in completing this survey. Your input will help us and our partners better serve all Wyoming and Colorado ranchers into the future.



**I: OPERATION CHARACTERISTICS**

In the first section, we ask you a few questions to gain a better understanding of the nature of your ranching operation.

1) **Approximately, what percentage of your ranching operation falls into each of the following land ownership categories? Write in the estimated percent.**

- Private \_\_\_\_\_%
- U.S. Forest Service \_\_\_\_\_%
- State Lands \_\_\_\_\_%
- Bureau of Land Management (BLM) \_\_\_\_\_%
- Other (please specify) \_\_\_\_\_%
- Total 100%**

2) **About how many private acres of land do you have in your ranching operation? Check one.**

- Less than 100 acres
- 100 – 249 acres
- 250 – 499 acres
- 500 - 999 acres
- 1,000 – 4,999 acres
- 5,000 acres or more

3) **As of January 2013, about how many head of cattle, sheep, horses and other livestock did you have on your ranching operation? Please write in a number, write "0" if none.**

- Cow-calf pairs \_\_\_\_\_
- Dry cows \_\_\_\_\_
- Yearling (stocker) cattle \_\_\_\_\_
- Sheep \_\_\_\_\_
- Goats \_\_\_\_\_
- Horses \_\_\_\_\_
- Other (Please list.) \_\_\_\_\_

4) **What percent of your ranching operation’s annual labor is supplied by the family? \_\_\_\_\_ %**

5) **About how many years have you managed this ranching operation? \_\_\_\_\_ years**

**II: NATURAL RESOURCE MANAGEMENT GOALS** Please tell us about your resource management goals.

1) **Grazing management involves balancing many goals. Below is a list of goals sometimes associated with grazing. Please rank the goals as they relate to the PRIORITIES you have in your operation.**

- |                         |                                  |                  |
|-------------------------|----------------------------------|------------------|
| A. Livestock production | D. Invasive plant management     | G. Soil health   |
| B. Forage production    | E. Recreation                    | H. Water quality |
| C. Carbon sequestration | F. Riparian and/or meadow health | I. Wildlife      |

**Please rank the goals above as they relate to the priorities you have for your operation. (1 is the highest priority; 9 is the lowest priority. Write the letter associated with the goal on the line next to the appropriate ranking below. If a goal is not applicable to your operation, please do not include it in the ranking.)**

|          |          |          |
|----------|----------|----------|
| 1. _____ | 4. _____ | 7. _____ |
| -        | -        | -        |
| 2. _____ | 5. _____ | 8. _____ |
| -        | -        | -        |
| 3. _____ | 6. _____ | 9. _____ |
| -        | -        | -        |

2) **Are there any additional goals related to natural resource management that are important to you?**

**III. MANAGEMENT PRACTICES AND PROGRAMS**

The next questions ask about your general approach to GRAZING the LARGEST are of PRIVATE land (owned or leased) that is NOT IRRIGATED, on which you control the management decisions. We recognize that grazing changes from year to year. Please answer for typical years.

1) **The NUMBER OF PASTURES (fenced areas) on the largest area of non-irrigated PRIVATE land is typically (check one):**

- 1                       2-5                       6-10                       More than 10

2) **The NUMBER OF HERDS or groups of livestock on the largest area of non-irrigated PRIVATE land is typically (check one):**

- 1                       2-5                       6-10                       More than 10

3) **In most pastures, the DURATION OF GRAZING in the largest area of non-irrigated PRIVATE land is typically (check one):**

- |  |  |
|--|--|
| <input type="checkbox"/> Continuous in most pastures through the year                              | <input type="checkbox"/> Moderate in most pastures- lasting for a few weeks at a time                                |
| <input type="checkbox"/> Continuous through the growing season in most pastures, but not year-long | <input type="checkbox"/> Long, in most pastures- lasting for periods of 1-3 months but not the entire growing season |
| <input type="checkbox"/> Short in most pastures- lasting for a few days at a time                  | <input type="checkbox"/> Other (please list): _____  |

4) **In most pastures, the GRAZING SEASON on the largest area of non-irrigated PRIVATE land is typically (check one):**

- |   |   |
|---|---|
| <input type="checkbox"/> All seasons        | <input type="checkbox"/> Only in the middle of the growing season |
| <input type="checkbox"/> The dormant season | <input type="checkbox"/> Only late in the growing season          |

- The entire growing season
- Intermittent through the growing season
- Only early in the growing season
- Other (please list): \_\_\_\_\_

**5) In most pastures, the STOCK DENSITY on the largest area of non-irrigated PRIVATE land is typically (check one):**

- 0-5 acres/animal unit
- 5-10 acres/animal unit
- 10-20 acres/animal unit
- 20-30 acres/animal unit
- 30-50 acres/animal unit
- >50 acres/animal unit

**6) In most pastures, REST from grazing on the largest area of non-irrigated PRIVATE land is typically (check one):**

- No rest
- All seasons
- The dormant season
- Only early in the growing season
- Only the middle of the growing season
- Only late in the growing season
- Intermittently in the growing season
- Other (please list): \_\_\_\_\_

**7) Which of the past SEVEN YEARS would you characterize as representative of your TYPICAL grazing management? Check all that apply.**

- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012

**8) We recognize that grazing may differ from pasture to pasture within the same large area of land. Are there any other elements of your general grazing management strategy that are important to understand? Please write your answer in the box [note: box deleted in this thesis due to required formatting of page numbers].**

Drought may change your management decisions and your ability to meet your management goals. Please tell us more about your approach to management with regard to drought events.

**9) What year was the last drought that affected your operation? Please list year or years: \_\_\_\_\_**

**10) During the last drought, did you have a drought management plan in place? Check one.**

- Yes
- No

**11) During the last drought, which of the following were impacted more severely than expected? Check all that apply.**

- N/A–have not experienced drought
- Grazing capacity
- Irrigation water availability
- Winter feed availability
- Weaning weights
- Reproduction rates
- Profitability
- Other: (please fill in): \_\_\_\_\_

**12) How do you manage for drought impacts? Check all that apply.**

N/A—have not experienced drought

| Management in response to drought   | Management to prepare for drought  |
|---|--|
| <input type="checkbox"/> Add alternative on-farm enterprise<br><input type="checkbox"/> Purchase feed<br><input type="checkbox"/> Allow livestock condition to decline; maintain herd size<br><input type="checkbox"/> Reduce herd size<br><input type="checkbox"/> Earn off-farm income<br><input type="checkbox"/> Rent additional pasture<br><input type="checkbox"/> Apply for government assistance program<br><input type="checkbox"/> Sell retained yearlings<br><input type="checkbox"/> Move livestock to another location<br><input type="checkbox"/> Wean early<br><input type="checkbox"/> Place livestock in a feedlot | <input type="checkbox"/> Increase flexibility by incorporating both cow-calf and stocker cattle<br><input type="checkbox"/> Increase flexibility by adding other livestock types<br><input type="checkbox"/> Add areas for grass banking (stockpile forage)<br><input type="checkbox"/> Employ conservative stocking rate to allow full grazing even in drought years<br><input type="checkbox"/> Incorporate pasture rest into grazing system<br><input type="checkbox"/> Use 1-3 month weather predictions to adjust stocking rate |

**13) Do you think drought will be more influential in your management plans/operations in the next ten years than it has been in the past ten years? Check one.**

Yes       No

**14) If another drought were to begin right now, how severely would this impact the economic viability of your operation? Check one.**

No differently than the last drought     
  Less severely than the last drought     
  More severely than the last drought     
  N/A—have not experienced drought

Monitoring may provide additional information on which to base management decisions. Please tell us more about your approach to monitoring on your operation.

