THESIS

MONTANA CATTLE RANCHERS' PERCEPTIONS OF USDA APHIS INVOLVEMENT IN BRUCELLOSIS MONITORING IN THE GREATER YELLOWSTONE AREA

Submitted by

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In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Summer 2019

Master's Committee

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ABSTRACT

MONTANA CATTLE RANCHERS' PERCEPTIONS OF USDA APHIS INVOLVEMENT IN BRUCELLOSIS MONITORING IN THE GREATER YELLOWSTONE AREA

Brucellosis is a bacterial disease that that causes abortions in domestic and wild ungulates including cattle, bison and elk. The disease has been almost completely eradicated in the U.S., besides the last remaining reservoir in the greater Yellowstone area (GYA). Brucellosis has spread rapidly through the region by migrating elk herds, making efforts to control and track the disease increasingly difficult. Brucellosis can also be transmitted to humans, making the GYA an area of increased public health concern. The need to increase communication and understand relationships between cattle ranchers and the federal government is important in mitigating the spread of brucellosis between animals and humans. The United States Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) regulates brucellosis management on a federal level, while the Montana Department of Livestock (DOL) enforces federal regulations on a state level through a brucellosis management program including a Designated Surveillance Area (DSA) program and brucellosis testing, vaccination and identification regulations. DSA boundaries represent areas of the GYA with potential brucellosis-infected animals. Described as a "wicked problem", brucellosis is an issue that demands an increased understanding of rancher perceptions that will gain insight on views of federal and state government involvement in brucellosis monitoring as well as the brucellosis problem itself. This study explored Montana cattle rancher perceptions through ten qualitative, in-depth interviews using a phenomenological approach. This study employed the Situational Theory of Publics

(STP) as a dominant theoretical framework, as it allows for a detailed classification of publics which helps explain how and why they seek information to overcome a problem. Complimentary to STP is the Situational Theory of Problem Solving (STOPS), which was used as a secondary framework to further analyze how publics scan and select information that fits within a problem-solving situation. The findings from this study suggest that rancher perceptions surrounding government agencies and brucellosis are shaped by rancher experiences with predators and economic burdens of brucellosis regulations. Data also uncovered that ranchers had varied levels of knowledge in the epidemiology of brucellosis, but all agreed that the disease was a threat to public health. While most of the ranchers found the DSA program and brucellosis management regulations to be of value, perceptions of government agencies were mixed. Ranchers felt they played a role in solving the brucellosis problem, but to different extents. Ranchers also recognized the need for increased communication surrounding brucellosis management in the GYA. Recommendations that developed from this study can help to find common ground between government agencies and Montana ranchers in the GYA, as well as help guide communication and discussion surrounding the control of the disease.

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CHAPTER 1—INTRODUCTION

Bovine brucellosis is a bacterial disease that causes abortions in domestic and wild ungulates including cattle, bison and elk (Schumaker, Peck, & Kauffman, 2012). Brucella abortus is the bacterium that causes the disease, which can be ingested or inhaled through contact with placental and/or mammary tissues and milk of infected animals. (Schumaker et al., 2012). Brucellosis has no cure, but a vaccination (RB51) exists for cattle that helps reduce abortions, though does not prevent infection (USDA APHIS, 2018). This is commonly referred to as the Bangs vaccine in the ranching community. However, no vaccination exists for both elk and bison (The National Academies of Sciences, Engineering and Medicine, 2017). The disease can be transmitted from animals to humans; however, animal vaccination programs and the pasteurization of milk in the early 1900s has mostly eliminated the issue in North America (NASEM, 2017). Though human cases of brucellosis are rare in the United States, it is one of the more prominent global zoonotic diseases (Schumaker et al., 2012). Efforts through the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) Brucellosis Eradication Program in 1934 successfully eradicated almost all brucellosis from domestic cattle and bison in the U.S. However, cattle in Idaho, Wyoming, and Montana have tested positive in recent years, due to the last remaining reservoir of brucellosis in the greater Yellowstone area (GYA), present in the free-ranging bison and elk populations (NASEM, 2017). Though bison were originally thought to have been the main transmitter of brucellosis to cattle, recent transmission has been directly tied to elk through genetic and epidemiological studies (NASEM, 2017). The transmission of pathogenic bacteria such as brucellosis between wildlife

and food animals has been coined a ‘wicked problem’ in published literature, meaning the complexity of transmission between species continues to grow and affects a multitude of stakeholders (Fournier, Young, Rajić, Greig, & LeJeune, 2015).

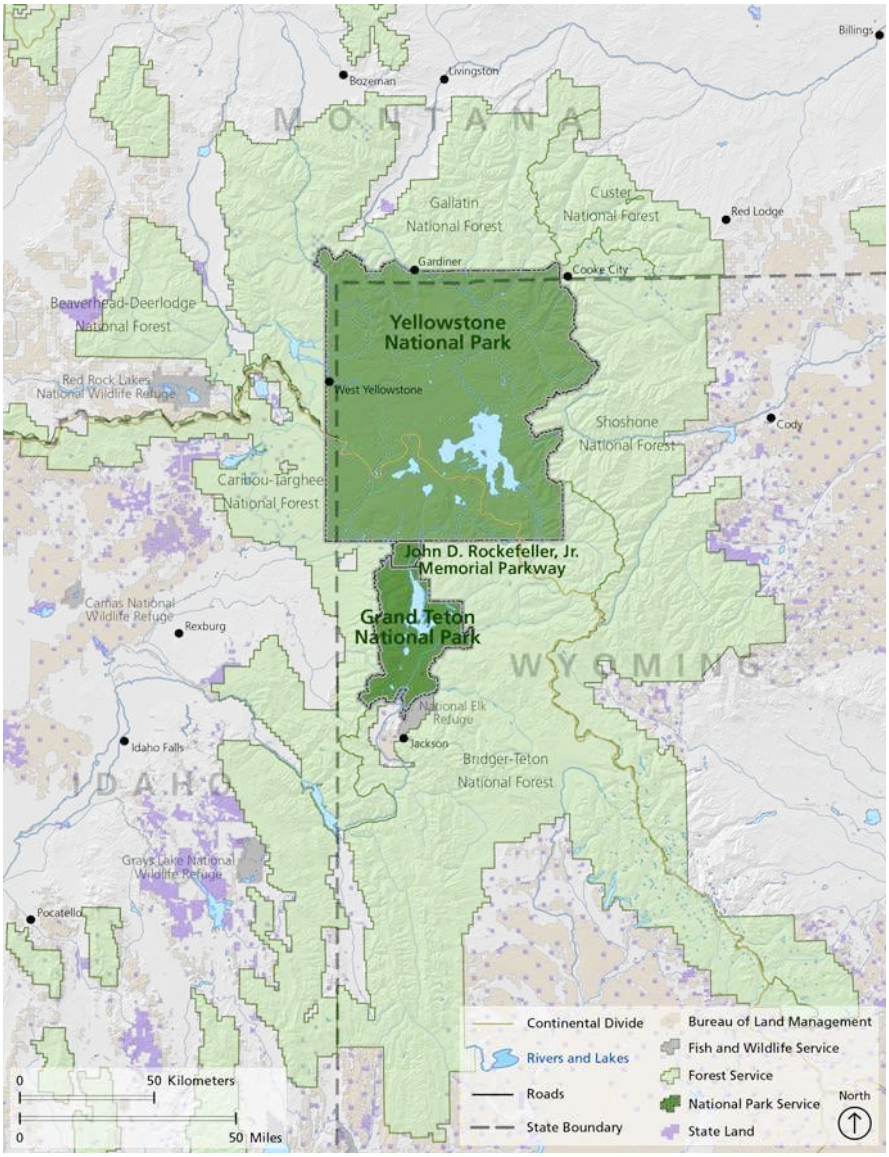

FIGURE 1. Map of the Greater Yellowstone Area (National Park Service, n.d.)

The GYA consists of approximately 22 million acres, encompassing the states of Wyoming, Montana and Idaho and is managed by state, federal and tribal governments, along with other

private entities (National Park Service, n.d.). A map of the GYA can be found in Figure 1. Brucellosis regulation is monitored at both the federal and state level. USDA APHIS is the federal arm that is responsible for overseeing national regulations surrounding prevention of brucellosis in livestock. The Montana Department of Livestock (DOL) is the state entity that enforces all federal brucellosis regulations for livestock, while the Montana Fish, Wildlife & Parks (FWP) is the state entity that monitors brucellosis in elk. Both Montana DOL and FWP are also part of the Interagency Bison Management Plan (IBMP), which encompasses many other state and federal agencies in the management the wild bison population in the GYA (Legislative Audit Division, Montana State Legislature, 2017). The IBMP helps to oversee bison movement out of Yellowstone National Park in order to mitigate brucellosis transmission between species. Though bison are not the main transmitters of the disease, the IBMP is still an important tool worth mentioning in brucellosis management in the wildlife-livestock interface in the GYA.

As part of the State-Federal Cooperative Brucellosis Eradication Program, USDA APHIS enforces a series of state brucellosis classifications based on disease detection in livestock. These state classifications include Class Free, Class A, Class B and Class C. A brucellosis Class-Free status means that no cattle or domestic bison in a state is found to be infected for 12 consecutive months, while actively participating in a disease surveillance program (USDA APHIS, 2018). Class C is given to states or areas of states with the highest brucellosis infection rate and are required to be placed under federal quarantine (Legislative Audit Division, Montana State Legislature, 2017). Class A and B are given based on reclassification standards that involve specific infection thresholds (USDA APHIS, 2018). A Class-Free status is important to state officials, as this classification ensures that livestock that are purchased from certain areas are not a threat to animal health (Legislative Audit Division, Montana State Legislature, 2017). Since

brucellosis is present in the wildlife of Montana, state animal health officials are required to follow additional federal regulations to maintain a Class-Free status, including implementation of a brucellosis management plan. This plan encompasses specific surveillance of epidemiological activities, testing and vaccination in geographic areas of the state in which the disease is present in wildlife (Legislative Audit Division, Montana State Legislature, 2017). These geographic boundaries, called designated surveillance areas, along with the specific regulations, are discussed in the next sections.

Between 1998-2016, 22 cattle herds and 5 domestic bison herds were infected with brucellosis in the GYA (NASEM, 2017). The state of Montana lost its federal brucellosis Class-Free status in 2008, which was estimated to cost Montana rancher's $11.5 million, due to herd quarantines and destruction, and travel restrictions across the entire state (Montana Department of Livestock, 2018). In an effort to reduce the costly economic impact on ranchers in non-affected areas, USDA APHIS established an interim rule in 2010 (finalized in 2014) in which required the creation of a brucellosis management plan for any state that had brucellosis-infected wildlife (NASEM, 2017). The brucellosis management plan included the creation of designated surveillance areas (DSAs), as well as a set of brucellosis testing and vaccination regulations (USDA, 2014). The creation of the DSAs allowed ranchers in non-affected areas to be free of brucellosis regulation, while herds contained in the DSAs still remained subject to brucellosis testing requirements and regulation.

A designated surveillance area (DSA) boundary is defined as representing any area of a state that has potentially brucellosis-infected wildlife (USDA APHIS, 2018). The Montana Department of Livestock (DOL) is the state-entity that upholds and implements all federal brucellosis regulations for livestock, including maintenance of the DSA boundaries. DOL

manages the often-changing boundaries, which are determined by Montana Fish, Wildlife & Parks (FWP) data. FWP brucellosis surveillance monitoring tracks the distribution and level of brucellosis exposure in the elk populations. A map of the current Montana DSA boundaries can be found in Figure 2. Though the creation of DSAs in the GYA aimed to monitor brucellosis in specific zones, the areas have continued to expand with the spread of the disease (NASEM, 2017).

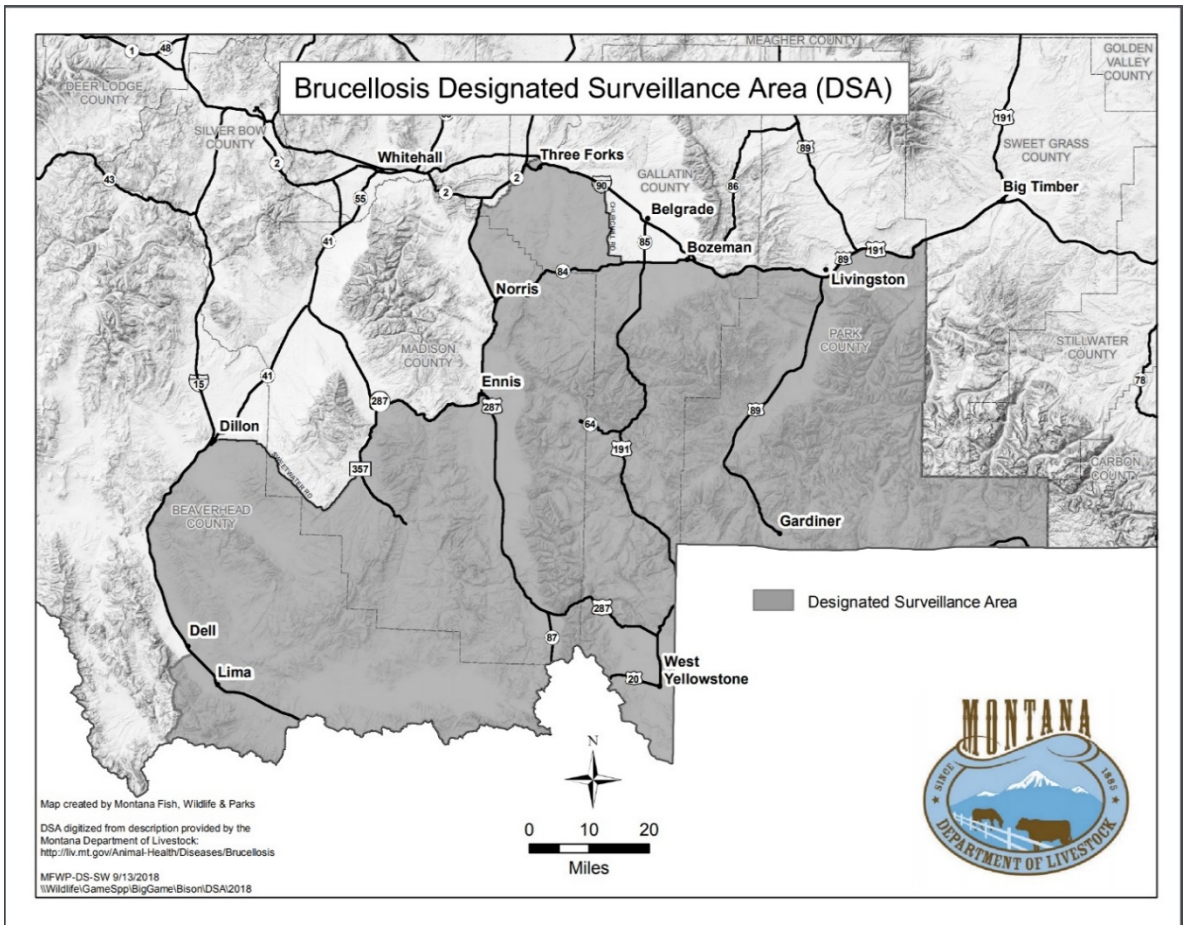

FIGURE 2. Map of current Montana DSA boundaries. (Montana Department of Livestock, 2018a)

"The increase in cattle infections in the GYA, coupled with the spread in wildlife, has been alarming for producers in the area; moreover, the risk of additional spread from

movement of GYA livestock to other areas across the United States is increasing due to impact outside of the GYA" (NASEM, 2017).

Although cattle ranchers outside of the DSA boundaries are not subject to regulation, the fear of the spread of brucellosis continues to thwart the region. The federally mandated brucellosis management plan regulations are summarized in Table 1. Additionally, a more detailed chart of testing and vaccination requirements for livestock based on age and risk period can be found in Appendix B. Overall, the brucellosis management plan helps to manage livestock in the DSA boundaries, in which livestock must be brucellosis tested each year, and additionally tested if they are moved outside of a DSA boundary or change ownership. This involves a producer contacting a veterinarian to collect the blood samples and send them to the state lab. All livestock must be officially identified with tags and all female cattle must be vaccinated as either a calf or an adult. State veterinarians also create individual brucellosis management plans for all ranchers that fall into DSA boundaries and are subject to regulations.

In addition to managing the DSA boundaries within the GYA, Montana DOL also oversees rancher compliance with the brucellosis testing, vaccination and identification requirements and provides monetary reimbursement for veterinarians that perform the work and submit the tests to the Montana Veterinary Diagnostic Lab. DOL also issues payments to ranchers in the DSA who have the tests done on ranch premises, in hopes of encouraging continued compliance (Montana Department of Livestock, 2017). However, survey data conducted by the Montana Legislative Audit Division concluded that only half of ranchers requested compensation, and this was seen in mostly large operations (Legislative Audit Division, Montana State Legislature, 2017).

TABLE 1: USDA APHIS Brucellosis Management Plan Regulations *Montana Department of Livestock (State-level enforcement)*
1) Creation and maintenance of **designated surveillance area (DSA) boundaries**
2) **Brucellosis Test Regulation (Bleeding)** • Required for the risk period of transmission: February 15th -July 16th of a given year. After July 16th, a brucellosis test is considered valid until February 15th of the following year. • During the risk period, all cattle or domestic bison that are sexually intact, at any age (used for breeding purposes) or 12 months of age (for non-breeding purposed) in the DSA must be tested for brucellosis within 30 days of: - ***Change of Ownership***: Defined as a sale from one rancher to another. - ***Movement***: Defined as livestock that are taken from an area within the DSA boundary to an area outside of the DSA to a pasture, grazing allotment, or holding area. This excludes movement to a livestock market, as brucellosis testing is done on the premise.
3) **Brucellosis Vaccination Regulation (Bangs Vaccination)** • All sexually intact female cattle or domestic bison 12 months of age or older in Beaverhead, Big Horn, Broadwater, Carbon, Gallatin, Jefferson, Madison, Park, Stillwater, and Sweet Grass counties must be official vaccinates. • Official vaccinates are calfhood or adult vaccinates (AV). • Vaccination requirements apply to resident female cattle as well as cattle seasonally grazing in these counties.
4) **Identification and Disease Traceability Regulation** • All sexually intact cattle and domestic bison (regardless of age) leaving the DSA must be officially identified. • Official individual identification tags include: - Electronic Identification Device (EID) tags (also known as RFID tags) - Orange brucellosis (metal or RFID) vaccination tags on officially brucellosis vaccinated females - Silver metal "Brite" tags (available to producers at no charge from the MDOL or USDA-APHIS office)

Note: Adapted from Montana Department of Livestock. (2018). Brucellosis/Montana's Designated Surveillance Area (DSA). Retrieved October 12, 2018, from http://liv.mt.gov/Animal-Health/Diseases/Brucellosis

The regulations of the brucellosis management plan impact approximately 78,500 head of livestock within the DSA boundaries. It is estimated that 5.2 percent of Montana's domestic cattle and bison herds as a whole are contained within the DSA boundaries (Legislative Audit Division, Montana State Legislature, 2017).

The GYA houses more than 5,500 bison that have direct lineage to the original bison herd that survived during the 1900s (NASEM, 2017). Over 125,000 elk also populate the area and are managed in part by the National Elk Refuge, federal and state wildlife agencies as well as through 22 supplemental elk feedgrounds in Wyoming (NASEM, 2017). Feedgrounds provide additional forage to roughly 23,000 elk to help sustain the population during winter months, as well as provide a way to limit comingling with cattle herds during high risk transmission months (Brennan, Cross, Portacci, Scurlock, & Edwards, 2017). However, feedgrounds are a hotspot for brucellosis, where the seroprevalence is high (around 20 percent) in comparison to non-feedground elk (Wyoming Game and Fish Department, 2014). Although supplemental feedgrounds are located in western Wyoming specifically, studies have found that the seroprevalence of brucellosis has spread to elk herds located in distant areas from the feedgrounds, which has shifted the risk of transmission to a broader area (Brennan et al., 2017). As elk populations surge across parts the GYA, the risk of elk transmission to cattle and bison has increased (Brennan et al., 2017). The reintroduction of grizzly bears and wolves have impacted the ecological landscape in the GYA, causing shifts in both the density and distribution of elk across the landscape (NASEM, 2017). While the once large population of elk on the northern Yellowstone range has declined, elk numbers have increased in other areas of the GYA (NASEM, 2017). "Wolves also shape elk distributions, as wolves reduce the availability of habitat and total forage. As a result, a greater number of elk are now found at lower elevations outside of YNP where wolves are less abundant" (White, Proffit and Lemke, 2012; NASEM, 2017). Although wolves may affect the spatial distribution of elk by either shifting behavior and dispersal, or population growth due to predation, "evidence is limited indicating that wolves have behaviorally shifted elk distributions at broad spatial scales" (NASEM, 2017, p. 60). A recent

study observed predator-prey interactions between female elk and wolves in the northern Yellowstone range, and found that elk do not necessarily avoid risky predation areas (Cusack, Kohl, Metz, Coulson, Stahler, Smith, MacNulty, 2019). This evidence may suggest that the presence of predators may not, in fact, affect elk spaciotemporal behavior. However, this study was only conducted in one portion of the GYA that possessed a lower elk population. More evidence is needed in order to fully understand broad spatial effects of elk distribution by predators in the GYA.

An additional challenge in the management of elk is the shift in land use by private landowners in the GYA, as many of these owners use their land as a source of feed and refuge for elk, making it harder to control the population through hunting initiatives (NASEM, 2017). The management of elk is a crucial part of attempting to control and eradicate brucellosis in the last remaining reservoir of the disease in the GYA.

Need for Study

Although ranchers in Wyoming and Idaho are affected by DSA enforcement in the GYA, the scope of this study focuses on Montana cattle ranchers specifically, due to time constraints. However, the researcher intends to include these stakeholders in further research endeavors in relation to brucellosis in the GYA.

This study examined Montana cattle ranchers' perceptions of USDA APHIS involvement in brucellosis monitoring in the GYA through the use of ten qualitative, in-depth interviews. Interviews were conducted through phone calls and video conferencing. Gaining insight into how Montana cattle ranchers' view federal involvement in brucellosis monitoring, along with perceptions of the brucellosis problem itself, helped inform communication strategies between

stakeholders. Effective communication is important, as collaborative management efforts between Montana cattle ranchers and federal government entities will be needed to control and potentially eradicate the spread of brucellosis to areas outside of the GYA.

NASEM concluded:

> "Coordinated efforts across federal, state, and tribal jurisdictions are needed, recognizing first that B. abortus in wildlife spreads without regard to political boundaries, and secondly that the current spread of brucellosis will have serious future implications if it moves outside of the GYA" (NASEM, 2017, p. 180).

As demonstrated, the need for multiple stakeholders to take control of the spread of brucellosis is critical, as well as continued communication around management efforts. Other literature has also echoed the need for improved disease mitigation strategies between stakeholders regarding transmission of pathogenic bacteria such as brucellosis, noting " a better understanding is needed of the social, cultural and economic aspects of wildlife and their role in the transmission of pathogenic bacteria to food animals to ensure the success of future risk prevention and mitigation strategies" (Fournier et al., 2015, p. 418).

Outside of the need to improve communication between ranchers and the federal government regarding disease control, the need to further understand ranchers' complex views of the government has become more apparent in recent years. Much, if not all of the literature that focuses on rancher perceptions of the U.S. government, involves the intense history of grazing cattle on federal lands and conservation initiatives (Lien, Svancara, Vanasco, Ruyle, & López-Hoffman, 2017). The fundamental tension between ranchers in the western U.S. and the federal

government began with the Homestead Act of 1862, which bolstered the Western Migration by giving settlers 160 acres of public land in exchange for settling the land for at least five years, and the option of purchasing the land thereafter for $1.25 per acre (The Library of Congress, n.d.). As settlers grew their cattle herds beyond their 160 acres , the need for more grazing access grew, which eventually led to the establishment of grazing fees and permits from the federal government in 1906 (Vincent, 2012). In exchange for access to more public land to graze cattle, ranchers had to comply with government oversight in addition to grazing fees. The introduction of the Endangered Species Act of 1973 further complicated the relationship between ranchers and the federal government, as public land usage became restricted due to preserving natural habitat (U.S. Fish and Wildlife Service International Affairs, n.d.). The passage of The Federal Land Policy and Management Act of 1976 was largely responsible for ending homesteading in the West, and established a more intensive public land policy (U.S. Department of the Interior, Bureau of Land Management, 2001).

Tensions between the federal government and ranchers were at a breaking point by 1980. Coined the "sagebrush rebellion", some western ranchers and other public land users began a movement consisting of heated opposition to government oversight and regulation of rangelands (Lien et al., 2017). The rebellion was comprised of political turmoil, grassroot movements, armed standoffs and heated debate between public land users, the Bureau of Land Management, and the U.S. Forest Service (Swearingen, Schimel, & Wiles, 2018). Carrying into present day, the sagebrush rebellion made national news coverage in 2014 with the armed standoff solicited by Nevada rancher Cliven Bundy, who refused to pay federal government grazing fees (Lien et al., 2017; Swearingen et al., 2018). In 2016, Bundy's son, Ammon Bundy, reignited tensions over government regulation of rangelands by organizing a 40-day armed occupation of the

Malhuer National Wildlife Refuge in Oregon with the help of other "militiamen" ranchers (Lien et al., 2017; Swearingen et al., 2018). These nationally covered events have drawn considerable attention from the public surrounding federal land usage and regulation, along with the portrayal of ranchers as antigovernment. Concerned of the stereotype that all ranchers were considered antigovernment, Lien et al. (2017) studied the values and attitudes of southeastern Arizona and southwestern New Mexico ranchers regarding ranching, conservation and government. Results produced three differing viewpoints, showing a complexity of values between the ranching population. Researchers found that two out of the three groups were mistrustful of the government, while all three groups held a commitment to conservation (Lien et al., 2017). Although Lien et al. studied views of the government in a conservation aspect, the results show the divergence of values and attitudes of the ranching community that are consistent with Montana cattle ranchers' perceptions of USDA APHIS and brucellosis monitoring. The need to further study rancher perceptions of the federal government in terms of disease control is evident in the lack of literature, as well as the need to understand the complex values held by ranchers. The information that developed from studying Montana cattle ranchers helped to find common ground between the federal government and brucellosis monitoring protocols, and combat misunderstandings about ranchers' view of the government, especially antigovernment stereotypes set forth from the sagebrush rebellion. Understanding the perceptions held by Montana cattle ranchers' regarding brucellosis monitoring efforts in the GYA will ultimately help guide communication and discussion surrounding the control of the disease that has the potential to impact the United States in its entirety.

Theoretical Framework

This study used James Grunig's Situational Theory of Publics (STP) as a theoretical framework, because it allows for a detailed classification of publics which helps explain how and why they seek information in order to communicate to overcome a problem (Grunig, 1979). A complimentary expansion of STP, the Situational Theory of Problem Solving (STOPS), was used as a secondary framework. STOPS theorizes that publics not only process messages, but scan and select information that fit within a situation that involves problem solving (Kim & Krishna, 2014). Grunig's theories provided a framework in which to analyze and classify emergent publics present among the Montana cattle ranching community in the GYA. In addition, STP and STOPS provided deeper insight into ranchers' perceptions of brucellosis monitoring and federal protocol. Other concepts such as relationship-building constructs between organizations and publics were also analyzed. Though many theories exist that would have also been suitable for this research, Grunig's theoretical frameworks were especially chosen for analytical lenses because brucellosis in the GYA presents a complex, multi-faceted problem that involves multiple stakeholders, and with them, multiple avenues of selecting and communicating information involved in problem solving. Grunig's theories also provided a unique theoretical foundation to analyze differences in perceptions around brucellosis in the Montana ranching publics in the GYA.

CHAPTER 2—LITERATURE REVIEW

Chapter two provides an overview of key concepts and theoretical frameworks for examining Montana cattle ranchers' perceptions of the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) involvement in brucellosis monitoring in the greater Yellowstone area. A synthesis of relevant literature was conducted to address the research questions as well as provide a theoretical basis for the research study. James Grunig's Situational Theory of Publics (STP) was chosen as the theoretical framework for this research because it aids in classification of publics in terms of how and why they seek information to communicate and respond to problems (Grunig, 1979). Additionally, it has been successfully applied in understanding publics' orientations to and potential communication solutions for other complex, controversial agricultural issues (Ruth, Lamm, Rumble, & Ellis, 2017). A subsequent framework that is expanded from STP is the Situational Theory of Problem Solving (STOPS), which was developed by Kim and Grunig to introduce communicative action in problem solving as a new concept, along with a new variable, situational motivation (Kim & Grunig, 2011). STOPS operates on the basis that people do not only take messages, but digest the information while making sense of its fit within a situation that demands problem solving (Kim & Krishna, 2014). This framework, along with STP, guided the creation of the research questions that ultimately provided a classification of publics among the Montana cattle ranching community and provided a deeper understanding of rancher perceptions of brucellosis monitoring and government involvement. Figure 3 illustrates the concepts and variables involved in STP and STOPS and how those were operationalized in this study. Specific concepts were defined based on the scope and goals of this study, including relationship-building pillars for

organizations and publics. Previous research studies that were designed to measure ranchers' perceptions regarding animal health and government agencies are also discussed.

Situational Theory of Publics

The Situational Theory of Publics (STP) provided a conceptual foundation to help describe the diversity of publics that exist among Montana's cattle ranching community as they relate to brucellosis monitoring in the greater Yellowstone area. This theory seeks to explain communication behavior on the foundation that attitudes and personal traits do not necessarily explicate the reasons behind why publics communicate; that is, STP assumes that publics control their behavior and often choose to engage in communication in order to improve that control (Grunig, 1979). In other situations, communication is the behavior that a public will control, often for consummatory or entertainment purposes. Moreover, the theory operates on the basis that how publics' view a situation or issue will ultimately affect whether or how they choose to communicate about it (Grunig, 1979). Cognitive, attitudinal and behavioral effects of publics are also explained by STP, showing the likelihood of the occurrence of communication between groups (Grunig, 1997). Before Grunig's classification of publics is discussed, it is important to understand the three independent variables in the theory that affect when, how and why a public communicates: problem recognition, constraint recognition and level of involvement. The independent variables are situational in that they gauge people's perceptions in specific contexts, especially contexts that involve conflict or problems (Grunig, 2005). To further clarify, Grunig argues that publics change, disappear and reappear as problems are solved or further developed, which means problem recognition, constraint recognition and level of involvement will constantly change between situations (Grunig, 1979).

Independent Variables of STP

Problem Recognition

Problem recognition is the degree to which a person recognizes a problem or issue and stops to consider ways to solve it (Grunig, 1979). In other words, a person will not communicate or seek information about something unless it seems problematic to them; the higher problem recognition, the higher the chances that a person will communicate and seek information about it. Problem recognition is often operationalized in quantitative studies by asking respondents if they "often, sometimes, rarely, or never" stop to think about an issue (Grunig, 1979, p. 24).

In this research study, problem recognition correlated to ways in which Montana cattle ranchers recognize and consider management practices to monitor the spread of brucellosis between domestic livestock and wildlife under direction of government agencies.

Constraint Recognition

Constraint recognition relates to ways in which a person views perceived barriers or factors that inhibit their ability to solve or contribute to a problem or issue (Aldoory & Sha, 2006; Grunig, 1979). Constraint recognition also relates to a person's ability to change a specific behavior or participate in some kind of action (Aldoory & Sha, 2006; Grunig, 1979). If a person has high constraint recognition, he or she is less likely to seek out additional information that might help construct his or her behavior (Grunig, 1979). If a person has low constraint recognition and high problem recognition, he or she will be more apt to communicate about an issue (Aldoory & Sha, 2006; Grunig, 1979). Operationally, constraint recognition is often measured quantitatively by asking respondents how they would respond to a variety of issues, including their perceived level of impact on the situation. For instance, respondents would be

asked if their actions would make little, no or great difference in the outcome of the situation (Grunig, 1979).

In this research study, constraint recognition was determined by the extent to which Montana cattle ranchers' view perceived barriers that limit their ability to help solve the brucellosis issue and co-exist with government regulations.

Level of Involvement

The last situational independent variable in STP is level of involvement, which explains when and how a person will communicate (Grunig, 1979). Level of involvement refers to one's personal relevance to a situation, or, in other words, how connected a person feels to a situation (Aldoory & Sha, 2006; Grunig, 1979). An increased level of involvement to a situation correlates to a higher probability that a person will communicate about it (Grunig, 1979). Level of involvement has been operationalized in quantitative studies through questions that ask respondents their level of connectedness to a situation, often using strong, moderate, weak or no connection as choices (Grunig, 1979).

In this study, level of involvement revolved around the extent to which Montana ranchers connected themselves to brucellosis monitoring protocols set forth by USDA APHIS in the greater Yellowstone area. Collectively, problem recognition, constraint recognition and level of involvement helped predict the two dependent variables of the theory: information seeking and information processing.

Dependent Variables of STP

Information Seeking

Information seeking is an active communication method that relies on a person's deliberate search for information that is of value for a particular situation (Aldoory & Sha, 2006;

Grunig, 1979). This behavior occurs when level of involvement is high. People who engage in information seeking normally participate in some type of behavior to interact within the situation, and hold attitudes, and organized perceptions about the issue (Aldoory & Sha, 2006).

Information seeking is especially important in this research study, as it informed animal health management practices related to brucellosis, and relationship-building among Montana cattle ranchers and government agencies. Relationship-building and measuring between organizations and publics is discussed at a later section. The combination of high problem recognition, high level of involvement and low constraint recognition would produce a public that would seek information and have a higher probability of communicating about the situation.

Information Processing

In contrast to information seeking, the second dependent variable is a passive communication method involving a person who stumbles upon information that they do not necessarily need (Grunig, 1979). People may pay some attention to the message while they process it unintentionally, leading to a more consummatory digestion of information (Grunig, 1979). From an agricultural standpoint, an example of information processing may come from a rancher who subscribes to a technical industry journal but only pays close attention to the cattle portions of the information. He or she may skim through the pages and process other agricultural related content unrelated to cattle versus actively seeking that information. Information processing was an important variable in this research, as ranching publics who engage in information processing regarding USDA APHIS involvement in brucellosis monitoring may be of interest.

Classification of Publics

STP offers a classification of publics that includes: nonpublics, latent publics, aware publics, and active publics, as well as sub-groups of active publics. Grunig defines a public as "a specialized group whose members have a reason to be interested in the activities and behaviors of organizations" (Grunig, 2005, p.778). Furthermore, Grunig rejected the idea of a "general public" in public relations research, as he argued that publics disappear and reappear as situations change course, meaning, there is no such thing as a permanent public (Grunig, 2005). Part of Grunig's theory of publics revolves around the notion that publics arise when organizations make consequential decisions that affect people who were not involved in the decision-making process (Grunig, 2005).

A nonpublic is simply a public who are not confronted or do not know of the problem (Grunig, 1983; Ruth et al., 2017). In this study, a nonpublic could fall into the category of a rancher residing outside of the greater Yellowstone area that is not affected by the issue of brucellosis and subsequent monitoring. This public could be a target public for agricultural communicators in terms of improving messaging around the spread of brucellosis.

A latent public is one that faces a similar problem but fails to detect the problem (Grunig, 1983; Ruth et al., 2017). For this research, that group might be ranchers who deal with brucellosis in Montana but are not directly affected by USDA APHIS involvement in monitoring in the Yellowstone area (i.e. ranchers who live in other regions of the state). These publics often have low problem recognition, but their level of involvement varies. This group is an important target for communication strategies, due to their sometimes moderate to high level of involvement (Aldoory & Sha, 2006).

Aware publics are publics who begin to recognize a problem but remain stagnant in their action (Grunig, 1983; Ruth et al., 2017). In this research study, aware publics were ranchers who deal or have dealt with brucellosis and begin to recognize the severity of the issue spreading to other species and to other areas of the state. This ultimately impacted how ranchers perceive government involvement in brucellosis monitoring.

An active public recognizes a problem and organizes to resolve it (Grunig, 1983; Ruth et al., 2017). Their issue involvement is high, restraint recognition is low and problem recognition is high. Ranchers who were involved in the USDA APHIS directed brucellosis monitoring and were proactive in solving issues surrounding it (i.e. control of the spread of disease, remediating economic burden of testing cattle before shipment, etc.) were considered an active public.

Additional Conceptualizations for Active Publics

Since public relations research often involves active publics, Grunig further conceptualized the levels and types of this classification including all-issue publics, apathetic publics, single-issue publics and hot-issue publics (Grunig, 1997).

An all-issue public is one that is active on all issues related to the study (Grunig, 1997; Grunig et al., 2005). This might be a portion of the active publics of Montana cattle ranchers who are aware and involved in all aspects of the USDA APHIS monitoring.

An apathetic active public is disinterested to all the issues being studied, while a single-issue public is only active on a slice of the problem as it relates to a small portion of the active population (Grunig, 1997; Grunig et al., 2005). For instance, a single-issue public might arise in the Montana cattle ranching community based on purely economic or environmental concerns.

Lastly, a hot-issue public is a group that is active on a single problem that impacts every person in the population, and often receives a large amount of media coverage (Grunig, 1997; Grunig et al., 2005). Hot-issue publics often morph into activist groups (Grunig, 1997).

Situational Theory of Problem Solving

As an extension of STP, the Situational Theory of Problem Solving (STOPS) was developed to explain more than if a public engages in passive or active communication. STOPS explains that a person's perception toward a problem, level of motivation to solve that problem and cognitive frames will ultimately inform whether they will engage in information forefending, permitting, forwarding, sharing, seeking or attending (Kim & Grunig, 2011).

Communicative action in problem solving is a newer concept developed by Grunig and Kim that "describes a problem solver's heightened communicative activeness in information taking, selecting and giving as one engages in problem solving" (Kim & Grunig, 2011, p. 124). The degree to which a person engages in these three actions is further expanded through a passive or active communication model, much like information processing and information seeking in STP (Kim & Grunig, 2011). However, in STOPS, information processing (passive communication) is renamed as information attending (Kim & Grunig, 2011).

The six variables of communicative action (information forefending, permitting, forwarding, sharing, seeking and attending) are conceptualized in three domains including information acquisition, information selection and information transmission (Kim & Grunig, 2011). As shown in Figure 3, information forefending and permitting fall under information selection; information forwarding and sharing fall under information transmission; and information seeking and attending fall under information acquisition (Kim & Grunig, 2011).

Information forefending is defined as an active communicative action in which a person "fends off" select information before consuming it, so as to judge its relevance and value to a problematic situation (Kim & Grunig, 2011). Information permitting, in contrast, is a passive communicative action in which a person accepts any new information, regardless of its value or relevance (Kim & Grunig, 2011).

Information forwarding is an active communicative action that involves a person that forwards information regardless of if it's asked for by the recipients (Kim & Grunig, 2011). This person is highly self-propelled by their increased problem recognition and is eager to share their problem-solving ideas with others (Kim & Grunig, 2011). In contrast, information sharing is when a person only shares information if it's asked of them to do so, making it a passive communicative action (Kim & Grunig, 2011).

Although discussed earlier, information attending refers to passive communicative behavior in which information consumption is unplanned, whereas information seeking is planned and deliberate (Kim & Grunig, 2011).

The communicative action model falls under the assumption that "the more one commits to a problem resolution, the more one becomes acquisitive of information pertaining to the problem, selective in dealing with information, and transmissive in giving it to others" (Kim & Grunig, 2011, p.125). Ultimately, people seek out select information that motivates them to solve a problem, and some information is more useful or relevant than others. When problem-solvers find information that aligns with their solution, the higher the chances that person will engage in transmitting that information to others (Kim & Grunig, 2011). In other words, when a person or public commits to solving a problem, an increased communicative activeness results in all three domains of communicative action (Kim & Grunig, 2011).

It is important to note that STOPS includes all three variables present in STP (problem recognition, constraint recognition and level of involvement) but also includes another variable called the referent criterion. Although the referent criterion was discussed in early renditions of STP, it was removed from the theory until STOPS was created, as STOPS was able to explain its involvement more effectively (Grunig, 1997; Kim & Grunig, 2011). A referent criterion is defined as "any knowledge or subjective judgmental system that influences the way one approaches problem solving" (Kim & Grunig, 2011, p.131). In other words, a referent criterion could be explained as decisional steps of past experiences that guide decisions around a new problem (Kim & Grunig, 2011).

The situational motivation in problem solving acts as a motivational concept that is a mediator between problem recognition, constraint recognition and level of involvement (Kim & Grunig, 2011). It is defined as the "extent to which a person stops to think about, is curious about, or wants more understanding of a problem" (Kim & Grunig, 2011, p.132). The main difference from STP is that this theory measures the effect of problem recognition—and what motivates a person to communicate (Kim & Grunig, 2011). Figure 3 combines both STP and STOPS in explaining how and why a public communicates in a situation. As the figure portrays, STP only describes one variable of communicative action, which is information acquisition through measuring problem, constraint and involvement recognition. STOPS shows that problem, constraint and involvement recognition are antecedent variables that ultimately inform a public's situational motivation in problem solving. The referent criterion is shown to have an independent effect, as this variable is more cognitive than perceptual (Kim & Grunig, 2011). Phrased differently, "people act on their perceptions, whereas motivation and cognition (i.e., a referent criterion) are enacted by the perceptions" (Kim & Grunig, 2011, p.132). The

communicative action model in STOPS expands the notions of information processing and seeking in STP, by theorizing that people use different communicative actions to acquire, select and transmit information.