**15) What types of informal monitoring do you do on your ranch? Check all that apply.**

- Observe grass height, density or     
  Observe amount of forage     
  Observe the condition of my  
 Observe erosion     
  Observe wildlife     
  Observe weather  
 I do NO informal monitoring     
  Other informal monitoring (describe):  
 \_\_\_\_\_

**16) In the last 10 years, what types of formal monitoring have you done on your private land, Forest Service and BLM allotments, or state lands grazing leases? For each land status on your ranch, please circle all that apply. If you are not familiar with the method circle NF.**

I do NO formal monitoring (*Check box*) (SKIP TO QUESTION 17)

|                  | Private Land | Forest Service, BLM or State Land | Not Familiar with this Method |
|------------------|--------------|-----------------------------------|-------------------------------|
| Measure rainfall | 1            | 2                                 | NF                            |
| Photo points     | 1            | 2                                 | NF                            |

|                              |   |   |    |
|------------------------------|---|---|----|
| Vegetation measurements      |   |   |    |
| Step point                   | 1 | 2 | NF |
| Nested frequency             | 1 | 2 | NF |
| Cover (ocular estimate)      | 1 | 2 | NF |
| Cover (line point intercept) | 1 | 2 | NF |
| Cover—other method           | 1 | 2 | NF |
| Density of key species       | 1 | 2 | NF |
| Clip biomass or residual     | 1 | 2 | NF |
| Grazing response index       | 1 | 2 | NF |
| Herbaceous utilization       | 1 | 2 | NF |
| Browse utilization           | 1 | 2 | NF |
| Riparian utilization         | 1 | 2 | NF |
| Stubble height               | 1 | 2 | NF |
| Proper functioning condition | 1 | 2 | NF |
| Streambank stability         | 1 | 2 | NF |
| Water quality                | 1 | 2 | NF |
| Wildlife habitat surveys     | 1 | 2 | NF |
| Wildlife counts              | 1 | 2 | NF |

Management practices vary greatly from one operation to another. Please tell us more about your management practices on your operation.

**17) In the last 5 years have you participated in any of the following programs with your ranching operation? *Check one for each program.***

- Land retirement conservation programs, for example, Conservation Reserve Program (CRP) or Wetland Reserve Program (WRP)  Yes  No
- Working land conservation programs, for example, Environmental Quality Incentives Program (EQIP) or Conservation Security Program (CSP)  Yes  No
- Wildlife habitat programs, for example, Landowner Incentive Program (LIP), or Ranching for Wildlife (RFW)  Yes  No
- Agricultural land and grassland preservation programs, for example, Farm and Ranchlands Protection Program (FRPP), or Grassland Reserve Program (GRP)  Yes  No
- Conservation easements  Yes  No

**18) In the last 5 years have you carried out any of the following management practices on your ranching operation? *Check all that apply.***

- Rotational grazing       Prescribed burning       Reseeding

|   |   |   |
|---|---|---|
| <input type="checkbox"/> Continuous, year-round grazing   | <input type="checkbox"/> Mechanical brush removal   | <input type="checkbox"/> Put in wildlife-friendly fencing   |
| <input type="checkbox"/> Low moisture supplements to distribute livestock, for example, Crystalyx                   | <input type="checkbox"/> Installed wildlife water development   | <input type="checkbox"/> Used herd guard dog or other companion animal to deter predators         |
| <input type="checkbox"/> Managed for sensitive plant or animal species (including threatened or endangered species) | <input type="checkbox"/> Holistic Resource Management, Savory grazing, or high intensity-short duration grazing | <input type="checkbox"/> Put in food plots (plant desirable plant species to distribute foraging) |
| <input type="checkbox"/> Grazed riparian areas for 30 days or less during the year                                  | <input type="checkbox"/> Put in erosion control structures  | <input type="checkbox"/> Multiple species grazing   |
| <input type="checkbox"/> Spring development   | <input type="checkbox"/> Used a herder to manage livestock distribution   | <input type="checkbox"/> Put in living fences   |
| <input type="checkbox"/> Fenced stream banks or riparian areas  | <input type="checkbox"/> Low-stress stock management  | <input type="checkbox"/> Non-use of land (other than related to drought)                          |
| <input type="checkbox"/> Laid water pipeline  | <input type="checkbox"/> Applied herbicides   | <input type="checkbox"/> Other (please list)<br>_____   |

**19) In the last 5 years have you participated in or implemented any of the following business practices with your ranching operation? *Check one for each practice.***

|   |                              |                             |
|---|------------------------------|-----------------------------|
| Direct marketing of livestock products, for example, meat, wool, milk or cheese | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Oil or gas leasing or extraction  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Guiding services for hunting and fishing  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Guiding services for bird watching and other types of wildlife viewing          | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Charged access fee for hunting, fishing, or wildlife viewing                    | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Agri-tourism including rural tourism, such as a dude ranch                      | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Received carbon off-set or carbon sequestration payments                        | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Wind energy development   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Geothermal energy development   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Grass-fed or grass-finished beef, lamb, or goat                                 | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Certified organic beef, lamb, or goat   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Bed & breakfast or other accommodations, for example, retreat facilities        | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Other (Please list.)<br>_____   |                              |                             |

20) A person's decisions about whether to engage in new activities are usually based on many factors. We would like to know what influences your decision to implement a new management tool or practice for your ranching operation. Please indicate below to what degree each of the following factors influences your decision. *Circle one number for each factor.*

|   | Does Not Influence | Slightly Influences | Moderately Influences | Strongly Influences |
|---|--------------------|---------------------|-----------------------|---------------------|
| Environmental benefits of the management practice                                       | 1                  | 2                   | 3                     | 4                   |
| Potential for the management practice to benefit the local economy                      | 1                  | 2                   | 3                     | 4                   |
| Management practice will help reduce the spread of invasive weeds                       | 1                  | 2                   | 3                     | 4                   |
| Reliable scientific information exists to support the use of the management practice    | 1                  | 2                   | 3                     | 4                   |
| Amount of time it takes for desired results from the management practice to be achieved | 1                  | 2                   | 3                     | 4                   |
| Amount of time desired results from the management practice will last                   | 1                  | 2                   | 3                     | 4                   |
| Impacts of the management practice on grazing capacity                                  | 1                  | 2                   | 3                     | 4                   |
| Impacts of the management practice on wildlife habitat                                  | 1                  | 2                   | 3                     | 4                   |
| Potential for direct financial gain from implementing the management practice           | 1                  | 2                   | 3                     | 4                   |