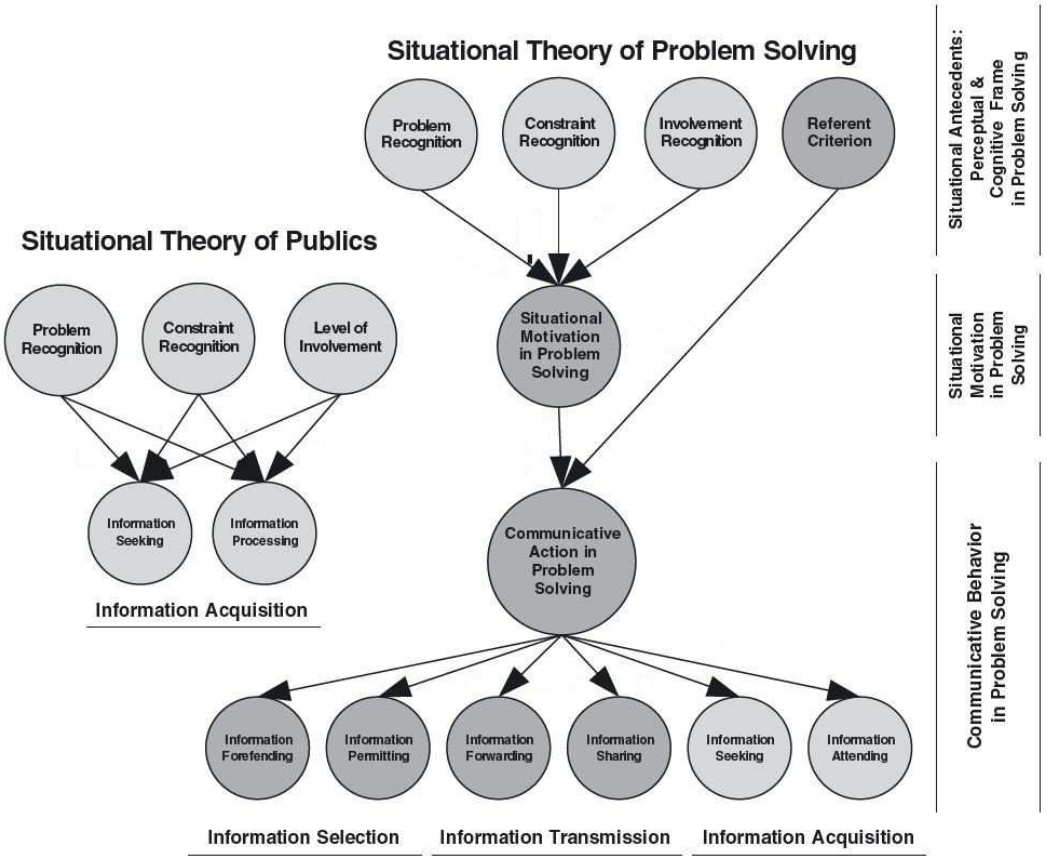

FIGURE 3. STP/STOPS Concept Map. Adapted from Kim & Grunig (2011).

Perception as a Concept

A central construct of this research study is the notion of perception; specifically, Montana cattle ranchers' perceptions of USDA APHIS involvement in brucellosis monitoring in the greater Yellowstone area. In this study, perception is referred to as "an individual's access to experience and interpretation of the world" (Given, 2008, p. 606). Given (2008) also describes perception as a set of lenses that "evolve from perspectives of location, subjectivity, particularity,

history, embodiment, contradiction, and the web of teachings imparted to the individual." Ultimately, studying ranchers' perceptions revealed multiple realities as it related to the brucellosis issue in Yellowstone, as perceptions are interpretations that in turn become an individual's truth (Given, 2008). Qualitative research gave the researcher greater access to understanding experiences and meaning from the individual (Given, 2008).

In relation to STOPS, Grunig and Kim (2011) note that:

> "One's perception is subjective to the individual (there are individual differences related to the same perceptual object and event), situational across time (it dissipates after problem resolution), and antecedent to motivation (individuals may or may not do something about the perceived state), cognitive processing (one may or may not think further about the perceived state), and communication behaviors (one may or may not seek, forward or forfend the information)" (p.132).

STOPS operates on the axis that people use their perceptions of a problematic state, ability to overcome the situation, and perceptual connectedness to the issue to engage in a communicative action that relates to the perceived problems (Kim & Grunig, 2011).

Cattle Rancher Perceptions of Animal Heath and Government Agencies

To this researcher's current knowledge, a large majority of studies that have examined cattle rancher perceptions surrounding government agencies and animal health issues were conducted outside of the United States. In one instance, a research team conducted interviews with English and Welsh cattle farmers to investigate producer perceptions around implementation of on-farm zoonotic control programs (Ellis-Iversen et al., 2010). The results from this study showed differences in farmers who intended and did not intend to implement zoonotic control strategies on their farms. Those who did not intend to implement control

strategies were described as needing a trusted source to influence them, indicating that a large barrier was the lack of knowledge around controlling zoonotic disease (Ellis-Iversen et al., 2010). Additionally, many farmers viewed their private veterinarian as their source of information regarding disease control, so the researchers recommended that more education should be available to veterinarians in order to reach more farmers. Both larger farms and younger farmers were more likely to implement disease control programs on their farms due to placing increased financial and social responsibility on industry rather than government entities (Ellis-Iversen et al., 2010).

Another study determined UK cattle farmer's perceptions around on-farm control of Escherichia coli 0157 (Toma, Low, Vosough Ahmadi, Matthews, & Stott, 2015). Through surveys, this study found that farmers who were more likely to vaccinate and devote more time and resources to controlling E. coli were those who: ultimately thought farmers were responsible for controlling disease spread; had farms that were open to the public and depended on that supplemental income; had stronger attitudes of the importance of disease control; were affected by outbreaks prior; had better developed knowledge of control and biosecurity measures; were using a health plan for their cattle; and those who raised dairy cattle rather than beef cattle (Toma et al., 2015). Recommendations from this research involved increasing targeted information around E. coli control to all farmers in an effort to strengthen or change perceptions surrounding the importance of on-farm control measures (Toma et al., 2015).

Circling back to the U.S., one group of researchers examined Texas cattle producers' barriers and social pressures to comply with foot-and-mouth disease (FMD) detection and control (Delgado, Norby, Dean, McIntosh, & Scott, 2012). This study found that perceived barriers of adapting to control methods for FMD included beliefs around economic consequences

and emotional consequences to compliance, such as concerns of depopulation and animal suffering (Delgado et al., 2012). Texas cattle producers' perceptions around FMD control were based on a list of key people including other producers, cattle industry groups and organizations, animal health regulatory agencies and veterinarians, to name a few. These people were identified as sources of social pressure among Texas cattle producers' in regard to FMD compliance and control. This study noted that "given the complex interplay between animals and their caregivers in the agricultural context, moral norms are likely to play important roles in understanding producer behavior. Trust in both regulatory agencies and other producers, as well as perceptions of the risk posed by FMD, were also influencers of cattle producers' behavior" (Delgado et al., 2012, p.132). Overall, results of this research echoed calls for increased education and communication around FMD control by government agencies, while also encouraging an in-depth look into social and psychological processes and perceptions held by cattle ranchers to understand behavior (Delgado et al., 2012).

An interesting study combined cattle rancher perceptions of elk in northern Arizona and subsequent perceptions of government oversight in elk management (Heydlauff, Krausman, Shaw, & Marsh, 2006). The results showed that ranchers had an overall negative view of elk, as many incurred monetary losses due to elk-related damage to their operations. Ranchers' also were not tolerant of elk and their place in the ecosystem, as cattle-elk competition for resources was one of the largest reported conflicts (Heydlauff et al., 2006). Ranchers also perceived poor agency management of elk, and believed that agencies did not take ranchers' needs into consideration. However, the researchers found in their agency survey data that agency personnel did recognize the effects of elk on ranchers (Heydlauff et al., 2006). This research suggests that

relationships between ranchers and agencies should be strengthened in order to find a common platform for further discussion.

Another study of particular interest utilized a qualitative thematic analysis focused on published research surrounding transmission of pathogenic bacteria between food animals and wildlife, but focused on the social, cultural and economic aspects of the transmission (Fournier et al., 2015). Brucellosis transmission was included in their literature search. The researchers found two themes that emerged from their analysis, with the first one being that the socio-economic aspects of pathogenic bacteria transmission between wildlife and food animals is a growing issue of global research, as many of the case studies were international (Fournier et al., 2015). Most all of the literature framed pathogenic bacteria transmission as a 'wicked problem' in which is "comprised of complex social, governance and public policy, and economic factors and implications" (Fournier et al., 2015, p. 426).The second theme that emerged from their analysis was that much of the literature proposed strategies to mitigate the transmission of pathogenic diseases, including "participatory, collaborative and multidisciplinary decision-making approached and the proactive incorporation of credible scientific evidence and local contextual factors into solutions" (Fournier et al., 2015, p. 417).The researchers also found that more contextual information surrounding stakeholder perceptions of transmission should be collected, including interviews, public consultations that support multi-stakeholder decision making and surveys (Fournier et al., 2015).

Previous research on rancher perception around animal health and government agencies shaped this study of Montana cattle ranchers' perceptions of USDA APHIS involvement in brucellosis monitoring in the greater Yellowstone area. Elk-cattle interaction was also heavily

situated in the problem of brucellosis transmission, so the literature that describes agency interaction with ranchers' perceptions of elk is of value.

Measuring Relationship Quality Between Organizations and Publics

As mentioned earlier in this chapter, the concept of relationship-building between publics and organizations was an important aspect of the study of Montana cattle ranchers. According to Hon and Grunig (1999), long-term relationships between publics and organizations can be strengthened and maintained through six components: control mutuality, trust, satisfaction, commitment, exchange relationships and communal relationships.

Control mutuality is "the degree to which parties agree on who has the rightful power to influence one another" (Hon & Grunig, 1999). Control mutuality between USDA APHIS and Montana cattle ranchers is a balance of being attentive to both the needs of APHIS and ranchers, while having each party involved in the decision-making process.

Trust has three dimensions including integrity, dependability and competence. These dimensions are part of a willingness to open up to each other, while believing the parties are fair and will do what they say they'll do (Hon & Grunig, 1999).

Satisfaction is when the benefits outweigh the costs of the relationship, and both parties are positive towards each other and their expectations.

Commitment is the "extent to which each party believes and feels that the relationship is worth spending energy to promote and maintain" (Hon & Grunig, 1999, p. 3). This involves both an actionable component in which there is a continuance commitment between parties, along with an emotional commitment, or affective commitment towards each other.

An exchange relationship refers to an organization and a public who exchanges benefits between each other because this exchange has happened in the past.

A communal relationship involves an exchange of benefits between parties, however this exchange is fueled by an overall concern for the welfare of the other party and not necessarily dependent on if the exchange of benefits occurred in the past (Hon & Grunig, 1999).

These six variables in relationship-building between organizations and publics help to solidify outcomes of relationships by demonstrating "changes in the cognitions, attitudes, and behaviors of publics—what people think, feel and do" (Hon & Grunig, 1999, p. 6). This was important to consider in examining Montana cattle rancher perceptions of government agencies. To further illustrate, "organizations generally make better decisions when they listen to and collaborate with stakeholders before they make final decisions rather than simply trying to persuade them to accept organizational goals after decisions are made" (Hon & Grunig, 1999, p. 8).

Recent research involving the cattle industry and the industry's views of USDA APHIS shows that some cattle producers have an unfavorable view of government oversight and "strongly value privacy and are sensitive to anything resembling government intrusion on their cattle business" (Abrams & Bonser, 2018, p. 5). Using Grunig and Hon's lens of relationship quality, they found that USDA APHIS needed to focus on communicating ways in which the cattle industry has influenced their actions (i.e., highlight control mutuality in the relationship) and focus on rebuilding communal relationships with cattle producers (Abrams & Bonser, 2018).

Examining the perceptions of Montana cattle ranchers helped uncover weaknesses in the six components of long-term relationship-building proposed by Grunig and Hon, and provided a starting point for future recommendations.

Research Questions

The purpose of this research was to describe Montana cattle ranchers' experiences and perceptions of the brucellosis problem in the greater Yellowstone area and the federal protocol in place to address the problem. The following research questions helped achieve this purpose:

1) **What are ranchers' perceptions of their experiences with the brucellosis problem in the greater Yellowstone area?**
    a. What are their perceptions of the problem? How were those shaped?
    b. What role do ranchers believe they play in helping solve the brucellosis problem in the greater Yellowstone area?
    c. In what ways do ranchers seek to communicate about the problem?
2) **What are ranchers' perceptions of federal protocols to address the brucellosis problem in the greater Yellowstone area?**
    a. How were/are those perceptions shaped? By what experiences, social norms, and interactions?
    b. What are their perceptions of the DSA solution?
    c. What are their perceptions of USDA APHIS? In what ways do ranchers communicate with APHIS regarding the problem?

CHAPTER 3—METHODS

The research questions were explored by conducting ten qualitative, in-depth interviews with Montana cattle ranchers in the greater Yellowstone area who were affected by brucellosis and by the federal protocols in place to control the spread of the disease. The need for qualitative research approaches using STP and STOPS frameworks is discussed thoroughly. Gaps in qualitative research pertaining to agricultural publics also is addressed. Overall research design, rancher selection, and data analysis and rigor is also discussed as well as how reliability and validity were addressed in the study.

Gaps in Qualitative Research using STP Theory with Agricultural Issues and Publics

Recent quantitative studies using STP as a basis of classifying agricultural publics recommend that future research focus on qualitative approaches (Lamm, Lundy, Warner, & Lamm, 2016; Ruth et al., 2017). As part of an effort to increase water conservation messaging, Lamm et al. (2016) found that one public perceived water conservation as a high problem (problem recognition) but did not feel responsible for the issue (low involvement recognition). This public was recommended as a target for water conservation messaging; however the researchers concluded that qualitative methods would help to further uncover and describe constraint recognition among that public in participating in conservation practices. That is, why did this aware public not participate in conserving water even though they saw it as a problem? In relation to Montana cattle ranchers, it was important to identify and clarify problem recognition around brucellosis and federal monitoring protocols, as well as the constraints that may fuel ranchers' perceptions.

To identify publics in states impacted by citrus greening, Ruth et al. (2017) categorized publics as active, aware, aroused, and inactive. Although the quantitative study uncovered differences among the publics in three states, the scholars urged future research using focus groups and in-depth interviews to study perceptions of citrus greening, as well as media and information consumption habits that lead to information-seeking behavior (Ruth et al., 2017).

Although STP has been studied extensively using quantitative methods to discover classifications among publics, there are few studies that employ qualitative approaches. Filling a gap in this research area would help to further conceptualize and operationalize Grunig's independent and dependent variables that could potentially lay the groundwork for further research (Aldoory & Sha, 2006). In-depth interviews offer an advantage to explore the concept of perception, as researchers can go into greater detail about the constructs that exist within the context of situational problems (Aldoory & Sha, 2006). Although quantitative survey methodology can be helpful when researchers seek to generalize the data, some scholars encourage the use of qualitative methods in the wake of low survey response rates. That is, although most qualitative work cannot be generalizable, researchers should weigh their options when choosing between methods (Aldoory & Sha, 2006).

Using quantitative approaches to measuring constructs, such as constraint recognition in STP, offers a host of challenges, as this variable is complex and dependent on other factors within publics. Cultural, social, economic, political and varied media consumption habits influence perceptions of personal constraints, forcing a complex concept into an abbreviated answer that may not be completely reflective of the public (Aldoory & Sha, 2006). That is, although quantitative methods may measure a complex concept using multiple question dimensions, it can still be difficult to capture findings that are reflective of a public without the

opportunity for follow-up clarifications between the researcher and respondent. Another consideration in quantitative methods is the survey length, as many scholars must condense questionnaires to have only a few questions measure each variable in order to avoid survey fatigue in respondents (Aldoory & Sha, 2006). Aldoory and Sha (2006) also argue that researchers sometimes must reduce the number of variables measured in a survey in order to reduce the survey length to avoid respondent fatigue. This can present another challenge when studying the theory, as not all the variables are accounted for (such as only measuring problem recognition and level of involvement, but not constraint recognition). Though qualitative studies often face the same problems of length in relation to respondent survey fatigue, a qualitative approach might help lessen the amount of time needed to identify and understand STP variables through a researcher's ability to directly interact with the respondent. A qualitative exploration using STP as a guiding framework for data analysis and interpretation has the potential to reduce the burden on research participants while potentially offering richer insights into the theory's constructs than could a quantitative study design.

The need for qualitative research pertaining to agricultural publics, specifically ranchers, is echoed in range and ranch management literature. As mentioned earlier, although quantitative methods serve a role in generalizing findings, surveys and questionnaires often only reach the surface when gauging perceptions. Much of the historical and socioeconomic factors involved in ranching and ranch management are not represented in quantitative data, and the "mental models" of ranchers are better suited to study through a qualitative lens (Sayre, 2004). Phrased differently, "ranchers do not behave like idealized economic firms, and the social processes that lead to good management cannot be reduced to the standard calculus of monetary costs and benefits" (Sayre, 2004, p. 669). Qualitative research can dig further into the social process of

ranchers and provide context for questions that may have complicated answers, like the values and motives of ranchers (Sayre, 2004). Qualitative methods can also unearth new factors that might have been invisible to quantitative researchers through their survey instruments and question design (Sayre, 2004).

An interesting recommendation from range management literature forms around the notion that ranchers adapt their mental models of ranching around their spatial and temporal characteristics (Sayre, 2004). That is, ranchers hold high value in their ranching tenure (time spent ranching), ability to keep the ranch in the family, and attachment to their ranch. Ranchers historical perspective of ranching, in addition to their spatial and temporal specific characteristics, are well suited for qualitative research. Ranchers' anecdotal and in-depth perceptions of ranching can often be evaluated against other published historical research, providing context for claims made from qualitative research (Sayre, 2004). This evidence alludes to the importance of studying Montana cattle rancher perceptions of government in the greater Yellowstone area as a historical background of government and rancher interaction in that area surfaced and allowed new factors to arise.

Research Design

John Creswell defines qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting" (Creswell, 1998, p. 15). A qualitative approach was chosen to study this phenomenon due to the open-ended nature of the research questions. Creswell notes that a qualitative approach is appropriate for topics that have little or no literature and need to be explored in detail (Creswell, 1998). This also allows the researcher to

assume the role of an active learner who is able to explain the situation from the participant's view that is free from judgement (Creswell, 1998). In other words, "the best way to understand what is going on is to become immersed in it and to move into the culture or organization being studied and experience what it is like to be a part of it" (Krauss, 2005, p. 760). Krauss also mentions that people construct multiple realities when they experience the same phenomenon, which relates to the STP notion of different classifications of publics surrounding an issue (Krauss, 2005). Finding meaning in multiple realities is one of the goals of qualitative research, which has much to do with how publics construct their social knowledge (Krauss, 2005). Krauss defines social knowledge as the "broad variety of human activities, concepts and ways of being social" (Krauss, 2005, p. 764). Understanding Montana cattle ranchers' social knowledge and how that affects their perceptions of brucellosis and federal involvement was key in understanding how these members define their reality (Krauss, 2005).

In-depth, semi-structured, focused interviews were used to determine meaning among Montana cattle ranchers. Open-ended questions encourage participation and allow for flexibility in the way participants explain their experiences (Ary, Jacobs, & Razavieh, 2002). A semi-structured interview design allows the researcher to develop targeted questions beforehand, but also leaves room for unplanned responses or further questions that can lead to more detailed and rich information (Richards & Morse, 2012). Due to the rapport that is established with participants, the researcher is often able to achieve accurate responses and details through in-depth interviewing (Wimmer & Dominick, 2013). Developing rapport with participants helped to decrease the tendency for the Hawthorne effect, in which participants change or adapt their responses because they are participating in a study (Ary et al., 2002). The interviews were

recorded and transcribed in an effort to capture information and also prepare the data for analysis, which is discussed in a later section (Richards & Morse, 2012).

Phenomenology

This study benefited from a phenomenological study approach, which sought to "find meaning of the lived experiences for several individuals about a concept or the phenomenon" (Creswell, 1998, p. 51). Experiences, in particular, are defined in phenomenology as "an individual's perceptions of his or her presence in the world at the moment when things, truths or values are constituted" (Richards & Morse, 2012). The concept of brucellosis in the greater Yellowstone area is a shared phenomenon among Montana cattle ranchers. One assumption that is critical to phenomenology is the idea that "perceptions present us with evidence of the world—not as it is thought to be, but as it is lived" (Richards & Morse, 2012, p. 45). In other words, people's perceptions of their lived experience is what will drive the interpretation of the data (Richards & Morse, 2012). Another assumption that was considered in the phenomenological approach is the idea that human existence and behavior are observed in the context of a one's own world, including relationships to other people, situations, and issues (Richards & Morse, 2012). Phrased differently, "acknowledging that people are in their worlds and are understandable only in their contexts" is important to do when interpreting and engaging in qualitative inquiry (Richards & Morse, 2012, p. 45).

Participant Selection

Montana cattle ranchers directly affected by the federal brucellosis regulations in the greater Yellowstone area were targeted for in-depth interviewing. This is due, in part, to the phenomenon of brucellosis being local to the Designated Surveillance Area (DSA) put forth by USDA APHIS. This approach allowed for targeted questioning in the local context and

participant world. Ary et. al (2002) mentions that "qualitative researchers cannot observe everything about the group or site that might be relevant to the research problem but they try to obtain a sample of observations believed to be representative of everything they could observe" (p. 428). Targeted rancher participants were located within the area in Figure 2, including Park, Gallatin, Madison and Beaverhead Counties.

Sampling was approached with a combination of purposive and snowball methods. A purposive sampling method is commonly used in qualitative research because the samples may provide deeper insight into meaning and understanding of the phenomenon being studied (Ary et al., 2002). Snowball sampling (or chain sampling) is a method that employs the knowledge of initial participants who recommend other potential participants that might be deemed suitable to participate in the study (Ary et al., 2002). This process is then replicated with the next round of participants. Since the study was focused on a specific area, snowball sampling was a suitable method since many ranchers knew of others in the local and surrounding communities. In addition, snowball sampling helps with the recruitment of hard to reach populations, as referrals help to increase the level of trust between the researcher and potential participants (Atkinson & Flint, 2001). Maximum variation sampling, a form of purposive sampling, was also used in this study (Lindlof, 1995). Maximum variation sampling allows the researcher to find variation in participants that are more representative of a population being studied in the nature of a phenomenon (Lindlof, 1995). This was achieved by asking respondents through a snowball method if they knew of participants that may have a different view from them, thus helping to maximize variations in experiences and perceptions of brucellosis monitoring in the GYA.

Although there is no rule in qualitative methods that states a mandatory number of

participants, a best practice is to cease interviewing when data saturation has been met, that is, when no new information is uncovered through the interviews (Ary et al., 2002).

According to the 2012 Ag Census, ranches with 20-49 head of cattle and ranches with no more than 2,500 head of cattle made up the majority of the beef cattle herds in Montana (Vilsack & Clark, 2012). Montana cattle ranchers in the greater Yellowstone area who had 20-2,500 head of beef cattle were specifically targeted. Beef cattle were chosen specifically, as dairy cattle make up a small percentage of the total cattle herd in Montana (Vilsack & Clark, 2012).

The researcher initially recruited participants in December 2018, as part of the Montana Stockgrowers Association Annual Trade Show and Convention in Billings, Montana. This organization was chosen as a base point to recruit ranchers, as Montana Stockgrowers is a non-profit that represents the Montana beef cattle ranching community through work in legislation, government agencies, the media and advocating for ranching to the public (Montana Stockgrowers Association, 2019). The members in this organization are varied in location and herd size, which provided a less homogenous sample from those in the greater Yellowstone area, capturing a greater diversity of participants.

Snowball sampling was employed to obtain ten in-depth interviews, or until data saturation had been met. Snowball sampling was based from the initial participants at the Montana Stockgrowers Association Annual Trade Show and Convention.

Data Collection

Data was collected through conducting ten in-depth, semi-structured interviews, via telephone or Internet video conferencing. After obtaining clearance from the Internal Review Board (IRB) at Colorado State University to conduct the research and collect data, the researcher began her initial participant recruitment in December 2018 at the Montana Stockgrowers

Association Convention. Snowball sampling was used based on initial recruitment. The following outline of the interview process is as follows:

1. Potential participants were recruited, recommended or identified via telephone or video conferencing.
2. Date, time and place for a one-hour interview was determined that was the best fit for the researcher's and participant's schedule.
3. Participants were verbally read the consent script (Appendix A), which explains the study in further detail, along with statements ensuring confidentiality and no risk.
4. The researcher asked the participant if she could record the interview in order for her to focus on the questions.
5. Participants verbally agreed to both the interview and recording device. The researcher recorded via an audio recorder or video conferencing tool. Audio was stored on a private, Internet cloud storage server as well as a local, password-protected computer hard drive.
6. The interview began with some demographic questions, asking for ranch size and approximate location, type of cattle, ranching tenure, etc.
7. The researcher referred to the interview guide to ask questions, while also being receptive to follow-up and clarification with additional or re-phrased questions.
8. Towards the end of the interview, the researcher asked if the participant would like to reiterate or add any additional insight that would be relevant to the study.
9. The researcher then closed by asking the participant for the contact information of another potential participant.

A probing technique was used during the in-depth interviews to keep the interview focused and relevant. Probes are a way to dig deeper into a question or topic, in order to clarify

or redirect comments (Ary et al., 2002). The researcher must be careful not to ask probing questions in a way that may hint to any specific response, as this can hinder the quality of the data collection (Ary et al., 2002).

After all interviews were conducted, the audio was transcribed word for word by the researcher. Transcription allowed the researcher to become familiar with the material and begin to develop emerging themes from the data. When referring to the participants in the research study, pseudonyms were given to each rancher in order to preserve anonymity and confidentiality. Transcriptions did include rancher names.

Instrumentation

The researcher developed an in-depth interview guide based on the research questions stated in earlier chapters. This guide sought to develop rapport with the participant by beginning with simpler questions that evolved into deeper discussion of issues as the interview proceeded. Since perception was an important concept in the study, the researcher took into consideration audio cues from the participant that were important to analyze. It was of particular importance that confidentiality was stressed to the participant in order to ensure that quality, truthful and relevant data was gathered. Questions were structured in a way that allowed for the researcher to "engage in an intensive learning process where new knowledge is achieved. Thus, as an important learning facilitator, qualitative research and qualitative data analysis in particular have the power to be transformative learning tools through their ability to generate new levels and forms of meaning, which can in turn transform perspectives and actions" (Krauss, 2005, p. 763). A complete interview guide, including the informed consent script can be found in Appendix A.

The two overarching research questions for this study involve Montana ranchers' experiences with the brucellosis problem in Yellowstone and their perceptions of federal protocols to address the brucellosis problem. The interview guide was designed to answer these research questions by including questions that involve concepts specific to brucellosis in Yellowstone, such as the elk and bison population and how they might affect cattle operations in the area (see Interview Guide Question 2) . Questions also aimed to gauge ranchers' understanding of the disease, transmission between species, how ranchers communicate with each other, as well as ways in which ranchers seek more information regarding brucellosis (see Interview Guide Question 4). The interview guide also includes questions designed to increase the researcher's understanding of ranchers' perceptions of USDA, USDA APHIS, and federal brucellosis monitoring (see Interview Guide Questions 3, 5-7).

Data Analysis

As discussed in a previous section, a phenomenological approach was employed to analyze data collected from the in-depth interviews. As such, the researcher did "bracket all a priori knowledge about the topic; by writing their assumptions, knowledge and expectations, they enter the conversation with no presuppositions" (Richards & Morse, 2012). Through transcription and seeking emergent themes throughout the data, the researcher put herself in the context of Montana cattle ranchers.

> "Within the data analysis process itself, although subjective understanding is expected to be reached through the exchange of ideas, interaction, and agreement between the researcher and participant, the researcher avoids imposing his or her views, sets aside any preconceived knowledge, and is open, sensitive, and empathetic to the participants' responses; a difficult set of tasks" (Krauss, 2005, p. 764).

Through transcription analysis, the researcher sought to "grasp an essence" of meaning throughout the data, in an effort to reflect on the situation from different aspects (Richards & Morse, 2012, p. 147). Emergent themes were found through the analysis of descriptive words that participants used to explain a certain situation and by grouping the descriptions based on similarities in meaning (Richards & Morse, 2012).

Phenomenological data analysis uses a series of steps to stratify themes in the data, called horizonalization (Creswell, 1998). The themes are then organized by clusters of meaning and united to create a textural description of the theme (Creswell, 1998). A structural description describes how the theme came to be. Using the "what" and "how" of a theme and its meaning informed answers to the research questions with respect to rancher perceptions.

Research Rigor

Reliability and validity in qualitative research encompass credibility, transferability, dependability and confirmability, which all inform the integrity of the research data (Ary et al., 2002). "The nearer the researcher gets to the conditions in which they actually do attribute meanings to objects and events the more opportunity researchers and respondents have to engage in meaning making together. Rigor in qualitative data analysis is therefore a necessary element for maximizing the potential for generating meaning" (Krauss, 2005, p.765). Both validity and reliability are needed to provide correct interpretations of the data. Validity is often referred to as credibility in qualitative research, which involves the "accuracy and truthfulness of the findings" (Ary et al., 2002, p. 451). Credibility considers the believability of the researcher's interpretations of the data. A researcher should be immersed in the respondents' research setting and have the ability to empathize with respondents' reasoning when answering questions (Krauss, 2005). Researcher immersion can help to establish credibility due to the hands-on approach to uncovering

meaning. One way credibility was established in the research study with Montana cattle ranchers was with the use of member checks, which is the process of asking participants if the research interpretation is accurate (Ary et al., 2002). Member checks were used with each participant in order to ensure credibility in all interviews.

Transferability, also considered external validity, is the application of qualitative data findings to "other people, settings, and times to the extent that they are similar to the people, settings, and times in the original study" (Ary et al., 2002, p. 454). The transfer is judged by potential users of the research, and those users compare the findings to other situations (Ary et al., 2002). Although the data for the Montana study is not generalizable to cattle ranchers across the nation, it provides a rich look into rancher perceptions of livestock disease and government entities that may be used as a starting place for similar studies.

Dependability, similar to reliability in quantitative research, is denoted as the "extent to which variation can be tracked or explained" in a study (Ary et al., 2002, p. 455). This is due to the fact that contexts change within the qualitative research method and therefore variability is expected (Ary et al., 2002). A way the researcher in the Montana cattle rancher study investigated dependability is through the use of code-recoding. This method had the researcher initially code the data but not analyze it right away. After a couple days, the researcher returned to the data, re-coded it and compared the two sets before analysis begins (Ary et al., 2002, p. 456).

The last qualitative concept that ensures validity and reliability in research is confirmability or neutrality. Confirmability means the data is free from bias in both the data collection and data analysis processes in the research (Ary et al., 2002, p. 456). "Because it may be impossible to achieve the levels of objectivity that quantitative studies strive for, qualitative researchers are concerned with whether the data they collect and the conclusions they draw would be confirmed

by others investigating the same situation" (Ary et al., 2002, p. 456). An audit trail method, which enables another researcher to analyze the same data and arrive at the same conclusion, was also employed to increase confirmability in the Montana study (Ary et al., 2002). The researcher kept tape recordings, transcriptions and field notes as a way to provide a trail of evidence. Researcher bias was also addressed through the use of reflexivity in the Montana cattle rancher study as a method to ensure confirmability and credibility.

Reflexivity is both a concept and a process (Dowling, 2006, as cited in Palaganas, Sanchez, Molintas & Caricativo, 2017). Conceptually, reflexivity requires a researcher to be actively self-aware throughout the research process, and understand they, as the researcher, are part of the participants social world (Palaganas et al., 2017). "Reflexivity as a process is introspection on the role of subjectivity in the research process" (Palaganas et al., 2017, p. 427). Researchers must constantly reflect on how their own characteristics affect their interpretations of data (Palaganas et al., 2017). It's important to note however, that "the researcher's positionality/ies does not exist independently of the research process nor does it completely determine the latter. Instead, this must be seen as a dialogue—challenging perspectives and assumptions both about the social world and of the researcher him/herself" (Palaganas et al., 2017, p. 427).

The researcher has an academic and professional background in animal agriculture, with specific interests in the livestock communication industry. The researcher completed her bachelor's degree in Animal Sciences from Colorado State University (CSU) and is currently pursuing her master's degree in Public Communication and Technology at CSU with a focus in agricultural communication. Before pursuing a master's degree, the researcher worked professionally in the beef cattle industry for five years. She is also a graduate research assistant for another research project involving USDA APHIS and livestock health, which influenced her

decision to continue research in livestock communication. The researcher used reflexivity in order to control for bias; she recognized her biases and wrote them down before, during, and after data collection and analysis (Ary et al., 2002). "As researchers, we need to be cognizant of our contributions to the construction of meanings and of lived experiences throughout the research process. We need to acknowledge that indeed it is impossible to remain "outside of " one's study topic while conducting research" (Palaganas et al., 2017, p. 426). Through the researchers' background and prior knowledge of cattle disease management, she was able to ask questions that pertained directly to cattle management and therefore, gain deeper insight into Montana ranchers' perceptions of brucellosis and brucellosis monitoring.

CHAPTER 4—FINDINGS

Chapter 4 details the findings of the ten in-depth interviews from Montana cattle ranchers in the DSA boundaries surrounding the greater Yellowstone area. Participants were chosen based on whether or not their cattle were contained within a DSA boundary, and owned between 20-2,500 head of beef cattle. The purpose of this research was to describe Montana cattle ranchers' experiences and perceptions of the brucellosis problem in the greater Yellowstone area and the federal protocol in place to address the problem. This study used James Grunig's Situational Theory of Publics (STP) as a theoretical framework, in conjunction with Kim and Grunig's Situational Theory of Problem Solving (Grunig, 1979; Kim & Grunig, 2011). Together, both frameworks provided an analytical lens in which to study and classify the broad publics of cattle ranchers in the DSAs of Montana as well as how these publics congregate and communicate around the problem of brucellosis. Hon and Grunig's pillars in relationship-building between organizations and stakeholders was also used as a foundation to provide communication recommendations, which is discussed in Chapter 5 (Hon & Grunig, 1999).

The following research questions helped achieve the purpose of the study:

1) **What are ranchers' perceptions of their experiences with the brucellosis problem in the greater Yellowstone area?**
    a. What are their perceptions of the problem? How were those shaped?
    b. What role do ranchers believe they play in helping solve the brucellosis problem in the greater Yellowstone area?
    c. In what ways do ranchers seek to communicate about the problem?

2) **What are Montana cattle ranchers' perceptions of federal protocols to address the brucellosis problem in the greater Yellowstone area?**
    a. How were/are those perceptions shaped? By what experiences, social norms, and interactions?
    b. What are their perceptions of the DSA solution?
    c. What are their perceptions of USDA APHIS? In what ways do ranchers communicate with APHIS regarding the problem?

Participants

Participants were recruited through purposive, maximum variation and snowball sampling methods, as discussed in Chapter 3. The ten ranchers that were interviewed had varied backgrounds in the cattle industry, and varied locations throughout the DSA boundaries. To protect confidentiality of participants in the DSA boundary in Montana, the exact locations of each ranch have been omitted. A summary of information regarding the participants can be found in Table 2.

TABLE 2: Summary of Participants

Rancher Name	**General Location**	**Ranching Tenure**
Tate	Beaverhead County	Third-Generation
Simon	Madison County	Third-Generation
Chris	Madison County	Second-Generation
Frank	Madison County	Fourth-Generation

Dan	Park County	Third-Generation
Jennifer	Park County	Second-Generation
Laura	Gallatin County	Fifth-Generation
Janet	Park County	Third-Generation
Eugene	Park County	Third-Generation
Kathleen	Gallatin County	Fourth-Generation

Tate, a third-generation rancher in Beaverhead County grazes his cattle on both private and federal land. Tate operates a cow-calf and stocker operation, so he deals with both younger cattle as well as his cow herd. Tate is heavily involved in local and national livestock organizations. When asked why ranching in the GYA was important to him, Tate replied:

> "I mean, it's our livelihood. I mean, obviously, number one, this is what we do. And I think if we looked at our landscape here, we're…I mean, the resource we have here is not really suitable to produce really any crops for human consumption, so we basically have the ability to grow hay and forage and pasture if we want. So agriculture is really important to us in ranching just because it gives us the opportunity to manage our resources sustainably and then produce something we can market."

Simon, a third-generation rancher in Madison County, took over his family's operation in the 1980s. Simon owns a cow-calf operation and primarily sells feeder steers and heifers. Though the operation owns a large pasture base, the ranch also leases 400 acres of grazing land. Due to the ranch's close proximity to a Montana Fish, Wildlife and Parks (FWP) elk management area, Tate works closely with FWP on many projects.

Chris, a second-generation rancher in Madison County, owns a cow-calf operation that dealt with a cow that was tested positive for brucellosis. Chris is an avid elk hunter as well as a rancher, which provided a unique perspective to this study.

Frank, a fourth-generation rancher in Madison County, owns a purebred seedstock operation utilizing only privately-owned land to pasture his cattle. The state of Montana is the largest seedstock producer, meaning the shipment of genetic material such as semen and embryos, as well as shipment of purebred cattle for breeding purposes (Purfeerst, 2019).

Dan, a third-generation rancher from Park County, owns his own cow-calf operation as well as manages another cow-calf ranch. Dan's cattle reside in close proximity to Yellowstone National Park and has dealt with the comingling of bison and cattle in the past. Dan is also an avid hunter.

Jennifer is a second-generation rancher in Park County, and is uniquely positioned as both a cattle producer and cattle broker. In her role as a cattle broker, Jennifer must deal with moving cattle in and out of the DSA boundaries, as well as communicate the regulation requirements to her clients on a regular basis. When asked why ranching in the GYA was important to her, she replied:

> "Well, one I would have to say the way I grew up was on this ranch and yeah, besides liking what you do every day, I would say people got to get their food. I think it's an important part of this whole ecosystem or whatever. It's very important. People don't realize, I think, how important it is."

Laura, a fifth-generation rancher in Gallatin County, manages a cow-calf operation with her husband. Laura is active on social media platforms, where she is passionate about sharing her ranch's story with consumers as way to combat public perceptions of ranching.

Janet, a third-generation rancher in Park County, is very vocal regarding her views of the brucellosis issue in the GYA. Janet is concerned about the lack of communication surrounding brucellosis and feels that her way of life is threatened by the increase in disease transmission.

Eugene, a third-generation rancher in Park County, was born and raised on his ranch. His cow-calf operation is located in close proximity to Yellowstone National Park, where he deals with both elk and wolves. Eugene is also an avid elk hunter.

Kathleen, a fourth-generation rancher in Gallatin County, runs two cow-calf herds with her husband. Her herds utilize both private and leased pasture land and she also raises hay and alfalfa. When asked why ranching was important to her and her family, Kathleen replied: "It's in our blood. It's our lifestyle. We're real proud to be ranchers and to raise the very best product for the consumer that we can."

Research Question 1

Research question 1 was developed to better understand rancher's perceptions of their experiences with the brucellosis problem in the greater Yellowstone area. Specifically, this question sought to understand rancher perceptions of the issue and understand how their perceptions were shaped. Another component to RQ 1 was to identify if ranchers felt that they played a role in helping to solve the brucellosis issue, and to understand the ways they communicate about the issue. Using STP and STOPS as guiding frameworks in the analysis of the interview data, several themes emerged from this question. The first theme that emerged was that rancher perceptions of brucellosis in the GYA were heavily shaped by their experiences with predators on their ranches, and therefore, elk and bison distribution and density. The second theme that emerged was that ranchers had varied levels of knowledge and understanding surrounding the epidemiology of brucellosis, including the purpose and effectiveness of the

Bangs (RB51) vaccination. Brucellosis as a threat to public health in the GYA emerged as a third theme, with over half of the ranchers' mentioning the potential dangers of transmission from the livestock-wildlife interface to humans. Lastly, most ranchers agreed that they felt they played a role in solving the issue, but to different extents. The ways in which they communicated their perceptions of brucellosis also varied, as well as the ways in which they sought information about the disease.

Predators Shape Rancher Perceptions of Elk and Brucellosis in the GYA

The presence of predators, particularly grizzly bears and wolves, were a major factor in rancher perception surrounding the brucellosis problem in the GYA. As mentioned in Chapter 1, the reintroduction of these species into the GYA ecosystem impacted the patterns of elk herds, causing unusual distribution and density as the elk have sought protection against predators. The herds have no longer made their way to the high elevations of mountain ranges, but rather have sought refuge with domestic cattle herds, exacerbating the transmission of brucellosis. All ranchers that were interviewed had at least some direct contact with predators on their ranches and had negative perceptions of their impact on the brucellosis issue. Chris offered his take on wolves, and his perception that the issue is not going away:

> "I think they've been dispersed from other regions too. The predators have a lot to do with how these elk have dispersed into these calving grounds that maybe historically weren't so much there. Like if you look over in the Madison Valley and all those elk are calving, there's a bunch of them out in the flats calving, and so the wolves are definitely an issue for that too. They're not going away. I don't see the patterns and the elk going away."

Simon mentioned his struggles with grizzly bears on his operation, and their effect on his cattle and dispersal of elk herds:

> "The bears are moving too. They're starting to come in the lower elevations. We've had bears right at our home place here where our hay operation is. We have had direct conflicts with them. We had one in our feedlot one night and we think, we're not exactly sure what happened but something spooked about 300 heifers, bad enough that they tore the fence all down. The riders noticed that the elk would hang out with the cattle and our observation was that there was some security for elk being with the cattle because there's humans around. The elk have definitely changed patterns and where they are calving."

More simply put, Simon offered this:

> "It's just another challenge added onto the challenge of agriculture. I guess the way that we look at it is that it's not a matter of it they're going to be infected with brucellosis from the elk. It's just a matter of when because we have so many elk that we live with year-round."