21) In general, which of the following statements best describes your approach to engaging in new management practices or programs with your ranching operation? *Check one.*

- I actively seek new management practices/programs beyond my local resources and I am willing to take financial risks to try these new practices/programs
- I seek new management practices/programs from my local resources and in general I am asked by members of the community for my opinion regarding new practices/programs
- I like to watch others and see how they do before adopting a new management practice/program, but I adopt before the average person
- Cautious, I adopt new management practices/programs after the majority of people have, generally due to economic necessity or increasing pressure from peers
- I tend to avoid new management practices/programs if possible, preferring to continue with what's worked in the past



**IV: PERCEPTIONS AND MANAGEMENT OF CHEATGRASS (*Bromus tectorum*)**

Cheatgrass (*Bromus tectorum*) is an invasive non-native annual grass that is causing problems in some regions of the West. In this section, we are interested in learning about your knowledge about and experiences with cheatgrass.

- 1) The presence of cheatgrass and the degree to which it creates problems varies in different counties, regions, and states throughout the western United States. To what degree do you consider the presence of cheatgrass in your county a problem? *Circle one number.*

| Not a Problem | Slight Problem | Moderate Problem | Extreme Problem |
|---------------|----------------|------------------|-----------------|
| 1             | 2              | 3                | 4               |

- 2) To the best of your knowledge, to what degree has cheatgrass increased or decreased in prevalence within your county over the past 5 years (since 2008)? *Circle one number.*

| Decreased Greatly | Decreased Slightly | No Change | Increased Slightly | Increased Greatly |
|-------------------|--------------------|-----------|--------------------|-------------------|
| 1                 | 2                  | 3         | 4                  | 5                 |

- 3) Ranchers have tried a variety of management tools to try to eradicate cheatgrass or shift the dominance of cheatgrass infested areas to more native plants. Please indicate which of the following management tools you have used to manage cheatgrass during the last 5 years (since 2008). *Circle one number for each statement.*

|   | Have Used | Have Not Used |
|---|-----------|---------------|
| Prescribed fire   | 1         | 0             |
| Application of an imazapic-based herbicide, for example, Plateau                          | 1         | 0             |
| Seeded a more desirable grass mix   | 1         | 0             |
| Any combination of prescribed fire, herbicide application, or seeding                     | 1         | 0             |
| Increased stocking rate early in the spring to graze out cheatgrass                       | 1         | 0             |
| Shifted grazing to later in the fall or early winter to facilitate perennial plant growth | 1         | 0             |
| Other (Please list.) _____  | 1         | 0             |

- 4) Has your management of cheatgrass changed during the past 5 years?  Yes  No

- 5) If you answered Yes to question 4 above, please briefly tell us why you changed your management.

**V: PERCEPTIONS AND USE OF STATE AND TRANSITION MODELS (STMs)**

1) The art and science of state and transition models have been developing for over a decade. Please circle the corresponding number for how familiar you were with the term or application of STMs prior to today. *Circle one number.*

| I have never heard of STMs before today | I have heard about STMs, but I have not read or used one | I have read about STMs | I have used STMs |
|---|--|------------------------|------------------|
| 1                                       | 2  | 3                      | 4                |

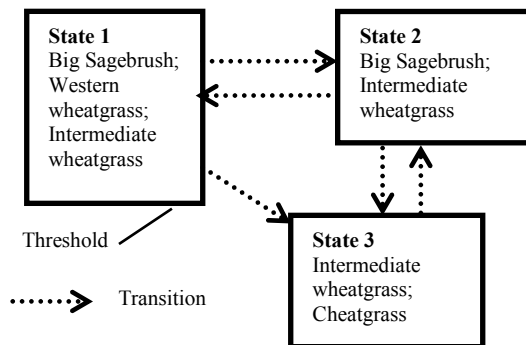


Figure 1. Example of a state and transition model diagram.

State and Transition Models (STMs) are a tool to visually display our current understanding of how specific types of land respond to different environmental events (such as drought and fire) and management practices (such as grazing, seeding, and shrub control). They can help managers identify the current ecological state of a specific piece of land and recognize the factors that could lead towards or away from the desired state for their management objectives. STMs can suggest potential indicators to use in measuring progress towards management objectives. They also provide a way to incorporate, organize, and share new knowledge gained through management experience or scientific studies. The USDA Natural Resources Conservation Service (NRCS) is developing STMs for all ecological sites. These STMs will be used by the NRCS, BLM, and US Forest Service to assess and monitor rangelands.

**PLEASE ANSWER THE FOLLOWING QUESTIONS TO THE BEST OF YOUR ABILITY.**

2) Based on what you know about STMs today, how might state and transition models help you reach your objectives for your ranching operation? Please indicate to what degree you think each of the following would be a benefit of using STMs. *Circle one number for each potential benefit.*

|   | No Benefits | Slight Benefits | Moderate Benefits | Major Benefits | No Opinion |
|---|-------------|-----------------|-------------------|----------------|------------|
| Better manage habitat for livestock and wildlife                                  | 1           | 2               | 3                 | 4              | 5          |
| Better manage nutrient needs for livestock and wildlife                           | 1           | 2               | 3                 | 4              | 5          |
| Gain a better understanding of the ecological conditions and processes on my land | 1           | 2               | 3                 | 4              | 5          |
| Increase plant species diversity  | 1           | 2               | 3                 | 4              | 5          |
| Shift plant community to a more desirable species composition                     | 1           | 2               | 3                 | 4              | 5          |
| Retain soil or limit erosion potential  | 1           | 2               | 3                 | 4              | 5          |
| Increase livestock productivity   | 1           | 2               | 3                 | 4              | 5          |

- 3) Has your knowledge or use of state and transition models changed during the past 5 years?  Yes  
 No
- 4) If you answered Yes to question 3 above, please briefly tell us why your knowledge or use of STMs has changed.

**VI: INFORMATION NEEDS AND PREFERENCES**

In this section, we are interested in learning where you get new information about grazing management and other related topics.