Dan also struggles with a massive grizzly bear population on his ranch, mentioning: "They estimate 50-75 grizzly bears that are in the same basin that we operate in," and he comes into contact with a grizzly bear "on average, 6 times a day." The grizzly bear population has been detrimental to the elk population where Dan ranches, as he explained:

> "We used to have a herd of 25,000 elk in the northern Yellowstone herd where we're at and now we're right at about 3,000. We've had a 90% reduction and I used to have about 600 elk on this ranch year-round and now there are 10, 20 maybe at most. So you know, I can't say it's a non-issue because the very small handful of elk that I have calve right where I calve [my cattle]."

In contrast, Tate discussed how predators have allowed the elk population to thrive and become too large in his part of the DSA, since elk are better protected from predators when they aren't in the high elevations, but co-habiting with cattle:

> "We've also got to deal with somewhat of a balance, if you will. The biggest problem we have in this whole scenario is that we've got a herd of elk that's way over objectives. And

then when you throw brucellosis on top of that, that really starts to cause some problems for us."

Frank, who manages all his cattle on his private land, also echoed his negative perceptions of the reintroduction of predators and how that has changed the ecosystem in a problematic way:

> "I would say [predators] completely changed the behavior of elk and now we used to have dispersed elk and now we have large herds of elk, and the elk do not go into the mountains anymore. They pretty much live the majority of the time on private land."

Frank also had a negative perception surrounding elk in general, especially since they migrate to his land constantly. When asked if elk overlap with his cattle during calving, Frank noted "We don't put up with it. They get moved. They're on private land and I really don't care how they get moved."

Kathleen deals with both grizzlies and wolves, but she has adapted management strategies to avoid possible losses to predators. She said weaning her calves earlier also helped to mitigate brucellosis transmission from the massive herds of elk, however, "it's not necessarily an economical way to go," she explained. She keeps her herds off of pasture land until the beginning of August in order to skirt the brucellosis issue, as most elk are done calving at that time. "It costs a lot more to dry lot them and keep them on feed [instead of turning them out to grass]," she discussed.

Janet has both negative perceptions of predators and elk:

> "So we never had predators, wolves or grizzly bears. The late 1990s when they reintroduced the wolf to Yellowstone, that changed the behavior of elk and brought elk to our backyard. So we never had migratory elk until the wolf came. Then the wolf packs expanded out of the park. So our summer grass is about 20 miles from our home place. We started seeing wolf activity up there. You know, sort of it was a coexistence situation and

> they were in and out. We've actually had their den not far from where our cows are. We've had as many as nine wolves running around doing their thing. We've had two really bad winters and the elk behavior is getting worse, meaning that they're coming earlier, staying later."

Janet continued to describe how the threat of transmission from elk has impacted her on an emotional level:

> "You know, I think this year is the first year that I have felt the extreme stress that I did with elk to the point where I mean, I would see an elk and I would almost start to cry because it was just such a bad place for them to be and there was no hope to move them. In a business like ours where there's a lot of stress anyway. I do think that is one of the things in this whole situation that is really overlooked by everyone is the amount of internal stress caused by looking out your window and seeing elk with your cows."

Chris and Dan, both avid hunters, had unique perceptions of elk. Though many other ranchers commented on the need to manage the elk population to help decrease transmission, Chris offered his take: "[Brucellosis] is not gonna magically go away by reducing the number of elk. I think it needs to be dealt with more on a management level down to make it easier on producers if [their cattle] do contract it." Dan explained his situation further:

> "I mean I'm still at high risk even though I don't have 600 [elk] on the ranch anymore, I only have 20 but they literally calve right where my cows do. I don't know what the answer is. I'm not willing to wipe out the remaining elk herd, trying to curb brucellosis."

Eugene, also an elk hunter, enjoys hunting season but becomes frustrated when the season is over and the elk migrate to his property, explaining:

> "There's 800 to a thousand or more that come in and they binge out hay stacks and eat all our grass. I'd like to leave grass through the winter for the spring for my cattle, but I don't have any because all these elk just literally clean it off."

Tate began his discussion with his appreciation for elk, even though he struggles with the increased herd size due to predation changes and the threat of brucellosis transmission:

> "Well, I think just on brucellosis alone, I think we want to step back a little bit and just talk a little bit about the wildlife. Number one, the wildlife is really important for us, and we enjoy having them on the landscape. It adds some value to our quality of live. We enjoy seeing them. From a real estate perspective, it's good to have them."

Laura, who had dealt with Yellowstone bison and elk comingling with her cattle in the past, discussed her take on living in harmony with wildlife:

> "The reality is brucellosis began with livestock. I mean, it's something that we, as human beings, have brought into this situation, so there have been times where people have perceived ranchers to be very anti-wildlife, very anti-bison. I think people think that's our mentality, but really, I feel like I have a pretty reasonable view of the situation. It's something that we brought to bison and elk herds. It has to be managed, but it's not the wildlife's fault. We're not anti-bison. We're trying to do our best to live in harmony with all of the wildlife. Obviously, we have to have some management, especially with sick elk."

Kathleen summed her perceptions up by adding, "the whole brucellosis issue and predators, they go hand in hand if you're truly managing your herd."

Ranchers' Possess Varied Levels of Understanding of Brucellosis Epidemiology

Ranchers had varied levels of knowledge and understanding surrounding the epidemiology of brucellosis, including the purpose and effectiveness of the Bangs (RB51) vaccination, which is required for all females in the DSA boundaries. The RB51 vaccinations helps to prevent abortions if an animal is infected with brucellosis, but does not necessarily prevent infections, as many cattle that have tested positive for brucellosis had been vaccinated (NASEM, 2017). Knowing this difference is an important aspect in managing brucellosis, especially if cattle are co-mingling with

elk, as other management tactics are necessary such as limiting contact with wildlife. Although Laura is concerned with brucellosis, she noted that it's not at the top of her management agenda because she feels her herd is well protected through the use of the Bangs vaccination:

> "[The cattle] do intermingle, on a very large level, with elk and so obviously that's a concern, but at the same time, we do take the precautions of managing our vaccine program so we do feel, as a herd mentality within our herd, that we are careful and safe to make sure we are protecting them as best we can."

Frank mentioned he was not happy with the RB51 vaccine, though misunderstood its original and current intended use:

> "I'm not that impressed with the new product. I think the old RB51, that's the one they used for years, they cleaned up the entire United States if there was a bunch of false positives, bit it actually did work. This one here, they call it the abortion preventer, whatever that means. They don't even call [the vaccine] as preventing brucellosis if you read the label on it."

Ranchers who were more heavily involved in local and state livestock organizations had an increased breadth of knowledge when it came to the disease epidemiology. Simon discussed his thoughts on the vaccine:

> "The RB51 we currently use doesn't prevent brucellosis; it only prevents abortions. If a better vaccine could be developed, that would actually prevent brucellosis in livestock, we really wouldn't worry about it, we would just vaccinate our cattle and go on our happy way because they couldn't be infected. Until that happens, we just have to live with the disease, we continue to vaccinate them to prevent abortions, but it isn't going to prevent the disease."

Tate also echoed his understanding of the disease and the current vaccination, noting:

> "I really think there's some real importance to the continued work on this vaccine to make it better. And like I said, a lot of us that are in the DSA are doing some sort of

booster. We're not just relying on one round of that vaccine. I think that's important to understand and continue with. No matter how good a vaccine is, it's probably not going to be 100% effective."

Janet discussed her thoughts on the vaccine, as well as her perceptions surrounding the possibility of an improved vaccine in the future:

> "So it's a terrible vaccine, but it's all we've got. It's my understanding that it's somewhere in that 65% effective against the disease and more like 75% effective against abortion. So really pretty worthless for ... well, not worthless, but your chances are pretty bad that your cattle are gonna get it anyway. With the vaccine, maybe they won't abort in the middle of all your cows and the infection won't spread. And you know, all these proponents out there that say, "Oh, well, life would just get better if we had a better vaccine." What pharmaceutical company is gonna tackle the GYA? It's a limited area for profit and the amount of money they would have to spend on R&D to develop it, plus it's still on the biosecurity list and you can't even test and do experiments. So a new vaccine's not gonna occur anytime soon and I know that our congressional delegation and others in the county have made a huge effort to try to get it off the homeland security list, and it fell on deaf ears. They won't do it. So I don't get that either, but between ... so RB 51 is all you got, and it's not great, but that's what you use."

Kathleen echoed Janet's thoughts on the vaccine, noting "the efficacy of those vaccines is questionable when you hear the percentages of effectiveness. And you know, when you stop to think about it, that's not a high enough percentage to really protect your herd."

Outside of vaccination knowledge, Dan mentioned a fairly misguided solution to the brucellosis problem, based on the transmission of the disease: "I thought about this quite a bit. I don't know what the answer is. I mean in a perfect world, I'd like to see the DSA go away and let brucellosis run its course. Everything is exposed to it and then we are done."

Brucellosis as a Threat to Public Health

Brucellosis as a threat to public health in the GYA emerged as a third theme, with over half of the ranchers' mentioning the potential dangers of transmission from the livestock-wildlife interface to humans. As mentioned in Chapter 1, brucellosis in humans in the United States is rare, due to the pasteurization of milk as well as initiatives set forth by the Brucellosis Eradication Program (USDA APHIS, 2018). However, transmission can occur from both livestock to humans and wildlife to humans if precautions are not taken when handing infected animal tissues or aborted fetuses, both of which ranchers and hunters have the potential to come across. Laura discussed her experiences with a story about an inexperienced rancher in her area:

> "There was a woman in [the valley] who had a small herd of Jersey's. She was selling them on Craigslist, her calf herd. The heifers that she was selling, I believe, were eight months old, and she hadn't done any Bangs vaccinations. When she was asked, [she replied] "No, I don't do that. I'm not going to do that." It turns out she was selling her raw milk. She did not know that brucellosis can be passed through milk, and she was right next to Yellowstone. That is, to me, a concern. That's more concerning than other issues surrounding brucellosis for me. It's really the lack of knowledge for people that have sort of a backyard herd. I mean, that's becoming more a public health issue than an animal health issue at that point. That bothers me a lot."

When asked about the threat to ranchers or hunters who may come into contact with an aborted fetus or infected tissue, Laura explains:

> "That's where I am gonna say it's not a matter of if it will happen, but a matter of when. Absolutely, with a hunter or a rancher, I definitely see that happening. There's a woman in White Silver Springs who got it. She got it as a child, from drinking milk, so even just talking to her about what she went through, it made me…I think, before that, it might not have occurred to me, but just having it close by, thinking "Oh, my gosh, it really could happen," yes, I definitely think that's a public health concern, absolutely."

Janet believed that most hunters in the GYA knew the dangers of brucellosis transmission, but like Laura, worried about transmission through milk:

> "So I know that if you're a smart hunter, you use gloves now. People used to not worry about that when they gutted their elk. I think if you're a smart guy, you put the gloves on. You don't gut out an elk anymore in the GYA - well anywhere you should - without gloves on because of disease.
>
> I think that with the resurgence of the raw milk, people drink raw milk and not pasteurized, that's an issue. We have ... I don't know if they're still doing it, but a couple years ago somebody was selling raw milk, not too far from here. Ironically, in what I would consider the hot zone where we've had the repeat infections. I thought, "Well, that's a wreck waiting to happen." I think in the big picture, we've all lost sight of the human health issue, but it's definitely there."

Tate also mentioned his fear of transmission through milk, as there are dairies contained in the DSA boundaries:

> "That's the issue. We know that's a big risk, right? We've got to realize that as this spreads, there's dairies involved that are within the DSA. We've got a lot of different issues around. I think it is a public health problem, there's no doubt about that."

Being a hunter as well as a cattleman, Chris discussed his thoughts on brucellosis transmission from both wildlife and livestock, as he dealt with a positive animal in his herd:

> "I mean, I'm an avid hunter. I wear gloves when I handle [an elk carcass] but I'll bet 75% of [hunters] don't. I think there's still a lot of people that don't use gloves when they pull a calf, or you're driving along there and there's an aborted fetus there. They just step out and grab it and throw it in the back of the truck and wipe their hands on their pants. We, after going through that, brucellosis, it wasn't as big an issue to me before, as it was after, and I set a standard for all our guys that if you have to deal with something like that, you will wear gloves. And I think people in this area are more aware of it than other places."

Eugene discussed how local media fail to mention the potential threat to public health, but focus more on the fact that cattle get infected:

> "The one thing the newspapers and all the things have not said is brucellosis, humans can contract it and it's not very often said. It's called undulant fever. And again, all the articles avoid that. They pretty much say, "Well cattle carry it and get it." And this and that but again it don't mention about humans. I know of a veterinarian that has it and I listened to him give a speech about it one time and it don't kill people but you can't get rid of it. I think it needs to be communicated out a lot more."

Kathleen also believed that the threat to public health should be communicated more, noting "the public health threat wasn't as prevalent an issue to start with, but I think it's always been there. It probably doesn't receive enough attention actually."

Rancher Roles in Solving and Communicating the Issue Varied

The degree to which ranchers felt they played a role in solving the brucellosis issue and ways in which they communicated their perceptions of the issue varied. Additionally, ranchers sought different routes when it came to seeking or processing more information about brucellosis and the regulations.

Tate, an active leader in livestock organizations, feels a strong role to solve the issue, openly communicates about it and actively seeks information:

> "I've been fairly involved at the state level of livestock organizations and even going to some DOL meetings. And it's like anything; the more you know, the more you kind of understand there's two sides of it. So if the DSA does not function, then it poses the whole state with some issues. And I think that's where I feel from those ranchers that I do business with and talk to, they give me the impression that, "Hey, I know this is a pain, but thank goodness that you guys are doing the work." But still the vast

majority of livestock in our state are not burdened by these additional costs and encumbrances. So, that's good news. It shows how important this program is really."

Tate also discussed that he felt communication surrounding brucellosis was fairly well disseminated, and is an important part of clarifying information to the ranching community:

> "There's obviously some news releases from time to time. But by and large, the DOL has hosted those town meetings. Kind of town hall type scenarios. And those are real helpful to get public opinion. I think they've been fairly good at that, whether they have an educational forum at a stockyard or at the firehall or the school in these little communities. Once again, those are really helpful for disseminating ... maybe the rumors. All of us can read something in print in an article, and come away with lots of different opinions of what that means. So I think those are always going to be important."

Simon, another actively involved rancher, works closely with Montana Fish, Wildlife and Parks and the Montana Department of Livestock on projects and sits on a citizen's brucellosis management committee. This committee is made up of various stakeholders that work together to brainstorm management strategies surrounding brucellosis. "Just because brucellosis isn't a problem in other places than around Yellowstone Park, doesn't mean that it's not all our problem. The reality of it is it's a political problem just as much as it is or maybe more than it is a disease problem" Simon explained.

Jennifer, both a rancher and cattle broker, constantly communicates the brucellosis issue to her clients, much to her chagrin. She described how many of her clients and fellow ranchers have no or little knowledge about being contained within the DSA:

> "Well, that's where a huge gap lies. And me being a cattle broker, I have to be on the ball, of course, as what regulations are going and what is happening. And that's what I find very odd is I am a person that I would think that the state veterinarians or that certain people should contact is the cattle brokers because when you're changing regulations and laws and

how things can be sold and what they need to do, you would think they would be contacting important people like the cattle broker. So, what I do is I send out letters throughout the year to my clients that are, whether they're in the DSA or not, send them letters on exactly what they have to do. But there's some people that live in the DSA that there are totally across the county from me, and they're a couple hundred miles away. And so, when I saw their cattle, I was never sure, "Okay, are they in the DSA?" And if they would forget to tell me, then they wouldn't get my letter that states everything in the DSA. And it's so surprising how some of the ranchers don't even know that they're in the DSA or they don't even know have a clue of what it means to be in the DSA. So, it's crazy. But I always follow up and send out letters myself to my clients that are in the DSA. And whenever I do, I get umpteen million phone calls from I bet 95% of them asking me more questions about, "Well, are you sure we have to do this?" They have no clue. And we're getting ready to ship cattle and then they didn't tag them right or something. It's just ... It's crazy."

Laura discussed how communication surrounding brucellosis is not necessarily a common occurrence:

> "Okay, so when something comes up, I definitely feel like it's a conversation over coffee, but I also don't think it's something that is talked about all the time. It's not like it's something that comes up at every CattleWomen's meeting, but when we we're having coffee, that it's something that's brought up. I think there are other issues that are more pressing, that come up more often, probably. It's something that you don't think about every day, and then there's a blizzard, and you sort of forget about it because you lost five calves in the blizzard. I think it's been part of our operation for so long that it's not something that's a present concern, if that makes sense."

When asked where she consumed information regarding brucellosis, Laura replied:

> "Probably in livestock news sources, so definitely not in any sort of national news would I recall seeing anything. Maybe many years ago, but for now, if a herd turns up positive, I definitely think we probably get it from the Western Livestock Report or something. Also,

on social media, people will say, “Oh, my gosh, the ranch next to me tested positive for brucellosis,” so then it kind of spreads like wildfire within our community.”

Like Laura, Eugene mentioned brucellosis isn’t discussed as much in his locale either :

“We pretty much hear it from the news. And, because neighbors talk. So news and neighbors. It used to be talked about more but it’s kind of like we’ve been at it so long that it’s kinda like old news. And so it’s now, “Well did you hear that so and so had brucellosis in another county or another state.”

Janet is an active voice in the ranching community regarding brucellosis. She offered her take on how the rest of the ranching community communicates:

“You know, I think ranchers read in the Ag papers and stuff like that, they're getting information. I think they talk to their vets. Not all vets are as up to speed as others I have noticed. So that makes a difference on which vet you use. I think because ... initially there was a lot more going on in rancher groups and different meetings. It was a topic always. I think it's somewhat static at this point and so because the regulations have kind of gelled. So I think people aren't pushing different stuff so much, so I think people are just sort of like, "Okay, it's brucellosis," and in the DSA, "I don't want elk around and this is what I have to do when I sell my cows.” So I think everybody's pretty much got that now, but when there are changes, I think it's pretty hard to get the word out.”

Janet also discussed how her need for actively seeking information has increased, especially when information surrounding brucellosis changes:

“[In the beginning] we were so involved in all of the different plans and what they were doing and the meetings. Now, it’s like nobody has any meetings. I don’t know if that’s because we’re not in the loop anymore or because they don’t invite you or because they don’t have them. I can’t believe it’s because they’re not having meetings because I think they review all these plans all the time. So we don’t really have contact with the state vet anymore, and I used to talk to them all the time. I don’t know why that is. I still see him at meetings because I’m on the statewide elk working group. I think that last one of those I

went to was probably 18 months ago. So you kind of have this feeling like, "I wonder what's really going on and why I'm not hearing anything."

Kathleen subscribes to a DOL email listserv to "stay abreast of brucellosis information." Like others, she mentioned that "once the issue has kind of died down, I don't think there's as much communication about it."

Dan explained that he doesn't communicate much on issues in the ranching community, but does speak up on FWP issues. In his opinion, he feels that the ranching community is active in their communication:

> "Well on a personal level, I am pretty bad at being proactive. Active at all. I'm my own worst enemy. On fish and wildlife stuff, I am fairly vocal on. I do make good contact with things like that that overlap with the ranch. But as far as the ranching community, meetings I just never go to those meetings. I hardly send emails to any reps or anything. Overall, there's a lot of active people out there and it seems like they're well heard as the local ranching community. But I'm so inactive I don't have a lot of contact."

Frank mentioned that he also felt most ranchers communicated about brucellosis, mostly between their veterinarian and the DOL, as he did. "The DOL, they always send a deal to the veterinarians, and they also…almost everybody in this area has a [brucellosis management] plan and those plans get updated, and then you get an update on what's going on, and the testing procedures and all that."

Chris discussed how some communication he finds on brucellosis can be problematic in terms of public perception, both in the ranching community and the general public:

> "Anytime there's a positive animal that comes out of the DSA, all it is a newsflash that comes across [the 5:00 news] that there is a ranch in Madison County that has brucellosis,

and that's it. There's no explanation for the public. They don't know what exactly is going on."

Research Question 2

Research question 2 was developed to better understand ranchers' perceptions of the federal protocols in place to address brucellosis monitoring in the greater Yellowstone area. Specifically, this question sought to characterize how these perceptions were shaped and understand specific contexts such as the DSA boundaries and federal government involvement. Another component to RQ 2 was to understand ways in which ranchers communicate with governing agencies surrounding disease management. Using STP and STOPS as guiding frameworks in the analysis of the interview data, several themes emerged from this question. One important finding dealt with the fact that most ranchers had little to no direct interaction with USDA APHIS; that is, although APHIS is the federal governing agency in brucellosis management, the Montana Department of Livestock (DOL) is in charge of maintaining regulations. Therefore, ranchers had more direct contact with the DOL and sometimes Montana Fish, Wildlife and Parks (FWP), who manage elk and bison. With this finding came the first emergent theme, in which ranchers had varied perceptions of governing agencies and the protocols in place to manage brucellosis. The second emergent theme from the data was the fact that a majority of the ranchers agreed that the DSA and subsequent regulations were needed and were of benefit to the rest of the state of Montana. Third, many perceptions of governing agencies and protocols in place to manage brucellosis were shaped based on direct and indirect costs incurred by ranchers as a result. Lastly, most ranchers felt that increased communication and education was needed by governing agencies to inform ranchers, veterinarians and the public regarding brucellosis management and transmission.

Mixed Perceptions of Government Involvement and Brucellosis Management Regulations

Tate had mixed opinions of both DOL and FWP, but had a fairly good grasp on limitations that each agency faces:

> "You know, I think from the health perspective, the monitoring that [FWP] is doing, I'm not sure today that they could do a whole lot else. I don't feel like maybe our partners in the Fish and Game and stuff really even feel like it's that big of a deal. It's not hurting their populations. But it's just continuing to grow. It's continuing to put more pressure on those of us in agriculture trying to make a living. And you couple that with the increase in the number of elk that are absolutely way over objective, I think that's the part I get frustrated with.
>
> As far as our Department of Livestock, I don't know that I can be too critical of them and what they're doing. Because I think that the finances they have and the means of what they're doing."

Dan's perceptions of APHIS and the DOL were fairly neutral, noting "I think they're doing the best they can with the resources they've got." Dan had direct contact with APHIS staff when they were sent to help bleed cows on his ranch, and mentioned they helped get the job done and were pleasant to deal with.

Eugene mentioned he believes that FWP and DOL are both "for the cattlemen." He described how he felt that both agencies were doing their best with the resources they had, and that they both continue to adapt and change with new information or problems. In regard to FWP, Eugene mentioned "I stay in close contact too, with them. And I mean they're asking me and the other neighbors, "Do you have suggestions?" So I mean they're willing to listen if we think of something."

Laura also mentioned that she felt DOL "was very producer friendly" and noted that she "very much believes that those programs are set up, ultimately to protect the rancher." Kathleen too,

mentioned, “I think the state DOL is probably doing as good a job, and they should be commended for their efforts, because I really think they have the producer in mind.”

Simon had positive perceptions of DOL, FWP and APHIS, as he had some involvement with each agency in the past:

> “The state vets have done a tremendous job in managing the brucellosis problem. One of the chief things that they got done was to change the protocol on the way that we deal with the disease. Dealing with the federal government can be a positive or negative experience depending on who you’re dealing with. But I think overall, APHIS has been really supportive of the brucellosis program and I think it’s mostly to the credit of the state veterinarian because he’s put where pressure needs to be routed there.”

Laura also commented on dealing with federal government agencies, mentioning a disconnect can often happen between the producer and agency:

> “Sometimes there's things, when any sort of government issued policy, that I think get lost in translation between actually physically doing things and what's happening in an office somewhere, so that obviously can come up in times, but as far as how I feel about nationwide, I think there tends to be a disconnect, now and again, between producer and government offices.”

Due to Simon’s proximity to a game management area, he has helped FWP with many of their elk projects. He complimented FWP on their willingness to do more to help and he “got on board with [FWP] and gave them some support from the land owner’s perspective to the agency.”

In contrast, Jennifer had fairly negative perceptions of governing agencies. When asked if she felt supported by agencies like USDA and DOL, Jennifer responded:

> “Probably not, not. I don’t think so. When I'm just sitting there in a meeting with APHIS and Fish and Wildlife and Parks or the state vet or whatever, they just all talk in circles and say that they're gonna get back to you. And then nothing happens.”

Frank discussed his negative perceptions towards both DOL and FWP and the federal government in general:

> "But as far as the state, Fish and Game doesn't do a dang thing. They might do a few studies and that's about as good as it gets with them. They have no management of these elk. Unfortunately, since we've had 16 years of Democratic governorship, in the previous administrations we had a DOL that was basically in the mindset of controlling a big disease, today we have a mindset of monitoring disease. Our DOL just lost their way."

Chris's perceptions were that FWP needed to step up their elk management, remarking "I think Fish and Game should be involved from a money standpoint and helping finance some of this." When asked if he felt that his voice as a rancher was being herd, Chris replied: "Yes. And I think the [Montana Stock Growers] are doing a good job, as much they can. I think the state level is understaffed, for one, but they ... I think they listen but that might be as far as it goes." In regard to APHIS in particular, Chris explained his views: "So I think their hands are tied as well, and then on the same token, they're probably more influenced from public perception of what's going on."

Janet had negative perceptions across all governing agencies, but most notably for USDA APHIS and FWP. Although she felt that APHIS had made some positive changes, including changing regulations from herd depopulation to quarantine, Janet described how she believed the rhetoric of eradication of brucellosis should be examined, noting that eradication is not achievable :

> "My frustration with USDA APHIS at this point in time is that they're still stuck in the whole eradication conversation and punitive damage conversation, and they're not looking 10-20 years down the road when DSAs are expanding and we're still having the same quarantine issues and there's no more state funding for quarantine testing. What to producers do then?

Janet's complaints about DOL were mostly about the lack of communication regarding regulations, noting "everybody doesn't ever get on the same page at the same time with the same understanding." As far as FWP, Janet felt the same way regarding the lack of communication, and mentioned that she felt in the "heart of hearts" that FWP didn't care about working with landowners to mitigate brucellosis. She ended with, "I think in this day and age, if you're an agency and you can't think outside of the box and try something different, then you have no purpose."

Kathleen also described her frustrations with the lack of involvement from FWP, explaining:

> "I even raised my hand at one of those meetings with the DOL a couple summers ago, and said "Where is FWP? Why aren't they at the table here, at this discussion?" Because it's their lack of management of those elk herds that's really promoting the issue here."

DSA and Brucellosis Management Regulations are Needed

The second emergent theme was that most ranchers agreed the DSA and subsequent regulations were needed and were of benefit to the rest of the state of Montana, at least.

Laura mentioned that she felt at ease with the regulations: "I would say that I feel like, as far as most transmittable diseases within cattle production, it's well monitored, in the sense that we've been brucellosis free, so it's not something that we probably worry about."

Simon had a more detailed account of why the DSA is important, noting it could potentially help catch brucellosis infection before the possible transmission to the rest of the herd, even though it's a "pain in the patootie to go through all the testing protocols":

> "I think it's working about as good as it can work. That's worked really well I think and it's mostly for the protection of the producers that live in the DSA that number one, if you

identify an animal soon enough coming off your ranch that has infected brucellosis, you have time to get your herd cleaned up before you turn out in the spring."

Tate discussed how working with the DOL to ensure proper management of the DSA regulations has been a positive experience, and ultimately helping to shape a positive perception regarding the DSA:

"The other thing right now is [DOL] does work, sets up these management plans for our herds in the DSA. It's important for us to cooperate with [DOL], and make sure that we do let them know what our normal flow of business is. Because they've got to have that understanding, too. I think that's good, and those are things that need to continue to happen."

Frank had relatively negative views about the DSA and its potential success:

"Well, it's growing. That's the big thing. I mean in probably another 10 years it will be probably ... 10, 20 years it'll be twice as big as it is now. I don't think it'll ever address the problem. I think what ends up happening is we will lose what funding the rest because it'll just get so out of control, and they'll basically say, "Oh well we can't cover it now, so you've got two ranchers or whatever and start your own. It'll be just a process of doing business."

Janet had mixed perceptions regarding the DSA and brucellosis management regulations, but agreed to some degree that they were needed:

"So, you know, in the black and white world, yes it helps because you're gonna catch the disease earlier, you're gonna be able to reassure your trading partners that you have a program in place that's not gonna send brucellosis their way or if by any chance something slips through, you have enough identification on all these animals that it's gonna be easier to trace back and figure it out. So on that level, yes it works.

However, Janet mentioned that on a producer level, the DSA and management regulations only created more work and more stress on both the rancher and the cattle.

Direct and Indirect Economic Burdens of Brucellosis Regulations Shape Perceptions

Perceptions of governing agencies and protocols in place to manage brucellosis were shaped based on direct and indirect costs incurred by ranchers as a result. Although ranchers are mandated to test for brucellosis, the state pays for the veterinarian to run the tests and reimburses the rancher to an extent (see Chapter 1 for more information). The required vaccination cost however, is incurred directly to the rancher. Other indirect costs, such as time spent working cattle and having to adapt cattle marketing practices that don't maximize profit (i.e. selling cattle at inopportune times of the year) are discussed.

Chris was able to give a concrete example of both direct and indirect costs that he incurred when one of his cows tested positive for brucellosis:

> "But by the time it was all said and done, and then we had to keep all the open cows that were on the ranch as well. They couldn't go through the sale barn. So that ended up costing us another $75,000 in hay. Indirect costs, the amount of calves, you ... you run those cows through an extra three times [to bleed]. You're obviously gonna have some cows that abort their calves, due to the extra stress, getting beat around the corrals. I figured combined total cost of it was about $170,000. Of that, the DOL reimbursed us close to $14,000. So total estimated loss of about $156,000. And so you put that in perspective of what it costs after the reimbursement. It's almost $90 a cow, of loss. For one positive. $80-$90 a head for one productive cow on the ranch. But it was, honestly, it was a nightmare of a process to go through."

Dan explained that he is a smaller producer, so direct costs aren't necessarily a huge deal for his operation, though he does have fears of what could happen:

> "[The cost] isn't huge, especially since we're a small operation. It's just a little more tedious kind of thing. Drawing blood, wait for tests. But not insurmountable, it's not a big deal. My big worry is one of these days I'm going to test positive. If I can't sell my calves,

I'm quarantined for the whole season through 3 negative test results. That's pretty tough to survive."

Tate discussed the hardship that both direct and indirect costs could have on ranchers:

"And so I know that once we have it, that quarantine process can take six months to a year to clean my herd up. Financially that's tough. Especially if it happens at the wrong time of the year. It's one thing to be quarantined for a few months, with a cow-calf operation, you can't just run cows through whenever you want. The work is one thing, but the costs of doing all these things are just going to stress an already pretty tough business to be in. There's not a lot of returns here. We've got some pretty small margins we're dealing with anyway."

Simon talked about potential indirect costs associated with the brucellosis regulations, and that had to do with the sale and shipment of cattle outside of the state and stigmas associated with the GYA region:

" That's been part of the problem, the political thing that I was talking about and that's exactly what we ran into [shipping cattle] there in Colorado was that there's this fear of this dreaded brucellosis coming to the state and that's been the thing the DOL have really done a masterful job of working around that politics and easing the fears of veterinarians in other states about the cattle from the DSA coming into their states. In our case, that guy in Colorado could just turn around and say, "Take your cattle and shove them, I'm not going to buy them."

Janet also discussed her fear of the potential indirect costs associated with marketing cattle in the GYA:

"So I have the fear that eventually there will be some market penalty for living in the DSA that at some point, these feed lot operators or breeding programs or whatever you end up doing with your calves that somebody's gonna say, "You know, I don't want to take the change that you live 30 miles from Yellowstone National Park, and you might have

brucellosis. I don't really care if you're testing or not. I don't want to take the chance. So I'm gonna go elsewhere and look for my cattle."

Additionally, Janet discussed other potential indirect costs that ranchers must endure:

> "If you end up with brucellosis, it most definitely has the ability to put you out of business. If all you had was enough hay for X amount of time, and now you have more cattle for this amount of time, then you have the cost of hay. If you don't have the right kind of facilities in the mountains to work our cattle, how are you supposed to get them tested. So that's a hardship. You've got added labor. You've got death loss from working them. You've got abortions, you've got cripples. So all kinds of stuff happens when you work cattle and that many of them."

Kathleen described the costs as "just time consuming, and it throws a monkey wrench in your operation if you're trying to move or sell your cattle, it's a real pain to have to do that." Jennifer explained how she lost out on many sales on cattle within the DSA boundaries due to testing requirements:

> "But to me as a country buyer [in the GYA], that's where I have lost many sales is because people need to ship their yearlings and then they find out that, "Oh, no. We have to bleed these heifers." You have to run them to the shoot again, you have to ID them, and then you have to wait three days to get your blood test back and then we can go with them. So, that's how I lose some deals because of that in the DSA."

Lack of Communication Regarding Brucellosis in the GYA

All ranchers felt the need for increased communication and education put forth by government agencies to inform ranchers, veterinarians and stakeholders about brucellosis management and transmission. Jennifer identified the lack of communication as a large issue in the GYA, especially when local veterinarians were unclear of the regulations:

> "Well, what's pretty crazy is that if you would make phone calls to some of the veterinarians that deal with the DSA people that they don't even know what the current regulations are.

> Half of the time I deal with vets, and I know more than what they know. And then that's where I come back and think the same thing is "how come people are not getting what they need, the information that they need out?" Yeah, I know. It's crazy. It would be nice for people to know."

Laura emphasized the lack of communication and education when it came to 'homestead' ranchers, or in other words, inexperienced ranchers that moved to the GYA:

> "The one thing I do think, that is a threat, and I am all about people living their life the way that they see fit, but one of the things that I see on a regular basis, especially in this area, are people who, in quotations, consider themselves homesteaders, and within that, they want to raise meat for themselves, and also to sell, but have absolutely no vaccines, and no antibiotics, and all those things, and with that comes the fact that you're losing the herd immunity, because this person who's bought 40 acres next to you refuses to vaccinate their cattle. I think that that is more of a threat than people give credit to."

Janet also mentioned the importance of reaching small or inexperienced ranchers through communication:

> "It's gotten better over time, but I'm such a big believer in communication. I don't think you can ever communicate enough because the errors that occur even when everybody thinks they're on the same page is ridiculous. So if you've got all these producers on the countryside that don't go to all the meetings, don't read the papers, don't want to be involved. Or the mom 'n' pops that have a dozen cows and don't really relate to anybody about anything. I mean, how are they gonna actually know? So mistakes are made. Things are missed."

Chris described feeling ignored by agencies when he tried to communicate regarding the costs he incurred from brucellosis regulations, explaining: "I tried to give this information on the amount of money I figured it costs us to a few different agencies, to try to show that it isn't just a small thing. And they pretty well waved it off."

Kathleen offered her take on the lack of communication among the agencies: “I don’t have any magic potion other than I just think more communication among the agencies and trying to work out solutions. I’ve always been disappointed that the DOL and FWP don’t talk to each other. I’m very resentful of that.”

Frank explained that more communication and education is needed to reach the general public, as brucellosis is a complex issue buried in a myriad of other issues in agriculture in Montana:

> “Well in our area, one of the biggest things I see is we're the ones that's keeping the open space. Bozeman and Big Sky, and these rivers and that, it's all getting bought up by these out-of-staters, and these people are all moving here, and they want all their open space and recreational areas. We're having to defend for water rights, and the grizzly bear thing. And so if we want to keep all this open space, they got to keep ranching healthy, and that's I guess my big pain of the deal is the more and more they subdivide, and chop up land, and build houses, what is left is what ranching has. And I think the big thing there is the more they ... We don't have good policies and that helps keep ranching healthy, the more we're going to lose open space.”

CHAPTER 5—CONCLUSIONS

Chapter 5 discusses the key findings, implications, conclusions and recommendations gathered from the ten in-depth interviews from Montana cattle ranchers in the DSA boundaries surrounding the greater Yellowstone area. The purpose of this research was to describe Montana cattle ranchers' experiences and perceptions of the brucellosis problem in the greater Yellowstone area and the federal protocol in place to address the problem. This study used James Grunig's Situational Theory of Publics (STP) as a theoretical framework, in conjunction with Kim and Grunig's Situational Theory of Problem Solving (Grunig, 1979; Kim & Grunig, 2011). These frameworks provided an analytical lens in which to study and classify the broad publics of cattle ranchers in the DSAs of Montana as well as how these publics congregate and communicate around the problem of brucellosis. Hon and Grunig's pillars in relationship-building between organizations and stakeholders was also used as a foundation to provide communication recommendations (Hon & Grunig, 1999).

The following research questions helped achieve the purpose of the study:

3) **What are ranchers' perceptions of their experiences with the brucellosis problem in the greater Yellowstone area?**
    a. What are their perceptions of the problem? How were those shaped?
    b. What role do ranchers believe they play in helping solve the brucellosis problem in the greater Yellowstone area?
    c. In what ways do ranchers seek to communicate about the problem?
4) **What are Montana cattle ranchers' perceptions of federal protocols to address the brucellosis problem in the greater Yellowstone area?**

d. How were/are those perceptions shaped? By what experiences, social norms, and interactions?
e. What are their perceptions of the DSA solution?
f. What are their perceptions of USDA APHIS? In what ways do ranchers communicate with APHIS regarding the problem?

Conclusions and Implications

Key Findings

Many themes emerged from the data collected from ten in-depth interviews with Montana cattle ranchers' in the greater Yellowstone area. Although the sample was purposive and based around a population in a defined area, the participants varied in their perceptions of the phenomenon of brucellosis in the GYA, signaling that the maximum variation sampling method was successful in creating variance in a population (Lindlof, 1995). The variation in rancher perceptions of government in this study also supported Lien et. al findings of divergence of values and attitudes of the ranching community, which helps to combat the anti-government stereotype often given to cattle ranchers (Lien et al., 2017).

Research question 1 revolved around rancher perceptions of their experiences with brucellosis in the GYA, along with exploring what shaped their perceptions surrounding the issue. The question also explored ways in which ranchers felt a role in solving the problem, along with communicating about it. Ways in which ranchers sought information about the disease were also explored.

The first theme that emerged from the data was that rancher perceptions of brucellosis in the GYA were heavily shaped by their experiences with predators that were reintroduced into the ecosystem. All ranchers had some form of direct contact with either grizzly bears and/or wolves,

which in turn effected the behavior of elk in terms of distribution and density, posing a large threat to cattle in terms of brucellosis transmission. These perceptions were complex, as though most ranchers agreed that predation was an issue, a level of appreciation for elk on the landscape was felt by many.

Rancher experiences varied in that some saw a large influx of elk on their private property, while others complained of the diminishment of herds in their areas due to the presence of predators. This finding is consistent with scientific evidence explaining the differing distribution and density of elk herds across the GYA due to predation (NASEM, 2017).

It is important to note that during the course of in-depth interviews, the U.S. Fish and Wildlife Service proposed the removal of the gray wolf from the List of Endangered and Threatened Wildlife on March 15, 2019 (Endangered and Threatened Wildlife and Plants; Removing the Grey Wolf, 2019). Due to this event, the first theme regarding rancher experiences with predators and subsequent perceptions of brucellosis could have been shaped and influenced by the recent proposal from US. Fish and Wildlife, rather than a foundational finding from the data.

The second theme that emerged was that ranchers had varied levels of knowledge and understanding surrounding the epidemiology of brucellosis, including the purpose and effectiveness of the Bangs (RB51) vaccination. The ranchers who were more actively involved in local and state organizations had more correct knowledge of disease transmission, along with knowing that the vaccination does not prevent infection. Knowing this information is important in managing co-mingling of wildlife, especially during calving when other strategies may be needed to protect a herd from transmission outside of vaccination.

Brucellosis as a threat to public health in the GYA emerged as a third theme, with many ranchers' mentioning the potential dangers of transmission from the livestock-wildlife interface to humans. While the ranchers interviewed in this study understood that it could be transmitted to humans, many mentioned that they do not believe all ranchers or hunters in the GYA possessed that knowledge.

The final emergent theme from RQ 1, was that most ranchers agreed that they felt they played a role in solving the issue, but to different extents. Those involved in local and state organizations found that it was easier to play a role in helping to solve the issue by being able to understand other sides of it. The ways in which they communicated their perceptions of brucellosis also varied. Some routinely communicated to other ranchers about the issue, and others felt it wasn't an everyday conversation unless a positive animal was found in their area. Many ranchers depended on finding new information about brucellosis from their local veterinarian, though some rancher experiences explained that not all veterinarians knew the correct information regarding regulations. Others found their information through the Montana Department of Livestock, specifically through conversations with the state veterinarians through discussions of individual brucellosis management plans. Some ranchers found their information through local TV news and through livestock news sources.

Research question 2 was developed to better understand ranchers' perceptions of the federal protocols in place to address brucellosis monitoring in the greater Yellowstone area. Specifically, this question sought to characterize how these perceptions were shaped, either by experiences, social norms or interactions. Another component to RQ 2 was to understand ways in which ranchers communicate with governing agencies surrounding disease management.

An important finding dealt with the fact that although APHIS is the federal governing agency in brucellosis management, the Montana Department of Livestock (DOL) enforces state regulations. Therefore, ranchers had more direct contact with the DOL and sometimes Montana Fish, Wildlife and Parks (FWP), though a few had perceptions surrounding APHIS in particular.

This finding guided the first emergent theme of RQ 2, which was that ranchers had varied perceptions of governing agencies and regulations in place to help manage brucellosis. These perceptions were shaped by past interactions with government personnel and regulations. Many ranchers felt that FWP needed to play a bigger role in the management of elk, especially in terms of financial contribution. Others felt that the DOL was doing the best job possible, with limited funding and resources. Those that had perceptions of USDA APHIS, varied in ways they felt supported as producers.

The second theme from RQ 2 was that even though ranchers did feel that the DSA regulations were a burden, many agreed that they were needed and were of value, especially to the rest of the state of Montana. In the past, brucellosis regulations required a whole herd to be depopulated if an animal was tested positive. With the current DSA regulations, if an animal is positive, it can be quarantined, but the whole herd does not get destroyed. The change in regulations from depopulation to quarantine was a positive step, in most rancher's opinions.