- 1) Have you ever looked for information on grazing management, drought management, cheatgrass management or state and transition models? Check one box for each topic. If you answer 'no' for all, skip to question number 3.

|                              |                             |                    |                              |                             |                             |                              |                             |                      |
|------------------------------|-----------------------------|--------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|----------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | Grazing management | <input type="checkbox"/> Yes | <input type="checkbox"/> No | Cheatgrass management       | <input type="checkbox"/> Yes | <input type="checkbox"/> No | Rangeland monitoring |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | Drought management | <input type="checkbox"/> Yes | <input type="checkbox"/> No | State and transition models |                              |                             |                      |

- 2) If you answered 'yes' to question number 1, what sources of information have you used? Circle all that apply for each topic or select 'Have Not Used this Source'.

|   | Grazing Management | Drought Management | Rangeland Monitoring | Cheatgrass Management | State and Transition Models | Have Not Used This Source |
|---|--------------------|--------------------|----------------------|-----------------------|-----------------------------|---------------------------|
| County extension office or agent  | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Private companies or consultant   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Industry magazine(s), for example, Progressive Cattleman                          | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Scientific journal(s)   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Environmental organization  | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Local or regional newspaper   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| County or city weed authority   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Radio   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| State government agency, for example, State Forest Service or Wyoming Game & Fish | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Television  | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |
| Federal government agency, for example,   | 1                  | 2                  | 3                    | 4                     | 5                           | 6                         |

| NRCS, USFS, BLM   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| Conferences or workshops  | 1 | 2 | 3 | 4 | 5 | 6 |
| Internet websites   | 1 | 2 | 3 | 4 | 5 | 6 |
| Advice from family, friends, and peers                              | 1 | 2 | 3 | 4 | 5 | 6 |
| Agricultural organizations, for example, Cattlemen's Association    | 1 | 2 | 3 | 4 | 5 | 6 |
| Professional association, for example, Society for Range Management | 1 | 2 | 3 | 4 | 5 | 6 |
| Other (Please list):  | 1 | 2 | 3 | 4 | 5 |   |

3) What is your preferred method for receiving information about rangeland management? *Check one.*

- Websites     
 Email     
 Word of mouth or face-to-face     
 Print publications     
 Other (please list): \_\_\_\_\_

4) How do you access the internet? *Check all that apply.*

- A dial-up connection     
 A high-speed connection     
 A smartphone     
 N/A – I do not use the internet

5) About how often do you access the internet? *Circle one.*

| Never | Very Rarely | Monthly | Weekly | Daily |
|-------|-------------|---------|--------|-------|
| 1     | 2           | 3       | 4      | 5     |

6) How would you rate the importance of the internet for the day-to-day management of your operation? *Circle one.*

| Not at All Important | Slightly Important | Moderately Important | Very Important | Extremely Important |
|----------------------|--------------------|----------------------|----------------|---------------------|
| 1                    | 2                  | 3                    | 4              | 5                   |

7) What are the biggest barriers to using information from the internet to augment your operation? *Check all that apply.*

- No internet access     
 Slow internet speed     
 Intermittent or unreliable internet connection
- Lack of time to find information online     
 Difficulty of determining which online sources are trustworthy     
 Lack of experience with using the internet to find information
- Difficulty finding information that is specifically applicable to my operation     
 All my informational needs are filled by sources other than the internet     
 There are no barriers to using information from the internet to augment my operation.
- Other (please specify): \_\_\_\_\_

Of the barriers listed above, which is the single biggest barrier to using information from the internet to augment your operation? *Single biggest barrier:* \_\_\_\_\_

8) When learning about rangeland management on the internet, which media formats do you or would you prefer? *Check all that apply.*

- Text
  Downloadable documents (e.g. .pdf files, Word files)
  Video  
 Audio files
  Pictures
  Games  
 Slideshows
  Other (please specify): \_\_\_\_\_

Of the media formats listed above, which is your first preference? *My first preference:*

\_\_\_\_\_

9) When making a choice that will affect the management of your operation, to what degree does information you find on the internet influence your decisions in each of the following management areas? *Circle the number that applies.*

| Management area   | Not at All | Slight Degree | Moderate Degree | High Degree | Very High Degree | Not Applicable |
|---|------------|---------------|-----------------|-------------|------------------|----------------|
| <b>Ranch Business Management</b>                            |            |               |                 |             |                  |                |
| Livestock purchasing  | 1          | 2             | 3               | 4           | 5                | 6              |
| Livestock marketing   | 1          | 2             | 3               | 4           | 5                | 6              |
| Buying/selling equipment                                    | 1          | 2             | 3               | 4           | 5                | 6              |
| Buying/selling feed or hay                                  | 1          | 2             | 3               | 4           | 5                | 6              |
| Infrastructure development (fences, wells, buildings etc.)  | 1          | 2             | 3               | 4           | 5                | 6              |
| Energy development  | 1          | 2             | 3               | 4           | 5                | 6              |
| Tourism/Hunting   | 1          | 2             | 3               | 4           | 5                | 6              |
| Participation in government programs (e.g. EQIP, WHIP, CRP) | 1          | 2             | 3               | 4           | 5                | 6              |
| Conservation easements                                      | 1          | 2             | 3               | 4           | 5                | 6              |
| Estate planning   | 1          | 2             | 3               | 4           | 5                | 6              |
| <b>Resource Management</b>                                  |            |               |                 |             |                  |                |
| Weather forecast/prediction                                 | 1          | 2             | 3               | 4           | 5                | 6              |
| Rangeland assessment or monitoring                          | 1          | 2             | 3               | 4           | 5                | 6              |
| Invasive species or weed management                         | 1          | 2             | 3               | 4           | 5                | 6              |
| Grazing management  | 1          | 2             | 3               | 4           | 5                | 6              |
| Rangeland seeding   | 1          | 2             | 3               | 4           | 5                | 6              |
| Prescribed fire   | 1          | 2             | 3               | 4           | 5                | 6              |
| Wildlife or habitat management                              | 1          | 2             | 3               | 4           | 5                | 6              |
| Drought management  | 1          | 2             | 3               | 4           | 5                | 6              |

|  |   |   |   |   |   |   |
|--|---|---|---|---|---|---|
| Wildfire or other natural disaster preparedness/recovery | 1 | 2 | 3 | 4 | 5 | 6 |
| Predator control   | 1 | 2 | 3 | 4 | 5 | 6 |
| <b>Livestock Herd Management</b>                         |   |   |   |   |   |   |
| Livestock genetics/breeding                              | 1 | 2 | 3 | 4 | 5 | 6 |
| Livestock health/veterinary care                         | 1 | 2 | 3 | 4 | 5 | 6 |
| Feeding/nutrition/forage quality                         | 1 | 2 | 3 | 4 | 5 | 6 |
| Low stress livestock handling                            | 1 | 2 | 3 | 4 | 5 | 6 |

**10) Please indicate how reliable you find you find the information on rangeland management from these sources to be. Circle the number that applies.**

| Information Source  | Not at All | Slight Degree | Moderate Degree | High Degree | Very High Degree | Not Applicable |
|---|------------|---------------|-----------------|-------------|------------------|----------------|
| <input type="checkbox"/> County Extension office or agent   | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Private companies or consultants   | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Industry magazine(s), for example, Progressive Cattleman                         | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Scientific Journal(s)  | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Environmental organization(s)  | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> County or city weed authority  | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Local or regional newspaper  | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> State government agency, for example State Forest Service or Wyoming Game & Fish | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Federal agency, for example, NRCS, BLM, USFS                                     | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Conferences or workshops   | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Family, friends, or peers  | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Agricultural organizations, for example, Cattlemen's Association                 | 1          | 2             | 3               | 4           | 5                | 6              |
| <input type="checkbox"/> Professional association, for example, Society for Range management              | 1          | 2             | 3               | 4           | 5                | 6              |

**11) Of the information sources listed in question 10, which sources do you use the internet to access? Check all that apply, using the checkboxes next to the information sources in the table above.**

## VII: BACKGROUND

In this last section, we would like to know more about your ranching operation and your background. This information will only be used in making comparisons and will remain strictly confidential.