The third theme demonstrated that many perceptions of governing agencies and subsequent regulations in place to manage brucellosis were shaped based on a ranchers' experience with direct and indirect costs incurred through management of the disease. Though direct costs were an issue, ranchers expressed the fear of unintended indirect costs associated with quarantine and testing, noting particularly the time in which they sold their cattle, which

was an important factor in their business. Extra feed costs, as well as undue stress on the animals were also mentioned.

Lastly, ranchers felt that increased communication and education was needed by governing agencies to inform ranchers, veterinarians and the public regarding brucellosis management and transmission. This was evident based on some ranchers' lack of knowledge of brucellosis epidemiology, as well as claims that other ranchers in the area are not aware of regulations in place. Changes in the agricultural and natural resource landscape were also discussed as major issues that affect communication surrounding brucellosis.

STP and STOPS as an Analytic Lens in the Montana Ranching Community

Grunig's Situational Theory of Publics and Kim and Grunig's Situational Theory of Problem Solving were used as an analytic lens when analyzing the data. Based on the emergent themes from the research questions which guided this study, it was found that a diverse public was present within the ranching community in the GYA. As mentioned earlier, this finding also aligns with other research that has confirmed the divergence in values and perceptions of ranchers in regard to government (Lien et al., 2017). This finding supports Grunig's theory in which publics change and orient themselves around problems that revolve organizations that make decisions that affect people not necessarily involved in the decision-making process (Grunig, 2005). Grunig's idea that publics are never stagnant was supported through this research, as ranchers changed their perceptions as new information or interactions with governing bodies emerged. This was evident as many ranchers changed their perceptions of government involvement when APHIS changed the regulations from herd depopulation or destruction, to herd quarantine. For instance, Alvin mentioned he knew of a rancher whose herd had to be depopulated when one heifer came up positive with brucellosis, explaining, "it was

really scary and it devastated them, it was like destroying a family because you work so hard on bloodlines and such. With the change in regulations, I don't feel that fear anymore. It was a good thing."

Ranchers interviewed for this study represented Grunig's classifications of aware and active publics. Recall that an aware public is a public that recognizes a problem, but does not actively try to solve or change it (Grunig, 1983). An active public, on the other hand, is one that recognizes the issue and organizes actions to solve the problem (Grunig, 1983). It could be hypothesized that the ranching community in the GYA may have nonpublics (ones that are not confronted with the issue) and latent publics (one that faces a similar problem but fails to detect it) based on comments from the ranchers that were interviewed (Grunig, 1983). For instance, Tate mentioned a potential nonpublic or latent public: "Whether or not everybody's always following the rules, I'd say most major ranchers are. There's probably a few small producers that are somewhat naïve and don't understand what's going on." Jennifer also talked about producers in the GYA who failed to recognize brucellosis as an issue, mentioning, "it's surprising how some of the ranchers' don't even know that they're in the DSA or they even have a clue of what it means to be in the DSA."

Based on Grunig's classification of an active public as having high issue involvement, low restraint recognition and high problem recognition, many of the ranchers interviewed for this study would fall into that category (Grunig, 1983). These ranchers were active in their local communities, as well as state and some federal agency involvement. These ranchers communicated about the issue frequently, partaking in active communicative behavior in problem solving, by communicating both with other ranchers and organizations, and sought information to further contribute to solutions (Kim & Grunig, 2011). For example, Tate

mentioned he had been "fairly involved at the state level of livestock organizations" when it came to communicating about brucellosis in the GYA and shared information with fellow ranchers. Simon mentioned his role in helping FWP in their elk surveillance studies, noting the research "has been tremendously helpful" and he felt it was his role to help remedy a solution. Both Tate and Simon had high situational levels of motivation.

Active publics in the GYA ranching community participated in all three domains of communicative action, including information selection, acquisition and sharing (Kim & Grunig, 2011). That is, active publics in the GYA ranching community participated in information seeking, in which they planned and deliberately sought new information around brucellosis (Kim & Gruing, 2011). This was partially through involvement in government organizations, as mentioned by Tate and Simon above, as well as Kathleen's active role in staying abreast on brucellosis information through an email listserv with the DOL. Active publics in the ranching community in the DSA also participated in information forefending, which is an active communicative behavior in which people select and judge information based on its relevance to the potential solution (Kim & Gruing, 2011). Ranchers found and communicated information that was relevant to solving the brucellosis issue in the GYA. Jennifer mentioned her constant communication with her clients in and out of the DSA, as she "always followed up and sent out letters herself to clients" in order to help disseminate information about brucellosis. Additionally, ranchers classified as active publics participated in information forwarding, which means they forwarded important and new information to the ranching community, regardless of if it was asked of them (Kim & Gruing, 2011). These ranchers had more positive perceptions of government agency involvement in brucellosis monitoring and more in-depth understanding of disease epidemiology. For instance, Kathleen had positive perceptions about the DOL and

listened to the state veterinarian's recommendations for herd management, understanding that the vaccination doesn't provide complete protect for the herd: "[RB51] is the best thing out there, but even that, the state vet tells us it's the best thing we have but it's not 100% effective." Active publics in the ranching community had high levels of situational motivation, as was their desire to be part of the solution. For instance, take Simon's claim: "Just because brucellosis isn't the problem in other places than around Yellowstone, doesn't mean that it's not all our problem."

Other ranchers interviewed could be classified under an analytic lens as aware publics. While these ranchers recognized that brucellosis was an issue in the GYA, they did not actively try to solve it or change it, through involvement in governing agencies or attending meetings for the livestock community. In regard to letting his voice be heard as a rancher in the GYA, Dan said: "I am pretty bad at being proactive. Active at all." Though Dan was aware of the brucellosis issue, his level of involvement and situational motivation were low, and he didn't participate in any level of active communicative action: "I get a flyer from that state. I pay attention to those things for the most part, and my vet kind of." Rather, his communicative action was passive in that he didn't actively seek new information but attended to it if it came his way. Ranchers classified as aware publics were also more apt to have brucellosis lower on their management agenda, had incorrect knowledge of the epidemiology of brucellosis and generally had negative perceptions of government agencies and the subsequent brucellosis monitoring protocols. Frank had negative perceptions of government involvement, mentioning that FWP "doesn't do a dang thing" and that "DOL has lost its way." Frank had incorrect knowledge of brucellosis epidemiology, and did not organize to help solve the issue actively. Laura also had a limited understanding of vaccination efficacy and felt that brucellosis "was something that's been a part of our operation for so long that it's not something that's a present concern." Though

Laura recognized the issue, it was not something she felt she needed to actively change or solve, as "it's just the reality of our area." Aware publics in the GYA ranching community also were more apt to engage in levels of passive communication, that is, this public had low levels of motivation to seek out more information to solve the issue (Kim & Grunig, 2011). This was also evident through examples provided above.

Aware publics have a high constraint recognition, even if their problem recognition and involvement are high (Aldoory & Sha, 2006). Phrased differently, aware ranching publics in the GYA may recognize brucellosis and monitoring as an issue, but feel ill-equipped to communicate or take responsibility in solving the issue. However, "once aware publics perceive constraints to be removed, they are more likely to become active" (Aldoory & Sha, 2006, p. 342). Two of Grunig's studies sought to categorize agricultural publics in Maryland, specifically poultry farms on the Eastern Shore and dairy farmers across the state (Grunig, Nelson, Richburg, & White, 1988). Grunig found that both agricultural publics studied were categorized as active, while aware publics were not found. "These variates suggest, then, that agricultural publics communicate more instrumentally than publics of other organizations. All are active publics for issues relevant to their farms; none communicate simply for "consummatory" purposes" (Grunig, Nelson, Richburg & White, 1988, p. 32). It can be surmised that aware publics in the ranching community of the GYA may not understand how brucellosis can affect their cattle operations, making brucellosis management not relevant and therefore a constraint to communicate.

Recall the referent criterion in the Situational Theory of Problem-Solving (STOPS), which was a variable that took into account perceptual and cognitive frames in problem solving (Kim & Grunig, 2011). The referent criterion was defined as "any knowledge or subjective judgmental system that influences the way one approaches problem solving" (Kim & Grunig,

2011, p.131). In other words, the referent criterion could be explained as decisional steps of past experiences that guide decisions around a new problem (Kim & Grunig, 2011). In both cases of classifications of publics in the Montana cattle ranching community in the GYA, the referent criterion was the perception of Montana losing brucellosis Class Free status in 2008. This event either encouraged ranchers to participate in a passive or active communicative action. For instance, all ranchers perceived the loss of Class Free status as a detrimental event to their cattle operations. Active publics used the referent criterion as a variable that pushed them to find more information to solve the issue, based on past experiences and their situational motivation in problem-solving was high. For instance, many ranchers commented that they feared losing market access to their cattle because of their location in the DSA, which motivated them to help solve the issue so as to protect their livelihood. In contrast, aware publics used the referent criterion as a sort of deterrent to participate in active communication, due to their past cognitive frames and experience with losing Class Free status. For example, Janet mentioned she felt it was out of her control when it came to solving the issue and avoiding losing Class Free status:

> "As I have gotten older and involved in everything around me, I think what strike me most about the cattle industry is all the thing you have no control over. You work and work and put your heart and soul into everything and it's those things that you have no control over that are gonna bring you down."

Others noted that it wasn't an issue of *"if* their herds were infected, but *when*". This mentality was also a referent criterion that played a role in determining if a rancher was to engage in active communicative behaviors in order to help solve the brucellosis issue, as ranchers felt there was nothing they could do to change it. This could also explain why many of the aware publics in the ranching community of the GYA had a high constraint recognition, that is, they felt they did not possess the tools to solve the issue, even if they recognized the problem.

Examining this research using Grunig's theories as a qualitative lens was useful in helping to contextualize rancher perceptions of brucellosis and government involvement in the GYA and examining the variation in ranching publics in the GYA. Problem recognition, level of involvement, constraint recognition, situational motivation and referent criterions were able to be explored and expanded upon, as well as different ways in which the Montana ranching community participated in active or passive communication. Adding a quantitative lens to this study would help to further examine and quantify more publics in the GYA, especially if the study reached more ranchers in the area. This research can serve as a starting point in developing targeted questions that address rancher perceptions as regulations change.

Pillars of Relationship-Building Between Stakeholders

The concept of relationship-building between publics and organizations was an important lens in which to analyze the data from Montana ranchers in the GYA. According to Hon and Grunig (1999), long-term relationships between publics and organizations can be strengthened and maintained through six components: trust, satisfaction, commitment, control mutuality, exchange relationships and communal relationships. Based on the findings, USDA APHIS, the Montana Department of Livestock (DOL) and the Montana Fish, Wildlife and Parks (FWP) could each benefit from spending more time implementing the six components of relationship-building between each other and the ranching community in the GYA. These three organizations are crucial in controlling the spread of brucellosis, as well as providing guidance to ranchers and conserving agricultural and natural resources. Additionally, ranching publics of the GYA would benefit from improved relationship quality with these organizations, as well as potentially tapping into latent publics that need to be more involved in the issue.

Montana DOL, FWP and USDA APHIS would greatly benefit from improving trust, satisfaction, commitment, control mutuality and improving both exchange and communal relationships with ranchers in the DSA (Hon & Grunig, 1999). These two organizations and local ranchers need to have the ability to be open with each other regarding funding, disease transmission, predator control, direct and indirect costs associated with regulations and other potential obstacles that affect one another.

Trust is a major factor in relationship-building between government and ranchers in the DSA, as some ranchers expressed skepticism at the agendas of each agency. For example, Janet expressed her distrust when she discussed how she stopped receiving communication surrounding meetings about brucellosis, noting "So you kind of have this feeling like, "I wonder what's really going on and why I'm not hearing anything." Janet also discussed that she felt like the government was more interested in tourism than securing the food supply, increasing her distrust: "In a state like Montana where tourism is starting to become more important than agriculture, where do you think they're gonna spend state dollars? Eventually they're going to quit worrying about the ag producers." Frank also distrusted the government in terms of keeping ranching relevant, noting "the big thing here is we don't have good policies that help keep ranching healthy, and we're going to keep losing open space." Government agencies like USDA APHIS, Montana DOL and FWP need to work to ensure the ranching community that their agendas support agricultural production.

Satisfaction between organizations and publics occur when the benefits outweigh the costs of the relationship, and both parties are positive towards each other (Hon & Grunig, 1999). Many Montana ranchers in the DSA felt dissatisfaction with their relationship with FWP in particular. Tate described his frustration with FWP:

> "I hate to say it this way, but if I'm thinking of [FWP's] perspective, they're like "Our elk numbers are over objective with the disease. So who cares? [Brucellosis] must not be hurting my population too much." FWP needs to pony up a bit more and take responsibility for what it's putting our livestock industry through."

Janet also discussed to dissatisfaction of FWP, noting "I don't know why [FWP] has that kind of power [to ignore ranchers]. I think in this day and age, if you're an agency and you can't think outside the box and try something different, then you have no purpose." It's important that there is satisfaction between ranchers in the DSA and FWP, because actions of both parties have the potential to affect the brucellosis issue for both livestock and wildlife.

Much like satisfaction, commitment from each party will be essential in the brucellosis issue, as the various stakeholders must find a common ground among one another for any hope in controlling the spread of disease. Both ranchers and government agencies must feel the relationship is worth investing into. While some ranchers felt commitment to governing agencies in their roles in communicating with agencies, many felt it wasn't worth the time to invest. Take Janet and her views on FWP: "So if you have an agency that is not trying, who is not communicating, who is not trying to make things easier for the land owner who is housing public elk on a routine basis, it's a little hard to stomach them." Kathleen felt her commitment to governing agencies was waning as well, explaining "FWP doesn't engage with DOL or producers. The producers are at the mercy of some of these regulations because DOL and FWP don't talk to each other."

Control mutuality is another key pillar that is a balance of being attentive to both the needs of the agencies and ranchers, while having each party involved in the decision-making process. Control mutuality is a harder in this case, due to the sheer number of stakeholders involved in surveillance, however, still possible to achieve. While governing agencies such as

APHIS, DOL and FWP needs to be attentive to rancher needs, ranchers also need to be active in the decision-making process. This is evident through ranchers who felt their voices were heard by governing agencies, and these ranchers were ones who were more actively involved in meetings and committees. Control mutuality could be improved by governing agencies through more active communication to ranchers in asking for their input on management decisions.

As trust, satisfaction, and commitment increase, an exchange relationship is developed between parties which eventually morphs into a communal relationship that takes into account each party's side of the issue (Hon & Grunig, 1999). Recall that an exchange relationship refers to an organization and a public who exchanges benefits between each other because this exchange has happened in the past (Hon & Grunig, 1999). A communal relationship involves an exchange of benefits between parties, however this exchange is fueled by an overall concern for the welfare of the other party and not necessarily dependent on if the exchange of benefits occurred in the past (Hon & Grunig, 1999). The more that governing agencies solicit feedback and input from ranchers in the DSA, the more that relationship-building will occur and develop into exchange and communal relationships. This is evident in the few ranchers who were actively involved in government, either through meetings or projects, because they felt their involvement was needed in order to help the organization further their research or goal. In contrast, those ranchers who had distrust, dissatisfaction and no commitment to helping governing agencies were less likely to engage in any kind of relationship that would help an agency.

As mentioned in Chapter 3, "organizations generally make better decisions when they listen to and collaborate with stakeholders before they make final decisions rather than simply trying to persuade them to accept organizational goals after decisions are made" (Hon & Grunig, 1999, p. 8). The brucellosis issue in the GYA poses an increased complexity in developing

relationships between organizations and existing publics in the Montana ranching community but has the potential to be improved by tapping into the six pillars of relationship-building between organizations.

Recommendations

The findings from this research study could aid in improved communication between federal and state government agencies and Montana ranchers contained in the DSA boundaries of the greater Yellowstone area. The variation in the publics which make up the ranching community in the GYA offer both challenges and benefits.

It was found that all ranchers interviewed had negative perceptions of predators and the way in which they changed the elk ecosystem. It is recommended that more active communication be disseminated from Montana Fish, Wildlife and Parks (FWP) regarding the agency's contribution in helping to monitor brucellosis spread in the GYA. While a few ranchers had positive views of FWP and their role in elk surveillance, a majority had negative perceptions regarding the agency's role in the issue. FWP should concentrate communication efforts to ranchers in the DSA in terms of town hall meetings, ranch visits to those who deal with an increased influx of elk on their private property as well as traditional forms of communication through email, press releases and agricultural news sources. More communication surrounding FWP's role in brucellosis surveillance may bridge gaps between publics who may lack trust in the agency.

On that note, an increased communication plan for both USDA APHIS and the Montana Department of Livestock (DOL) is necessary for relationship-building as well as providing higher quality communication to a variety of stakeholders. All ranchers agreed that better

communication from governing agencies was a felt need, most notably to local veterinarians and inexperienced or smaller ranchers. Many ranchers used their local veterinarian as their main source of information, but some noted that information regarding new regulations or issues were often incorrect. Many ranchers also commented on the rise in inexperienced 'homesteaders' or small ranches that were unaware of the brucellosis issue in the GYA. It is recommended that APHIS and DOL focus and develop Hon and Grunig's (1999) relationship-building pillar of commitment in order to increase quality communication to reach these publics. For instance, the level of commitment from APHIS and DOL may be deemed as weak to the publics who fall under the radar in terms of staying up to date with correct information regarding brucellosis. Veterinarians and inexperienced ranchers may not see the importance of the relationship with APHIS and DOL. Hon & Grunig note that each party must believe that the relationship is worth maintaining and continuing, to possess a high level of commitment (Hon & Grunig, 1999). As the level of commitment from APHIS and DOL increases, higher communication quality will result from stakeholders, as they begin to spend energy to maintain the relationship and increase their commitment in helping solve the brucellosis issue. In another study that sought to identify relationship-building opportunities between APHIS and cattle producers, researchers also recommended that commitment was a relationship quality in which to improve (Abrams & Bonser, 2018). One strategy discussed was to tailor information to cattle producers through presentations, phone conferences and written letters, as these forms of communication were best suited to demonstrate the organization's commitment to the ranching community (Abrams & Bonser, 2018). It is important for APHIS and DOL to reach out and solidify their commitment to these publics, along with finding better methods in notifying local veterinarians in the GYA of any changes in disease monitoring regulations. Variations in knowledge of brucellosis

epidemiology also warrants a closer look into providing higher quality communication for ranchers in the GYA, especially in terms of vaccination effectiveness.

More than half of the ranchers interviewed also mentioned the need to communicate and educate the public (outside of ranching) regarding the brucellosis issue, as ranchers are often painted to be anti-wildlife or abusive of natural resources. As open space and ranching land continues to disappear, it will be crucial for agencies to gauge public perceptions of ranching in order to make the best management decisions.

Along with improved communication around brucellosis regulations, it is recommended that FWP, DOL and USDA APHIS disseminate more information regarding the public health threat of brucellosis. Though the ranchers who were interviewed knew that transmission could occur, many mentioned that other ranchers or elk hunters may not possess this knowledge. Public health agencies like the Centers for Disease Control (CDC) may be of value in helping to communicate and educate publics in the GYA and surrounding areas of the risk of brucellosis transmission.

One last recommendation would be for USDA APHIS, DOL and FWP to work closer together in presenting a united and cohesive front for ranchers in the DSA. These three organizations are crucial in monitoring and controlling the spread of brucellosis in the GYA and are often perceived as organizations that work against each other. Coordinating communication efforts between organizations to disseminate to ranchers in the DSA may help to build better interagency relationships as well as improve rancher perceptions of government agencies.

Limitations and Future Research

A limitation of this study was that only one stakeholder in the brucellosis issue in the greater Yellowstone area was examined. Though a variation in rancher perceptions and experiences provided an array of findings, not every rancher in the DSA boundary was interviewed, and other perceptions may exist.

The use Grunig's theories as analytical lenses in this research study was useful in evaluating the contextual factors that contributed to ranchers' perceptions of government and brucellosis regulations. Foundations of both STP and STOPS allowed the researcher to examine the variables of problem recognition, constraint recognition, level of involvement, situational motivation, effects of referent criterion and communicative actions through in-depth interviews. As mentioned earlier, taking this research and applying a quantitative lens would help to expand and quantify the findings to a larger sample of ranchers in the DSA. The findings and implications from this study could also provide a basis for more targeted questions to encompass a larger population of ranchers as well. This research is the first of its kind to examine Grunig's theories using qualitative methods, and therefore a unique methodical addition in which to study STP, STOPS and Hon and Grunig's pillars of measuring relationship quality. Future research should employ both quantitative and qualitative methods in examining Grunig's theories, as both would provide a well-rounded and quantifiable study.

The researcher plans to pursue an extension of this research study in her PhD work, in which she plans to utilize in-depth interviews, focus groups and survey methods to examine stakeholder perceptions in the Montana Department of Livestock, Montana Fish, Wildlife and Parks, USDA APHIS, Yellowstone National Park, domestic bison producers, elk hunters, veterinarians, wildlife biologists and environmental and wildlife conservation groups. Doing so

will provide a well-rounded view of stakeholder perceptions surrounding brucellosis in the greater Yellowstone area and add to a robust research agenda that encompasses both agricultural and natural resource communications.