**1) Of your annual gross income, what percent comes from (write in your best estimate):**

|  |             |
|--|-------------|
| Income from livestock                                | _____ %     |
| Income from wildlife                                 | _____ %     |
| Income from crops                                    | _____ %     |
| Income from other on-ranch sources (e.g. dude ranch) | _____ %     |
| <u>Income from off-ranch sources</u>                 | _____ %     |
| <b>Total</b>   | <b>100%</b> |

**2) What was the last year of school you completed? Check one.**

- Grade school
- Some high school
- Completed high school or GED
- Some college or vocational/technical school
- Completed 4 year college degree Major \_\_\_\_\_
- Completed a graduate or professional degree (MS, PhD, MD, JD, DVM, etc.) Major \_\_\_\_\_

**3) When you are no longer operating your farm or ranch, which of the following best describes what you expect will happen to the operation? Check one.**

- It will be operated by my spouse
- It will be operated by my children
- It will be operated by other relatives
- It will be operated by a non-relative who is currently involved with the ranch
- It will be operated by individuals not involved with the current operation
- It will be converted to a non-farm use
- Don't know

**4) Not including the generations after you, how many generations of ranchers have there been in your family? Check one (if you have a spouse, please answer for the longer heritage).**

- 1- I am a first generation rancher
- 2-my parents were ranchers
- 3-my grandparents were ranchers
- 4-my great grandparents were ranchers
- 5-my great great grandparents were ranchers
- I don't know
- Other (please list) \_\_\_\_\_

**5) What is your gender? Check one.**

- Male
- Female

**6) In which year were you born? \_\_\_\_\_**

**7) What is your approximate gross annual income? Check one.**

- Less than \$19,999
- \$80,000 - \$199,999
- \$800,000 - \$999,999

- \$20,000 - \$49,999       \$200,000 - \$499,999       Between \$1 million & \$5 million  
 \$50,000 - \$79,999       \$500,000 - \$799,999       Over \$5 million

Thank you for your help with this important study! Your participation is greatly appreciated. Please feel free to use the remaining space for any additional comments.

***Please return your completed questionnaire in the enclosed envelope to:***

Dept. of Forest and Rangeland Stewardship  
Colorado State University  
Attn. Shayan Ghajar  
P.O. Box 150969  
Lakewood, CO 80215

**Phone:** (970) 329-4175

**Email:** [Shayan.Ghajar@colostate.edu](mailto:Shayan.Ghajar@colostate.edu)

***Thank you for your time in completing this survey.  
Your input is valuable and appreciated.  
Thank you again.***

If you have any questions about your rights as a survey respondent, you may contact Janell Barker of the CSU Institutional Review Board at (970) 491-1655.

Cover photo courtesy of the Bureau of Land Management



APPENDIX E: REMINDER POSTCARD

Last week, a questionnaire about your knowledge, management practices, and information needs about grazing and rangeland management was mailed to you. This questionnaire is being sent to a sample of ranchers and land managers in Colorado and Wyoming with the intent to ensure your voice is heard in two research and extension projects which evaluating the effectiveness of our outreach efforts.

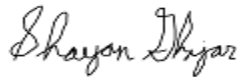
If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so as soon as possible. The success of this project depends on the willingness of people like you to respond. We are especially grateful for your help and believe your response will help us to develop useful rangeland management outreach tools for all generations.

If you did not receive a questionnaire, or if it was misplaced, please call Shayan Ghajar at (970) 329-4175 or email [qajarkhan@gmail.com](mailto:qajarkhan@gmail.com) and we will get another one in the mail to you.

Sincerely,



Maria Fernandez-Gimenez, Ph.D.  
Principal Investigator



Shayan Ghajar  
Graduate Research Assistant

APPENDIX F: NON-RESPONSE BIAS CHECK SCRIPT

**For NASS Use:**

ID #: \_\_\_\_\_  
\_\_\_\_\_

### Section A ~ Introduction

Hello, my name is \_\_\_\_\_. I'm conducting a follow-up on a recent mail survey administered by Colorado State University, CSU Extension, and the University of Wyoming Extension.

1. About two months ago, a random sample of Wyoming and Colorado ranchers were mailed the survey asking questions about their knowledge, management practices, and information needs. Do you remember receiving the questionnaire?
- YES (Continue to 2)                       NO

**[If answer is “No”]** It was sent in a large envelope. **[If respondent still says “no,” check the mailing address we have for them. If that was incorrect, or respondents still maintains they did not receive a questionnaire, note “did not receive” – DNR – on data sheets.]** Thank you for your time.

2. According to our records, we did not receive a questionnaire back from you. **Move onto the next paragraph.**

3. Many of the land managers have returned their survey, but a part of any study is to provide an explanation for why some people did not return their survey. We need to know whether land managers who answered the survey differ in any significant way from land managers who didn't. Your responses will remain confidential and will only be associated with an identification number. If you can spare a few minutes, it would really help us if you could answer some quick questions. Do you have a few minutes to talk with me?
- YES (Continue)                       NO

**[If answer is “no”]** Thank you for your time. Have a {good day/evening}.

**[If answer is “yes”]** Thank you. To begin, a portion of the survey was about adoption of new management practices.

### Section B ~ Operation

The first few questions will give us a better understanding of the nature of your ranching operation and your experience with new business practices.