REFERENCES

Abrams, K. A. & Bonser, C. R. (2018, September). *Agricultural stakeholders' perceptions of the federal government research process and its products: A case study with the livestock producers' antimicrobial use study*. Paper presented at the Western Region American Association of Agricultural Education Research Conference, Boise, Idaho.

Aldoory, L., & Sha, B. L. (2006). The situational theory of publics: Practical applications, methodological challenges, and theoretical horizons. In Toth, E. (Ed.), *The future of excellence in public relations and communication management: Challenges for the next generation*. (pp. 339-355). doi:10.4324/9781410613967

Ary, D., Jacobs, L. C., & Razavieh, A. (2002). *Introduction to research in education* (6th ed.). Belmont, CA: Wadsworth.

Atkinson, R., & Flint, J. (2001). Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social Res Update*, *33*. Retrieved from http://sru.soc.surrey.ac.uk/SRU33.html

Brennan, A., Cross, P. C., Portacci, K., Scurlock, B. M., & Edwards, W. H. (2017). Shifting brucellosis risk in livestock coincides with spreading seroprevalence in elk. *PLOS ONE*, *12*(6), e0178780. doi:10.1371/journal.pone.0178780

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five approaches.* Thousand Oaks, CA: SAGE Publications.

Cusack, J. J., Kohl, M. T., Metz, M. C., Coulson, T., Stahler, D. R., Smith, D. W., & MacNulty, D. R. (2019). Weak spatiotemporal response of prey to predation risk in a freely interacting system. *Journal of Animal Ecology*, *0,*1– 12. doi:10.1111/1365-2656.12968

Delgado, A. H., Norby, B., Dean, W. R., McIntosh, W. A., & Scott, H. M. (2012). Utilizing qualitative methods in survey design: Examining Texas cattle producers' intent to participate in foot-and-mouth disease detection and control. *Preventive Veterinary Medicine*, *103*(2–3), 120–135. doi:10.1016/j.prevetmed.2011.09.012

Dowling, M. (2006). Approaches to reflexivity in qualitative research. *Nurse Researcher, 13*(3), 7-21.

Ellis-Iversen, J., Cook, A. J. C., Watson, E., Nielen, M., Larkin, L., Wooldridge, M., & Hogeveen, H. (2010). Perceptions, circumstances and motivators that influence implementation of zoonotic control programs on cattle farms. *Preventive Veterinary Medicine*, *93*(4), 276–285. doi:10.1016/J.PREVETMED.2009.11.005

Endangered and Threatened Wildlife and Plants; Removing the Gray Wolf (Canis lupus) From the List of Endangered and Threatened Wildlife, 84 Fed. Reg. 9648 (proposed March 15,

2019) (to be codified at 50 C.F.R. pt. 17).

Fournier, A., Young, I., Rajić, A., Greig, J., & LeJeune, J. (2015). Social and economic aspects of the transmission of pathogenic bacteria between wildlife and food animals: A thematic analysis of published research knowledge. *Zoonoses and Public Health*, 62(6), 417–428. doi:10.1111/zph.12179

Given, L. (2008). *The SAGE encyclopedia of qualitative research methods*. Thousand Oaks, California: SAGE Publications. doi:10.4135/9781412963909 NV - 0

Grunig, J. E. (1997). A situational theory of publics: Conceptual history, recent challenges, and new research. In D. Moss, T. MacManus & D. Vercic (Eds.), *Public relations research: An international perspective* (pp. 3-46). London: International Thomson Business.

Grunig, J. E. (1979). Research on science communication: What is known and what needs to be known. *Journal of Applied Communications*, *62*(4). doi:10.4148/10510834.1882

Grunig, J. E. (1983). Communication behaviors and attitudes of environmental publics: Two studies. *Journalism Monographs*, *81*.

Grunig, J. E. (2005). Situational theory of publics. In R.L. Heath (Ed.) *Encyclopedia of public relations* (Vol. 2). (pp. 778-780). Thousand Oaks, CA: SAGE Publications.

Grunig, J. E., Nelson, C. L., Richburg, S. J., & White, T. J. (1988). Communication by Agricultural Publics: Internal and External Orientations. *Journalism Quarterly*, *65*(1), 26–38. https://doi.org/10.1177/107769908806500104

Heydlauff, A. L., Krausman, P. R., Shaw, W. W., & Marsh, S. E. (2006). Perceptions regarding elk in northern Arizona. *Wildlife Society Bulletin (1973-2006)*, *34*(1), 27–35. Retrieved from http://www.jstor.org/stable/3784931

Hon, L. C., & Grunig, J. E. (1999). *Guidelines for measuring relationships in public relations.* Gainesville, FL: The Institute for Public Relations, Commission on Public Relations Measurement & Evaluation. Retrieved from http://www.instituteforpr.org/research_single/guidelines_measuring_relationships/

Kim, J.-N., & Grunig, J. E. (2011). Problem solving and communicative action: A situational theory of problem solving. *Journal of Communication*, *61*(1), 120–149. doi:/10.1111/j.1460-2466.2010.01529.x

Kim, J.-N., & Krishna, A. (2014). Publics and lay informatics: A review of the situational theory of problem solving. *Annals of the International Communication Association*, *38*(1), 71–105. doi:10.1080/23808985.2014.11679159

Krauss, S. E. (2005). The qualitative report research raradigms and meaning making: A primer. *The Qualitative Report*, *10*(4), 758–770. Retrieved from http://www.nova.edu/ssss/QR/QR10-4/krauss.pdf

Lamm, A. J., Lundy, L. K., Warner, L., & Lamm, K. W. (2016). Associating importance with behavior: Providing direction for water conservation communication. *Journal of Applied Communications*, *100*(3). doi:10.4148/1051-0834.1229

Lien, A. M., Svancara, C., Vanasco, W., Ruyle, G. B., & López-Hoffman, L. (2017). The land ethic of ranchers: A core value despite divergent views of government. *Rangeland Ecology & Management, 70*(6), 787–793. doi:10.1016/J.RAMA.2017.06.004

Lindlof, T. R. (1995). *Qualitative communication research methods: Vol. 3. Current communication: An advanced text series*. Thousand Oaks, CA: Sage.

Legislative Audit Division, Montana State Legislature. (2017). *Audit Report: Brucellosis Management in the State of Montana, Department of Livestock, Department of Fish, Wildlife & Parks.* Retrieved from https://leg.mt.gov/content/Publications/Audit/Report/16P-06.pdf

Montana Department of Livestock. (2018a). Brucellosis/Montana's Designated Surveillance Area (DSA). Retrieved October 12, 2018, from http://liv.mt.gov/Animal-Health/Diseases/Brucellosis

Montana Department of Livestock. (2018b). *Department of Livestock Announces New Brucellosis Rules*. Retrieved from http://liv.mt.gov/Portals/146/news/2018/MDOL rule adoption pr.pdf?ver=2018-10-11-151640-970

Montana Stockgrowers Association. (2019). About Us - Montana Stockgrowers Association. Retrieved April 13, 2019, from https://mtbeef.org/about/

National Park Service. (n.d.). *Greater Yellowstone Ecosystem - Yellowstone National Park.* Retrieved from https://www.nps.gov/yell/learn/nature/greater-yellowstoneecosystem.htm

Palaganas, E. C., Sanchez, M. C., Molintas, M. P., & Caricativo, R. D. (2017). Reflexivity in Qualitative Research: A Journey of Learning. *The Qualitative Report, 22*(2), 426-438. Retrieved from https://nsuworks.nova.edu/tqr/vol22/iss2/5

Purfeerst, J. (2019). Get to know the 2019 Seedstock 100 Operations. *Beef Magazine*. Retrieved from https://www.beefmagazine.com/seedstock/get-know-2019-seedstock-100-operations

Richards, L., & Morse, J. M. (2012). *README FIRST for a user's guide to qualitative methods.* Thousand Oaks, CA: SAGE Publications.

Ruth, T., Lamm, A. J., Rumble, J. N., & Ellis, J. D. (2017). Identifying publics in citrus producing states to address the issue of citrus greening. *Journal of Applied Communications, 101*(3). doi:10.4148/1051-0834.1847

Sayre, N. F. (2004). Viewpoint: The need for qualitative research to understand ranch management. *Journal of Range Management, 57*(6), 668-674.

Schumaker, B., Peck, D., & Kauffman, M. (2012). Brucellosis in the greater yellowstone area: Disease management at the wildlife–livestock interface. *Human–Wildlife Interactions, 6*(1). Retrieved from https://digitalcommons.usu.edu/hwi/vol6/iss1/7

Swearingen, M., Schimel, K., & Wiles, T. (2018). Timeline: A brief history of the sagebrush rebellion. *High Country News*. Retrieved from https://www.hcn.org/articles/a-history-of-the-sagebrush-rebellion

The Library of Congress. (n.d.). *Homestead act: Primary documents of American history*. Retrieved from https://www.loc.gov/rr/program/bib/ourdocs/homestead.html#American

The National Academies of Sciences Engineering and Medicine. (2017). *Revisiting brucellosis in the greater Yellowstone area*. Washington, DC: The National Academies Press. doi:10.17226/24750

Toma, L., Low, J. C., Vosough Ahmadi, B., Matthews, L., & Stott, A. W. (2015). An analysis of cattle farmers' perceptions of drivers and barriers to on-farm control of Escherichia coli O157. *Epidemiology and Infection, 143*(11), 2355–2366. doi:10.1017/S0950268814003045

U.S. Department of the Interior, Bureau of Land Management and Office of the Solicitor. (2001). *The federal land policy and, management act of 1976, as amended.* Washington, D.C.: U.S. Department of the Interior, Bureau of Land Management Office of Public Affairs. Retrieved from https://www.blm.gov/or/regulations/files/FLPMA.pdf

U.S. Fish and Wildlife Service International Affairs. (n.d.). *Endangered species act*. Retrieved from https://www.fws.gov/international/laws-treaties-agreements/us-conservation-laws/endangered-species-act.html

United States Department of Agriculture. (2014). *Brucellosis regionalization risk assessment model: An epidemiologic model to evaluate the risk of B. abortus infected and undetected breeding cattle moving out of the designated surveillance areas in Idaho, Montana and Wyoming.* Fort Collins, CO: Animal and Plant Health Inspection Service, Center for Epidemiology and Animal Health. Retrieved from https://www.aphis.usda.gov/animal_health/animal_diseases/brucellosis/downloads/risk_assessment_model.pdf

United States Department of Agriculture-Animal and Plant Health Inspection Service (USDA APHIS). (2018). *National Brucellosis Eradication Program*. Retrieved from https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/!ut/p/z0/fY7LDoIwFES_hiW5xRjUJVEDPuIaumkutcjV0kJbjP69hLhw5fLMTCYHOJTADT7phoGsQT1xxVNxSbY5Wy-Tc77fJSwrNodTsUoZyxdwBP5_MD3QfRh4BlxaE9QrQIl9S17MaILQVDt074h5FHZ0orFy9DOhoQ61aBXq

Vilsack, T., & Clark, C. Z. F. (n.d.). *Montana State and County Data Volume 1, Geographic Area Series, Part 26.* United States Department of Agriculture. Retrieved from www.nass.usda.gov.

Vincent, C. H. (2012). *Congressional research service report for congress grazing fees: Overview and issues.* Retrieved from https://fas.org/sgp/crs/misc/RS21232.pdf

Wimmer, R. D., & Dominick, J. R. (2013). *Mass media research: An introduction.* (10th ed.) Boston: Cengage Learning, Wadsworth.

White, P.J, Proffitt, K.M., Lemke, T.O. (2012). Changes in elk distribution and group sizes after wolf restoration. *American Midland Naturalist. 167:*174-187.

Wyoming Game and Fish Department. (2014). *Wyoming game and fish fepartment annual report.* Retrieved from https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Wildlife-Disease/Brucellosis/Brucellosis-Reports

APPENDIX A

Recruitment Email

Dear [insert name],

My name is Chelsea Bonser and I am a researcher from Colorado State University in the Department of Journalism and Media Communication. I also earned by B.S. in animal science from CSU before starting my Master's focused on agricultural communication.

My thesis project will focus on exploring Montana cattle ranchers' perceptions of USDA APHIS involvement in brucellosis monitoring in the greater Yellowstone area. I'm looking to understand cattle rancher relationships with APHIS, along with perceptions of the brucellosis issue in its entirety in the Yellowstone area. Your insights will contribute to an in-depth look into rancher-government relations as well as help to inform potential strategies to control the spread of brucellosis.

You are one of several cattle ranchers in the greater Yellowstone area that I would like to interview for my research. Your perspectives will help to make recommendations for improving how government agencies communicate with ranchers, as well as potential recommendations for mitigating the brucellosis issue in the area. The interview will take about an hour.

Your identifying information, including name, ranch, or role, will not be connected to your data. Data will only be accessible by myself on a password-protected and encrypted file. Data will be reported, in aggregate, in reports, academic papers, and/or presentations.

I aim to complete all of our interviews during the weeks of February 18th. Would you be interested in participating?

If you would like to participants or have any questions, please don't hesitate to ask. I would be happy to speak by phone, if you prefer. My number is 810-990-7177.

Sincerely,

Chelsea Bonser
Master's student, Public Communication & Technology
Chelsea.Bonser@colostate.edu
810-990-7177
Colorado State University

Informed Consent Script for Montana Cattle Ranchers

To begin, I'd like to thank you for your participation in my research interview. I'll be sharing some information regarding your rights as a participant in this research.

As a reminder, my name is Chelsea Bonser and I'm a graduate student at Colorado State University studying agricultural communications. My thesis project will focus on exploring Montana cattle ranchers' perceptions of USDA APHIS involvement in brucellosis monitoring in the greater Yellowstone area. I'm looking to understand cattle rancher relationships with APHIS, along with perceptions of the brucellosis issue in its entirety in the Yellowstone area. Your insights will contribute to an in-depth look into rancher-government relations as well as help to inform potential strategies to control the spread of brucellosis.

Please understand that all of your correspondence with me is completely confidential and no identifying information will be attached to your data. This includes your name, ranch operation demographics, specific location or any other potentially identifying information. Your data will be reported in sum with other Montana cattle producers, but again, no identifying information will be included.

With permission, I'd like to record this interview to refer to the data at later dates after all interviews are completed. This will help me to focus on our conversation in real time, instead of being focused on recording notes. This recording will be transcribed and only used for my analysis; no one else will be able to access it through a password protected computer and hard drive. After data is analyzed, the recording and transcription will be destroyed. If you are uncomfortable at any time with the recorder, please let me know and I will cease operation of it.

Your cooperation and participation in this interview are completely voluntary. You can discontinue at any time with absolutely no risk or consequence. There are also no anticipated risks involved in this interview. Should you have any questions or concerns regarding your rights as a research participant, the Colorado State University Research Integrity and Compliance Review Office can be reached at 970-491-1553.

[Ask verbally and acquire response]
Do you understand what you are being asked to do?
Do you have any questions before we begin?
Do you agree to participate in the study?
May I use the audio recorder for our interview today?

Interview Guide for Montana Cattle Ranchers

1. **To start off, tell me a little bit about your cattle operation and background in Montana.**

a. How long have you been a rancher in the greater Yellowstone area?
b. What is the approximate size of your ranch, including cattle numbers and acreage?
c. (If needed/have time) Why is ranching important to you and/or your family?
d. What are some the current challenges you face with your cattle operation?
*If brucellosis is mentioned, "tell me more about that?"

2. **What do you know about the brucellosis issue?**

a. How is it affecting you?
b. What do you think about the issue itself? Are you concerned or feel confident that it's manageable? Essentially, I'm curious about you varied opinions and feelings about brucellosis?
c. Do you view brucellosis as a problem in your operation? Why or why not?
d. How do you view the elk and bison populations in the area? Do you find them to be a problem?
e. Do you think you have a role or responsibility in helping to solve the problem in Yellowstone? Do you feel your voice is heard?
f. In what ways do you communicate to other ranchers or to other stakeholders about brucellosis?
g. How would you describe other ranchers' opinions of this issue in the area?

3. **The USDA has stepped in to help control the spread of brucellosis, specifically APHIS. What are your overall views of USDA and USDA APHIS?**

a. Do you find their oversight as helpful? Why or why not?
b. Do you think the USDA has your best interest as a rancher? Why or why not?

4. **I'm trying to understand more about how you learn about and discuss the brucellosis issue.**

a. Do you talk about this with other ranchers?
b. How do you find out about news related to brucellosis?
c. If not mentioned, do you ever get information from USDA APHIS on this issue?
d. Do you ever reach out to APHIS? How so? What are those interactions like?

5. **What are your perceptions of the DSA solution?**

a. Do you feel that it helps solve the brucellosis problem? Why or why not?
b. How does the DSA solution affect you as a rancher?
c. What do you think could work well with this approach? What would you change?
d. Do you think other ranchers in your situation feel the same way?
e. What other federally mandated policies do you think have shaped your opinions of the DSA solution? (If not mentioned, bring up the state mandated DSA of 2008)

6. **Are there other solutions you have considered?**

7. **What are your overall views of USDA APHIS in general? How has their management of and communication about this issue affected your view of them?**

8. **That's all my planned questions. Is there anything I didn't ask you about, but seems relevant to what we're studying that you'd like to share?**

Knowing the aim of our research, is there anything you'd like to reiterate from our conversation today? *Thank you again for your participation. Would you be available for follow-up questions for additional information? How would you prefer I contact you for a quick response?*

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX (970) 491-2293

Date: November 29, 2018

To: Katie Abrams, Ph.D., Journalism & Media Communication
Chelsea Bonser, Journalism & Media Communication

From: IRB Coordinator, Research Integrity & Compliance Review Office (RICRO_IRB@mail.colostate.edu)

Re: Montana Cattle Ranchers' Perceptions of USDA APHIS Involvement in Brucellosis Monitoring in the Greater Yellowstone Area

Funding: Unfunded

IRB ID: 084 -19H **Review Date:** November 29, 2018
This project is valid from three years from the review date.

The Institutional Review Board (IRB) Coordinator has reviewed this project and has declared the study exempt from the requirements of the human subject protections regulations with conditions as described above and as described in 45 CFR 46.101(b):

Category 2 - Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

The IRB determination of exemption means that:

- **This project is valid for three years from the initial review.** After the three years, the file will be closed and no further research should be conducted. If the research needs to continue, please let the IRB Coordinator know before the end of the three years. You do not need to submit an application for annual continuing review.
- You must carry out the research as proposed in the Exempt application, including obtaining and documenting (signed) informed consent if stated in your application or if required by the IRB.
- Any modification of this research should be submitted to the IRB through an email to the IRB Coordinator, prior to implementing any changes, to determine if the project still meets the Federal criteria for exemption.
- Please notify the IRB Coordinator (RICRO_IRB@mail.colostate.edu) if any problems or complaints of the research occur.

Please note that you must submit all research involving human participants for review by the IRB. **Only the IRB or designee may make the determination of exemption**, even if you conduct a similar study in the future.

APPENDIX B

Montana's Brucellosis Program Quick Reference Card

Inspection Date	Sex	Sexually Intact?	Age	Intended Purpose	Bruc Test Required?	Test Date	Test Valid For	ID Req'd?	Bangs Vacc Required?
Feb 16 - July 15 (High risk time period)	Male	Yes	≥12 mo	Any	Yes	Feb 16 - July 15	30 days	Yes	n/a
			<12 mo	Breeding	Yes	Feb 16 - July 15	30 days	Yes	n/a
			<12 mo	Feeding	No	n/a	n/a	Yes	n/a
		No	Any age	Any	No	n/a	n/a	No	n/a
	Female	Yes	≥12 mo	Any	Yes	Feb 16 - July 15	30 days	Yes	Yes
			<12 mo	Breeding	Yes	Feb 16 - July 15	30 days	Yes	Yes
			<12 mo	Feeding	No	n/a	n/a	Yes	Yes
		No	Any age	Any	No	n/a	n/a	No	n/a
July 16 - Feb 15 (Low risk time period)	Male	Yes	≥12 mo	Any	Yes	July 16 - Feb 15	until Feb 15	Yes	n/a
			<12 mo	Breeding	Yes	July 16 - Feb 15	until Feb 15	Yes	n/a
			<12 mo	Feeding	No	n/a	n/a	Yes	n/a
		No	Any age	Any	No	n/a	n/a	No	n/a
	Female	Yes	≥12 mo	Any	Yes	July 16 - Feb 15	until Feb 15	Yes	Yes
			<12 mo	Breeding	Yes	July 16 - Feb 15	until Feb 15	Yes	Yes
			<12 mo	Feeding	No	n/a	n/a	Yes	Yes
		No	Any age	Any	No	n/a	n/a	No	n/a

- Brucellosis testing requirement applies to animals located within the DSA
- Vaccination requirement applies to females located within Beaverhead, Madison, Gallatin, or Park Co
- Official individual ID includes bangs tags, silver USDA tags, or RFID tags

Please call the Animal Health Office in Helena if you have any questions: 406-444-2043