- 6) About how many **private (deeded) acres** of land do you have in your ranching operation? *Check one.*

|                     |                          |                 |                          |                     |                          |
|---------------------|--------------------------|-----------------|--------------------------|---------------------|--------------------------|
| Less than 100 acres | <input type="checkbox"/> | 250 – 499 acres | <input type="checkbox"/> | 1,000 – 4,999 acres | <input type="checkbox"/> |
| 100 – 249 acres     | <input type="checkbox"/> | 500 - 999 acres | <input type="checkbox"/> | 5,000 acres or more | <input type="checkbox"/> |

7) **Approximately, what percentage of your ranching operation falls into each of the following categories? Write in the estimated percent.**

|                                      |  |
|--------------------------------------|--|
| Private (Deeded) _____%              | State Lands _____%                     |
| U.S. Forest Service _____%           | Bureau of Land Management (BLM) _____% |
| Other _____ (Please specify.) _____% |  |

8) **What percent of your ranching operation’s annual labor is supplied by the family? \_\_\_\_\_ %**

9) **About how many years have you managed this ranching operation? \_\_\_\_\_ years**

10) **In general, which of the following statements best describes your approach to engaging in new management practices or programs with your ranching operation? Check one.**

Innovative:   
 [You seek new practices/programs beyond local resources AND you are willing to take financial risks.]

Strongly Pro-active:   
 [You seek from local resources AND community members ask you for your opinion.]

Pro-active:   
 [You watch others try new practices/programs AND see the results before adopting, BUT you adopt before the average person.]

Cautiously Active:   
 [Generally, you adopt new practices/programs when necessary (i.e., economic necessity or pressure from peers.)]

Observer:   
 [You avoid new practices/programs if possible and you prefer to continue with what has worked in the past.]

### Section C ~ Perceptions

The next question is about your perception of cheatgrass, a non-native annual grass.

1) **The presence of cheatgrass and the degree to which it creates problems varies in different counties, regions, and states throughout the western United States. To what degree do you consider the presence of cheatgrass in your county a problem? Circle one number.**

| Not a Problem | Slight Problem | Moderate Problem | Extreme Problem |
|---------------|----------------|------------------|-----------------|
| 1             | 2              | 3                | 4               |

The next question is about State and Transition Models. State and transition models are box and arrow diagrams that show how plant communities change with management, climate, or other disturbances.

- 2) **The art and science of state and transition models have been developing for over a decade. Please indicate which of the following best describes your familiarity with the term and application of STMs. *Circle one number.***

---

| <b>I have never heard of STMs before today</b> | <b>I have heard about STMs, but I have not read or used one</b> | <b>I have read about STMs</b> | <b>I have used STMs</b> |
|--|---|-------------------------------|-------------------------|
| 1  | 2   | 3                             | 4                       |

**SURVEY CONTINUES . . GO TO NEXT PAGE**

## Section D ~ Information Sources

The next set of questions is about where you prefer to get new information about rangeland management topics.

- 1) **Have you ever looked for information on grazing management? Pause for answer after each. Drought management? Cheatgrass management? State and transition models? Check one box for each topic. If you answer 'no' for all, skip to question number 2.**

|   |   |   |
|---|---|---|
| <input type="checkbox"/> Yes<br><input type="checkbox"/> No | <input type="checkbox"/> Yes<br><input type="checkbox"/> No | <input type="checkbox"/> Yes<br><input type="checkbox"/> No |
| Grazing management<br>Drought management                    | Cheatgrass management<br>State and transition models        | Rangeland monitoring  |

- a. **[If respondent answers, yes, ask] Next, I am going to read a list of information sources. Please tell me to what degree you find the information provided by the source to be reliable. If you have not used this source, please say “not applicable.”**

| Information Source   | Not at | Slight Degree | Moderate Degree | High Degree | Very High | Not Applicab |
|--|--------|---------------|-----------------|-------------|-----------|--------------|
| County Extension office or agent                                 | 1      | 2             | 3               | 4           | 5         | 6            |
| Private companies or consultants                                 | 1      | 2             | 3               | 4           | 5         | 6            |
| Industry magazine(s), for example, Progressive                   | 1      | 2             | 3               | 4           | 5         | 6            |
| Scientific Journal(s)  | 1      | 2             | 3               | 4           | 5         | 6            |
| Environmental organization(s)                                    | 1      | 2             | 3               | 4           | 5         | 6            |
| County or city weed authority                                    | 1      | 2             | 3               | 4           | 5         | 6            |
| Local or regional newspaper                                      | 1      | 2             | 3               | 4           | 5         | 6            |
| State government agency, for example State Forest Service or     | 1      | 2             | 3               | 4           | 5         | 6            |
| Federal agency, for example, NRCS BLM USFS                       | 1      | 2             | 3               | 4           | 5         | 6            |
| Conferences or workshops   | 1      | 2             | 3               | 4           | 5         | 6            |
| Family, friends, or peers  | 1      | 2             | 3               | 4           | 5         | 6            |
| Agricultural organizations, for example, Cattlemen’s Association | 1      | 2             | 3               | 4           | 5         | 6            |
| Professional association, for example, Society for Range         | 1      | 2             | 3               | 4           | 5         | 6            |

- 2) **How do you access the internet at work? Check all that apply.**

A dial-up connection     
  A high-speed connection     
  A smartphone     
  N/A – I do not use the internet

- 3) **About how often do you access the internet? Circle one.**



|              |                    |                |               |              |
|--------------|--------------------|----------------|---------------|--------------|
| <b>Never</b> | <b>Very rarely</b> | <b>Monthly</b> | <b>Weekly</b> | <b>Daily</b> |
| 1            | 2                  | 3              | 4             | 5            |

4) How would you rate the importance of the internet in the performance of your daily professional duties? *Circle one.*

|                             |                           |                             |                       |                            |
|-----------------------------|---------------------------|-----------------------------|-----------------------|----------------------------|
| <b>Not at All Important</b> | <b>Slightly Important</b> | <b>Moderately Important</b> | <b>Very Important</b> | <b>Extremely Important</b> |
| 1                           | 2                         | 3                           | 4                     | 5                          |

### Section E ~ Demographics

The following are the last set of questions I will ask you. This information will only be used in making comparisons and will remain strictly confidential.

8) What was the last year of school you completed? *Check one.*

- Grade school
- Some high school
- Completed high school or GED
- Some college or tech school
- Completed 4 year college degree  Major \_\_\_\_\_
- Completed a graduate or professional degree (MS, PhD, MD, JD, DVM, etc.)  Major \_\_\_\_\_

9) When you are no longer operating your farm or ranch, which of the following best describes what you expect will happen to the operation? *Check all that apply.*

- |   |   |
|---|---|
| It will be operated by my spouse <input type="checkbox"/>   | It will be operated by individuals not involved with the current operation <input type="checkbox"/> |
| It will be operated by my children <input type="checkbox"/>   | It will be converted to a non-farm use <input type="checkbox"/>                                     |
| It will be operated by other relatives <input type="checkbox"/>   | Don't know <input type="checkbox"/>   |
| It will be operated by a non-relative who is currently involved with the ranch <input type="checkbox"/> |   |

10) What is your gender? *Check one.*

- Male  Female

11) In which year were you born? \_\_\_\_\_

**12) What is your approximate gross annual income? Check one.**

|                     |                          |                       |                          |                                   |                          |
|---------------------|--------------------------|-----------------------|--------------------------|-----------------------------------|--------------------------|
| Less than \$19,999  | <input type="checkbox"/> | \$80,000 - \$199,999  | <input type="checkbox"/> | \$800,000 - \$999,999             | <input type="checkbox"/> |
| \$20,000 - \$49,999 | <input type="checkbox"/> | \$200,000 - \$499,999 | <input type="checkbox"/> | Between \$1 million & \$5 million | <input type="checkbox"/> |
| \$50,000 - \$79,999 | <input type="checkbox"/> | \$500,000 - \$799,999 | <input type="checkbox"/> | Over \$5 million                  | <input type="checkbox"/> |

Thank you for your help with this important study. Your participation is greatly appreciated.

In the future, if you have any questions regarding this research please do not hesitate to call the Graduate Research Assistant for this project, Shayan Ghajar at (970) 329-4175. You can also contact the Principal Investigator for the study, Dr. Maria Fernandez-Gimenez at (970) 491-0409.

Thank you again for your time. Have a good {day/evening}.

APPENDIX G: INTERVIEW INTRODUCTORY LETTER

[date]

Dear [last name],

I am Shayan Ghajar, a research assistant with Colorado State University in the Department of Forest and Rangeland Stewardship, working on a research project titled “*The Internet, Innovation, and the Range: Documenting Ranchers’ Internet Use and Preferences*,” which is funded with support from the US Department of Agriculture. The purpose of this research is to determine the effectiveness of the internet as a tool for the dissemination of range management practices to ranchers and natural resource professionals. This research will help provide an understanding of the ways in which individuals in ranching or natural resource management professions obtain information on the World Wide Web. We hope the results of this study will offer the potential to improve the way websites are tailored to people such as yourself.

I am contacting you as an individual who could provide valuable insight into how ranchers or natural resource managers use the internet to augment their management techniques. If you are willing, I’d like to interview you as part of this study. The interview would take about one hour of your time, and would take place at a time and location of your choosing. The interviews will be digitally audio recorded, with your consent. Participation is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

There are no direct benefits to you; however, we hope that this research will help provide insight into how best to develop websites and digital tools that will help ranchers and natural resource professionals find useful and timely information on rangeland management techniques. Although I cannot provide any financial compensation for your participation in this study, I would be more than happy to spend a day or so helping you with your business, if you’d like.

There are no known risks associated with this research project. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known and potential, but unknown, risks. Your identifying information and answers to the interview questions will be kept confidential, and we will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or the content of that information. For example, your name will be kept separate from your research records, and these two things will be stored in different places under lock and key.

If you choose not to participate, please let us know so that we may ensure you are not contacted again in the future. If you are interested in participating or would like to learn more about our project, please contact me directly by telephone (703-967-3662) or by email ([qajarkhan@gmail.com](mailto:qajarkhan@gmail.com)). You may also contact the principal investigator Dr. Maria Fernandez-Gimenez by phone (970-491-0409) or by email ([maria.fernandez-gimenez@colostate.edu](mailto:maria.fernandez-gimenez@colostate.edu)). If I do not hear from you, I will follow up with a telephone call to you next week to be sure that you received this letter.

Best Regards,

Shayan Ghajar  
Graduate Research Assistant  
Colorado State University  
Fort Collins, CO 80523

Maria Fernandez-Gimenez  
Associate Professor  
Colorado State University  
Fort Collins, CO 80523

APPENDIX H: INTERVIEW FACT SHEET

## **The Internet, Innovation, and the Range: Documenting Ranchers' Internet Use and Preferences**

### **Purpose**

The purpose of this research is to determine the effectiveness of the internet as a tool for the dissemination of range management practices to ranchers and natural resource professionals. This research will help us understand how individuals in ranching or natural resource management professions obtain rangeland management information on the World Wide Web.

### **Objectives:**

- Identify patterns of rancher and NR professionals' internet use in Colorado and Wyoming
- Determine which types of webpages and media formats are preferred by ranchers for learning about ranch management
- Document current range-related websites and evaluate their ease of use, accessibility, topics, and content
- Use the data collected to find the most effective ways to communicate range management techniques to ranchers and natural resource professionals via the internet

### **Need for Research:**

The spread of potentially beneficial rangeland management techniques and tools can be either limited or facilitated by the way information about these tools is communicated to potential users. Despite the growing importance of the World Wide Web as an information source in the United States, no one has studied the use of the internet by ranchers in the West, few studies examine internet use by natural resource professionals, and no research has tried to determine the most effective methods to convey range management information online.

### **Methods:**

1. Conduct short in-person or telephone interviews ranchers and natural resource professionals about their use of the internet
2. Document and analyze existing rangeland management websites
3. Conduct a mail survey of ranchers in Colorado and Wyoming about their internet use patterns and preferences. The questions about internet use will be part of a larger survey about rangeland and grazing management practices.

### **Expected Outcomes and Benefits:**

This research will help CSU and others provide more useful rangeland management information in more accessible and useable internet formats to ranchers and natural resource professionals.

### **How Can I Help?**

- Participate in a short (20-30 minutes) in-person or telephone interview about your internet use and preferences
- If you are randomly selected to receive the mail survey (target date for mailing January 2013) complete and return the survey

### **Time frame:**

Research: September 2012 to September 2013

**Project Contacts:**

If you are interested in participating or would like to learn more about our project, please contact Shayan Ghajar by telephone (703-967-3662) or by email ([qajarkhan@gmail.com](mailto:qajarkhan@gmail.com)). You may also contact the principal investigator Dr. Maria Fernandez-Gimenez by phone (970-491-0409) or by email ([maria.fernandez-gimenez@colostate.edu](mailto:maria.fernandez-gimenez@colostate.edu)). We'd be happy to answer any questions about the project you may have, and hope to hear from you soon.

APPENDIX I: INTERVIEW CONSENT FORM



**Colorado State University**  
**Consent to Participate in a Research Study**

**TITLE OF STUDY:** The Internet, Innovation, and the Range: Documenting Ranchers' Internet Use and Preferences.

**PRINCIPAL INVESTIGATOR:** Maria E. Fernandez-Gimenez, Associate Professor, Dept. of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523-1472. Telephone: 970-491-0409. Email: [Maria.Fernandez-Gimenez@colostate.edu](mailto:Maria.Fernandez-Gimenez@colostate.edu).

**RESEARCH ASSOCIATE:**

Shayan Ghajar, Graduate Research Assistant, Dept. of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523-1472. Telephone: 703-967-3662. Email: [qajarkhan@gmail.com](mailto:qajarkhan@gmail.com).

**SPONSOR OF THE STUDY**

Researchers from the Department of Forest and Rangeland Stewardship at Colorado State University are conducting this study with support from the US Department of Agriculture. The overall research project will last until May 2014.

**WHAT IS THE PURPOSE OF THIS STUDY?**

The primary goal of this research is to investigate how ranchers and agency professionals use the internet to find information relevant to rangeland management.

**WHAT WILL I BE ASKED TO DO?**

We would appreciate your participation in an interview. If you participate, we will ask you questions about your internet use as it relates to your rangeland management activities. The questions will be about your internet access, use of the internet to find range management information and/or augment your operation, your preferred range-related websites, media formats, and what range-related information you might like to see online in the future. You will not receive any kind of payment for participating in this study. The interview will be digitally recorded, with your permission. The interview will take about one hour of your time. If needed to clarify your answers or ask a follow up question, we may contact you again in the future for a brief conversation.

**WHAT ARE THE POSSIBLE RISKS FROM TAKING PART IN THIS STUDY?**

There are no known risks to participating in this study. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

**WHAT ARE THE POSSIBLE BENEFITS FROM TAKING PART IN THIS STUDY?**

Although there are no direct benefits to you, the interview will help identify the internet use patterns and preferences of ranchers and natural resource professionals. In turn, this information has the potential to improve the quality of future websites tailored to rangeland managers. The research team may also put together websites on specific topics of relevance to rangeland management—these websites would be guided by the expressed preferences of our range management participants. Study results will be shared with participants, community members, and the wider community of range professionals.

**WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH?**

The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

**WHO WILL SEE THE INFORMATION THAT I GIVE?**

We will keep private all research records that identify you, to the extent allowed by law. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private and confidential. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or the content of that information. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key. You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court.

**PARTICIPATION IN THIS RESEARCH IS VOLUNTARY**

Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

**WHAT IF I HAVE QUESTIONS?**

We would be happy to answer questions you may have, and encourage you to contact us with any questions prior to deciding to participate in the study. If you have questions after agreeing to participate, you may contact the investigator, Maria Fernandez-Gimenez, at 970-491-0409. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, at 970-491-1655. We will give you a copy of this consent form to take with you.

**WHAT ELSE DO I NEED TO KNOW?**

To ensure the accurate documentation of your words, we would prefer to digitally record your interview. Please initial below your choice of being audio recorded.

YES, you may audio record our interview.

NO, I would prefer not to be audio recorded.

This consent form was approved by the CSU Institutional Review Board for the protection of human subjects in research on \_\_\_\_\_.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing 2 pages.

\_\_\_\_\_  
Signature of person agreeing to take part in the study

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed name of person agreeing to take part in the study

\_\_\_\_\_  
Name of person providing information to participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Research Staff

APPENDIX J: SEMI-STRUCTURED INTERVIEW SCRIPT

## **INTERVIEW SCHEDULE - RANCHERS**

### *Ranch Characteristics*

1. Could you give me an overview of your ranch?
  - a. What animals and products do you produce?
    - i. What is your primary product?
  - b. How would you summarize your goals in raising livestock?
2. Would you tell me a little about the lands your livestock graze?
  - a. Do you graze primarily private or public lands or a mixture of both?
3. What new range, herd or business management practices have you implemented in the past 5 years?
  - a. Can you tell me where you first learned about this innovation?
  - b. What led you to make this change?

### *Internet Access*

4. Could you tell me a little bit about your ability to access the internet?
  - a. What electronic devices do you have with internet access? PC, Mac, laptop, smart phone, tablet?
  - b. How do you usually access the internet?
  - c. How often do you use the internet?

### *Internet Use*

5. What uses have you found for the internet on your ranch? (Uses can be things such as looking up information on plants or animals, checking market conditions, business communications, video auctions, vet books, learning about invasive species management techniques, and so on)
  - a. What activity related to ranch management do you most use the internet for? How often?
  - b. When did you first start using the internet to augment your ranching activities?
    - i. How has your use of it changed over time?
    - ii. How do you see your internet use changing in the coming years?
6. What sites do you visit most frequently to help with day to day ranch management (if any)?
  - c. What about these sites makes them useful?
7. Do you use social networking sites such as Facebook, Twitter, or similar sites?
  - d. What do you use these sites for when it comes to ranch management?

### *Internet and Information Gathering*

8. Do you use the internet to find information on new management practices (such as different grazing systems, monitoring methods, ecologically beneficial practices, and so on)?
  - a. If so, what topics have you researched?
  - b. Has any of this research changed your opinions on any topics?
  - c. Has any of this research changed your management practices in any way?
9. Which information sources do you trust the most when it comes to finding information on management practices?
  - d. How does your trust (or lack of trust) for information sources you find on the internet compare to these trusted sources?
    - i. Which are the top three sources?

- ii. What are the biggest barriers to your use of the internet?
- e. Do new web-based methods of communication help you contact or access these sources?
- f. Do you use the internet to check on practices you hear about from other sources?
- 10. What information might you want to see provided on the Web in the future?
- 11. Have you ever used the internet to learn about invasive species like cheatgrass?
  - g. Was the information you found useful to managing the invasive species?
- 12. Have you ever used the internet to learn about state and transition models?

*Most Useful Formats*

- 13. What types of online media do you (or would you) find most useful for learning about new management practices? Examples include videos, articles, powerpoints or slideshows, other varieties, and any combination of the above.
- 14. What types of websites do you (or would you) find the most useful for learning about new management practices? Examples could include blogs, Twitter, a facebook page, Wikipedia-style site, general website such as those used by Extension, other types of site, or any combinations of the above.

*Demographic Attributes*

- 15. The next questions will be to get some basic information about you.
  - a. Where and when were you born?
  - b. How long have you been ranching?
  - c. How many generations has your family had the ranch?
  - d. How many generations has your family been ranching?
  - e. Which family members (if any) are involved in the ranch?
  - f. What is the highest level of formal education you completed?
  - g. Do you have any formal education related to rangeland or ranch management?

APPENDIX K: ANIMAL UNIT CONVERSION RATES

**Animal Unit Equivalence Ratios.** The ratios we used to convert specific types of animal into animal units to calculate the number of animal units owned by each respondent. Only animal types listed by rancher respondents are included in the table.

| Type of animal      | Animal Unit Equivalent | Source of Ratio       |
|---------------------|------------------------|-----------------------|
| Cow/calf pair       | 1.35                   | Vallentine (2000)     |
| Cow (non-lactating) | 1                      |                       |
| Yearling            | 0.7                    |                       |
| Bull                | 1.5                    |                       |
| Young bull          | 1.15                   |                       |
| Horse               | 1.25                   |                       |
| Sheep               | 0.2                    |                       |
| Goat                | 0.17                   |                       |
| Donkey              | 1                      | Boulder County (2013) |
| Llama               | 0.2                    | USDA NRCS (2006)      |

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[fc.sc.egov.usda.gov/MT/www/technical/range/NRPH\\_MT9\\_Ch\\_6.pdf](ftp://ftp-fc.sc.egov.usda.gov/MT/www/technical/range/NRPH_MT9_Ch_6.pdf)

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